Oracle® Communications Core Session Manager

Essentials Guide
Release S-CZ7.1.5 M1
Formerly Net-Net SIP Multimedia Xpress

October 2014

ORACLE

Notices

Contents

About this Guide

Oracle® Communications Core Session Manager (CSM) applies core session control to reduce the complexity and cost of delivering high-value, revenue generating SIP multimedia services. Oracle CSM can be used to support a broad range of SIP services including residential or business voice, GSMA-defined Rich Communication Suite (RCS) services and fixed mobile convergence (FMC) for small subscriber populations or initial service rollouts.

Release Version S-Cz7.1.5 M1 is supplied as virtual machine software or as a software-only delivery suitable for operation on server hardware. Refer to sales documentation updates for information further specifying hardware support.

Memory requirements for the Oracle CSM is deployment specific. Support for configuration sizing is available.

Related Documentation

The following table lists the members that comprise the documentation set for this release. Refer to version SCZ7.1.2 of the applicable software documents:

Document Name	Document Description
Release Notes	Contains information about the current documentation set release, including new features and management changes.
ACLI Configuration Guide	Contains information about the administration and software configuration of the Oracle Communications Session Border Controller.
ACLI Reference Guide	Contains explanations of how to use the ACLI, as an alphabetical listings and descriptions of all ACLI commands and configuration parameters.
Maintenance and Troubleshooting Guide	Contains information about logs, performance announcements, system management, inventory management, upgrades, working with configurations, and managing backups and archives.
MIB Reference Guide	Contains information about Management Information Base (MIBs), Acme Packet's enterprise MIBs, general trap information, including specific details about standard traps and enterprise traps, Simple Network Management Protocol (SNMP) GET query information (including standard and enterprise SNMP GET query names, object identifier names and numbers, and descriptions), examples of scalar and table objects.
Accounting Guide	Contains information about accounting support, including details about RADIUS accounting.
HDR Resource Guide	Contains information about the Historical Data Recording (HDR) feature. This guide includes HDR configuration and system-wide statistical information.
Administrative Security Essentials	Contains information about support for the Administrative Security license.

Release Caveats

This section list caveats related to Version S-Cz7.1.5 M1 of the Oracle CSM.

- The SLRM does not honor a P-CSCF's cluster configuration. Instead the SLRM assigns each P-CSCF to a cluster using round-robin selection.
- Do not load configurations from sibling products, the Oracle SBC for example, on the Oracle CSM. Those configurations are incompatible with the Oracle CSM, causing incorrect operation. Users should configure the Oracle CSM from scratch or use another valid Oracle CSM configuration.

- Configuration elements specific to the SLRM, including lb-interface are not compatible with Oracle CSM configuration elements. The **set-component-type** command provides a warning indicating that the user must delete any prior configuration and create the new component type configuration from scratch to avoid potential configuration conflicts. Note the sample output below.

  ```
  SCZ715_64# set-component-type core-load-balancer
  WARNING: Changing component type is service impacting.
  ******************************************************
  Ensure that you follow these steps if you choose to
  change the component type:
  1. Issue the delete-config command.
  2. Reboot.
  ******************************************************
  Continue with the change [y/n]?:
  ```

- With this release, the SLRM incorrectly interprets a P-CSCF's preferred cluster ID as the default cluster. Therefore the SLRM selects an Oracle CSM in the default cluster, if possible. If there are no available Oracle CSMs in the default cluster, the SLRM selects a cluster in a round-robin fashion.
- Upgrades from SCz6.3.15 to SCz7.1.5 requires a reboot. The use of multiple channels for HA transactions uses an operation mode that requires a reboot. For an HA configuration, reboot of both the primary and secondary Oracle CSMs is required.
- Configuring support for SNMPv3 is not supported as a real-time configuration change. Reboot the system after establishing an SNMPv3 configuration on the Oracle CSM.
- The **set system-state** command does not function properly on the Oracle CSM. Do not execute this command on an Oracle CSM.
- The fallback-to-local-policy option only works with ENUM-based deployments. Do not configure this option for Cx or LST-based deployments.
- The ISC interface does not work when dialog transparency is enabled on the Oracle CSM.
  - Resolution - Do not enable dialog transparency if your Oracle CSM must support ISC.
- The Oracle CSM does not work with an iFC when its default handling is set to “SESSION CONTINUED”.
- Multi-stage routing does not work for S-CSCF routing functions.
- The Oracle CSM accepts only the first message received from an application server in response to messages from the Oracle CSM that included an ODI. The Oracle CSM drops any subsequent messages with the same ODI.
  - Resolution - Do not configure an AS to fork responses to the Oracle CSM that include an ODI originally provided by the Oracle CSM.
- The Oracle CSM is available for operation over OVM with limited functionality.
- By default, storage is not persistent across a reboot of a Oracle CSM virtual machine. You must create persistent storage space for log and dump file data.
  - Issue - Generic virtual machine installation documentation may not include the requirement to run the command format hard-disk during virtual machine installation.
  - Resolution - Run the command format hard-disk to create a persistent partition for your /opt directory, within which you can store data needed after a reboot. Perform this procedure the FIRST time you start your Oracle CSM.
- The Oracle CSM does not send third party registration for the entire implicit registration set. It only sends this for the specific public user identity that is registering, de-registering or re-registering.
- Instead of routing a message via local policy, the Oracle CSM incorrectly issues an LIR under the following conditions:
  - The Oracle CSM is not configured with the e164-primary-config and e164-secondary-config options.
  - The Oracle CSM receives a request with a tel-URI or a sip-URI with the user=phone parameter.

Note that the Oracle CSM returns an error if the LIA does not include a server, and routes the message to the server if the LIA includes a server.

Revision History

Date	Revision Number	Description
April 8, 2014	Revision 1.00	• Initial Release
May 9, 2014	Revision 1.10	• Clarifies a caveat indicating that the fallback-to-local-policy option works only with DDNS databases for this release.

1

Oracle USM Supporting the IMS Core

General Description

The Oracle CSM functions in an IMS core. It communicates with the HSS to obtain Authorization, Authentication, S-CSCF assignment, and ultimately routing instructions. To accomplish these functions, the Oracle CSM can perform the SIP registrar role in conjunction with an HSS.

Message Authentication for SIP Requests

The Oracle CSM authenticates requests by configuring the sip authentication profile configuration element. The name of this configuration element is either configured as a parameter in the sip registrar configuration element's authentication profile parameter or in the sip interface configuration element's sip-authentication-profile parameter. This means that the Oracle CSM can perform SIP digest authentication either globally, per domain of the Request URI or as received on a SIP interface.

After naming a sip authentication profile, the received methods that trigger digest authentication are configured in the methods parameter. You can also define which anonymous endpoints are subject to authentication based on the request method they send to the Oracle CSM by configuring in the anonymous-methods parameter. Consider the following three scenarios:

- By configuring the methods parameter with REGISTER and leaving the anonymous-methods parameter blank, the Oracle CSM authenticates only REGISTER request messages, all other requests are unauthenticated.
- By configuring the methods parameter with REGISTER and INVITE, and leaving the anonymous-methods parameter blank, the Oracle CSM authenticates all REGISTER and INVITE request messages from both registered and anonymous endpoints, all other requests are unauthenticated.
- By configuring the methods parameter with REGISTER and configuring the anonymous-methods parameter with INVITE, the Oracle CSM authenticates REGISTER request messages from all endpoints, while INVITES are only authenticated from anonymous endpoints.

User Authorization

In an IMS network, the Oracle CSM requests user authorization from an HSS when receiving a REGISTER message. An HSS is defined on the Oracle CSM by creating a home subscriber server configuration element that includes a name, ip address, port, and realm as its basic defining data.

UAR/UAA Transaction

Before requesting authentication information, the Oracle CSM sends a User Authorization Request (UAR) to the HSS for the registering endpoint to determine if this user is allowed to receive service. The Oracle CSM populates the UAR's AVPs as follows:

- Public-User-Identity—the SIP AOR of the registering endpoint
- Visited-Network-Identity—the value of the network-id parameter from the ingress sip-interface.
- Private-User-Identity—the username from the SIP authorization header, if it is present. If not, this value is the public User ID.
- User-Authorization-Type—always set to REGISTRATION_AND_CAPABILITIES (2)

The Oracle CSM expects the UAA to be either:

- DIAMETER_FIRST_REGISTRATION
- DIAMETER_SUBSEQUENT_REGISTRATION

Any of these responses result in the continued processing of the registering endpoint. Any other result code results in an error and a 403 returned to the registering UA (often referred to as a UE). The next step is the authentication and request for the H(A1) hash.

SIP Digest User Authentication

Authentication via MAR/MAA

To authenticate the registering user, the Oracle CSM needs a digest realm, QoP, and the H(A1) hash. It requests these from a server, usually the HSS, by sending it a Multimedia Auth Request (MAR) message. The MAR's AVPs are populated with:

- Public-User-Identity—the SIP AOR of the endpoint being registered (same as UAR)
- Private-User-Identity—the username from the SIP authorization header or the SIP AOR if the AOR for PUID parameter is enabled. (Same as UAR)
- SIP-Number-Auth-Items—always set to 1
- SIP-Auth-Data-Item -> SIP-Item-Number—always set to 1
- SIP-Auth-Data-Item -> SIP-Authentication-Scheme—always set to SIP_DIGEST
- Server-Name—the home-server-route parameter in the sip registrar configuration element. It is the URI (containing FQDN or IP address) used to identify and route to this Oracle CSM.

The Oracle CSM expects the MAA to include a SIP-Auth-Data-Item VSA, which includes digest realm, QoP and H(A1) information as defined in RFC2617. The information is cached for subsequent requests. Any result code received from the HSS other than DIAMETER_SUCCESS results in a 403 error response returned for the original request.

The MAR/MAA transaction is conducted with the server defined in the credential retrieval config parameter found in the sip-authentication profile configuration element. This parameter is populated with the name of a home-subscriber-server configuration element.

SIP Authentication Challenge

When the Oracle CSM receives a response from the HSS including the hash value for the user, it sends a SIP authentication challenge to the endpoint, if the endpoint did not provide any authentication headers in its initial contact the with Oracle CSM. If the endpoint is registering, the Oracle CSM replies with a 401 Unauthorized message with the following WWW-Authenticate header:

```
WWW-Authenticate: Digest realm="atlanta.com", domain="sip:boxesbybob.com",
qop="auth", nonce="f84f1cec41e6cbe5aea9c8e88d359", opaque="", stale=FALSE,
algorithm=MD5
```

If the endpoint initiates any other request to the Oracle CSM besides REGISTER, the Oracle CSM replies with a 407 Proxy Authentication Required message with the following Proxy-Authenticate header:

```
Proxy-Authenticate: Digest realm="atlanta.com", qop="auth",
nonce="f84f1cec41e6cbe5aea9c8e88d359", opaque="", stale=FALSE, algorithm=MD5
```

Authentication Header Elements

- Domain—A quoted, space-separated list of URIs that defines the protection space. This is an optional parameter for the "WWW-Authenticate" header.
- Nonce—A unique string generated each time a 401/407 response is sent.
- Qop—A mandatory parameter that is populated with a value of "auth" indicating authentication.
- Opaque—A string of data, specified by the Oracle CSM which should be returned by the client unchanged in the Authorization header of subsequent requests with URIs in the same protection space.
- Stale—A flag indicating that the previous request from the client was rejected because the nonce value was stale. This is set to true by the SD when it receives an invalid nonce but a valid digest for that nonce.
- Algorithm—The Oracle CSM always sends a value of "MD5"

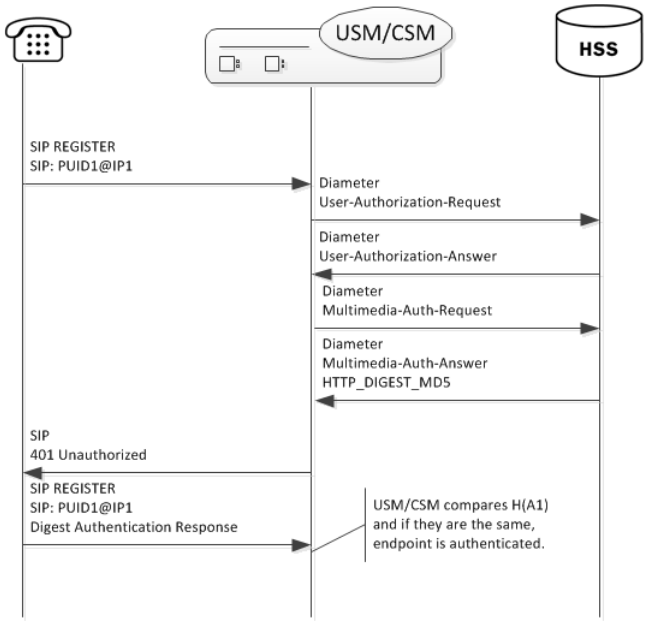
SIP Authentication Response

After receiving the 401/407 message from the Oracle CSM, the UA resubmits its original request with an Authorization: header including its own internally generated MD5 hash.

Oracle CSM Authentication Check

At this point, the Oracle CSM has received an MD5 hash from the HSS and an MD5 hash from the UA. The Oracle CSM compares the two values and if they are identical, the endpoint is successfully authenticated. Failure to match the two hash values results in a 403 or 503 sent to the authenticating endpoint.

The following image shows the User Authorization and Authentication process:



Note: Diagram information states "USM/CSM" when the applicable content applies to both the Oracle USM and the Oracle CSM.

The Oracle CSM acts as a SIP Registrar and updates an HSS with the state of its registrants.

IMS-AKA Support

The Oracle CSM also supports IMS-AKA for secure authentication end-to-end between UAs in an LTE network and an IMS core. It supports IMS-AKA in compliance with 3GPP specifications TS 33-203 and TS 33-102.

The goal of IMS-AKA is to achieve mutual authentication between end station termination mechanisms, such as an IP Multimedia Services Identity Module (ISIM), and the Home Network (IMS Core). Achieving this goal requires procedures both inside and outside the core. Ultimately, IMS performs the following:

- Uses the IMPI to authenticate the home network as well as the UA;
- Manages authorization and authentication information between the HSS and the UA;
- Enables subsequent authentication via authentication vectors and sequence information at the ISIM and the HSS.

The Oracle CSM authenticates registrations only. This registration authentication process is similar to SIP Digest. The process accepts REGISTER requests from UAs, conducts authorization procedures via UAR/UAA exchanges and conducts authentication procedures via MAR/MAA exchanges and challenges with the UA.

Configuration and operational support are not the same on the Oracle USM and Oracle CSM. This is because the Oracle USM can perform the P-CSCF role as well as the I-CSCF and S-CSCF roles. Applicable configuration to support IMS-AKA on the P-CSCF access interface is documented in the Security chapter of the *Oracle Communications Session Border Controller ACLI Configuration Guide*. This configuration includes defining an IMS-AKA profile, enabling the **sip-interface** for IMS-AKA and configuring the **sip-port** to use the profile.

There is no configuration required for the S-CSCF role, but there is an optional configuration that specifies how may authentication vectors it can accept from the HSS. The S-CSCF stores these authentication vectors for use during subsequent authentications. Storing vectors limits the number of times the device needs to retrieve them from the HSS. The default number of authentication vectors is three.

Authentication Sequence - Registration

UAs get service from an IMS core after registering at least one IMPU. To become registered, the UA sends REGISTER requests to the IMS core, which then attempts to authenticate the UA.

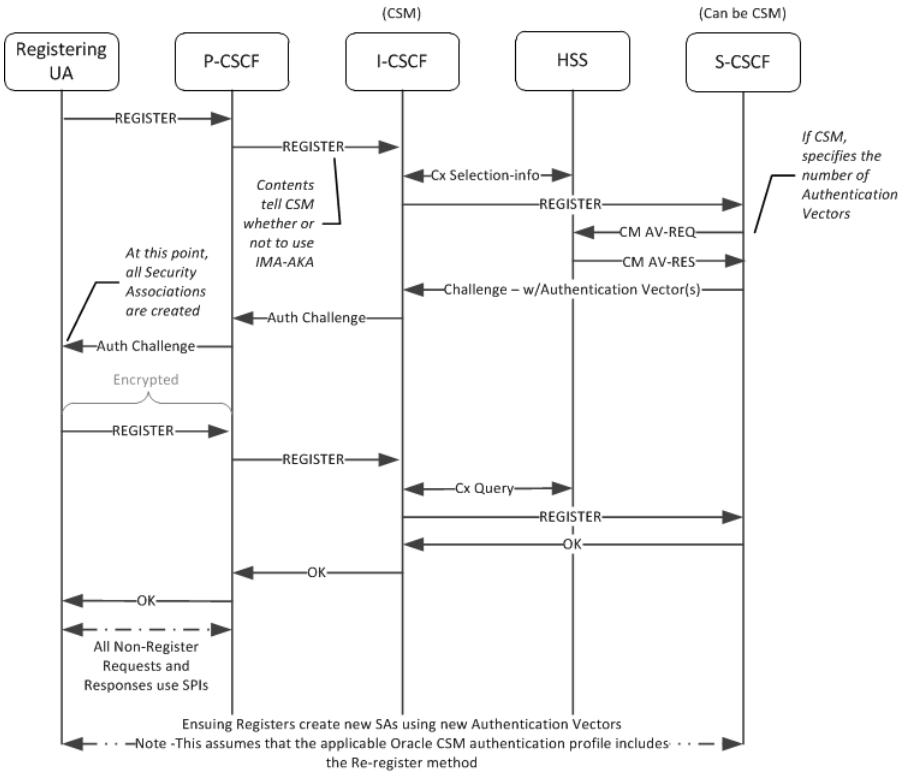
The first device to receive the REGISTER at the core is a P-CSCF, such as the Oracle USM. For the Oracle USM, appropriate configuration determines that it uses IMS-AKA as the authentication mechanism on the access interface. For an Oracle CSM, the presence and state of the “integrity-protected” parameter in the Authorization header of a REGISTER triggers the use of IMS-AKA. If the value of this parameter is either “yes” or "no", IMS-AKA is invoked. If the parameter is not present, or it is set to any other value, the Oracle USM falls back to SIP Digest authentication.

To proceed with IMS-AKA authentication, the P-CSCF engages in S-CSCF selection procedures via the I-CSCF to identify the target S-CSCF. Having identified the S-CSCF (your Oracle CSM), the I-CSCF forwards the REGISTER to it. The I-CSCF next engages in standard UAR and MAR procedures. For IMS-AKA deployments, the HSS follows procedures defined in TS 33-203 to create authentication vectors for the UA. The HSS provides the vectors to the S-CSCF, which then proceeds with authentication procedures defined in TS 33-203.

After processing, the S-CSCF uses authentication vectors to challenge the UA. The UA uses the information in this challenge to, first, authenticate the Home Network. Having confirmed the network, the UA then prepares and sends its authentication information back towards the S-CSCF. The S-CSCF is then responsible for authenticating the UA. The S-CSCF sends a 200OK back to the UA upon successful authentication, allowing the UA to get service from the HN.

The Oracle CSM caches the AOR’s registration and stores authentication vectors for subsequent authentications, thereby minimizing the work required by the HSS.

The overall sequence is depicted below.



Outside the Core

LTE networks include UAs that have an IP Multimedia Service Identity Module (ISIM) or equivalent. ISIMs are configured with a long-term key used to authenticate and calculate cipher keys, as well as IP Multimedia Private and Public Identities (IMPI and IMPU). The ISIM serves as the means of authenticating the home network to the UA. The UA, in turn, sends information based on it's ISIM configuration to the home network, which can then authenticate the UA.

Establishment of Security Associations (SAs) to and from the UA are the responsibility of the P-CSCF. The P-CSCF should also be capable of managing the processes when the UA is behind a NAT.

Note: Within the context of IMS-AKA, only traffic between the P-CSCF and the UA is encrypted.

Authentication Success

When using IMS-AKA, successful registration of a UA consists of registering at least one IMPU and the IMPI authenticated within IMS. The UA begins this process by sending it REGISTER request to the P-CSCF properly specifying IMS-AKA authentication. IMS then performs standard procedures to identify the appropriate S-CSCF. Upon receipt of the REGISTER, the S-CSCF checks for the presence of an authentication vector. If it is present the S-CSCF issues the authentication challenge; if not, it requests authentication vector(s) from the HSS. Note that the Oracle CSM allows you to request multiple authentication vectors via configuration. The HSS provides the following components within an authentication vector:

- RAND—random number
- XRES—expected response
- CK—cipher key
- IK—integrity key
- AUTN—authentication token

The MAR provided to the S-CSCF differ from that of SIP digest authentication requests as follows:

- The SIP-Number-Auth-Items AVP specifies the number of authentication vectors, which is equal to the home-subscriber-server's num-auth-vectors setting.
- The SIP-Authentication-Scheme AVP specifies the authentication scheme, Digest-AKAv1-MD5.

At this point, the Oracle CSM can send the authentication challenge to the UA. If multiple authentication vectors were provided by the HSS, the Oracle CSM can independently authenticate the UA until the pool is exhausted. The S-CSCF stores the RAND it sends to the UA to resolve future synchronization errors, if any. No authentication vector can be used more than once. This is validated by the ISIM, using a sequence number (SQN).

When a P-CSCF receives an authentication challenge, it removes and stores the CK and the IK. The P-CSCF forward the rest of the information to the UA.

The UA is responsible for verifying the home network. Having received the AUTN from the P-CSCF, the UA derives MAC and SQN values. Verifying both of these, the UA next generates a response including a shared secret and the RAND received in the challenge. The UA also computes the CK and IK.

Upon receipt of this response, IMS provides the message to the S-CSCF, which determines that the XRES is correct. If so, it registers the IPMU and, via IMS sends the 200 OK back to the UA.

Authentication Failure

Either the UA or IMS can deny authentication via IMS-AKA. In the case of the UA, this is considered a network failure; in the case of IMS there would be a user authentication failure.

Network Authentication Failure

The UA determines that the HN has failed authentication, it sends a REGISTER request with an empty authorization header parameter and no authentication token for synchronization (AUTS). This indicates that the MAC parameter was invalid as determined by the UA. In this case, the S-CSCF sends a 403 Forbidden message back to the UA.

User Authentication Failure

IMS-AKA determines user authentication failure as either:

- IK incorrect—If the REGISTER includes a bad IK, the P-CSCF detects this and discards the packet at the IPSEC layer. In this case, the REGISTER never reaches the S-CSCF.
- XRES incorrect—In this case, the REGISTER reaches the S-CSCF. The S-CSCF detects the incorrect XRES, the S-CSCF sends a 4xxx Auth_Failure message back to the UA via IMS.

Synchronization

Synchronization refers to authentication procedures when the (REFRESH TIMING) is found to be stale. This is not an authentication failure.

The UA may send an AUTS in response to the challenge, indicating that the authentication vector sequence is "out-of-range". Upon receipt of the AUTS, the S-CSCF sends a new authorization vector request to the HSS. The HSS checks the AUTS and, if appropriate sends a new set of authentication vectors back the the S-CSCF. Next the S-CSCF sends 401 Unauthorized back to the UA. Assuming the UA still wants to register, this would trigger a new registration procedure.

Optional IMS-AKA Configuration

The following configuration enables the Oracle CSM to specify, on a per-HSS basis, the number of authentication vectors it can download per MAR. Making this setting is not required as it has a valid default entry (3).

home subscriber server

To configure the number of authentication vectors to download from a home subscriber server (HSS):

1. In Superuser mode, type **configure terminal** and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type **session-router** and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type **home-subscriber-server** and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# home-subscriber-server
ORACLE(home-subscriber-server)#
```

4. **Select**—If already configured, choose the home subscriber server for which you want to set the number of authentication vectors.
5. **num-auth-vector**— [1-10] 3 default - The number of authentication vectors downloaded from HSS per MAR. The range is from 1-10 with 3 as the default.
6. Type **done** when finished.

Oracle CSM as Registrar

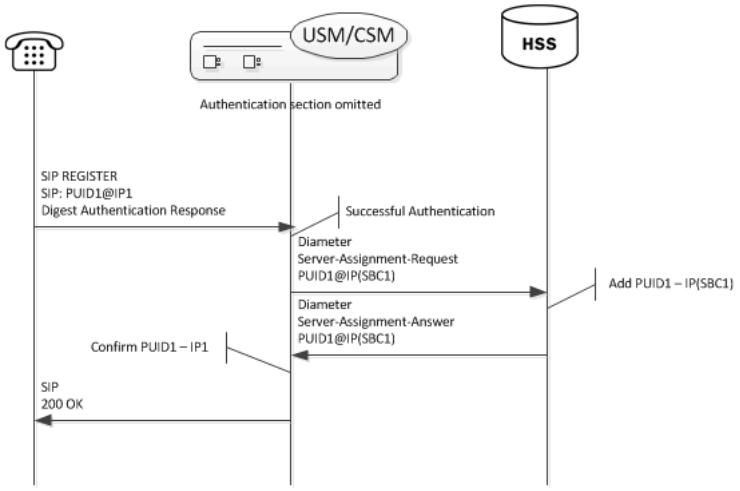
Creating a sip registrar configuration element enables the Oracle CSM to act as a SIP registrar. When registration functionality is enabled, the Oracle USM actually registers endpoints rather than only caching and forwarding registrations to another device. Oracle CSM registry services are enabled globally per domain, not on individual SIP interfaces or other remote logical entities.

On receiving a REGISTER message, the Oracle CSM checks if it is responsible for the domain contained in the Request-URI as defined by the domains parameter and finds the corresponding sip registrar configuration. This is a global parameter—all messages are checked against all sip registrar domains. Thus you could create one sip registrar configuration element to handle all .com domains and one sip registrar configuration element to handle all .org domains. The Oracle CSM begins registrar functions for all requests that match the configured domain per sip-registrar configuration element.

A UA is considered registered once a SAA assignment is received from the HSS, after which the Oracle CSM sends a 200 OK message back to the registering UA.

New Registration

The following image shows a simplified call flow for a registering user:



Limiting AOR Contacts

The Oracle CSM allows you to limit the number of contacts that apply to AORs. If the Oracle CSM receives a registration request that exceeds the maximum that you configured, it responds with a local response, a 403 Forbidden by default, and does not register the additional contact. The system only rejects registration requests that exceed the maximum. Existing contacts persist normally.

The system checks against the maximum in the following circumstances:

- A new registration is received
- The location-update-interval expires
- A call-id changes (and the forward-reg-callid-change option is enabled)
- A registrar message sequence number has skipped a number
- There is any change to the contact list

If the number of contacts in the initial registration exceeds the maximum, the Oracle CSM rejects the entire registration. In addition, if you configure this feature while the system is operational, your setting only applies to new registrations.

You configure these maximums on a per-registrar basis. The value ranges from 0-256. The feature is RTC supported.

HSS Server Assignment

As the Oracle CSM registers UAs, it requests to assign itself as the S-CSCF for the registering AoR. The Oracle CSM's S-CSCF identity is configured in the home-server-route parameter in sip-registrar configuration element. This is a entered as a SIP URI (containing FQDN or IP address) and is used to identify and route messages to this Oracle CSM on behalf of the registered user.

Server Assignment Messages

The Oracle CSM sends a Server Assignment Request (SAR) to the HSS requesting to confirm the SIP or SIPS URI of the SIP server that is currently serving the user. The SAR message also serves the purpose of requesting that the Diameter server send the user profile to the SIP server. The SAR's AVPs are populated as follows:

- Public-User-Identity—the SIP AOR of the endpoint being registered (same as UAR)
- Private-User-Identity—the username from the SIP authorization header, if it is present. If not, this value is the public User ID. (Same as UAR)
- Server-Name—the home server route parameter in the sip-registrar configuration element. It is the FQDN or IP address used to identify and route to this Oracle CSM sent as a URI.
- Server-Assignment-Type—the value of this attribute depends upon the registration state:
  - REGISTRATION (1)—for all new and refreshing registrations.
  - Set to TIMEOUT_DEREGISTRATION (4)—when the contact is unregistered due to expiration. This occurs if the force-unregistration option is configured in the sip config.
  - USER_DEREGISTRATION (5)—when the contact is unregistered by the user (contact parameter expires=0).
- User-Data-Already-Available—always set to USER_DATA_ALREADY_AVAILABLE (1)

Server-Assignment-Response

The Oracle CSM expects a DIAMETER_SUCCESS code in the SAA to indicate that the assignment was successful. Then a 200 OK response is returned to the registering user. Any other Diameter result code is an error and results in an error response for the original REGISTER request (by default 503) and the contacts to be invalidated in the registration cache.

Register Refresh

When a UA sends a register refresh, the Oracle CSM first confirms that the authentication exists for that UE's registration cache entry, and then is valid for the REGISTER refresh. (If a valid hash does not exist for that AoR, then the Oracle CSM sends an MAR to the HSS to retrieve authentication data once again).

Next, the Oracle CSM determines if the it can perform a local REGSITER refresh or if the HSS needs to be updated. If any of the following 3 conditions exists for the re-registering UA, the Oracle CSM updates the HSS:

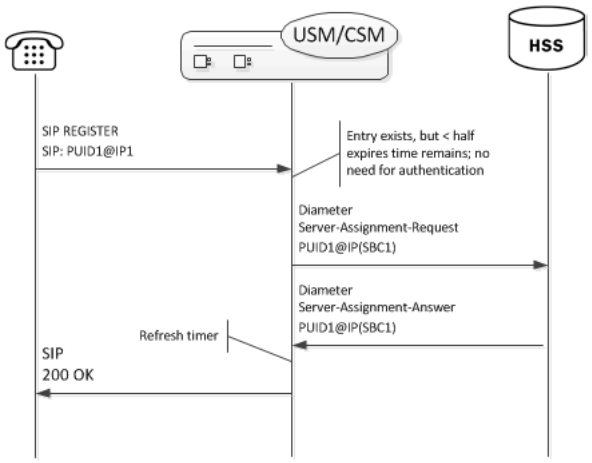
- The location update interval timer has expired—This value, configured in the sip registrar configuration element ensures that HSS database always has the correct Oracle CSM address by periodically sending SARs for each registered contact.

- The message's call-id changes while the forward-reg-callid-change option in the sip config configuration element is set. This covers the case where the UA changes the Oracle CSMs through which it attaches to the network.
- The REGISTER message's Cseq has skipped a number. This covers the case in which a user registered with Oracle CSM1, moves to Oracle CSM2 , and then returns to Oracle CSM1.

If the Oracle CSM updates the HSS database because of matching one of the above conditions, the access side expiration timer per contact is reset to the REGISTER message's Expires: header value, and returned in the 200 OK. This happens even in the case when the reREGISTER was received in the first half of the previous Expires period. In addition, the core-side location update interval timer are refreshed on both active and standby.

When the above three conditions are not met, the registration expiration proceeds normally.

If the timer has not exceeded half of its lifetime, a 200 OK is returned to the UA. If the timer has exceeded half of its lifetime, the Oracle CSM just refreshes the access-side expiration timer; the registration cache expiration timer for that AoR begins its count again.



Core-side SAR Lifetime

The Oracle CSM maintains a timer for user registrations per SAR on the core side as specified above. The core-side SAR lifetime timer is configured in the location update interval parameter in the sip registrar configuration element. This timer ensures that the HSS always has the correct Oracle CSM address, by sending SAR messages periodically.

Entry Unregistration

Because AoRs and not contacts are referenced by the HSS, an AoR is valid and should not be removed from HSS until all associated contacts have been removed or expired. If all the contacts are removed for an AoR by receiving REGISTER messages with Expires:0 header, then the SAR sent to the HSS includes Server-Assignment-Type of USER_DEREGISTRATION (5).

When the force-unregister option in the sip config is enabled, then the HSS is explicitly updated when all of the contacts for an AoR have expired. This event prompts the Oracle CSM to send a SAR to the HSS using the Server-Assignment-Type of TIMEOUT_DEREGISTRATION (4).

The HSS can send a Registration-Termination-Request to request removing a registration, which corresponds to entries in the Oracle CSM's registration cache. When an RTR is received, the following AVPs are expected:

- Private-User-Identity—Username of the user, which is being de-registered.
- Associated-Identities—The Private-Id's in the same subscription which need to be de-registered. (optional)
- Public-Identity—One or more public-Id's of the user being de-registered. (optional)

For the AoR specified by the Private-User-Identity AVP, all associated contacts are removed in the registration cache. The Oracle CSM sends a Registration Termination Answer to the HSS to indicate success.

User Registration based on Reg-ID and Instance-ID (RFC 5626)

Sometimes a user's device reregisters from a different network than its original registration. This event should be considered a location update rather that a completely new registration for the Contact. The Oracle CSM can perform this way by considering the endpoint's reg-id and instance-id parameters defined in *RFC 5626*.

The Oracle CSM identifies new REGISTER requests received on a different access network as a location update of the existing binding between the Contact and AoR. Without this feature, the Oracle CSM would create a new binding and leave the old binding untouched in the local registration cache/ENUM database. This scenario is undesirable and leads to unnecessary load on various network elements including the Oracle CSM itself.

The following conditions must be matched to equate a newly registering contact as a location update:

For a received REGISTER:

- The message must not have more than 1 Contact header while 1 of those Contact headers includes a reg-id parameter. (failure to pass this condition prompts the Oracle CSM to reply to the requester with a 400 Bad Request).
- The Supported: header contains outbound value
- The Contact header contains a reg-id parameter
- The Contact header contains a +sip.instance parameter

After these steps are affirmed, the Oracle CSM determines if it is the First hop. If there is only one Via: header in the REGISTER, the Oracle CSM determines it is the first hop and continues to perform Outbound Registration Binding processing.

If there is more than 1 Via: header in the REGISTER message, the Oracle USM performs additional validation by checking that a Path: header corresponding to the last Via: includes an ob URI parameter, Outbound Registration Binding may continue.

If the Oracle CSM is neither the first hop nor finds an ob URI in Path headers, it replies to the UA's REGISTER with a 439 First Hop Lack Outbound Support reply.

reREGISTER Example

The user (AoR) bob@example.com registers from a device +sip.instance= <urn:uuid:0001> with a reg-id ="1", contact URI = sip:1.1.1.1:5060. A binding is be created for bob@example.com+<urn:uuid:0001>+reg-id=1 at sip: 1.1.1.1.:5060.

Next, Bob@example.com sends a reREGISTER with the same instance-id but with a different reg-id = 2 and contact URI = sip:2.2.2.2:5060.

The previous binding is removed. A binding for the new contact URI and reg-id is created. bob@example.com +<urn:uuid:0001>+reg-id=2 at sip:2.2.2.2:5060

Outbound Registration Binding Processing

An outbound registration binding is created between the AoR, instance-id, reg-id, Contact URI, and other contact parameters. This binding also stores the Path: header.

Matching re-registrations update the local registration cache as expected. REGISTER messages are replied to including a Require: header containing the outbound option-tag.

If the Oracle CSM receives requests for the same AOR with some registrations with reg-id + instance-id and some without them, the Oracle CSM will store them both as separate Contacts for the AOR; The AoR+sip.instance+reg-id combination becomes the key to this entry.

Wildcarded PUID Support

The Oracle CSM supports the use of wildcarded Public User IDs (PUIDs), typically for registering multiple endpoints on a PBX with a single PUID. A wildcard is composed of a regular expression that, when used in a PUID prefix, represents multiple UEs. The group of UEs is referred to as an implicit registration set and share a single service profile. This support is typically implemented to reduce HSS resource requirements. The regular expressions themselves are in form of Perl Compatible Extended Regular Expressions (PCRE).

Each implicit registration set is associated with an explicitly registered distinct PUID. Typically, this distinct PUID is the PBX itself. The implicit registration set is dependent on the distinct PUID, including the distinct PUID's registration status.

There is no Oracle CSM configuration required.

Wildcarded PUID support is applicable to both I-CSCF and S-CSCF operation. In addition, all Oracle CSMs in the applicable data paths must be in the same trust domain.

To allow the feature, the Oracle CSM supports:

- Wildcarded PUID AVP in the LIR, SAR and SAA
- User Profile AVP in the SAA
- P-Profile-Key across the Mw interface, as defined in RFC 5002

Note also that the HSS must support the wildcarded-public-Identify AVP.

ACLI Instructions

The following configuration enables the Oracle CSM to authorize and authenticate registering users. In addition it sets the Oracle CSM to request itself as the S-CSCF for the registering users.

home subscriber server

To configure a home subscriber server (HSS):

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type home-subscriber-server and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# home-subscriber-server
ORACLE(home-subscriber-server)#
```

4. name—Enter the name for this home subscriber server configuration element to reference from other configuration elements.
5. state—Set this to enabled to use this configuration element.
6. address—Enter the IP address of this HSS. Both IPv4 and IPv6 addressing is supported.
7. port—Enter the port which to connect on of this HSS, the default value is 80.
8. realm—Enter the realm name where this HSS exists.
9. Type done when finished.

SIP Authentication Profile

To configure the SIP Authentication Profile:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-authentication-profile and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-authentication-profile
ORACLE(sip-authentication-profile)#
```

You may now begin configuring the SIP Authentication Profile configuration element.

4. name—Enter the name of this SIP authentication profile that will be referenced from a SIP registrar (or a SIP interface) configuration element.
5. methods—Enter all the methods that should be authenticated. Enclose multiple methods in quotes and separated by commas.
6. anonymous-methods—Enter the methods from anonymous users that require authentication. Enclose multiple methods in quotes and separated by commas.
7. digest-realm—Leave this blank for Cx deployments.
8. credential-retrieval-method—Enter CX.
9. credential-retrieval-config—Enter the home-subscriber-server name used for retrieving authentication data.
10. Type done when finished.

SIP Interface

The full SIP interface should be configured according to your network needs. Please refer to the Oracle SBC ACLI Configuration Guide.

To configure a SIP Digest Authentication on a specific SIP Interface:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-interface and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-interface
ORACLE(sip-interface)#
```

4. Type select and choose the number of the pre-configured sip interface you want to configure.

```
ORACLE(sip-interface)# select
<realm-id>:
1: private 192.168.101.17:5060
2: public  172.16.101.17:5060
selection: 1
```

5. registration-caching—Set this parameter to enabled.
6. ims-access—Set this parameter to enabled for access interfaces, when applicable. Core interfaces should have this feature disabled.
7. sip-authentication-profile—Set this to the name of an existing sip-authentication profile if you wish to authenticate per SIP interface.
8. Type done when finished.

SIP Registrar

To configure the Oracle CSM to act as a SIP Registrar:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-registrar and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)#
```

4. name—Enter a name for this SIP registrar configuration element.
5. state—Set this to enabled to use this SIP registrar configuration element.
6. domains—Enter one or more domains that this configuration element will invoke SIP registration for. Wildcards are valid for this parameter. Multiple entries can be entered in quotes, separated by commas.
7. subscriber-database-method—Set this to CX.
8. subscriber-database-config—Enter the home-subscriber-server configuration element name that will handle REGISTER messages for this domain. The HSS configuration element includes the actual IP address of the server that SAR's are sent to.
9. authentication-profile—Enter a sip-authentication-profile configuration element's name. The sip authentication profile object referenced here will be looked up for a REGISTER message with a matching domain in the request URI. You may also leave this blank for the receiving SIP Interface to handle which messages require authentication if so configured.
10. home-server-route—Enter the identification for this Oracle CSM that will be sent as the Server-Name in MAR and SAR messages to the HSS. This value should be entered as a SIP URI.
11. location-update-interval—Keep or change from the default of 1400 minutes (1 day). This value is used as the timer lifetime for core-side HSS updates.
12. Type done when finished.

Maximum Number of Contacts

To configure a sip-registrar with a maximum of 10 contacts per AOR:

1. From superuser mode, use the following command sequence to access sip-registrar element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)# select
```

   Select the registrar you want to configure.

2. Specify the number of contacts.

```
AORACLE(sip-registrar)# max-contacts-per-aor 10
AORACLE(sip-registrar)# done
```

Response to Exceeding Maximum Contacts

To configure local response for the Oracle CSM to issue when max-contacts-per-aor is exceeded:

1. From superuser mode, use the following command sequence to access local-response and add an entry.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# local-response-map
```

2. Access the entries configuration.

```
ORACLE(local-response-map)# entries
```

3. Specify the local error you need to configure.

```
ORACLE(local-response-map-entry)# local-error contacts-per-aor-exceed
```

4. Specify the sip-reason for this error.

```
ORACLE(local-response-map-entry)# sip-reason forbidden
```

5. Specify the error code for this error.

```
ORACLE(local-response-map-entry)# sip-status 403
ORACLE(local-response-map-entry)# done
local-response-map-entry
        local-error                     contacts-per-aor-exceed
        sip-status                      403
        q850-cause                      0
        sip-reason                      forbidden
        q850-reason
        method
        register-response-expires
ORACLE(local-response-map-entry)# exit
```

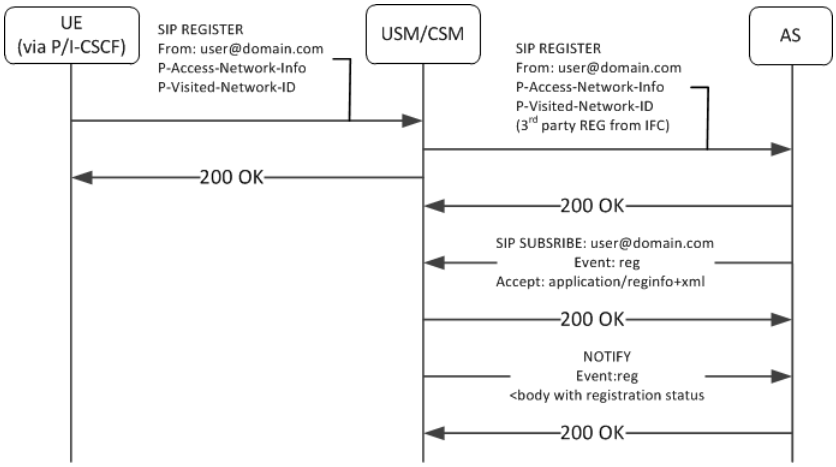
SIP Registration Event Package Support

The Oracle CSM supports UA subscriptions to the registration event package, as defined in RFC3680. As such, it maintains contact with entities, often application servers, that need to know about UA registration events and provides those application servers with notifications when registration events occur.

Common usage for this functionality includes:

- Forcing re-authentication
- The provision of welcome notices to users who need information or instructions customized to their location

An operational example, shown below, begins with the Oracle CSM performing 3rd party registration on behalf of a UA to an AS, based on the iFC request from the UA. The AS, being an appropriately authorized UA itself, subscribes to NOTIFY messages on reg events for the initial UA. The Oracle CSM sends a 200OK to the AS, and then proceeds to forward NOTIFY messages about that UE's registration events to the AS.



This feature is relevant when the Oracle CSM is performing S-CSCF functions. You enable this feature on the Oracle CSM per registrar, by simply creating a profile and applying it to the applicable registrar.

SUBSCRIBE Processing

When the Oracle CSM has the reg-event notification function enabled for a registrar, it includes the allow-events header in its 200OK replies to successful REGISTERS. This lets UEs know that they can subscribe to registration event packages.

When the Oracle CSM receives reg-event subscription requests, it follows the sequence below to process SUBSCRIBE requests for reg events:

1. Determines validity of the request.

Subscriptions cannot include more than one package name. If there is more than one package name in the request, the Oracle CSM replies with a 400 Bad Request message.

2. Determines if it can be a notifier, as follows:

   - The SUBSCRIBE must include EVENT=reg.
   - The requesting UA must be in the same domain as the registrar.

   If both of the above are true, the Oracle CSM proceeds with the request.

3. Authorizes the request. The Oracle CSM only authorizes requests from UEs that come from the same realm and layer 2 connection on which it received the initial REGISTER.
   Furthermore, the Oracle CSM only authorizes the following UEs:

   - Public user identities from UEs that are subscribing to their own registration events.
   - Public user identities that this user owns. Examples include implicitly registered public user identities.
   - Entities that were included in the PATH header of the target UE's registration.
   - All ASs that are listed in the UE's iFC and that are part of the trust domain.

   If all of the above are true, the Oracle CSM proceeds with the request. If not, it sends 403 Forbidden to the requester.

4. Determines how it is functionally related to the UA. The Oracle CSM only processes subscriptions for users in its registration cache, replying with a 403 Forbidden if not. For cached users, the Oracle CSM forwards the request to the registrar if it is the P-CSCF. If it is the S-CSCF, it sends a 200 OK and begins to act as notifier.

5. Identifies the subscription duration, as follows, and sends the 200 OK to the UE:

   If there is no Expires header in the UE's 200OK message, the Oracle CSM applies it's own configured minimum or the default (600000 seconds), whichever is greater.

   If the SUBSCRIBE includes an Expires header, the Oracle CSM honors the request unless it is less than the configured minimum.

   If the SUBSCRIBE's Expires header is less than the minimum subscription time configured in the registration event profile, the Oracle CSM denies the subscription, sending a 423 Too Brief message.

   When the Oracle CSM encounters an Expires header set to 0, it terminates the subscription. This is referred to as unsubscribing.

SUBSCRIBE REFRESH Requests

Subscriptions must be refreshed to keep them from expiring. ASs accomplish this by sending SUBSCRIBE REFRESH messages to the Oracle CSM. Messages must be received from authorized subscribers and on the same realm and connection as the original SUBSCRIBE or the Oracle CSM rejects the refresh request.

Reg Event NOTIFY Messages

When configured, the Oracle CSM issues NOTIFY messages to subscribed ASs when significant registration events occur. NOTIFY messages sent by the Oracle CSM comply fully with RFC3680. Events that trigger NOTIFY messages include:

- Registered
- Registration refreshed
- Registration expired
- Registration deactivated
- UE unregistered

The Oracle CSM does not send NOTIFY messages for the following events:

- Registration created
- Registration shortened
- Registration probation
- Registration rejected

Additional detail about NOTIFY messages that is specific to the Oracle CSM includes:

- The Oracle CSM always sends full information on all contacts, and indicates such within the reginfo element. The Oracle CSM does not utilize the partial state described within RFC 3680.
- Wildcarded PUIDs are included, enclosed in the <wildcardedIdentity> tag within the <registration> element.
- The Oracle CSM does not include the following optional attributes within the contact element:
  - expires
  - retry-after
  - duration registered
  - display-name
- The Oracle CSM uses the optional unknown-param element within the contact element to convey UA capabilities and distribute reg-id, sip.instance and header filed attributes.

An example of the XML body of a NOTIFY message below documents the registration status for the AOR joe@example.com.

```
<reginfo xmlns="urn:ietf:params:xml:ns:reginfo"   xmlns:xsi=http://www.w3.org/
2001/XMLSchema-instance version="0" state="full">
  <registration aor="sip:joe@example.com" id="as9" state="active">
    <contact id="6" state="active" event="registered">
      <uri>sip:joe@pc887.example.com</uri>
    </contact>
      <contact id="7" state="terminated" event="expired">
      <uri>sip:joe@university.edu</uri>
    </contact>
  </registration>
</reginfo>
```

Use the show registration and show sipd subscription commands to display all information about each subscription.

Reducing NOTIFY Traffic

RFC 3265 stipulates that the Subscription server sends NOTIFY messages to all subscribers when a UA sends a registration refresh. This can generate excessive NOTIFY traffic. You, however, can mitigate this by configuring the Oracle CSM to limit notification traffic. By specifying the number of seconds between NOTIFY messages, you prevent the Oracle CSM from sending notifications upon events that do not generate a change in the registration database.

Database changes that trigger notifications when this option is configured include:

- The Cseq number of the REGISTER message increases by more than 1
- The call-ID changes
- A contact parameter changes
- The number of contacts changes

Upon expiry of this timer, the Oracle CSM sends out a NOTIFY for every registration event subscription. Note also that the Oracle CSM does not send the cseq attribute in the CONTACT element when this interval is configured.

Configuring Registration Event Package

This section shows you how to create reg-event profiles and apply those profiles to sip-registrars. These profiles enable the monitoring of UA registration events and the delivery of state change notifications to each UA that subscribes to the package. The procedure includes:

- Create one or more registration-event profiles
- Apply each profile to the applicable sip-registrar
- Optionally specify the registration event notification interval timer

Registration Event Profile Configuration

To configure a registration event profile:

1. From superuser mode, use the following command sequence to access regevent-notification-profile command.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# regevent-notification-profile
ORACLE(registration-event-profile)#
```

2. To define the profile, simply name it and specify a timeout in seconds.

```
ORACLE(registration-event-profile)# name reg-event-profile1
ORACLE(registration-event-profile)# min-subscription-duration 2500
ORACLE(registration-event-profile)# done
ORACLE(registration-event-profile)# exit
```

3. Navigate to the registrar for which you want registration event package support.

```
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)# regevent-notification-profile reg-event-profile1
ORACLE(sip-registrar)# done
ORACLE(sip-registrar)# exit
```

Optional NOTIFY Refresh Frequency

To specify optional NOTIFY refresh frequency:

1. From superuser mode, use the following command sequence to access registration-event-profile command within session router.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# regevent-notification-profile
ORACLE(registration-event-profile)#
```

2. To enable NOTIFY, set the send-notify-for-reg-refresh option to the time, in seconds,

```
ORACLE(registration-event-profile)# options notify-refresh-interval=1800
ORACLE(registration-event-profile)# done
ORACLE(registration-event-profile)# exit
```

   Prepend the option with the + sign if you have multiple options configured that you want to retain.

```
ORACLE(registration-event-profile)# options +notify-refresh-interval=1800
```

   Running the command without the + character causes the system to remove any previously configured options.

Message Routing

The Oracle CSM provides two major types of routing that use the routing precedence parameter in the sip registrar. Routing precedence can be set to either registrar (HSS) or local policy. Routing precedence is set to registrar by default. There are additional controls that the user may configure to refine message routing.

Registrar routing uses the configured subscriber database and registration cache to route the call. Local policy routing lets you configure routing decisions within the Oracle CSM's local policy routing functionality.

Within the context of local policy routing, the Oracle CSM chooses the next hop through the network for each SIP session based on information received from routing policies and constraints. Routing policies can be as simple as routing all traffic to a proxy or routing all traffic from one network to another. Routing policies can also be more detailed, using constraints to manage the volume and rate of traffic that can be routed to a specific network. For example, you can manage volume and rate of traffic to enable theOracle CSM to load balance and route around softswitch failures.

When a message arrives at the Oracle CSM, it determines whether it is coming from a session agent. If so, the Oracle CSM checks whether that session agent is authorized to make the call. Local policy is then checked to determine where to send the message.

Depending on whether the Oracle CSM is performing originating or terminating services for the call, described in the chapter on operations within the IMS core, it performs those services prior to routing to the endpoint.

If the Oracle CSM is unable to proceed with routing a request, it replies to the UA that sent the request with a 4xx response.

This chapter provides an overview of registrar routing for perspective, but focuses on local policy routing. Local policy routing is configuration intensive, allowing precise route specification. As a result, configuring local policy routing is a complex process requiring that the user understand the purpose and interaction of multiple configuration elements. This chapter also provides descriptions and configuration instruction on additional routing controls, such as the use of multistage and UA capability routing.

Registrar Routing

When the routing precedence parameter is set to registrar, the Oracle CSM is using the HSS as a resource within the context of its routing decisions.

When an INVITE arrives, the Oracle CSM checks its own registration cache for a pre-existing matching contact in the INVITE. If it finds a match, it forwards the request to that location. If it does not find a match, it issues an Location Information Request (LIR) to the HSS. If the HSS's response, called an LIA, provides an assigned S-CSCF for that UA, the Oracle CSM proceeds as described below in the section LIR/LIA Transaction.

Note that you can configure the Oracle CSM to fallback to a local policy lookup if the lookup via the registrar fails. Configure this by adding the fallback-to-localpolicy option to the sip-registrar configuration element.

For situations where the database routing decision needs to be done in lieu of the default, you can set routing precedence to local-policy. Note that you can configure a routing entry that points to an HSS by setting a policy attribute with a next-hop of cx:<home-subscriber-server-name> within the local-policy.

LIR/LIA Transaction

An LIR includes the Public-User-Identity AVP, which contain a UA's actual PUID. The HSS responds with the assigned S-CSCF server (often a Oracle USM) for this PUID. The answer is the form of a Location Info Answer (LIA). The LIA includes the assigned S-CSCF in the Server Name AVP.

If the S-CSCF returned in the LIR is this Oracle CSM, then the Oracle USM performs unregistered termination services for this UA. (This situation indicates that the UA is currently unregistered.) Such services could include directing the call to voice mail. If the HSS returns an S-CSCF in the LIA that is not this Oracle CSM, it forwards the request to that S-CSCF.

Default Egress Realm

The sip registrar configuration element should be configured with a default egress realm id. This is the name of the realm config that defines the IMS control plane, through which all Oracle CSMs, HSSs, and other network elements communicate and exchange SIP messaging. It is advisable to configure this parameter to ensure well defined reachability among Oracle CSMs.

Routing Based on UA Capabilities

In compliance with RFC 3841, the Oracle CSM is able to make forwarding and forking decisions based on preferences indicated by the UA. To do this, the Oracle CSM evaluates each callee's AOR contact to determine the capabilities advertised by the UA and uses this information to make forwarding and forking decisions.

Prior to this support, the Oracle CSM made routing preference decisions solely via the q value present in the contact header. In cases where the preferences were equal, the Oracle CSM simply forwarded to those contacts simultaneously (parallel forking). In cases where the q value were not equal, the Oracle CSM forwarded in sequence (sequential forking), forwarding to the highest q value first.

The Oracle CSM now extends upon this functionality by scoring contacts, based on their capabilities, and making forwarding decisions using that score in addition to the q value.

There is no additional Oracle CSM configuration required to enable or invoke this processing. This functionality is supported for HSS, ENUM and Local Database configurations.

UE Capabilities

RFC2533 includes a framework that defines feature sets. Feature sets make up a group of media capabilities supported by a UA, individually referred to as media feature tags. In session networks, feature tag information is converted to a form specified in RFC3840 and exchanged between devices in the network to establish lists of UA capabilities. Based on these capabilities, session operation procedures are performed that facilitate preferred communications modalities.

RFC3840 defines:

- The format a UA uses to specify feature sets
- How a UA registers capabilities within the network
- An extension to the contact header so that it can include feature parameters
- The media tags that specify each capability

The full list of applicable media tags is presented in RFC 3840. Examples of tags include audio, automata, data, mobility, application and video.

Registering Capabilities at the Oracle CSM

Endpoints register their capabilities by listing them in the Contact headers of the REGISTER request. The Oracle CSM stores these feature parameters in its registration cache along with the other contact information. In the case of ENUM databases, the Oracle CSM also sends capabilities information to the ENUM infrastructure so that it can maintain capabilities records.

In addition to the standard set of tags, the Oracle CSM supports storing custom feature tags. Tags formatted with a + sign preceding the tag are recognized as custom tags. The exception to this are tags formatted using +sip.<tagname>, which are registered sip media feature tags.

An example of a contact header specifying audio, video and methods capabilities is shown below:

Contact: sip:u1@h.example.com;audio;video;methods="INVITE,BYE";q=0.2

Preferential Routing

The Oracle CSM routes using UA capabilities only when acting as S-CSCF. It calculates preferred forwarding and forking using this information in conjunction with UA requests. This calculation is based on Preferential Routing, as defined in RFC3841. Note that the q value is used in this calculation.

Using Preferential Routing, the Oracle CSM creates a target UA list from applicable contacts by matching capabilities with preferences. After creating the match list, it scores UEs based on how closely they match the preferred criteria. The system determines the forwarding order referring to the q value first and then the routing score. UEs for which both scores are equal are forwarded at the same time. All remaining UEs are forwarded sequentially.

The table below presents an example wherein the result of matching and scoring calculations causes the Oracle CSM to forwards sequentially to UE3, then UE2, then UE1.

User Agent	q Value	Preferential Score
UE3	1000	1000
UE1	500	1000
UE2	1000	700

UAs may or may not include capability request information in their messages. Preferential routing processing accounts for this by defining both explicit and implicit feature preference processing procedures.

Explicit Feature Preference

RFC3841 defines the two headers that a UA can use to explicitly specify the features the target UA must support, including:

Accept-Contact: — UEs the session initiator would like to reach

Reject-Contact: — UEs the session initiator does not want to reach

When the Oracle CSM receives messages that includes these headers, it gathers all the contacts associated with the AOR and creates a target list using preferential routing calculations. The example below, drawn from RFC 3841, specifies the desire to route to a mobile device that can accept the INVITE method.

Accept-Contact: *;mobility="mobile";methods="INVITE"

The "require" and explicit Feature Tag Parameters

RFC 3841 defines operational procedures based on the require and explicit feature tag parameters, which the Oracle CSM fully supports. UAs include these parameters in the accept-contact: header to further clarify capabilities requirements for the session. The Oracle CSM can use these parameters to exclude contacts or specify the forwarding order.

To summarize the use of these parameters per RFC 3841:

When both parameters are present, the Oracle CSM only forwards to contacts that support the features and have registered that support.

If only the require parameter is present, the Oracle CSM includes all contacts in the contact list, but uses a forwarding sequence that places the "best" match (with the most matching capabilities) first from those with the same q value.

If only the explicit parameter is present, the Oracle CSM includes all contacts in the contact list, but uses a forwarding sequence that places contacts that have explicitly indicated matching capabilities before those with the same q value. Unlike requests that specify both require and explicit, non-matching contacts may be tried if the matching ones fail.

If neither parameter is present, the Oracle CSM includes all contacts in the contact list, but determines a "best" match based on the "closest" match to the desired capabilities. Again the forwarding order starts with contacts that have the same q value.

Note that this preferential routing sequence can proceed with attempts to reach contacts with a lower q value after the sequences above are exhausted. Note also that the orders calculated by preferential routing never override any forwarding order specified by the UA.

Implicit Feature Preference

If the caller does not include accept-contact or reject-contacts in the message, the Oracle CSM makes implicit feature preference assumptions. Implicit feature preference forwards messages to target UEs that support the applicable method, and, in the case of SUBSCRIBE requests, that support the applicable event.

For implicit feature preference cases, the Oracle CSM uses the UE's q value solely to determine parallel and sequential forking.

ACLI Instructions

Configuring the SIP Registrar's Routing Precedence

To configure a SIP registrar configuration element for message routing:

1. In Superuser mode, type configure terminal and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type session-router and press Enter to access the session router path.

   ```
   ORACLE(configure)# session-router
   ```

3. Type sip-registrar and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)#
```

4. Type select and choose the number of the pre-configured sip interface you want to configure.
5. routing-precedence— Set this to either registrar or local-policy depending on your deployment.
6. egress-realm-id—Enter the default egress realm for Oracle CSM messaging.
7. Type done when finished.

Home Subscriber Server

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type home-subscriber-server and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# home-subscriber-server
ORACLE(home-subscriber-server)#
```

4. Begin configuring your HSS, or type select and choose the number of the pre-configured HSS you want to configure.
5. Type done when finished.

Tel-URI Resolution

The Oracle CSM can initiate number resolution procedures for requests that have tel-URI or SIP-URI (with user=phone) numbers in the R-URI. It does this by querying number resolutions services, including the local routing table(s) or ENUM server(s) to resolve the R-URI to a SIP URI. In addition, the original R-URI may not include a full E.164 number. As such, you can also configure the Oracle CSM to perform a number normalization procedure and ensure it presents a full E.164 number for resolution. Upon successful resolution, the Oracle CSM proceeds with ensuing signaling procedures.

To configure the Oracle CSM to perform these lookups, you create applicable local-routing-config or enum-config elements and set an option within the sip-registrar that specifies a primary and, optionally, a secondary local-routing-config or enum-config that the sip-registrar uses for LRT or ENUM lookups. If there is no ENUM configuration on the sip-registrar, the Oracle CSM forwards applicable requests to a border gateway function via local policy.

Refer to the Net-Net SD ACLI Configuration guide, Session Routing and Load Balancing chapter for complete information on how to configure a local-routing-config and an enum-config.

Number Lookup Triggers

Use cases that are applicable to number lookups and the associated Oracle CSM procedures include:

- Request from the access side:
  1. The Oracle CSM performs originating services.
  2. If the R-URI is a tel-URI or SIP-URI (with user=phone), it requests e.164 resolution from the ENUM server(s), regardless of its presence in the registration cache.
- Request from core side including request for originating services:
  1. The Oracle CSM performs originating services.
  2. If the R-URI is a tel-URI or SIP-URI (with user=phone), it requests e.164 resolution from the ENUM server(s), regardless of its presence in the registration cache.
- Request from core side, for terminating services only:
  1. If the R-URI is a tel-URI or SIP-URI (with user=phone) and is not in the Oracle CSM cache, it performs an LIR.

2. If the LIA reply indicates the tel-URI or SIP-URI (with user=phone) is not provisioned, the Oracle CSM requests e.164 resolution from the ENUM server(s).

Actions Based on Lookup Results

The Oracle CSM forwards to the resultant SIP-URI under the following conditions:

- The SIP-URI is in the Oracle CSM cache, in which case the Oracle CSM performs terminating services.
- The SIP-URI is not in the Oracle CSM cache, and the Oracle CSM is configured to service the returned domain. In this case, the Oracle CSM performs the following:
  1. The Oracle CSM issues an LIR for the SIP-URI.
  2. The Oracle CSM forwards the message to the correct S-CSCF.
- The SIP-URI is not in the Oracle CSM cache, and the Oracle CSM is not configured to service the returned domain.
  In this case, the Oracle CSM performs refers to local policy to forward the message via local policy.

PSTN Breakout Routing

The Oracle CSM complies with RFC 4694 for operation with request-URIs that include carrier identification code/ route number/number portability database dip indicator (cic/rn/npdi) information and routes those requests according to the rn information. The routing process includes utilization of local policy configured to break the request out of the home network via gateways such as a BGCF.

The Oracle CSM does not validate any rn or cic information. Instead, it simply routes the request. Note that the Oracle CSM uses cic information instead of rn if both are present in the request. RFC 4694 compliant circumstances under which the Oracle CSM does not use rn, cic and npdi information include:

- Invalid routing information, including rn present, but npdi missing.
- Invalid routing information, including npdi present, but rn missing.
- Request uses a sip-URI presented without user=phone.

If the request includes originating services as well as cic/rn/npdi information, the Oracle CSM performs those services rather than break out. If, after completing originating services, the request still includes cic/rn/npdi information, the system performs this breakout.

Primary and Secondary ENUM Configuration

For the purpose of redundancy, the Oracle CSM allows you to configure these number lookups to use a backup resource in case the lookup at the primary fails. Such scenarios include losing contact with the primary ENUM/LRT server config (query time-out) and the entry is not found at the primary (LRT or ENUM).

To apply primary and secondary number lookup resources to a sip-registrar:

1. From superuser mode, use the following command sequence to access the sip-registrar element and select the registrar you want to configure.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)# select
```

2. Specify the resources to use with the options command.

   Prepend the option with the + character if you have multiple options configured that you want to retain. Running the command without the + character causes the system to disable any previously configured options.

   To specify primary and secondary ENUM servers:

```
ORACLE(sip-registrar)# options +e164-primary-config=enum:<enum-config name>
ORACLE(sip-registrar)# options +e164-secondary-config=enum:<enum-config
name>
ORACLE(sip-registrar)# done
```

To specify primary and secondary LRT resources:

```
ORACLE(sip-registrar)# options +e164-primary-config=lrt:<lrt-config name>
ORACLE(sip-registrar)# options +e164-secondary-config=lrt:<lrt-config name>
ORACLE(sip-registrar)# done
```

Bear in mind that an enum-config can reference multiple servers. When the Oracle CSM references an enum-config, queries follow the normal enum-config sequence, checking each referenced server in order. If the lookup is not successful at the primary, the Oracle CSM checks the servers in the registrar's e164-secondary-config.

In addition, each enum-config may refer to a different top-level-domain. This allows you to configure the Oracle CSM to successfully perform lookups within two domains.

HSS Initiated User Profile Changes

The Oracle CSM can receive Push Profile Request (PPR) messages from an HSS and update the state of the IMS User Profile and associated subscription information it has cached locally. The SIP digest authentication information can also be updated and reassociated with an AoR in case that has changed too. The Oracle CSM expects to receive the following AVPs in a PPR message.

- Private-User-Identity—the username, whose subscription/authentication data has changed.
- SIP-Auth-Data-Item—if present new authentication data is included here.
- User-Data—if present new User data is included here.
- Charging-Information—if present new charging information is included here.

The Oracle CSM replies to an HSS's PPR in a PPA message with the following AVPs:

- Result-Code—indicates Diameter base protocol error. Valid errors for in a PPA are:
  - DIAMETER_SUCCESS—The request succeeded.
  - DIAMETER_ERROR_NOT_SUPPORTED_USER_DATA—The request failed. The Oracle CSM informs HSS that the received user information contained information, which was not recognized or supported.
  - DIAMETER_ERROR_USER_UNKNOWN—The request failed because the Private Identity is not found in Oracle CSM.
  - DIAMETER_ERROR_TOO_MUCH_DATA—The request failed. The Oracle CSM informs to the HSS that it tried to push too much data into the Oracle CSM.
  - DIAMETER_UNABLE_TO_COMPLY—The request failed.
- Experimental-Result—indicates diameter application (3GPP/Cx) error if present.

Other Diameter Cx Configuration

Host and Realm AVP Configuration for Cx

You can configure the values sent in the origin-host, origin-realm and destination-host AVPs when the Oracle CSM communicates with a server over the Cx interface. Configure destination-host when you want to precisely specify the HSS with which these Cx exchanges take place.

The applicable configuration parameters are located in the home-subscriber-server configuration element. The parameters used to configured the AVPs are origin-realm, origin-host-identifier and destination-host-identifier. The AVPs are constructed as follows:

```
Origin Host AVP = <origin-host-identifier>.<origin-realm>
Origin Realm AVP = <origin-realm>
Destination Host AVP = <destination-host-identifier>.<destination-realm>
```

If the origin-realm is not configured, then the realm parameter in the home-subscriber-server configuration element will be used as the default. If origin-host-identifier is not configured, then the name parameter in the home-subscriber-server configuration element will be used as the default.

If these parameters are not configured, then the AVPs are constructed as follows:

```
Origin Host = <HSS Config name>.<HSS Config realm>.com
Origin Realm AVP = <HSS Config realm>
Destination Host = <HSS Config name>.<HSS Config realm>.com
```

ACLI Instructions

1. In Superuser mode, type configure terminal and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type session-router and press Enter to access the session router path.

   ```
   ORACLE(configure)# session-router
   ```

3. Type home-subscriber-server and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

   ```
   ORACLE(session-router)# home-subscriber-server
   ORACLE(home-subscriber-server)#
   ```

4. origin-realm—Set this to a string for use in constructing unique Origin Host and Origin Realm AVPs.
5. origin-host-identifier—Set this to a string for use in constructing a unique Origin Host AVP.
6. destination-host-identifier—Set this to a string for use in constructing a unique Destination Host AVP.
7. Save your work.

Initial Filter Criteria (IFC)

The Oracle CSM, acting as a S-CSCF, downloads a set of rules known as Initial Filter Criteria (IFC) from the HSS/AS. IFCs are downloaded over the Cx interface.

iFCs are a way for an S-CSCF to evaluate which ASs should be involved in the call flow for a given user agent (UA). iFCs are functionally defined by Boolean statements, whose component parts are expressed in XML; they reference the destination AS(s) where a desired service is provided.

IFC Evaluation

IFCs are evaluated as described in 3GPP TS 29.228. The Oracle CSM supports all tags found in the 3GPP initial filter criteria specifications. An IFC is evaluated until its end, after which the call flow continues as expected.

SIP Registration

When the Oracle CSM receives an authenticated REGISTER request from a served UA, it sends an SAR request to the HSS to obtain an SAA which includes iFCs associated with the UE's subscription. Within the context of registration, the Oracle CSM also manages third party registration procedures in conjunction with iFC exchanges or manually via the ACLI. These procedures are described in the Third Party Registration chapter.

SIP Call

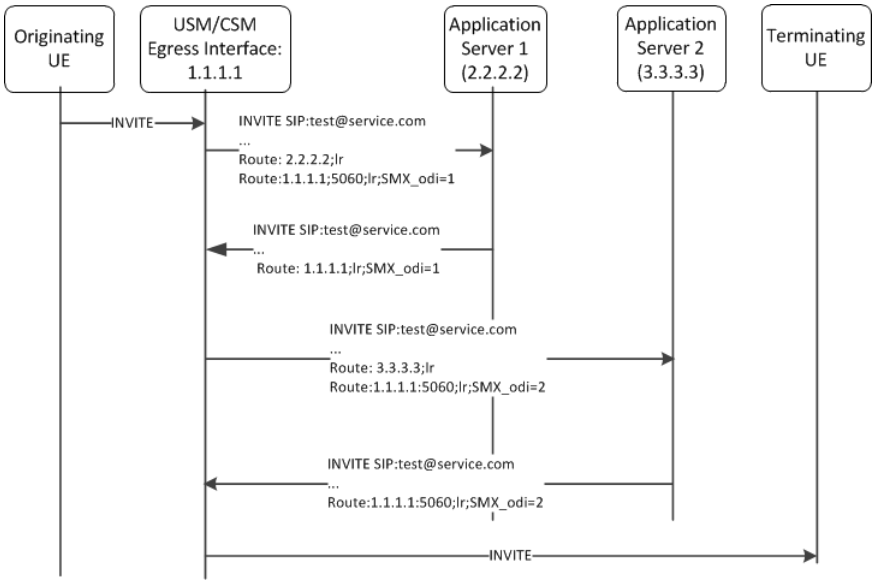
The Oracle CSM evaluates all IFC logic to determine that messages with matching characteristics are sent to the proper AS specified in the iFC evaluation using the IP Multimedia Service Control (ISC) interface. In this INVITE, the Oracle CSM adds two Route headers. The first (top) route header contains the target AS's URI. The second Route parameter is built using the IP address of the egress SIP interface and contains the ODI as a parameter. For example:

```
INVITE SIP:test@service.com
...
Route:2.2.2.2;lr
Route:1.1.1.1:5060;lr;smx_odi=1
```

If the AS routes the call back to the Oracle CSM, it is expected to include the ODI parameter that it received from the Oracle CSM, unchanged. The presence of the ODI parameter indicates that IFC evaluation needs to continue from where it left off for this call. If this continuation of IFC evaluation results in another AS URI, the Oracle CSM

initiates a request towards that AS this time with a new ODI. In this way, the ODI is a state-signifier of Service Point Triggers.

The process continues until IFC evaluation is completed. Below is an example of an IFC evaluation completing after two iterations.



The iFC continues to be evaluated completely which may result in the INVITE being forwarded to additional ASs. At the conclusion of evaluating the iFC, the Oracle CSM checks if the target of the initial request is registered to itself, or not. If the UA is not registered locally the Oracle CSM forwards the request by regular means into the network. If the target UA is registered locally, the Oracle CSM proceeds to obtain iFCs for the target and begin iFC evaluation for the terminating side of the call.

Evaluating Session Case in the P-Served-User Header

The P-served-user header field conveys the identity of the served user, the session case that applies to the particular communication session, and application invocation, as defined in RFC 5502 and TS 24.229. The Session Case (sescase) and Registration State (regstate) parameters are either populated by the UA originating the message or by the Oracle CSM after it determines if a request is originating or terminating, and registered or unregistered

The P-served-user header is created and added to an outgoing request if the next hop is trusted. A trusted next hop is an entity defined by a session agent whose trust-me parameter is enabled. Likewise, the P-served-user header is stripped if the request is forwarded to a next hop that is not known to be trusted.

When the Oracle CSM creates a P-served-User header, the user value in the originating case is the user value found in the P-Asserted-Identity header field. In the terminating case, the user value is taken from the Request URI.

Supported Sessioncase and Registration State

The following cases are supported for IFC evaluation. Conditions for classifying the calls as such are listed below.

Originating request by a UA, Registered User

When the Oracle CSM receives an Initial request, it is validated as an originating request from a registered user when the following conditions are met:

- The request is a dialog creating request or a standalone request.
- There is no "odi" parameter in the top route of the request.
- The regstate and sescase parameters of the P-served-user indicate for this to be treated as originating request for a registered user OR "The request is received from a registered contact.

Originating request by a UA, Unregistered User

When the Oracle CSM receives an Initial request, it is validated as an originating request from an unregistered user when the following conditions are met:

- The request is a dialog creating request or a standalone request.
- There is no "orig" parameter in the top route of the request.
- The served user is unregistered.
- The request is from an AS or I-CSCF and the top route header contains the orig parameter OR
  The regstate and sescase of the P-served-user header indicates that the request is an originating request for an unregistered user.

Terminating Requests to a UA, Registered User

When the Oracle CSM receives an Initial request, it is validated as a terminating request towards a registered user when the following conditions are met:

- The request is a dialog creating request or a standalone request.
- There is no "orig" parameter in the top route of the request.
- There is no "odi" parameter in the top route of the request.
- The regstate and sescase parameters of the P-served-user indicate for this to be treated as terminating request for a registered user OR the request is finished with originating services if applicable and the request is destined to a user who is currently registered with the Oracle CSM.
- If the Request-URI changes when visiting an application server, the Oracle CSM terminates the checking of filter criteria and routes the request based on the changed value of the Request-URI, per 3GPP Specification TS 23.218.

Terminating Requests to a UA, Unregistered User

See the IFC Support for Unregistered Users section for this case.

- If the Request-URI changes when visiting an application server, the Oracle CSM terminates the checking of filter criteria and routes the request based on the changed value of the Request-URI, per 3GPP Specification TS 23.218.

Additional Options

- The Oracle CSM can populate the top Route: header with the sescase value for ASs that require it. In such a case, the parameter is created as either call=orig or call=term. This behavior is enabled by configuring the add-sescase-to-route option in the ifc-profile.
- When the dialog-transparency parameter in the sip-config is set to enabled and your network includes multiple ASs, you should add the dialog-transparency-support option in the ifc-profile.

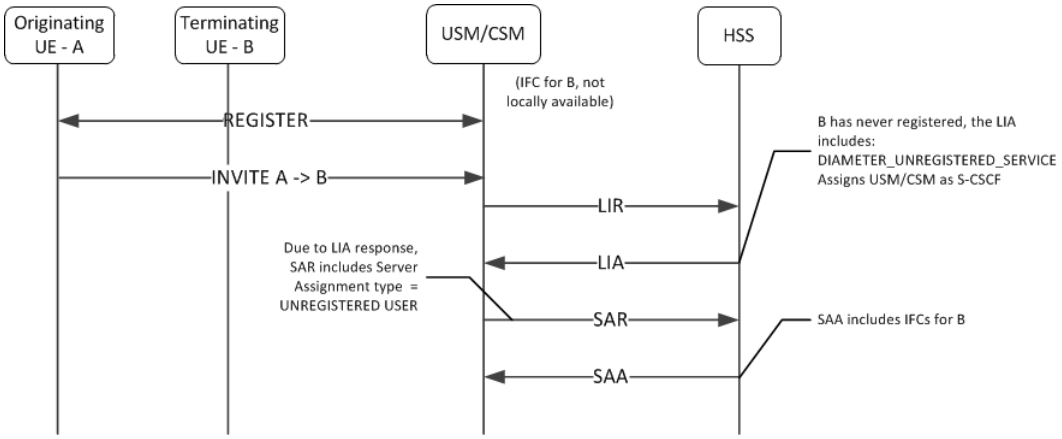
IFC Support for Unregistered Users

The Oracle CSM can download Initial Filter Criteria (IFC) from the HSS for unregistered users. This section displays applicable message sequence diagrams.

UE-terminating requests to an unregistered user

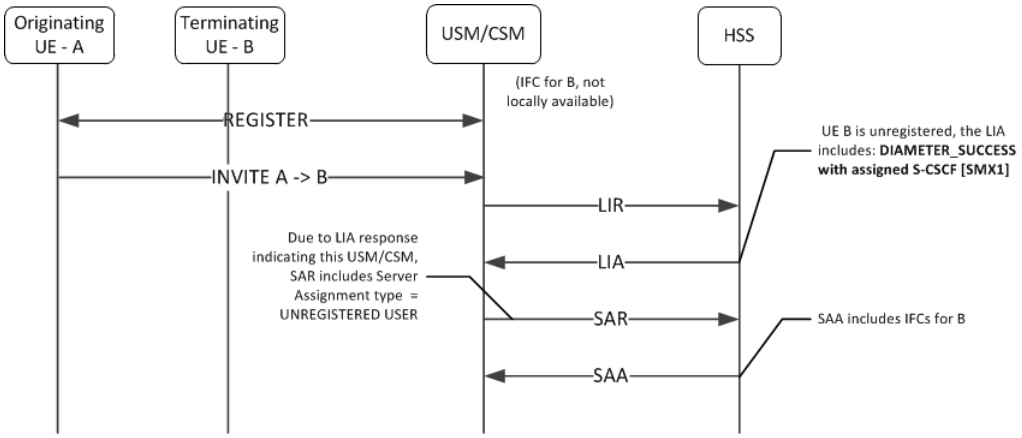
The Oracle CSM downloads and executes IFCs for the terminating end of calls. The following call flows indicate possible cases for the terminating unregistered user.

Terminating UA - Not Registered

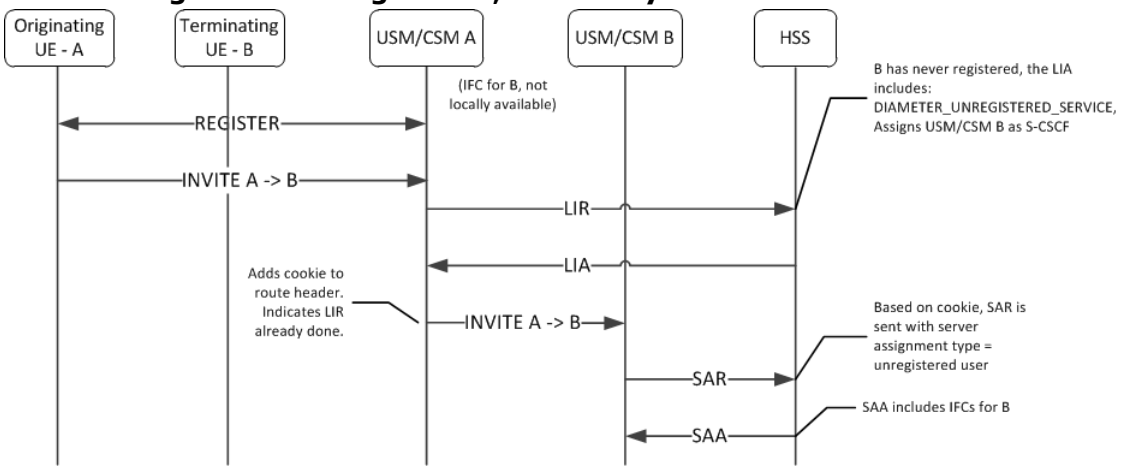


Terminating UA - Not registered

UE originally registered as a consequence of an originating or terminating request or an S-CSCF has stored the user profile.



Terminating UA - Not Registered, Served by other Oracle CSM



UE Subsequent Registration

If the Oracle CSM has a cached IFC downloaded for an unregistered UA who later registers to that Oracle CSM, the cached IFC will be cleared and updated with the IFC downloaded by the registration process.

Caching the Downloaded IFC

When the Oracle CSM downloads IFCs for unregistered users, they are saved to a local cache. If the IFC cache fills up, an older cached IFC for a user is released.

Optimizing IFC Updates

The Oracle CSM aims to reduce the number of IFC updates traversing the network to save bandwidth and transactional overhead. Unless the unregistered UE's IFC entry has been deleted because of exhausting cache space, the following optimizations are performed:

- If IFCs are available locally, then an SAR/SAA operation to download IFCs will not be performed.
- If a previous IFC download operation did not return any IFCs, then subsequent calls to that unregistered user will not invoke the SAR/SAA messaging to download IFCs.

Push Profile Request (PPR) updates

The HSS can push service profile updates for private IDs. The Oracle CSM can process PPR updates for unregistered entities. If the user entry has been deleted because IFC cache space has been exhausted, the PPRs will not be processed.

ACLI Instructions

SIP Registrar

To create an IFC Profile:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type ifc-profile and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# ifc-profile
ORACLE(ifc-profile)#
```

4. name—Enter a name for this IFC profile.
5. state—Set this to enabled to use this ifc-profile.
6. options—Set the options parameter by typing options, a Space, the option name with a plus sign in front of it, and then press Enter.

   If you type the option without the plus sign, you will overwrite any previously configured options. In order to append the new options to the options list, you must prepend the new option with a plus sign.

   The options included in this section are: add-sescase-to-route and dialog-transparency-support.
7. Type done when finished.

SIP Registrar

To enable IFC support in a SIP Registrar:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-registrar and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)#
```

4. Type select and choose the number of the pre-configured SIP registrar configuration element you want to configure.

```
ORACLE(sip-registrar)# select
name:
1: registrar1
selection:1
ORACLE(sip-registrar)#
```

5. ifc-profile—Set this parameter to the name of the IFC profile you just created.
6. serving-function—Set this parameter to disabled when you want the Oracle CSM to act solely as an I-CSCF. When disabled, the Oracle CSM always forwards requests from unregistered users to the serving group. The default is enabled, which retains the S-CSCF function on this Oracle CSM.
7. serving-group—Set this parameter to a Session Agent Group (SAG) name. The Oracle CSM forwards requests from unregistered users to this group when the serving function parameter is disabled. Use of this parameter requires the prior configuration of a SAG that includes all prospective S-CSCFs. The name you give to that group is the name you specify as an argument to this parameter.
8. Type done when finished.

Shared and Default iFCs

The Oracle CSM supports Shared iFCs (SiFC), as defined by TS 29.229 and Default iFCs, which are an Oracle extension upon SiFCs. SiFCs provide an operator with the ability to create iFC templates and apply them to a large number of UEs. The SiFC process optimizes the provisioning, storage and transfer of service profile information. The default IFC (DiFC) establishes a configuration wherein the iFC associations are available on the Oracle CSM itself. This establishes a backup scenario in case the HSS is not responsive.

To support the SiFC feature on the Oracle CSM, you create a profile that refers to a local, XML-formatted file. This file specifies the iFCs to be shared. You apply these profiles to registrars to specify where they are used.

When an SiFC configuration is in place, the Oracle CSM notifies the HSS that it supports SiFCs within the Supported-Features AVP in the SAR. The HSS replies to confirm that it supports SiFCs within the SAA. The SiFC feature must be enabled on the HSS.

Note that the form and function of the SiFC and DiFC files are compatible. You can use the same file for both SiFC and DiFC configuration, if desired.

SiFC Usage

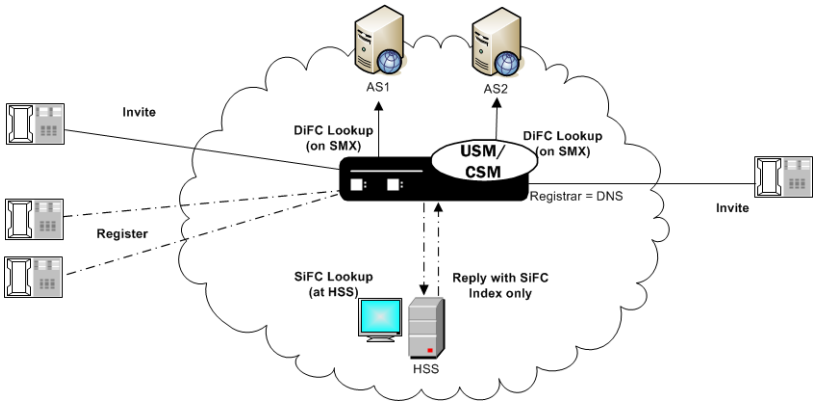
When an applicable end station registers, the Oracle CSM forwards the registration to the HSS normally. Given SiFC configuration however, the HSS sends a service-profile containing the SiFC identifiers to the Oracle CSM rather than the entire service definition. The Oracle CSM parses these identifiers and maps the user to the locally stored filter criteria.

The <IFCSet id =”x”> tags in the XML file on the Oracle CSM map to the HSS identifiers.

DiFC Usage

In contrast to SiFCs, the Oracle CSM fires DiFCs within the context of a session. During the session, the Oracle CSM associates the iFCs within the DiFC file with the user, as needed. DiFC usage is invoked during session initiation.

Note that DiFCs are database agnostic. You can use DiFCs for HSS, ENUM and local database configurations. An operational overview of SiFCs and DiFCs is shown below.



SiFC/DiFC File Example

An example of a Oracle CSM local SiFC/DiFC XML file, including a single iFC Set containing a single iFC, is presented below.

```
<?xml version="1.0" encoding="UTF-8"?>
<IFCSets>
  <IFCSet id=”0”>
    <InitialFilterCriteria>
      <Priority>0</Priority>
      <TriggerPoint>
        <ConditionTypeCNF>0</ConditionTypeCNF>
        <SPT>
          <ConditionNegated>0</ConditionNegated>
          <Group>0</Group>
          <Method>INVITE</Method>
          <Extension></Extension>
        </SPT>
      </TriggerPoint>
    <ApplicationServer>
      <ServerName>sip:172.16.101.26:5060</ServerName>
      <DefaultHandling>0</DefaultHandling>
    </ApplicationServer>
    <ProfilePartIndicator>0</ProfilePartIndicator>
  </InitialFilterCriteria>
</IFCSet>
</IFCSets>
```

Note that the Shared IFCSet contains the integer value property (id=”0”) that associates these filter criteria with users registered with the Oracle CSM. In the case of SiFC, it is the value that the HSS should send when referencing shared sets. In the case of DiFC, the integer is meaningless. The Oracle CSM loads and executes default iFCs in the order they appear within the XML file.

iFC Execution Order

Within the context of the 3GPP standards, the Oracle CSM evaluates explicitly downloaded iFCs first when determining where to look for a service. If the Oracle CSM cannot execute on the service based on explicitly downloaded iFCs, it refers to the SiFC, then the DiFC information to identify an AS that supports the service.

Refreshing SiFC and DiFC Files

Given the nature of local file usage, an ACLI command is available to allow the user to refresh SiFC and DiFC contexts in memory after the user has saved changes to the SiFC and DiFC files. Run the following command to deploy these changes:

ORACLE# refresh ifc <ifc-profile name>

Note also that the Oracle CSM validates the SiFC and DiFC files whenever you Activate your configuration.

SiFC and DiFC Configuration

To configure the Oracle CSM to use Shared and Default IFCs:

1. From superuser mode, use the following command sequence to access ifc-profile element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# ifc-profile
```

2. Define your profile.
3. name—Enter a name for this IFC profile.

```
ORACLE(ifc-profile)# name acmeTelecomIFC
```

4. state—Set this to enabled to use this ifc-profile.

```
ORACLE(ifc-profile)# state enabled
```

5. default-ifc-filename—Specify filename and, if not stored in the default directory /code/ifc, the applicable pathname.

```
ORACLE(ifc-profile)# default-ifc-filename Afile.xml.gz
```

6. shared-ifc-filename—Specify filename and, if not stored in the default directory /code/ifc, the applicable pathname.

```
ORACLE(ifc-profile)# shared-ifc-filename Bfile.xml.gz
```

7. options—Set the options parameter by typing options, a Space, the option name with a plus sign in front of it, and then press Enter.

```
ORACLE(ifc-profile)# done
```

8. Apply the ifc-profile to your sip registrar.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-registrar
```

Select the registrar you want to configure and apply the profile.

```
ORACLE(sip-registrar)# select
ORACLE(sip-registrar)# ifc-profile acmeTelecomIFC
ORACLE(sip-registrar)# done
```

Distinct and Wildcarded Public Service Identity (PSI) Support

The Oracle CSM supports the use of distinct Public Service Identity (PSI) and wildcarded PSIs, typically for specifying access to a service. There is no configuration required on the Oracle CSM to enable this support.

Administrators use individual PSI entries and/or wildcarded PSIs as service identifiers on an HSS. These identifiers provide the information needed to direct applicable messages to applicable application servers. Distinct PSIs can reside within individual PSI entries; wildcarded PSI entries are managed within iFC lists. Wildcarded PSI support is typically implemented to reduce HSS resource requirements. By configuring a wildcarded PSI, administrators can use a single record within the iFC to manage multiple resources.

A wildcard is composed of an expression that, when used in a user part, provides for access to multiple service resources. The regular expressions themselves are in form of Perl Compatible Extended Regular Expressions (PCRE).

For example, consider the following two service resources:

- sip:chatroom-12@core.com
- sip:chatroom-64@core.com

These two service resources can be represented simultaneously at the HSS using the following syntax:

- sip:chatroom-!.*!@core.com

The Oracle CSM caches filter criteria information that uses this wildcard syntax. This avoids the need for SAR/SAA exchanges between the Oracle CSM and the HSS every time an entity requests the service. The Oracle CSM is equally capable of caching distinct PSIs, which similarly offloads the need for SAR/SAA exchanges during service resource location processes.

For most call flows, the Oracle CSM does not evaluate the expression for the purpose of finding a match. Instead, it keeps the syntax provided by the HSS in its cache and provides the wildcarded syntax in the applicable AVP.

To allow the feature, the Oracle CSM supports:

- Wildcarded public user identity AVP in the LIA, SAR and SAA
- User Profile AVP in the SAA
- P-Profile-Key across the Mw interface, as defined in RFC 5002

Configuring SIP Ping OPTIONS Support

You can configure the Oracle CSM to respond to SIP ping OPTIONS. This support is typically configured on an S-CSCF so it can respond to pings OPTIONS sent by a P-CSCF:

To configure an SIP Options Ping response support:

1. From superuser mode, use the following command sequence to access ping-response command on a sip-interface element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-interface
ORACLE(sip-interface)# sel
```

2. Enable the support with the ping-response command.

```
ORACLE(http-config)# ping-response enabled
ORACLE(http-config)# done
```

ping-response—Enable ping-response to allow your device to respond to ping OPTIONS. For example, this feature is useful within hybrid deployment environments on a P-CSCF as a means of verifying the S-CSCF's availability. This configuration allows the S-CSCF to respond to SIP ping OPTIONS.

Redundancy and Load Balancing with HSS Servers

The Oracle CSM allows you to operate with multiple HSS servers, supporting:

- Redundancy - Continue normal operation despite HSS failure.
- Load Balancing - Divide the traffic load between HSS servers in a group of HSSs. Preference is based on the HSS list order configured on the Oracle CSM.

You configure HSS servers within HSS Groups to support this functionality. For redundancy, you create and assign HSS groups, and apply either the hunt or fail-over strategy to your HSS group. To implement load balancing, you configure the applicable HSS group with a the round-robin server allocation strategy. This functionality assumes the HSS infrastructure itself is configured for redundancy.

The Oracle CSM establishes and manages multiple Cx connections with each applicable HSS. This management is achieved by connection identifiers on the Oracle CSM that allow it to distinguish between connections. This provides the network with the flexibility of being able to use multiple paths to a given HSS regardless of AVP values.

About HSS Groups

You configure HSS groups based on your redundancy and failover design. You accomplish this by configuring your HSS groups with the applicable HSS servers. You then assign your group to a registrar. HSS group configuration does not preclude assigning an HSS in the group to a registrar individually.

HSS groups can contain individual HSSs. Members of an HSS group are prioritized by the server list; the first server in the list takes the highest priority; the last takes the lowest. You can manually disable an HSS group, if desired, which prevents the Oracle CSM from attempting to access any of the HSS servers via that group.

HSS group members do not need to reside in the same domain, network, or realm. The Oracle CSM can allocate traffic among member HSSs regardless of their location. It uses the allocation strategies you configure for the group to distribute traffic across the group members.

Group allocation strategies define how the Oracle CSM selects an HSS. For example, the hunt strategy selects HSSs in the order in which they are listed. Allocation strategies include the following:

Allocation Strategy	Description
failover	For HSS redundancy deployments, the failover strategy specifies that the Oracle CSM selects the next highest priority HSS server for all operations if the first HSS fails. The Oracle CSM does not resume operation with the initial HSS when it comes back into service.
hunt	For HSS redundancy deployments, the hunt strategy specifies that the Oracle CSM select HSSs in the order in which they are configured in the HSS group. If the first HSS is available, all traffic is sent to the first HSS. If the first HSS is unavailable, all traffic is sent to the second HSS. The system follows this process for all HSS servers in the group. When a higher priority HSS returns to service, all traffic is routed back to it.
roundrobin	This strategy targets HSS load balancing deployments. The Oracle CSM selects each HSS in the order in which it appears in the group list, routing diameter requests to each HSS in turn.

Paths taken by specific messaging is constrained by the purpose of that messaging, and refined by a group's allocation strategy. Applicable messaging includes UAR/UAA, MAR/MAA, SAR/SAA and LIR/LIA. For both failover and hunt strategies, all messaging is sent to the current active server. For the round-robin strategy, messaging is distributed to group members sequentially, using the member list order.

Connection Failure Detection

The Oracle CSM detects that a connection between itself and a given HSS has failed if either a diameter request fails or the diameter DWR/DWA handshake fails. If the HSS does not respond to five requests, the Oracle CSM marks that HSS as out of service.

The Oracle CSM forwards unacknowledged messages to subsequent HSSs based on strategy. It changes the destination host AVP of these messages and marks then with the T flag. The HSS recognizes the T flag as an indication that the request may be a duplicate, caused by a problem in the network.

Periodically, the Oracle CSM attempts to establish diameter connections with out of service HSS servers. When those connections succeed, the Oracle CSM marks the HSS as in-service and resumes using it within the context of the configured redundancy and load balancing strategy.

Configuring HSS Groups

To configure HSS groups:

1. In Superuser mode, type configure terminal and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type session-router and press Enter to access the system-level configuration elements.

   ```
   ORACLE(configure)# session-router
   ```

3. Type hss-group and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# hss-group
ORACLE(hss-group)#
```

4. name—Enter a unique name for the HSS group in Name format.
5. state—Enable or disable the HSS group on the Oracle CSM. The default value is enabled. Valid values are:
   - enabled | disabled
6. origin-host-identifier— Set this to a string for use in constructing a unique Origin Host AVP. This setting always takes precedence over the origin-host-identifier configured for the home-subscriber-server. This setting is required.
7. strategy—Indicate the HSS server allocation strategy you want to use. The strategy you chose selects the HSS servers that will be made available by this hss-group. The default value is hunt. The valid values are:
   - hunt—Selects HSS servers in the order in which they are listed. For example, if the first server is online, all traffic is sent to the first server. If the first server is offline, the second server is selected. If the first and second servers are offline, the third server is selected. When the Oracle CSM detects that a higher priority HSS is back in service, it routes all subsequent traffic to that HSS.
   - roundrobin—Selects each HSS server in the order in which they are listed in the destination list, selecting each server in turn, one per session.
   - failover — Selects the first server in the list until failure is detected. Subsequent signaling goes to the next server in the list.
8. hss-configs—Identify the HSS servers available for use by this hss-group. This list can contain as many HSS servers as is necessary. An hss-config list value must correspond to a valid hss-config.

   Display syntax for the hss-configs parameter by typing the question mark character after the parameter name on the ACLI.

```
ORACLE(hss-group)# hss-configs ?
<string> list of home-subscriber-server configs for this group
         for single-entry: hss1
         for multi-entry: (hss1 hss2)
         for adding an entry to an existing list: +hss3
         for deleting an entry from an existing list: -hss3
         for multiple entries add/remove from a list: +/-(hss1 hss2)
```

   The following example shows an HSS group using the hunt allocation strategy applied.

```
hss-group
        name                            group-test1
        state                           enabled
        origin-host-identifier
        strategy                        hunt
        hss-configs                     hss1, hss2
        last-modified-by                admin@console
        last-modified-date              2013-05-13 14:58:01
```

Stream Control Transfer Protocol Overview

The Oracle CSM supports the use of the Stream Control Transmission Protocol (SCTP) as transport protocol for connections with an HSS (Cx interface). This section explains SCTP and provides instructions for SCTP configuration on an Oracle CSM home-subscriber-server configuration element.

SCTP was originally designed by the Signaling Transport (SIGTRAN) group of IETF for Signaling System 7 (SS7) transport over IP-based networks. It is a reliable transport protocol operating on top of an unreliable connectionless service, such as IP. It provides acknowledged,
error-free, non-duplicated transfer of messages through the use of checksums, sequence numbers, and selective retransmission mechanism.

SCTP is designed to allow applications, represented as endpoints, communicate in a reliable manner, and so is similar to TCP. In fact, it has inherited much of its behavior from TCP, such as association (an SCTP peer-to-peer connection) setup, congestion control and packet-loss detection algorithms. Data delivery, however, is significantly

different. SCTP delivers discrete application messages within multiple logical streams within the context of a single association. This approach to data delivery is more flexible than the single byte-stream used by TCP, as messages can be ordered, unordered or even unreliable within the same association.

Support is compliant with RFC 4960, Stream Control Transmission Protocol.

SCTP Packets

SCTP packets consist of a common header and one or more chunks, each of which serves a specific purpose.

- DATA chunk — carries user data
- INIT chunk — initiates an association between SCTP endpoints
- INIT ACK chunk — acknowledges association establishment
- SACK chunk — acknowledges received DATA chunks and informs the peer endpoint of gaps in the received subsequences of DATA chunks
- HEARTBEAT chunk — tests the reachability of an SCTP endpoint
- HEARTBEAT ACK chunk — acknowledges reception of a HEARTBEAT chunk
- ABORT chunk — forces an immediate close of an association
- SHUTDOWN chunk — initiates a graceful close of an association
- SHUTDOWN ACK chunk — acknowledges reception of a SHUTDOWN chunk
- ERROR chunk — reports various error conditions
- COOKIE ECHO chunk — used during the association establishment process
- COOKIE ACK chunk — acknowledges reception of a COOKIE ECHO chunk
- SHUTDOWN COMPLETE chunk — completes a graceful association close

SCTP Terminology

This section defines some terms commonly found in SCTP standards and documentation.

SCTP Association is a connection between SCTP endpoints. An SCTP association is uniquely identified by the transport addresses used by the endpoints in the association. An SCTP association can be represented as a pair of SCTP endpoints, for example, assoc = { [IPv4Addr : PORT1], [IPv4Addr1, IPv4Addr2: PORT2]}.

Only one association can be established between any two SCTP endpoints.

SCTP Endpoint is a sender or receiver of SCTP packets. An SCTP endpoint may have one or more IP address but it always has one and only one SCTP port number. An SCTP endpoint can be represented as a list of SCTP transport addresses with the same port, for example, endpoint = [IPv6Addr, IPv6Addr: PORT].

An SCTP endpoint may have multiple associations.

SCTP Path is the route taken by the SCTP packets sent by one SCTP endpoint to a specific destination transport address or its peer SCTP endpoint. Sending to different destination transport addresses does not necessarily guarantee separate routes.

SCTP Primary Path is the default destination source address, the IPv4 or IPv6 address of the association initiator. For retransmissions however, another active path may be selected, if one is available.

SCTP Stream is a unidirectional logical channel established between two associated SCTP endpoints. SCTP distinguishes different streams of messages within one SCTP association. SCTP makes no correlation between an inbound and outbound stream.

SCTP Transport Address is the combination of an SCTP port and an IP address. For the current release, the IP address portion of an SCTP Transport Address must be a routable, unicast IPv4 or IPv6 address.

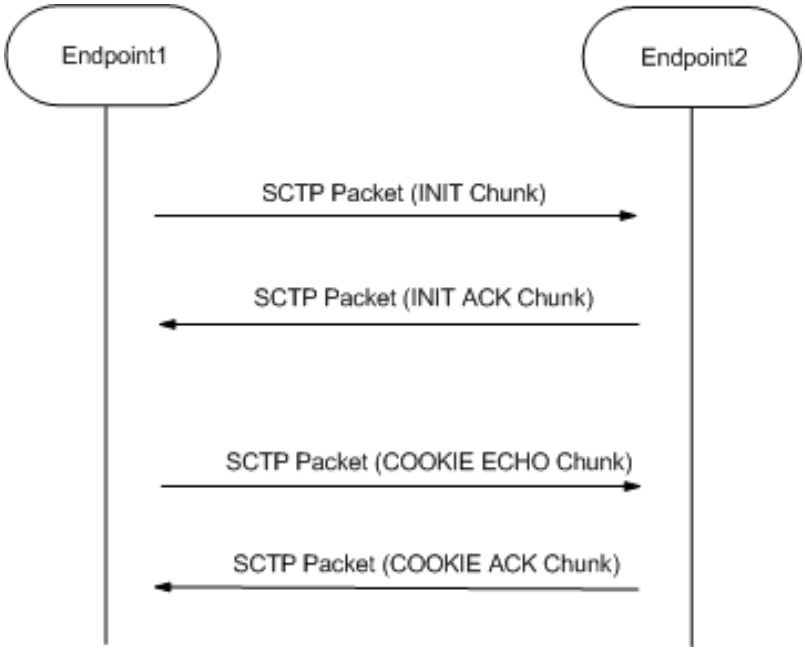
An SCTP transport address binds to a single SCTP endpoint.

SCTP Message Flow

Before peer SCTP users (commonly referred to as endpoints) can send data to each other, an association (an SCTP connection) must be established between the endpoints. During the association establishment process a cookie

mechanism is employed to provide protection against security attacks. The following figure shows a sample SCTP association establishment message flow.

Endpoint1 initiates the association by sending Endpoint2 an SCTP packet that contains an INIT chunk, which can include one or more IP addresses used by the initiating endpoint. Endpoint2 acknowledges the initiation of an SCTP association with an SCTP packet that contains an INIT_ACK chunk. This chunk can also include one or more IP addresses at used by the responding endpoint.



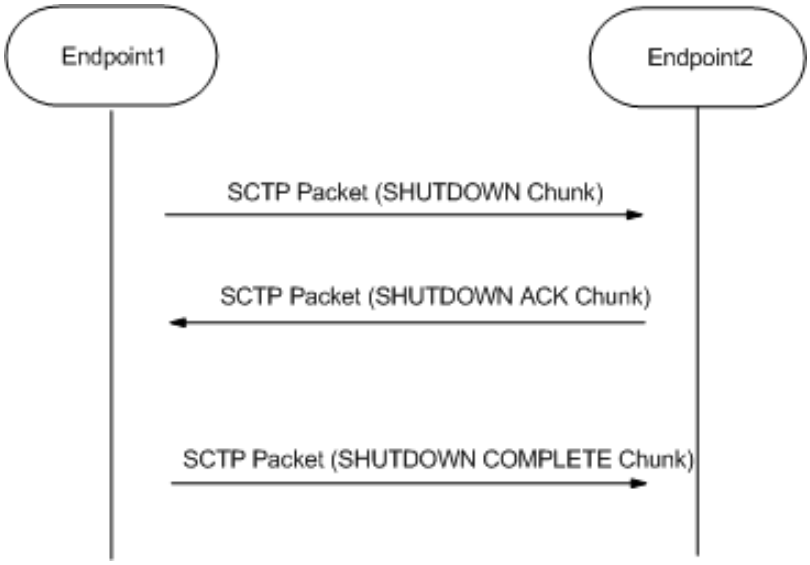
Both the INIT chuck (issued by the initiator) and INIT ACK chunk (issued by the responder) specify the number of outbound streams supported by the association, as well as the maximum inbound streams accepted from the other endpoint.

Association establishment is completed by a COOKIE ECHO/COOKIE ACK exchange that specifies a cookie value used in all subsequent DATA exchanges.

Once an association is successfully established, an SCTP endpoint can send unidirectional data streams using SCTP packets that contain DATA chunks. The recipient endpoint acknowledges with an SCTP packet containing a SACK chunk.

SCTP monitors endpoint reachability by periodically sending SCTP packets that contain HEARTBEAT chunks. The recipient endpoint acknowledges receipt, and confirms availability, with an SCTP packet containing a HEARBEAT ACK chunk.

Either SCTP endpoint can initiate a graceful association close with an SCTP packet that contains a SHUTDOWN chunk. The recipient endpoint acknowledges with an SCTP packet containing a SHUTDOWN ACK chunk. The initiating endpoint concludes the graceful close with an SCTP packet that contains a SHUTDOWN COMPLETE chunk.

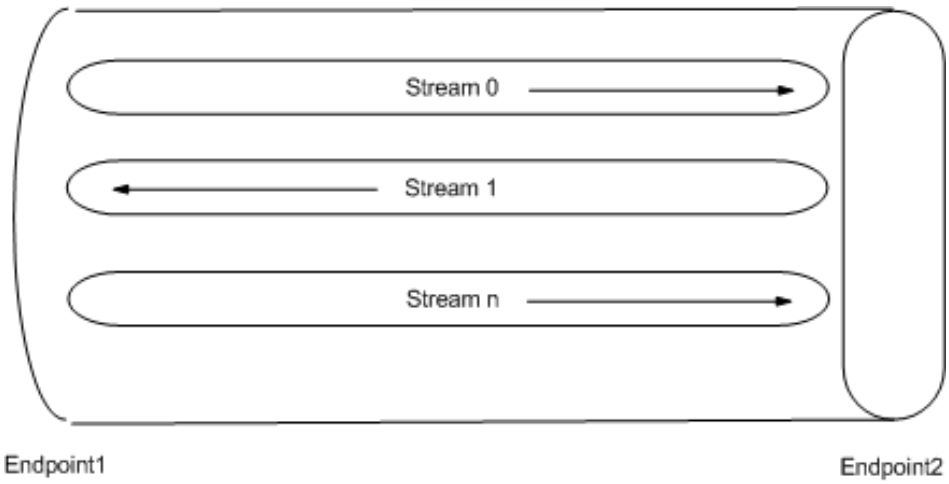


Congestion Control

SCTP congestion control mechanism is similar to that provided by TCP, and includes slow start, congestion avoidance, and fast retransmit. In SCTP, the initial congestion window (cwnd) is set to the double of the maximum transmission unit (MTU) while in TCP, it is usually set to one MTU. In SCTP, cwnd increases based on the number of acknowledged bytes, rather than the number of acknowledgements in TCP. The larger initial cwnd and the more aggressive cwnd adjustment provided by SCTP result in a larger average congestion window and, hence, better throughput performance than TCP.

Multi-Streaming

SCTP supports streams as depicted in the following figure which depicts an SCTP association that supports three streams,



The multiple stream mechanism is designed to solve the head-of-the-line blocking problem of TCP. Therefore, messages from different multiplexed flows do not block one another.

A stream can be thought of as a sub-layer between the transport layer and the upper layer. SCTP supports multiple logical streams to improve data transmission throughput. As shown in the above figure, SCTP allows multiple unidirectional streams within an association. This multiplexing/de-multiplexing capability is called multi-streaming and it is achieved by introducing a field called Stream Identifier contained in every DATA chunk) that is used to differentiate segments in different streams.

Delivery Modes

SCTP supports two delivery modes, ordered and unordered. Delivery mode is specified by the U bit in the DATA chunk header — if the bit is clear (0), ordered delivery is specified; if the bit is set (1), unordered delivery is specified.

Within a stream, an SCTP endpoint must deliver ordered DATA chunks (received with the U bit set to 0) to the upper layer protocol according to the order of their Stream Sequence Number. Like the U bit, the Stream Sequence Number is a field within the DATA chunk header, and serves to identify the chunk's position with the message stream. If DATA chunks arrive out of order of their Stream Sequence Number, the endpoint must delay delivery to the upper layer protocol until they are reordered and complete.

Unordered DATA chunks (received with the U bit set to 1) are processed differently. When an SCTP endpoint receives an unordered DATA chunk, it must bypass the ordering mechanism and immediately deliver the data to the upper layer protocol (after reassembly if the user data is fragmented by the sender). As a consequence, the Stream Sequence Number field in an unordered DATA chunk has no significance. The sender can fill it with arbitrary value, but the receiver must ignore any value in field.

When an endpoint receives a DATA chunk with the U flag set to 1, it must bypass the ordering mechanism and immediately deliver the data to the upper layer (after reassembly if the user data is fragmented by the data sender).

Unordered delivery provides an effective way of transmitting out-of-band data in a given stream. Note also, a stream can be used as an unordered stream by simply setting the U bit to 1 in all DATA chunks sent through that stream.

Multi-Homing

Call control applications for carrier-grade service require highly reliable communication with no single point of failure. SCTP can assist carriers with its multi-homing capabilities. By providing different paths through the network over separate and diverse means, the goal of no single point of failure is more easily attained.

SCTP built-in support for multi-homed hosts allows a single SCTP association to run across multiple links or paths, hence achieving link/path redundancy. With this capability, and SCTP association can be made to achieve fast failover from one link/path to another with little interruption to the data transfer service.

Multi-homing enables an SCTP host to establish an association with another SCTP host over multiple interfaces identified by different IP addresses. With specific regard to the Oracle CSM these IP addresses need not be assigned to the same physical interface, or to the same physical Network Interface Unit.

If the SCTP nodes and the according IP network are configured in such a way that traffic from one node to another travels on physically different paths if different destination IP address are used, associations become tolerant against physical network failures and other problems of that kind.

An endpoint can choose an optimal or suitable path towards a multi-homed destination. This capability increases fault tolerance. When one of the paths fails, SCTP can still choose another path to replace the previous one. Data is always sent over the primary path if it is available. If the primary path becomes unreachable, data is migrated to a different, affiliated address — thus providing a level of fault tolerance. Network failures that render one interface of a server unavailable do not necessarily result in service loss. In order to achieve real fault resilient communication between two SCTP endpoints, the maximization of the diversity of the round-trip data paths between the two endpoints is encouraged.

Multi-Homing and Path Diversity

As previously explained, when a peer is multi-homed, SCTP can automatically switch the subsequent data transmission to an alternative address. However, using multi-homed endpoints with SCTP does not automatically guarantee resilient communications. One must also design the intervening network(s) properly.

To achieve fault resilient communication between two SCTP endpoints, one of the keys is to maximize the diversity of the round-trip data paths between the two endpoints. Under an ideal situation, one can make the assumption that every destination address of the peer will result in a different, separate path towards the peer. Whether this can be achieved in practice depends entirely on a combination of factors that include path diversity, multiple connectivity, and the routing protocols that glue the network together. In a normally designed network, the paths may not be

diverse, but there may be multiple connectivity between two hosts so that a single link failure will not fail an association.

In an ideal arrangement, if the data transport to one of the destination addresses (which corresponds to one particular path) fails, the data sender can migrate the data traffic to other remaining destination address(es) (that is, other paths) within the SCTP association.

Monitoring Failure Detection and Recovery

When an SCTP association is established, a single destination address is selected as the primary destination address and all new data is sent to that primary address by default. This means that the behavior of a multi-homed SCTP association when there are no network losses is similar to behavior of a TCP connection. Alternate, or secondary, destination addresses are only used for redundancy purposes, either to retransmit lost packets or when the primary destination address cannot be reached.

A failover to an alternate destination is performed when the SCTP sender cannot elicit an acknowledgement — either a SACK for a DATA chunk, or a HEARTBEAT ACK for a HEARTBEAT chunk — for a configurable consecutive number of transmissions. The SCTP sender maintains an error-counter is maintained for each destination address and if this counter exceeds a threshold (normally six), the address is marked as inactive, and taken out of service. If the primary destination address is marked as inactive, all data is then switched to a secondary address to complete the failover.

If no data has been sent to an address for a specified time, that endpoint is considered to be idle and a HEARTBEAT packet is transmitted to it. The endpoint is expected to respond to the HEARTBEAT immediately with a HEARTBEAT ACK. As well as monitoring the status of destination addresses, the HEARTBEAT is used to obtain RTT measurements on idle paths. The primary address becomes active again if it responds to a heartbeat.

The number of events where heartbeats were not acknowledged within a certain time, or retransmission events occurred is counted on a per association basis, and if a certain limit is exceeded, the peer endpoint is considered unreachable, and the association is closed.

The threshold for detecting an endpoint failure and the threshold for detecting a failure of a specific IP addresses of the endpoint are independent of each other. Each parameter can be separately configured by the SCTP user. Careless configuration of these protocol parameters can lead the association onto the dormant state in which all the destination addresses of the peer are found unreachable while the peer still remains in the reachable state. This is because the overall retransmission counter for the peer is still below the set threshold for detecting the peer failure.

ACLI Instructions for Configuring SCTP for DIAMETER Transport

Use the following steps to configure SCTP as the layer 4 transport for an HSS.

- Create an SCTP-based home-subscriber-server
- Associate network interfaces with existing realms
- Set SCTP timers and counters

Configuring an HSS Server for SCTP

HSS servers are created during the IMS environment configuration process.

1. From superuser mode, use the following command sequence to access home-subscriber-server configuration.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# home-subscriber-server
ORACLE(home-subscriber-server)#
ORACLE(home-subscriber-server)#
```

2. Use the address parameter to provide the IP address of the network interface that supports the Cx port.

   This is the primary address of a the local multi-homed SCTP endpoint.

```
ORACLE(home-subscriber-server)# address 172.16.10.76
ORACLE(home-subscriber-server)#
```

3. Retain the default value, 3868 (the well-known DIAMETER port) for the port parameter.

```
ORACLE(home-subscriber-server)# port 3868
ORACLE(home-subscriber-server)#
```

4. Use the transport-protocol parameter to identify the layer 4 protocol.

   Supported values are TCP and SCTP.

   Select SCTP.

```
ORACLE(home-subscriber-server)# transport-protocol sctp
ORACLE(home-subscriber-server)#
```

5. Use the multi-homed-addrs parameter to specify one or more local secondary addresses of the SCTP endpoint.

   Multi-homed addresses must be of the same type (IPv4 or IPv6) as that specified by the address parameter. Like the address parameter, these addresses identify SD physical interfaces.

   To specify multiple addresses, bracket an address list with parentheses.

```
ORACLE(home-subscriber-server)# multi-homed-addrs 182.16.10.76
ORACLE(home-subscriber-server)#
```

   To specify multiple addresses, bracket an address list with parentheses.

```
ORACLE(home-subscriber-server)# multi-homed-addrs (182.16.10.76
192.16.10.76 196.15.32.108)
ORACLE(home-subscriber-server)#
```

6. Remaining parameters can be safely ignored.
7. Use done, exit, and verify-config to complete configuration of the home-subscriber-server.

```
ORACLE(home-subscriber-server)# done
ORACLE(session-router)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Configuring the Realm

After configuring an HSS server, which identifies primary and secondary multi-homed transport addresses, you list the network interfaces that support these primary and secondary addresses in the realm assigned during **realm-config** configuration.

1. From superuser mode, use the following command sequence to access realm-config configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# media-manager
ORACLE(media-manager)# realm-config
ORACLE(realm-config)#
```

2. Use the select command to access the target realm.
3. Use the network-interfaces command to identify the network interfaces that support the SCTP primary and secondary addresses.

   Network interfaces are identified by their name.

   Enter a list of network interface names using parentheses as list brackets. The order of interface names is not significant.

```
ORACLE(realm-config)# network-interfaces (mo1 m10)
ORACLE(realm-config)#
```

4. Use done, exit, and verify-config to complete realm configuration.

```
ORACLE(realm-config)# done
ORACLE(media-manager)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Setting SCTP Timers and Counters

Setting SCTP timers and counters is optional. All configurable timers and counters provide default values and most default to recommended values as specified in RFC 4960, Stream Control Transmission Protocol.

Management of Retransmission Timer, section 6.3 of RFC 4960 describes the calculation of a Retransmission Timeout (RTO) by the SCTP process. This calculation involves three SCTP protocol parameters: RTO.Initial, RTO.Min, and RTO.Max. Suggested SCTP Protocol Parameter Values section 15 of RFC 4960 lists recommended values for these parameters.

The following shows the equivalence of recommended values and ACLI defaults.

RTO.Initial = 3 seconds sctp-rto-initial = 3000 ms (default value)

RTO.Min = 1 second sctp-rto-min = 1000 ms (default value)

RTO.Max = 60 seconds sctp-rto-max = 60000 ms (default value)

Path Heartbeat, section 8.3 of RFC 4960 describes the calculation of a Heartbeat Interval by the SCTP process. This calculation involves the current calculated RTO and a single SCTP protocol parameter — HB.Interval.

The following shows the equivalence of recommended the value and ACLI default.

HB.Interval = 30 seconds sctp-hb-interval = 3000 ms (default value)

Acknowledgement on Reception of DATA Chunks, section 6.2 of RFC 4960 describes requirements for the timely processing and acknowledgement of DATA chunks. This section requires that received DATA chunks must be acknowledged within 500 milliseconds, and recommends that DATA chunks should be acknowledged with 200 milliseconds. The interval between DATA chunk reception and acknowledgement is specific by the ACLI sctp-sack-timeout parameter, which provides a default value of 200 milliseconds and a maximum value of 500 milliseconds.

Transmission of DATA Chunks, section 6.1 of RFC 4960 describes requirements for the transmission of DATA chunks. To avoid network congestion the RFC recommends a limitation on the volume of data transmitted at one time. The limitation is expressed in terms of DATA chunks, not in terms of SCTP packets. The maximum number of DATA chunks that can be transmitted at one time is specified by the ACLI sctp-max-burst parameter, which provides a default value of 4 chunks, the limit recommended by the RFC.

SCTP Network Parameters are not RTC

SCTP configuration parameters within the network-parameters element are not real-time configuration (RTC) supported. Reboot your system for changes to these parameter to take effect.

Specifying the Delivery Mode

As described in Delivery Modes, SCTP support two delivery modes, ordered and unordered.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# system
ORACLE(system)# network-parameters
ORACLE(network-parameters)#
```

2. Use the sctp-send-mode parameter to select the preferred delivery mode.

   Choose ordered or unordered.

```
ORACLE(network-parameters)# sctp-send-mode unordered
ORACLE(network-parameters)#
```

3. Use done, exit, and verify-config to complete delivery mod configuration.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Setting Path Failure Detection

As described in Monitoring, Failure Detection and Recovery, when its peer endpoint is multi-homed, an SCTP endpoint maintains a count for each of the peer's destination transport addresses.

Each time the T3-rtx timer expires on any address, or when a HEARTBEAT sent to an idle address is not acknowledged within an RTO, the count for that specific address is incremented. If the value of a specific address count exceeds the SCTP protocol parameter Path.Max.Retrans, the endpoint marks that destination transport address as inactive.

The endpoint resets the counter when (1) a DATA chunk sent to that peer endpoint is acknowledged by a SACK, or (2) a HEARTBEAT ACK is received from the peer endpoint.

When the primary path is marked inactive (due to excessive retransmissions, for instance), the sender can automatically transmit new packets to an alternate destination address if one exists and is active. If more than one alternate address is active when the primary path is marked inactive, a single transport address is chosen and used as the new destination transport address.

Use the following procedure to configure path failure detection.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# system
ORACLE(system)# network-parameters
ORACLE(network-parameters)#
```

2. Use the sctp-path-max-retrans parameter to assign a value to the SCTP protocol parameter Path.Max.Retrans.

   Allowable values are integers within the range 0 through 4294967295 that specify the maximum number of RTOs and unacknowledged HEARTBEATS. In the absence of an explicitly configured integer value, sctp-path-max-retrans defaults to 5 (RTO and/or HEARTBEAT errors per transport address, the recommended default value from RFC 4960).

   When configuring endpoint and path failure detection, ensure that the value of the sctp-assoc-max-retrans parameter is smaller than the sum of the sctp-path-max-retrans values for all the remote peer's destination addresses. Otherwise, all the destination addresses can become inactive (unable to receive traffic) while the endpoint still considers the peer endpoint reachable.

```
ORACLE(network-parameters)# sctp-path-max-retrans 5
ORACLE(network-parameters)#
```

3. Use done, exit, and verify-config to complete path failure detection configuration.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Setting Endpoint Failure Detection

As described in Monitoring, Failure Detection and Recovery, a single-homed SCTP endpoint maintains a count of the total number of consecutive failed (unacknowledged) retransmissions to its peer. Likewise, a multi-homed SCTP endpoint maintains a series of similar, dedicated counts for all of its destination transport addresses. If the value of these counts exceeds the limit indicated by the SCTP protocol parameter Association.Max.Retrans, the endpoint considers the peer unreachable and stops transmitting any additional data to it, causing the association to enter the CLOSED state.

The endpoint resets the counter when (1) a DATA chunk sent to that peer endpoint is acknowledged by a SACK, or (2) a HEARTBEAT ACK is received from the peer endpoint.

Use the following procedure to configure endpoint failure detection.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# system
ORACLE(system)# network-parameters
ORACLE(network-parameters)#
```

2. Use the sctp-assoc-max-retrans to assign a value to the SCTP protocol parameter Association.Max.Retrans.

   Allowable values are integers within the range 0 through 4294967295 which specify the maximum number of transmission requests. In the absence of an explicitly configured integer value, sctp-assoc-max-retrans defaults to 10 (transmission re-tries, the recommended default value from RFC 4960).

```
ORACLE(network-parameters)# sctp-assoc-max-retrans 10
ORACLE(network-parameters)#
```

3. Use done, exit, and verify-config to complete endpoint failure detection configuration.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Limiting DATA Bursts

Section 6.1 of RFC 4960 describes the SCTP protocol parameter, Max.Burst, used to limit the number of DATA chunks that are transmitted at one time.

Use the following procedure to assign a value to the SCTP protocol parameter, Max.Burst.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# system
ORACLE(system)# network-parameters
ORACLE(network-parameters)#
```

2. Use the sctp-max-burst parameter to assign a value to Max.Burst.

   Allowable values are integers within the range 0 through 4294967295 that specify the maximum number of DATA chunks that will be sent at one time. In the absence of an explicitly configured integer value, sctp-max-burst defaults to 4 (DATA chunks, the recommended default value from RFC 4960).

```
ORACLE(network-parameters)# sctp-max-burst 4
ORACLE(network-parameters)#
```

3. Use done, exit, and verify-config to complete configuration of DATA burst limitations.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
```

```
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Setting the SACK Delay Timer

An SCTP Selective Acknowledgement (SACK) is sent to the peer endpoint to acknowledge received DATA chunks and to inform the peer endpoint of gaps in the received subsequences of DATA chunks. Section 6.2 of RFC 4960 sets a specific requirement for a SACK Delay timer that specifies the maximum interval between the reception of an SCTP packet containing one or more DATA chunks and the transmission of a SACK to the packet originator.

Use the following procedure to set the SACK Delay timer.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

   ```
   ORACLE# configure terminal
   ORACLE(configure)# system
   ORACLE(system)# network-parameters
   ORACLE(network-parameters)#
   ```

2. Use the sctp-sack-timeout parameter to assign a value to the SACK Delay timer.

   Allowable values are integers within the range 0 through 500 which specify the maximum delay (in milliseconds) between reception of a SCTP packet containing one or more Data chunks and the transmission of a SACK to the packet source. The value 0 indicates that a SACK is generated immediately upon DATA chunk reception

   In the absence of an explicitly configured integer value, sctp-sack-timeout defaults to 200 ms (the recommended default value from RFC 4960).

   ```
   ORACLE(network-parameters)# sctp-sack-timeout 200
   ORACLE(network-parameters)#
   ```

3. Use done, exit, and verify-config to complete configuration of the SACK Delay timer.

   ```
   ORACLE(network-parameters)# done
   ORACLE(system)# exit
   ORACLE(configure)# exit
   ORACLE(configure)# exit
   ORACLE# verify-config
   -------------------------------------------------------------------------
   Verification successful! No errors nor warnings in the configuration
   ORACLE#
   ```

Setting the Heartbeat Interval

Both single-homed and multi-homed SCTP endpoints test the reachability of associates by sending periodic HEARTBEAT chunks to UNCONFIRMED or idle transport addresses.

Use the following procedure to assign values used in Heartbeat Interval calculation.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

   ```
   ORACLE# configure terminal
   ORACLE(configure)# system
   ORACLE(system)# network-parameters
   ORACLE(network-parameters)#
   ```

2. Use the sctp-hb-interval parameter to assign an initial Heartbeat Interval duration.

   Allowable values are integers within the range 0 through 4294967295 that specify the initial Heartbeat Interval in milliseconds. In the absence of an explicitly configured integer value, sctp-hb-interval defaults to 30000 milliseconds (30 seconds, the recommended default value from RFC 4960).

As described in Section 8.3 of RFC 4960, the value specified by sctp-hb-interval is assigned to the SCTP protocol parameter HB.Interval, which provides a default interval until actual calculations have derived a fluctuating interval based on network usage. The value specified by the sctp-hb-interval parameter is used during these calculations.

```
ORACLE(network-parameters)# sctp-hb-interval 30000
ORACLE(network-parameters)#
```

3. Use done, exit, and verify-config to complete Heartbeat Interval configuration.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

Setting the RTO

An SCTP endpoint uses a retransmission timer to ensure data delivery in the absence of any feedback from its peer. RFC 4960 refers to the timer as T3-rtx and to the timer duration as RTO (retransmission timeout).

When an endpoint's peer is multi-homed, the endpoint calculates a separate RTO for each IP address affiliated with the peer. The calculation of RTO in SCTP is similar to the way TCP calculates its retransmission timer. RTO fluctuates over time in response to actual network conditions. To calculate the current RTO, an endpoint maintains two state variables per destination IP address — the SRTT (smoothed round-trip time) variable, and the RTTVAR (round-trip time variation) variable.

Use the following procedure to assign values used in RTO calculation.

1. From superuser mode, use the following command sequence to access network-parameters configuration mode.

```
ORACLE# configure terminal
ORACLE(configure)# system
ORACLE(system)# network-parameters
ORACLE(network-parameters)#
```

2. Use the sctp-rto-initial parameter to assign an initial timer duration.

   Allowable values are integers within the range 0 through 4294967295 that specify the initial duration in milliseconds. In the absence of an explicitly configured integer value, sctp-rto-initial defaults to 3000 milliseconds (3 seconds, the recommended default value from RFC 4960).

   As described in Section 6.3 of RFC 4960, the value specified by sctp-rto-initial is assigned to the SCTP protocol parameter RTO.Initial, which provides a default RTO until actual calculations have derived a fluctuating duration based on network usage. The value specified by the sctp-rto-initial parameter seeds these calculations.

```
ORACLE(network-parameters)# sctp-rto-initial 3000
ORACLE(network-parameters)#
```

3. Use the sctp-rto-min and sctp-rto-max parameters to assign an RTO floor and ceiling.

   Allowable values are integers within the range 0 through 4294967295 that specify the minimum and maximum durations in milliseconds. In the absence of an explicitly configured integer value, sctp-rto-min defaults to 1000 ms
   (1 second, the recommended default value from RFC 4960), and sctp-rto-max defaults to 60000 ms (60 seconds, the recommended default value from RFC 4960.)

   As described in Section 6.3 of RFC 4960, the values specified by sctp-rto-min and sctp-rto-max are assigned to the SCTP protocol parameters, RTO.min and RTO.max that limit RTO calculations. If a calculated RTO duration is less than RTO.min, the parameter value is used instead of the calculated value; likewise, if a calculated RTO duration is greater than RTO.max, the parameter value is used instead of the calculated value.

```
ORACLE(network-parameters)# sctp-rto-min 1000
ORACLE(network-parameters)# sctp-rto-max 60000
ORACLE(network-parameters)#
```

4. Use done, exit, and verify-config to complete RTO configuration.

```
ORACLE(network-parameters)# done
ORACLE(system)# exit
ORACLE(configure)# exit
ORACLE(configure)# exit
ORACLE# verify-config
-------------------------------------------------------------------------
Verification successful! No errors nor warnings in the configuration
ORACLE#
```

2

The Session Load Balancer and Route Manager

Functional Overview

Subscriber-aware Load Balancing and Route Management (SLRM) is a proprietary mechanism within the Oracle CSM that presents a single target for devices sending SIP messages to your IMS core over the applicable interfaces. As such, SLRM provides load-balanced services connecting users to a group of Oracle CSMs as if they are a single node. Its load balancing functions are limited to operation with other Oracle CSMs as targets over Diameter. Oracle has developed and maintains a proprietary interface, the Sc interface, to manage load balancing operations with target Oracle CSMs. This interface is documented below.

The SLRM acts as an extension upon I-CSCF operation within the Oracle CSM. It dynamically discovers and evaluates resource utilization of Oracle CSMs deployed in the core. Having discovered and identified each Oracle CSM's status, the SLRM then distributes traffic between them. Applicable traffic includes:

- SIP REGISTERs;
- Out-of-the-blue SIP INVITEs from application servers; and
- SIP INVITES from end-stations external to your network for which terminating services may apply.

The user must explicitly set their Oracle CSM to operate as an SLRM using the command **set-component-type**. The user can confirm this operational mode using the **show ims-core-product-type** or the **display-component-type** command.

Product Functional Matrix

The SLRM is a component of the Oracle CSM/USM product group, which Oracle develops using the same software, basing the discrete operational functionality on configuration and deployment within an IMS core. The Oracle USM and Oracle CSM are distributed as separate products. The Session Load Balancer and Route Manager (SLRM) is distributed as a special configuration of an Oracle CSM.

Refer to the table below to understand product nomenclature as specified by configuration and functionality. Minimum configuration excludes universally common box configurations, such as interfaces and realms.

Nomenclature	Minimum Configuration	Functionality
OC-CSM	**registrar**, **home-subscriber-server**, **authentication-profile**	IMS S-CSCF and I-CSCF
OC-USM	**ims-access**, **registrar**, **home-subscriber-server**, **authentication-profile**	IMS P-CSCF, I-CSCF and S-CSCF

Nomenclature	Minimum Configuration	Functionality
SLRM	**set-component-type, lb-interface**, **lb-core-config**	I-CSCF, Proprietary I-CSCF Load Balancing

References to these product names must be understood within the context of their nomenclature and configuration for the purposes of understanding which functions they perform and which functions they do not perform.

Physical Deployment

The SLRM is typically deployed in an High Availability (HA) configuration, which includes multiple Oracle CSMs operating redundantly as SLRMs. There are no limitations to the number of platforms deployed as SLRMs or the number of devices with which they interoperate.

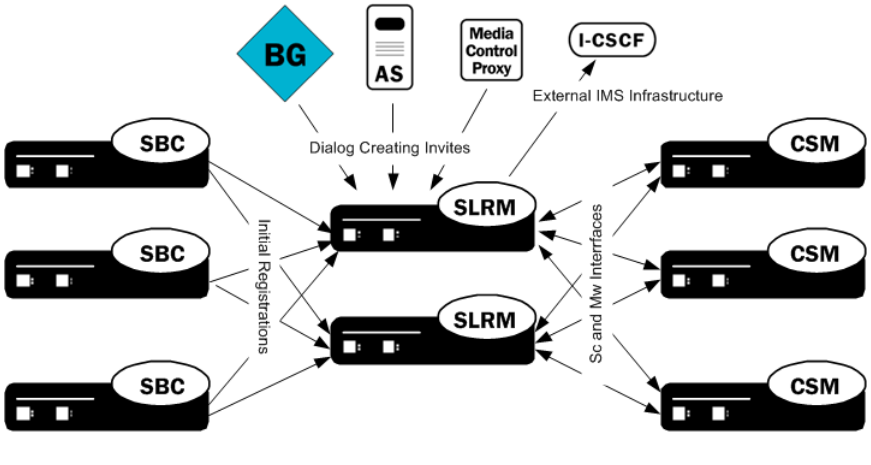
An SLRM typically resides between the network's P-CSCFs (usually Oracle SBCs) and S-CSCFs, load balancing initial registrations from the P-CSCF and INVITEs from a variety of sources. P-CSCFs send registrations. Devices from which the SLRM may receive these INVITEs include:

- AS
- BGCF
- MGCF

The SLRM may also receive traffic that it does not load balance. This includes traffic for which the target S-CSCF is already known. In these cases, the I-CSCF follows 3GPP standards for operational behavior.

Active-Active Redundancy

Multiple devices performing the SLRM function can, and should, reside in parallel to provide redundant SLRM operation. The SLRM function is not dialog stateful, which allows active-active redundancy. Typically, the SLRM configuration on each redundant device is exactly the same.



Active-Active High Availability Operation

Configuring the devices running SLRM as Session Agents within Session Agent Groups on Oracle SBCs is one method of establishing redundant connectivity. A more generic means of establishing redundant connectivity could be to use DNS techniques, such as dynamic or round-robin DNS, as the means for the P-CSCFs to reach redundant SLRMs.

SLRM-Supported Diameter Interfaces

Standard Diameter interfaces that the SLRM may support between itself and external devices include:

- Mw—The SLRM load balances all initial registration traffic.
- ISC—The SLRM may be in the path for the initial dialog transaction, but is bypassed by the AS for subsequent dialog messages.

- Mi—The SLRM may be in the path for the initial dialog transaction, but is bypassed by the BGCF for subsequent dialog messages.
- Mr—The SLRM may be in the path for the initial dialog transaction, but is bypassed by the media control device for subsequent dialog messages.

Oracle CSM's Role as S-CSCF

The Oracle CSMs that participate as S-CSCFs in an SLRM load balanced deployment are responsible for performing these key functions:

- Sends information about itself to the SLRM, including:
  - Cores serviced—The user configures Oracle CSM registrars with core names. A core name abstracts a registrar, providing a means of correlating domains serviced by a core between the Oracle CSM and the SLRM.
  - Cluster membership—All Oracle CSMs reside within a default cluster (null). The user can configure specific cluster membership to establish geographic-based preferences with which the SLRM can restrict traffic unless and until outages require that the infrastructure route that traffic outside of the preferred geography.
  - Number of current endpoints—An Oracle CSM's known number of endpoints includes registered and unregistered users within the registration cache.
  - Maximum endpoint capacity—The Oracle CSM determines maximum endpoint capacity dynamically. It uses the current number of endpoints and the resources in use by those endpoints to determine maximum endpoint capacity. The SLRM uses this number as part of its criteria to establish load balance order.
  - Operational resources available—The Oracle CSM also tracks current CPU and memory utilization.
- Manages cluster membership via refresh timing.
- Manages SLRM core registration via refresh timing.
- Responds to SLRM-initiated rebalance processes.
- Supports manual rebalance processes from the Oracle CSM.
- Maintains connectivity with the SLRM function via watchdog messaging

The user specifies registrars for load balancing on an Oracle CSM using a registrar's (**ims-core**) parameter, which aligns with a core name configured on the SLRM. These configurations establish 'load-balance group' names between Oracle CSMs and SLRMs.

Having determined core membership, the SLRM determines a target Oracle CSM by evaluating the endpoint capacity information provided by the Oracle CSMs and identifying the best target for the traffic.

Logical Deployment

The key configurations used to establish load balancing operation, includes:

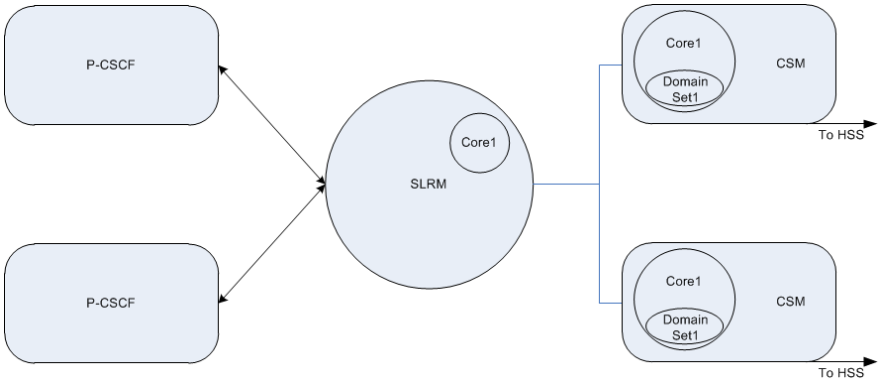
- Core—This required configuration provides a reference between Oracle CSM registrars and the load balancing configuration. After configuration, each Oracle CSM advertises its supported cores to the SLRM, which then creates a list of load-balance candidates for those cores.
- Cluster—This configuration refines the list of Oracle CSMs between which the SLRM balances traffic. The user can establish geographical preferences between Oracle SBCs and Oracle CSMs via cluster configuration on both devices. The default cluster ID, null, allows unconfigured Oracle CSMs and third party P-CSCFs to belong to clusters.

Explanations and configuration instructions for cores and clusters are presented below.

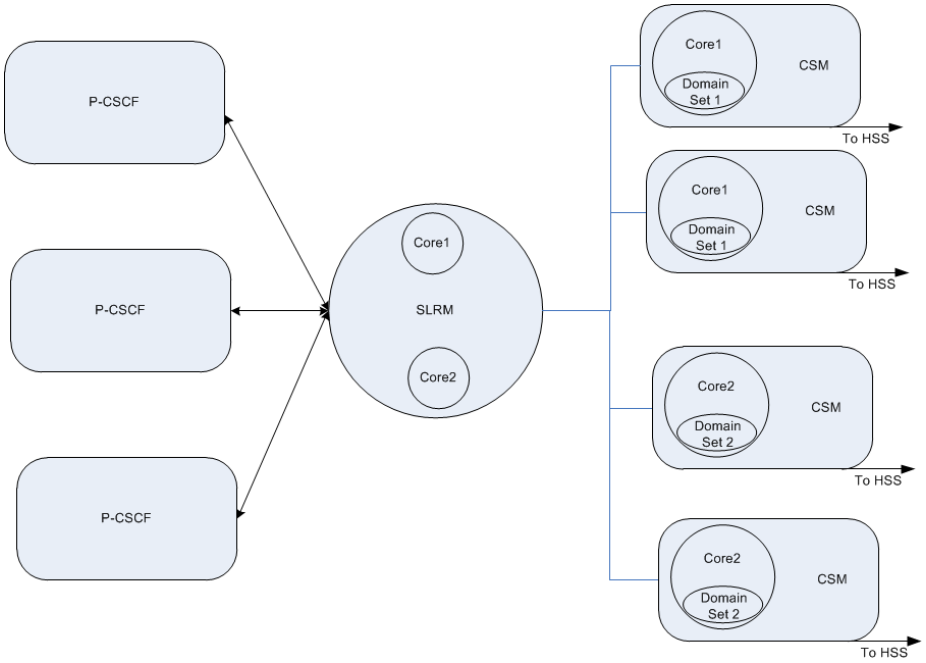
SLRM Core

An SLRM core is a required configuration that establishes a group of Oracle CSMs to which an SLRM load balances registrations and applicable INVITEs. The user configures cores to equate to Oracle CSM SIP registrars, which service the associated set of domains at the HSS. An SLRM's core configuration includes a list of domains, that must match those of the target registrars. Although the original REGISTER or INVITE is sent by a device that is unaware of core configuration, the REGISTER or INVITE does include target domain. The SLRM recognizes the target domain and, based on the core configuration, associates the message with the applicable core.

The Oracle CSM includes a core configuration within each sip-registrar that it advertises to the SLRM. Core names must be the same on the SLRM and the Oracle CSMs. Based on this advertisement, the SLRM groups Oracle CSMs that service the same set of domains for load balancing.



The SLRM supports any number of cores. In the diagram below, the SLRM services both Core1 and Core2. There are 2 Oracle CSMs for each core. The SLRM load balances registrations from P-CSCFs for Core1 between the Oracle CSMs at the top of the diagram and those for Core2 between the bottom.



You create core configurations on both the SLRM and all applicable Oracle CSMs.

Cluster Configuration

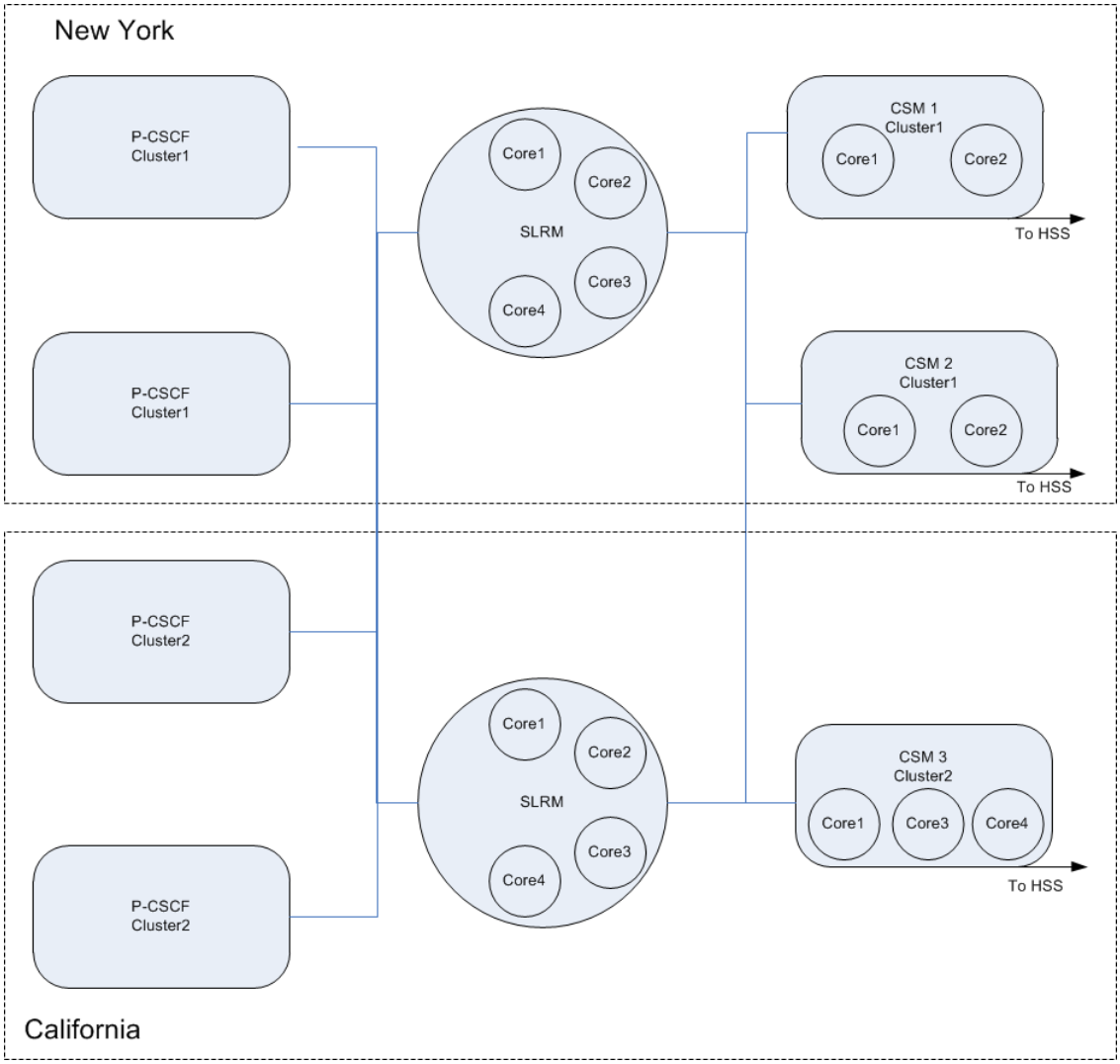
As stated, core configurations ensure that the SLRM does not send traffic to an Oracle CSM that does not service that core's domain(s). Cluster configuration can refine these constraints by establishing a group of Oracle CSMs for which core re-balancing is preferred. The SLRM attempts to load balance Oracle CSMs that belong to the same cluster first. If all Oracle CSMs in that cluster are unavailable, the SLRM can choose an Oracle CSM that services the correct core, but belongs to a different cluster.

Each participating Oracle CSM must belong to at least one cluster to participate in load balancing processes. To accommodate this requirement, all Oracle CSMs belong to the null cluster by default. (Cluster configuration is a string, which is empty by default.) In addition, the SLRM adds any P-CSCF without a cluster configuration to the null cluster.

As deployments grow, however, the operator may need to balance the requirements of maintaining connectivity during outages with the value of keeping core traffic regionally focused. The configuration of multiple clusters

logically separates groups of Oracle CSMs. The operator can configure these cluster to establish "affinity" between P-CSCFs and Oracle CSMs that reside, for example, in the same geographic region.

Noting the diagram below, a REGISTER coming from a P-CSCF in New York could be sent to a Oracle CSM that services Core1. All things equal, SLRM can choose CSM 1, CSM 2 or CSM 3. Cluster configuration, however, can defer the selection of CSM 3, thereby preventing the traffic from traversing the long span to California. Furthermore, if both CSM 1 and CSM 2 become unavailable, SLRM has the option of forwarding to CSM 3 because it supports Core1.



SLRM Operation

An Oracle CSM that is not configured to perform SLRM functions performs standard I-CSCF and S-CSCF functions. When configured for SLRM however, the S-CSCF functions are no longer available. Instead, the SLRM performs the following tasks as a 'front-end' to a pool of load balanced Oracle CSMs:

- Establishing the load balance pool
- Balancing traffic
- Re-balancing traffic

These operational functions are described in the following sections.

Establishing the Load Balance Pool

The SLRM creates pools of Oracle CSMs to load balance new registrations and applicable INVITEs. These pools include Oracle CSM that service the same cores. The SLRM ranks Oracle CSMs to create an ordered list from which it can choose registration targets.

Oracle's Diameter Sc interface includes messaging sequences and AVPs to support the interaction between the SLRM and Oracle CSMs. Key to this interaction is the Oracle CSM specifying cluster membership and registering to service cores at the SLRM. Load balanced pools for a given core include only the Oracle CSMs registered for that core.

Supporting information over the Sc interface provides the details of the Oracle CSM's registration. To this end, a client-server relationship exists, with the SLRM function acting roughly as server:

- Upon startup, each Oracle CSM advertises its cluster membership, and subsequently the IMS "cores" it services and its resource utilization. This allows the SLRM function to group Oracle CSMs for load balancing.
- At agreed upon intervals, the Oracle CSM resends advertisements to confirm or change SLRM-core registration and resource utilization.
- The Oracle CSM is also capable of initiating graceful shutdown procedures to remove itself from any load balance pool.

Sc interface registration information that aligns with the functions above include:

- New Registration — The SLRM includes this Oracle CSM in the "core" lists and begins to assign users to it.
- Re-Registration — The SLRM refreshes the list of cores within which this Oracle CSM participates.
- De-Registration — The SLRM removes this Oracle CSM from the core list from which it is de-registering.

After a Oracle CSM registers with the SLRM, the SLRM tracks its state. The SLRM only includes devices in the proper state when making load balancing calculations. Oracle CSM states include:

- In Service — The Oracle CSM has registered at the SLRM. The SLRM can include this device in its load balancing calculations and send it endpoint registrations.
- Out of Sync — Capacity information is unreliable. The Sc interface is down or the SLRM registration has timed out. This device would be selected last. The device goes back in-service if the Sc interface recovers or it re-registers with the SLRM. The system uses a back-off timing algorithm to determine when to send connectivity re-attempts, beginning with 70 seconds and proceeding by exponentially increasing the time between connectivity re-attempt until it reaches 1920 seconds (32 minutes).
- Out of Service — Not available for use by this core. The device is not responding to attempts at re-establishment. The SLRM brings the device back into service using a truncated exponential back-off method that is capped at 32 minutes.
- Destroyed — The SLRM has removed this device from this core's list because it has explicitly de-registered.

Balancing

Balancing is the act of the SLRM maintaining an ordered list of Oracle CSMs to which it sends traffic for a given core.

Having established each Oracle CSM state, the SLRM groups all Oracle CSMs that service a given core into clusters. The SLRM then establishes load balance lists labeled:

- Preferred — The administrator has configured both the target Oracle CSM and the source P-CSCF within the same cluster.
- Alternative — The target Oracle CSM and the source P-CSCF are not in the same cluster.

Note: For single cluster deployments, all Oracle CSMs registered to the SLRM function belong to the default cluster. If all P-CSCFs are in the default cluster, then every Oracle CSM is "Preferred" for every registration.

Having categorized each Oracle CSM within their clusters, the SLRM then creates, and on an on-going, dynamic basis using KPIs from SLRM-registration updates, maintains the load balance order as follows:

- Preferred Oracle CSMs — Sorted by free endpoint capacity.
- Preferred, Out of Sync Oracle CSM — Add to the bottom of the preferred list, sorted by free endpoint capacity.

- Alternative Oracle CSMs — Sort by free endpoint capacity and add to list after all preferred Oracle CSMs.
- Alternative, Out of Sync Oracle CSM — Add to the bottom of the alternative list, sorted by free endpoint capacity.

There may be multiple Alternative Oracle CSM groups. Alternative groups are selected in round-robin fashion.

Free endpoint capacity is calculated as percent utilization based on supported capacity and current utilization. It is reported by the Oracle CSM to the SLRM via the Sc interface.

SLRM distributes each message individually based on the criteria above. If a message fails at a Oracle CSM in the list, SLRM proceeds by sending the message to the next Oracle CSM in the composite list.

Re-balancing

Re-balancing is the process of taking some number of registered users from a functioning Oracle CSMs and redistributing them between other Oracle CSMs. Re-balancing occurs when manually invoked by the user from the Oracle CSM using the **release-users** command.

The Oracle CSM initiates a Reg-Event process to de-register the users. This process includes the following steps:

1. The Oracle CSM waits for users to send registration refresh.
2. Upon receipt of the users first registration refresh, the Oracle CSM sends an Administrative_Deregistration SAR to the HSS.
3. The Oracle CSM sends a 504 Server Timeout to any ensuing registration refreshes by the endpoint.
4. The HSS sets the PUID to Not Registered and clears its S-CSCF association.
5. The HSS sends an SAA back to the Oracle CSM.
6. The Oracle CSM de-registers the user.
7. The Oracle CSM sends a NOTIFY messages to all REGEVENT subscribers indicating the de-registration event has taken place.

Note that the Oracle CSM can accept new registrations during the re-balance process. The process includes a time out at 30 minutes, after which the **release-user** command stops releasing users regardless of whether it has reached the configured user count. If the user issues the **release-users** command again, the Oracle CSM re-starts the process. After completion, the Oracle CSM echoes a message indicating the re-balance is complete.

Note: If an HA switchover occurs before the release-users command has finished, the process does not continue to release users. If desired, the user can re-issue the command on the backup system after the switchover is complete.

I-CSCF Operation

As noted earlier, a device running the SLRM function can also act as an I-CSCF. All I-CSCF functions are 3GPP compliant.

Memory and CPU Overload Protection

The Oracle CSM protects itself from memory (heap) and CPU overload using configurable limits for their usage.

If the CPU usage exceeds the configured setting, the system sends a 503 error in response to any initial dialog request or standalone transactions. There are two memory (heap) related thresholds, the first of which generates 5xx replies, the second of which drops all messages.

This is true regardless of whether the system is performing SLRM or S-CSCF functions.

The Sc Interface

Oracle has define the Sc interface to define information exchange between the Oracle CSM and the SLRM. This is a custom diameter interface designed to include the following:

- Oracle CSM registration and deregistration on the SLRM function
- Capabilities negotiation between the Oracle CSM and the SLRM function
- KPIs that specify Oracle CSM status to the SLRM function
- Error information

Sc Interface Messages

The Sc Interface uses four message types to perform the SLRM function, including:

- Capabilities Exchange
- Device Watchdog
- Service Association
- Core Registration

Each message type uses a pre-defined request/answer sequence using timing that is dynamically managed and impacts the client-server as well as the load balance operational state between the SLRM and the Oracle CSM. Each sequence includes a response code in the answer message indicating if the request was a success or failure.

The high-level format, which shows message AVPs, for each of these messages is provided in the Sc Interface Appendix within this document. See RFC 6733 for detailed, generic information about Diameter message packet format and handling.

Capabilities Exchange Messages

The capabilities exchange message sequence, CER/CEA, is standard Diameter messaging used as a means of correlating client capabilities with server services. The CER message is used to discover peer's identity and exchange capabilities, including applications supported, vendor-Id and device addressing information. Key AVPs that must match include:

- Vendor-Id = 9148 (Oracle-Acme-Id)
- Vendor-Specific-Application-ID = 9999 (Oracle-Acme-Sc)

The Oracle CSM proceeds with presenting its cluster membership and registering its cores upon a successful CEA response.

Device Watchdog Messages

The device watchdog message sequence, DWR/DWA, is standard Diameter messaging used on idle connections to check peer availability and detect transport failures. Watchdog messaging can determine availability status between client and server. The sequence is initiated by both the SLRM function and the Oracle CSM depending on the devices' inter-operational state and the timing of the last successful exchanges.

On idle connections, this message is sent at a default interval of 60 seconds.

If watchdog messaging's is unable to confirm connectivity, the SLRM de-registers the applicable Oracle CSM and removes it from any load-balance pools.

Service Association Messages

The service association message sequence, SVR/SVA, is proprietary Diameter messaging that the Oracle CSM uses to advertise itself to an SLRM, specify its status in terms of service and capacity information, and remove its association with that SLRM. The process can be understood as a registration process. The Oracle CSM uses this messaging for the following purposes:

- INITIAL — On boot up, the Oracle CSM sends the request to advertise itself to the SLRM. This includes Oracle CSM's registration information. This information is updated every 20 seconds.

- REFRESH — The Oracle CSM uses this message to refresh/update its association (registration) with the SLRM. If the Capacity/Service info is not refreshed and it expires, the SLRM considers the Capacity/Service info to be invalid, so it changes the Oracle CSM status to "Out of Sync". Changes to the following trigger a refresh with updated info immediately:
  - A change in service information, such as Cluster-Id.
  - The Oracle CSM cannot handle anymore endpoints.
  - The Oracle CSM can handle endpoints again.
- TERM — The Oracle CSM uses this message to terminate its association (de-register) with the SLRM. On receiving this message, the SLRM removes the peer Oracle CSM and clear all state information.

The Oracle CSM specifies the service association request type in the SVR's Request Type AVP.

Core Registration Messages

The core registration exchange message sequence, CRR/CRA, is proprietary Diameter messaging that the Oracle CSM uses to populate, refresh and update its participation within SLRM cores. This messaging is used in the following registration scenarios:

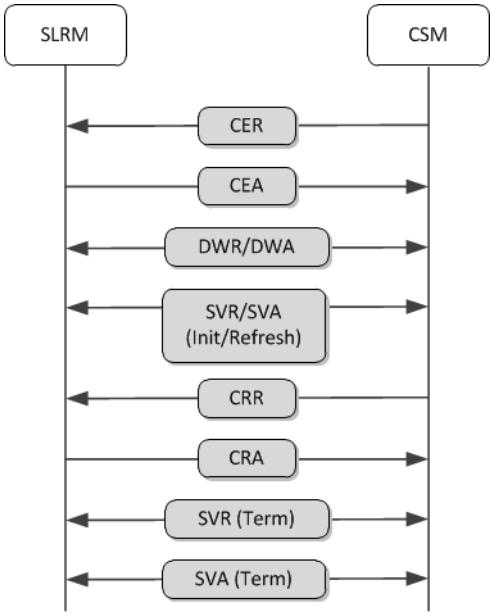
- REGISTRATION — The Oracle CSM sends the request to register the available cores to the SLRM. The registration refresh interval, which defaults to 60 seconds, is included in the Refresh-Interval AVP. If the registration is not refreshed and registration expires, then the SLRM considers that Oracle CSM to be timed out.
- DE-REGISTRATION — The Oracle CSM sends this request to de-register a core on SLRM. Upon receipt, the SLRM removes the specified core for the Oracle CSM and the Oracle CSM is considered to be no longer serving the core.
- RE-REGISTRATION — The Oracle CSM sends this message to refresh and update the registration of its cores. Upon receipt, the SLRM resets the expiration time and updates the core information. This message is sent at the default interval of 60 seconds. Additional notes on re-registration include:
  - Changes to Core-Info do not affect existing cache entries.
  - The systems use new values for future registrations/transactions.

The Oracle CSM specifies the registration scenario in the Registration Type AVP.

Sc Interface Messaging

The SLRM function uses the Sc interface to determine when and how to load balance Oracle CSMs. For the purposes of Diameter exchange, the Oracle CSM acts as client and the SLRM function acts as agent (server). This messaging includes standard Diameter exchanges, complemented with proprietary exchanges to handle all aspects of load balancing.

A typical message flow between SLRM and Oracle CSM is shown below.



Sc interface messaging procedures, from the perspective of the SLRM function, includes these steps.

1. The SLRM listens on a TCP socket for connection requests from peer Oracle CSMs.
2. After establishing a new Diameter connection, the SLRM waits for a CER from the peer CSM. The SLRM closes the connection if it does not get a CER after a timeout.
3. The SLRM exchanges the peer identity, supported vendor-ids and application-ids with the peer Oracle CSM within the CER/CEA exchange. A successful CER/CEA handshake creates a new peer relationship. If there is any error in the initial handshake, the SLRM sends an appropriate error response in the CEA and closes the connection.
4. The SLRM sends periodic DWR requests on idle connections, to check the availability of peer Oracle CSMs. The SLRM also responds to DWR's from peer Oracle CSM's
5. The SLRM responds to SVR requests sent by Oracle CSMs to advertise themselves to the SLRM.
6. The SLRM responds to CRR requests as follows.
   - On a new registration, the SLRM starts managing the cores for the Oracle CSM.
   - On re-registration, the SLRM refreshes and updates the information of the cores for the Oracle CSM.
   - On de-registration, the SLRM removes the core and stops managing the core for the Oracle CSM.

SLRM rejects bad message requests with error responses.

Sc interface messaging procedures, from the perspective of the Oracle CSM, includes these steps.

1. The Oracle CSM establishes a diameter session with peer SLRM. The initial handshake includes Diameter connection is setup and the capabilities exchange negotiation (CER/CEA).
2. The Oracle CSM sends periodic DWR requests on idle connections, to check the availability of the peer SLRM. The Oracle CSM also responds to DWR's from peer SLRMs.
3. The Oracle CSM advertises itself and sends periodic refreshes to update current Capacity using SVR/SVA requests.
4. The Oracle CSM periodically registers with the IMS cores that it is serving using CRR/CRA requests.
5. During shutdown, the Oracle CSM de-registers with the SLRM using a SVR/SVA (TERM) transaction.

Sc Interface Response Codes

The Oracle CSM and SLRM function insert a set of base protocol response codes to the Result-Code AVP of Response messages to indicate what has transpired based on the request. The sole Sc interface response code indicating success is DIAMETER_SUCCESS 2001.

- SC_DIAMETER_SUCCESS 2001

- SC_DIAMETER_FIRST_ASSOC 2002
- SC_DIAMETER_SUBSEQ_ASSOC 2003
- SC_DIAMETER_FIRST_REG 2004
- SC_DIAMETER_SUBSEQ_reg 2005

There are multiple response codes used to indicate failure, including:

- SC_DIAMETER_ERROR_CORE_NOT_FOUND 5001
- SC_DIAMETER_ERROR_PEER_NOT_FOUND 5002
- SC_DIAMETER_ERROR_PROTO_VER_MISMATCH 5003
- SC_DIAMETER_ERROR_DATABASE 5004
- SC_DIAMETER_ERROR_TIMEOUT 5005
- SC_DIAMETER_ERROR_UNABLE_COMPLY 5012

The format of each response message includes the response code AVP indicating one of the results above. Message format is provided in the Sc Interface Appendix. See RFC 6733 for detailed, generic information about Diameter response-code AVPs.

Proprietary SLRM AVP Descriptions

Req-Type AVP

The Req-Type AVP is of type Enumerated and indicates the type of registration (service association) requested by this SVR. The following values are defined:

- INITIAL (0) — This indicates the establishment of the association (eg, registration) between this Oracle CSM to the SLRM.
- REFRESH (1) — This indicates refreshes the association of this Oracle CSM to the SLRM.
- TERM (2) — This indicates the termination of the association (eg, de-registration) of thisOracle CSM to the SLRM.

Cluster-Id AVP

Uniquely identifies the cluster to which this Oracle CSM belongs. The default cluster is zero. This AVP is included in the SVR request.

Pct-Used-CPU AVP

Indicates the percentage CPU used in a CSM. This AVP is included in SVR request.

Note: Percentage CPU is provided by Oracle CSM for information purposes only. The SLRM displays it in show commands, but does not take any action based on this value.

Pct-Used-Mem AVP

Indicates the percentage memory of used in the Oracle CSM. This AVP is included in SVR request.

Note: Percentage memory is provided by Oracle CSM for information purposes only. The SLRM displays it in show commands, but does not take any action on this value.

EP-Srv-Cnt AVP

Gives the number of endpoints currently serviced by the Oracle CSM. This AVP is included in the SVR request.

Proto-Ver AVP

Specifies the Sc interface version in SVR request. This AVP is included only in the initial SVR request.

Max-EPs-Supp AVP

Specifies the maximum number of contacts that a Oracle CSM can support. This number starts as the user-configured value on the Oracle CSM, but then is adjusted based on available system resources on the Oracle CSM.

Core-Reg-Type AVP

The Core-Reg-Type AVP is of type Enumerated and indicates the type of registration in the CRR request. The following values are defined:

- REGISTRATION (0) — This indicates registration of cores for the Oracle CSM.
- RE-REGISTRATION (1) — This indicates refresh/update/addition of cores for the Oracle CSM.
- DE-REGISTRATION (2) — This indicates de-registration of cores for the Oracle CSM.

Ims-Core AVP

Specifies the IMS core served by the Oracle CSM, as configured within the SIP registrar's ims-core setting. This AVP is included in the CRR request.

Srv-Assoc-ID AVP

This auto-generated string establishes an association relationship between the Oracle CSM and the SLRM. This AVP is included in the SVR request and answer.

Srv-Assoc-Exp

This AVP specifies the expiry time for the service association to which this Oracle CSM registered within this sequence. This AVP is included in the CRR request and is always 80 seconds with refreshes established via SVR sent every 20 seconds.

Core-Reg-Exp AVP

This AVP specifies the expiry time for the core registration to which this Oracle CSM registered within this sequence. This AVP is included in the CRR request and is always 240 seconds, with refreshes established via CRR sent every 60 seconds.

Soft-Ver AVP

Specifies the software version running on the Oracle CSM or SLRM. This AVP is included only in the initial SVR request.

Grouped AVPs

Oracle's Sc Diameter interface specifies grouped AVPs for use within its messaging. These AVPs are expanded below.

Core-Info AVP

A grouped AVP used to send service related information of a Oracle CSM in CRR messages. This grouped AVP contains the following AVPs:

- Srv-info — Service route of IMS core on the target Oracle CSM. This is a grouped AVP that includes the service info and service route AVPs.
- Ims-Core — IMS core served by Oracle CSM.

Srv-Info AVP

The Sc interface's service info AVP is a grouped AVP nested within the core-info AVP. It provides the SLRM function with the routes used to access the applicable ims-cores via this Oracle CSM.This grouped AVP has the following information in it.

- Service Info — Designation of this grouped AVP
- Service Route — The route to the target Oracle CSM

SLRM Configuration

This section explains how to configure functionality specific to the SLRM. It does not include configuration steps for elements that it shares in common with its corresponding Oracle CSMs (for example, **system-config**, **phy-interface**, **network-interface** and so forth).

SLRM configuration is quite simple. Aside from basic network connectivity, the service interfaces and the IMS core architecture, much of the configuration is otherwise learned dynamically learned from the Oracle CSMs that comprise the cluster.

Configuration elements include:

set-component-type—Defines operational behavior as either SLRM or CSM.

lb-interface—A multi-instance element identifying the Sc listening interface. There is typically only one **lb-interface** per device. Parameters include the local address, associated with realm, of the interface that the SLRM uses for SLRM signaling.

lb-core-cfg—A multi-instance element identifying every core the SLRM services, as well as the domains serviced within that core.

set-component-type

Use the **set-component-type** command to define the system's operational mode as either SLRM or CSM..

1. From superuser mode, use the following ACLI command sequence to access the **set-component-type** configuration element.

   - core-session-manager—Defines the device as an I-CSCF and S-CSCF.
   - core-load-balancer—Defines the device as an I-CSCF and SLRM.

   The device responds by displaying user requirements for changing component type. If the user attempts to set the component type to the current component type, the system provides a message indicating this and takes no further action.

```
ORACLE# set-component-type core-load-balancer
WARNING: Changing component type is service impacting.
*******************************************************
  Ensure that you follow these steps if you choose to
  change the component type:

  1. Issue the delete-config command.
  2. Reboot.
*******************************************************
Continue with the change [y/n]?:
```

2. Type **y** to make the change.
   The system displays a message indicating the component type.
3. Be sure to **delete-config** and **reboot** to complete the procedure.

lb-interface

Use the following procedure to perform required **lb-interface** configuration.

1. From superuser mode, use the following ACLI command sequence to access the **lb-interface** configuration element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# lb-interface
ORACLE(lb-interface)#
```

2. **name**—Use the **name** parameter to specify the name for this interface.

3. **state**—Enables or disables this interface for the Sc interface.
4. **address**—Specifies the IP address of the SLRM from which this Oracle CSM sends Sc interface traffic.
5. **port**—Specifies the port on the SLRM interface from which the Oracle CSM sends Sc interface traffic.
6. **realm**—Specifies the local realm to which this Sc interface applies.

lb-core-config

Use the following procedure to perform required lb-core-config configuration.

1. From superuser mode, use the following ACLI command sequence to access the **lb-core-config** configuration element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# lb-core-config
ORACLE(lb-core-config)#
```

2. **core-name**—Use the **core-name** parameter to specify the name of this lb-core-config. This name must match the name of an lb-config on the Oracle CSM.
3. **state**—Enables or disables this **lb-core-config** instance.
4. **domains**—List of domains associated with this core. This list must match that of the corresponding registrar at the Oracle CSM.
5. **forwarding-realm**—Specifies the realm of the SLRM interface from which it sends Sc interface traffic.
6. **hss-config**—Specifies the name of the hss-config that matches the applicable HSS. The SRLM sends UARs and LIRs associated with this core to this HSS.

   Note - The configuration options described in the Primary and Secondary ENUM Configuration section within the Diameter Oracle CSM chapter applies to the lb-core-config element. See that section for instructions on configuring those options here.

Oracle CSM Configuration

This section describes the configuration necessary to allow an Oracle CSM to join an SLRM load balanced cluster. Configuration is simplified to allow for an easy and seamless migration.

Configuration required at the Oracle CSM includes:

- **cluster-id**— A parameter within the system-config element that specifies the cluster to which this Oracle CSM belongs.
- **lb-cfg**—A multi-instance element identifying the Sc listening interface on the SLRM(s).
- **sip-registrar**—This configuration element has two applicable parameters.
  - **ims-core**—Parameter that specifies the matching SLRM core name to which this registrar applies.
  - **lb-cfg**—List of **lb-cfg** elements that this registrar uses to register its cores.

The following subsections explain these configurations.

cluster-id

Use the following procedure to perform **cluster-id** configuration within the system-config element on the Oracle CSM.

1. From superuser mode, use the following ACLI command sequence to access the system-config configuration element.

```
ORACLE# configure terminal
ORACLE(configure)# system-config
ORACLE(system-config)#
```

2. Select the **system-config** element. The **system-config** element is a single-instance element.

3. Use the **cluster-id** parameter to specify the cluster to which this Oracle CSM belongs. The default value is null, which ensures that this Oracle CSM can participate as a load balanced device with SLRM even though it has not been explicitly configured.

```
ORACLE(system-config)# cluster-id new-york
```

lb-cfg

Use the following procedure to perform required lb-cfg configuration.

1. From superuser mode, use the following ACLI command sequence to access the lb-config configuration element.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# lb-config
ORACLE(lb-config)#
```

2. **name**—A name for this **lb-cfg** element.
3. **state**—Enables or disables this configuration. When enabled, the Oracle CSM starts Sc interface signaling to this target SLRM.
4. **address**—Specifies the IP address of the SLRM to which this Oracle CSM sends Sc interface traffic.
5. **port**—Specifies the port on the SLRM interface to which the Oracle CSM sends Sc interface traffic.
6. **realm**—Specifies the local realm to which this Sc interface applies.

ims-core and lb-list

Use the following procedure to perform required **ims-core** and **lb-list** configuration within the selected **sip-registrar**.

1. From superuser mode, use the following ACLI command sequence to access sip-registrar configuration element.

```
ORACLE# configure terminal
ORACLE(configure)# sip-registrar
ORACLE(sip-registrar)#
```

2. Select the **sip-registrar** you intend to configure.
3. **ims-core**—Use the **ims-core** parameter to specify the core identification for this registrar. The domains supported by this **sip-registrar** must be the same as those in the SLRM's **lb-core-cfg** list.
4. **lb-list**—Use the **lb-list** parameter to specify an **lb-cfg** to communicate to the SLRM over the SC interface.

Releasing Users

Manual rebalancing consists of executing the release-users command from the Oracle CSM performing the SLRM function.

release-user

This command releases registered users from the Oracle CSM on which the command is issued. The SLRM re-balances the deployment by registering these users on another Oracle CSM upon the next registration cycle. This command only releases users up to the count specified. The process includes a time out at 30 minutes, after which the **release-user** command stops releasing users regardless of whether it has reached the configured user count. A user is only released if it is not in an active session.

Note: If an HA switchover occurs before the release-users command has finished, the process does not continue to release users. If desired, the user can re-issue the command on the backup system after the switchover is complete.

Parameter

<count>	Specify the number of users that the system must release. The system marks this number of users for release, and begins to remove users until it reaches this number.
stop	The system removes all users from the list of users currently marked for release.
status	The system displays a list of all users marked for release from each cluster.

Path

release-user is an command available to superusers.

Release

First appearance: S-Cz7.1.5

Obtaining SLRM-Related Information

This section explains commands you can use to display or obtain SLRM load balance information. Methods of obtaining this information includes the **show load balancer** ACLI command and SNMP.

display-component-type

On an Oracle CSM, the **display-component-type** command shows the user the current operational mode as either **core-session-manager** or **core-load-balancer**.

Example

```
ORACLE# display-component-type
Component Type is: core-session-manager
SCZ715_64#
```

show load-balancer

On the device running the SLRM function and any load balanced Oracle CSMs, the **show load-balancer** command is the root command for displaying all load balance statistics. The various arguments the command supports narrows the output for clarity and specificity.

Arguments

stats [load balancer name]—Shows cumulative statistics on a per load-balancer basis. Adding a **load-balancer-name** as an argument narrows the output to the load-balancer specified.

members—Shows statistics on members in a cluster.

cores <core-name>—Shows load balance statistics on a per-core basis. Adding a **core-name** as an argument narrows the output to the core specified.

interface <argument>—Shows the cumulative statistics for all load balance interfaces on this device.

- **lb-interface-name**—Adding an **interface-name** as an argument narrows the output to the interface specified.
- **peer-address:port**—Adding **peer-address:port** as an argument narrows the output to the address/port specified.

Example

```
ORACLE# show load-balancer interface if3
```

show sipd endpoint-ip

The show sipd endpoint-ip <user | IP address> command displays information about each endpoint. For a supplied AoR, the Oracle CSM displays all associated contacts (both access and core side), the expiration of each contact entry and associated 3rd Party Registration information. For example:

```
ORACLE# show sipd endpoint-ip 11111
User <sip:111111@172.16.17.100>
  Contact exp=1198
    UA-Contact: <sip:111111@172.16.17.100:5060> UDP keep-acl
         realm=net172 local=172.16.101.13:5060 UA=172.16.17.100:5060
    SD-Contact: <sip:111111-s37q249kvluaa@192.168.101.13:5060> realm=net192
    Call-ID: 1-15822@172.16.17.100'
Third Party Registration:
   Third Party Reg User=<sip:111111@172.16.17.100> state: REGISTERED
   Expire Secs=298 seqNum= 1 refreshInterval=300
   Call-ID: d355a67277d9158e7901e46a12719663@192.168.101.13
   Third Party Reg User=<sip:111111@172.16.17.100> state: REGISTERED
   Expire Secs=178 seqNum= 1 refreshInterval=180
   Call-ID: 07ebbdebfdf64a48985bb82fa8b4c595@192.168.101.13
```

SLRM MIB Objects and Traps

The following MIB objects and traps are supported for the Oracle CSM and its SLRM function. Please consult the *S-Cz7.1.2 MIB Reference Guide* for more SNMP information.

Acme Packet System Management MIB (ap-corelb.mib)

The following table describes the SLRM-related SNMP GET query names for the Oracle Core Load Balancer MIB (ap-corelb.mib).

SNMP GET Query Name	Object Identifier Name: Number	Description
Object Identifier Name: apCoreLBModule (1.3.6.1.4.1.9148.3.19)		
Object Identifier Name: apCoreLBMIBObjects (1.3.6.1.4.1.9148.3.19.1)		
Object Identifier Name: apCoreLBMIBGeneralObjects (1.3.6.1.4.1.9148.3.19.1.1)		
apCoreLBMemberAddress	1.3.6.1.4.1.9148.3.19.1.1.1	This is the IP address of the CSM registered with the SLRM.
apCoreLBMemberAddressType	1.3.6.1.4.1.9148.3.19.1.1.2	This is the protocol version of the IP address of the CSM registered with the SLRM.
apCoreLBMemberPort	1.3.6.1.4.1.9148.3.19.1.1.3	This is the IP port of the CSM registered with the SLRM.
apCoreLBMemberId	1.3.6.1.4.1.9148.3.19.1.1.4	The cluster Id of the Core LB member.
apCoreLBReasonCode	1.3.6.1.4.1.9148.3.19.1.1.5	The reason for the core member failure. Values include service assoc terminated (0), service assoc timeout (1) and connection down (2).

SLRM Traps

The table below identifies traps that apply specifically to the SLRM function.

Trap Name: OID	Description
apCoreLBMemberOOSTrap	The system sends this trap when any member of a load balanced core is not responsive.
apCoreLBMemberInServiceTrap	The system sends this trap when any member of a load balanced core becomes responsive after failure.

The system sends the failure trap when the registered Oracle CSM's become unavailable for the following reasons:

- The Sc interface goes down. (0)
- The member's registration expires. (1)
- The Oracle CSM does not respond to SIP requests. (3)

Query apCoreLBReasonCode to determine the reason code. The system sends the clear trap when the Oracle CSM becomes responsive again.

3

Local Subscriber Tables

Local Subscriber Table

A local subscriber table (LST) is an XML formatted file that contains one or more usernames associated with a hash as encrypted or plaintext. The LST is saved locally on the Oracle CSM's file system.

LSTs enable a standalone Oracle CSM node or high-availability (HA) pair to forego relying on an external user database. Thus the Oracle CSM does not need to communicate with a server to authenticate users. This can eliminate the operational complexity of deploying a highly available credential storage system.

LST Runtime Execution

The LST is loaded on boot up when the configuration is appropriately set. Incoming messages thereafter can then be authenticated based on the credentials in the LST. If the Oracle CSM can not load an LST file, three things occur:

1. The following log message is recorded at the NOTICE level:

   ```
   LST [table-name] was not loaded - [filename] has error loading XML file
   ```
2. The message stated above is printed on the ACLI.
3. A 503 Response is returned to the UA that sent the initial REGISTER message to the Oracle CSM.

LST Configuration

To configure the Oracle CSM to use LSTs for authentication, you need to create a local subscriber table configuration element that identifies that LST. You then need to set the sip authentication profile configuration to reference that LST configuration so that when messages requiring authentication are received and processed by a sip registrar configuration element, the Oracle CSM will use the identified LST for authentication.

In a local subscriber table configuration, you must define an object name, identify the specific LST filename (and path). If the filename is entered without a path, the Oracle CSM looks in the default LST directory, which is /code/lst. If the LST file is located elsewhere on the Oracle CSM, you must specify the filename and absolute path. For example /code/path/01302012lst.xml.

The corresponding sip authentication profile must be set to use the local subscriber table configuration element you just created. First set credential retrieval method to local, set the digest realm appropriately (this is required for authentication), and finally set the credential retrieval config parameter to the name of the local subscriber table configuration element that you just created. At this point you may save and activate your configuration.

Unencrypted passwords for each user in the table is computed with the MD5 hash function as follows:

```
MD5(username:digest-realm:password)
```

ACLI Instructions

LST Table

To configure the Oracle CSM to use an LST:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type local-subscriber-table and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# local-subscriber-table
ORACLE(local-subscriber-table)#
```

You may now begin configuring the local subscriber table configuration element.

4. name—Enter the name of this local subscriber table configuration element that will be referenced from a SIP registrar configuration element.
5. filename—Enter the filename that describes this LST XML file. If no path is given, the Oracle CSM looks in the /code/lst directory. You may provide a complete path if the file is located elsewhere.
6. secret—Enter the PSK used in encryption and decryption of the passwords in the XML file. Once saved, this value is not echoed back to the screen in plaintext format. See LST Subscriber Hash and Encryption.
7. Type done when finished.

SIP authentication profile

To configure the Oracle CSM to utilize an LST, continuing from the previous step:

1. Type exit to return to the session router path.
2. Type sip-authentication-profile and press Enter.
3. Type select to choose the existing sip-authentication-profile configuration element you wish to use LST for authentication.

```
ACMESYSTEM(sip-authentication-profile)# select
<name>:
1: name=sipAuthSMX1 digest-realm=acme.com credential-retrieval-method=loacl
selection: 1
ACMESYSTEM(sip-authentication-profile)#
```

4. digest-realm—Enter the digest realm used for authenticating here.
5. credential-retrieval-method—Set this parameter to local to use an LST.
6. credential-retrieval-config—Enter the name of the LST configuration you just configured.
7. Type done when finished.

LST Redundancy for HA Systems

LSTs must be synchronized between redundant nodes to ensure that the standby node contains identical LST files. You can either SFTP the same LST file to both the active and standby node, or you can use the synchronize command. The synchronize command is always executed from the active system. It copies the specified file from the active to the standby node placing the copy in the same file location on the standby node. Use the synchronize lst command as follows:

```
ACMESYSTEM# synchronize lst file.xml
```

Note: The synchronize command does not reload the LST files.

Reloading the LST

After copying a new LST file to the Oracle CSM (and its standby peer), you can reload this newer file from the ACLI using the refresh lst command. For example:

```
ORACLE# refresh lst <local-subscriber-table name>
```

Using the refresh lst command selects the LST by name to refresh. Alternatively, saving and activating the configuration will reload the configuration as well and should be used when configuration parameters have also changed.

Note: In an HA pair of Oracle CSMs, you must independently execute the refresh lst command on both the active and standby systems.

LST File Compression

To save local disk flash space, you can compress the LST XML file using .gz compression. The resultant file must then have an .xml.gz extension.

LST File Format

The LST file format is as follows:

```
<?xml version="1.0" encoding="UTF-8"?>
<localSubscriberTable encrypt-algo="aes-128-cbc">
<subscriber username="alice@apkt.com" hash="02:5E:78:D8:7E:75:A3:39"
encrypted="true"/>
<subscriber username="bob@apkt.com" hash="bc4b2a76b9719d911017c59"
encrypted="false"/>
<subscriber username="acme@apkt.com" hash="5d41402abc4b2a76b9719d9"
encrypted="false"/>
</localSubscriberTable>
```

The LST file's elements are as follows:

localSubscriberTable

This is the head element in the XML file. Each file can have only one head element. The following attribute is found in this element:

- encrypt-algo—This indicates the algorithm type used to encrypt the hash in the XML file. The key for this encryption will be a preshared key and is configurable in the local subscriber table configuration element with the secret parameter.
- The value in this element is for display purposes only.
- Currently AES-128-CBC is the only supported encryption algorithm.

subscriber

This element has the subscriber information. And has the following 3 attributes:

- username—The value given in the username attribute must be same as the username that will be sent in the Authorization Header in the Request message from the users. Refer RFC 2617 Http Authentication for details.
- hash—The hash provided in the XML must be an MD5 hash of the Username, digest-realm and the password of the user. This is same as the H(A1) described in RFC 2617.

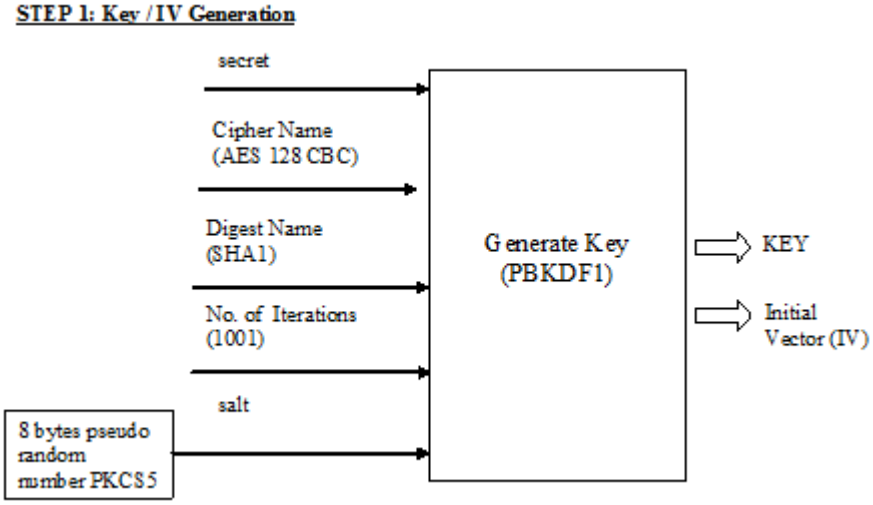
  hash = md5(username:digest-realm:password)
- encrypted—The encrypted flag indicates if the "hash" given in the XML file is encrypted or not

LST Subscriber Hash and Encryption

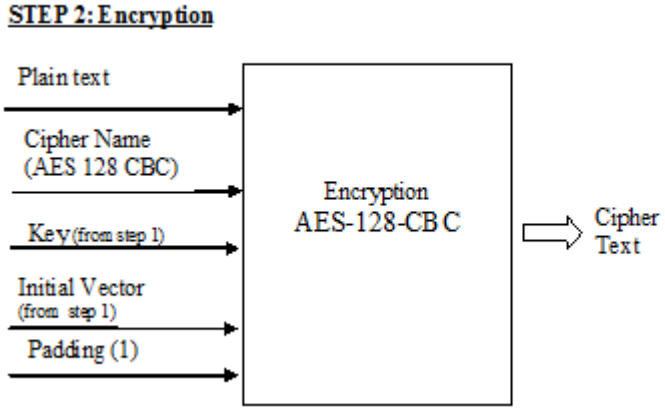
You may additionally use AES-128 CBC to encrypt the hash in the subscriber element in the LST XML file. The PSK used for encryption is configured in the secret parameter and an 8-byte pseudo random number is used as the salt. The LST file must set the encrypted attribute per subscriber element to true. To derive the final encrypted data you place

in the XML file, three steps are performed according to the following blocks. The output of the last step, Formatting final Encrypted Data, is inserted into the LST files, subscriber element's hash value, when the encrypted attribute is set to true.

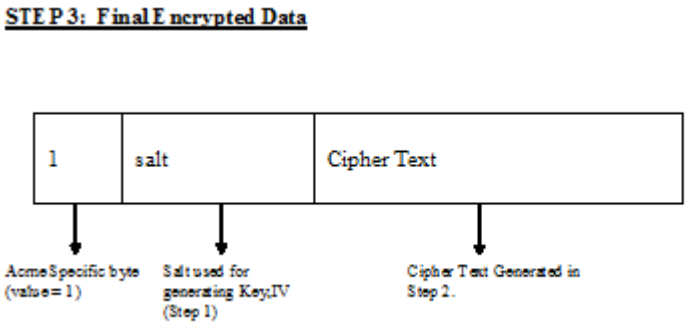
Key Initialization Vector



Encryption



Formatting final Encrypted Data

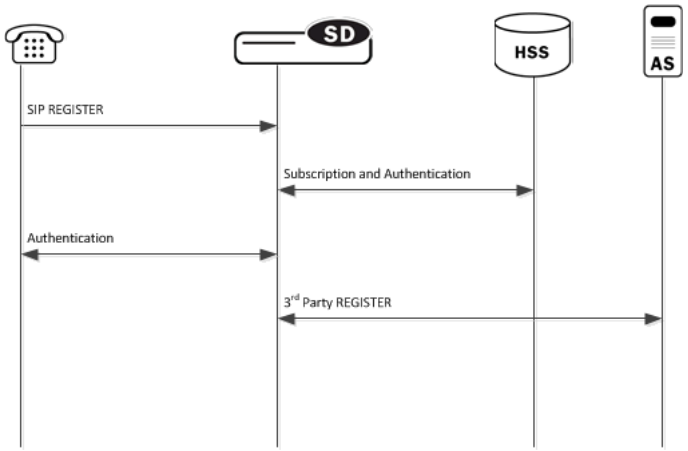


4

Third Party Registration

Third party registration support on the Oracle CSM provides a mechanism for sending registration information to a third party server. An IM (Instant Messaging) server might be the recipient of a third party REGISTER message.

The Oracle CSM accepts incoming REGISTER requests from UAs. After the UA has been registered with the Oracle CSM, the Oracle CSM sends a third party REGISTER message to a third party server.



The Oracle CSM supports third party registration via two methods:

- For scenarios in which UAs receive iFCs from the HSS and the Oracle CSM's default iFC configuration, the Oracle CSM generates third party registration requests and responses for matching triggers in its iFC evaluation.

  Some third party servers may want the UA's entire original request to the Oracle CSM and response from the Oracle CSM to the UA provided to them. The Oracle CSM supports these scenarios, in some cases requiring additional configuration.
- For scenarios in which the UA needs a third party registration that is not explicitly prescribed within iFCs, you can configure a third party server on the Oracle CSM and achieve third party registration support.

  For these configurations, the Oracle CSM attempts third party registration to those servers for all UAs that register via the applicable Oracle CSM registrar.

For both methodologies, you must configure all third party servers as session agents.

Third Party Registrations via iFCs

The Oracle CSM performs third party registrations based on the iFC downloaded for the user. If the filter criteria successfully evaluates to a third party server, a third party registration entry is dynamically added in the Oracle CSM. The dynamic entry is automatically deleted if there are no more registrations being handled for that third party registration host.

When third party registration is performed by iFCs, the Oracle CSM generates the registration messages as follows:

- The Contact: header is populated with the URI from the home server route configuration of the sip-registrar associated with the registration. If the home server route is left blank, the Oracle CSM uses the IP address of the egress interface.
- The From: header of the new REGISTER message is the same as the FROM in the original message.
- The To: header of the new REGISTER message is the the same as the TO in original message (AOR).

Embedded REGISTER

As an option within standard iFC third party registration support, the Oracle CSM supports 3GPP's methodology of embedding the original UE registration (and/or its response from the S-CSCF/Registrar) as a MIME body in the third party REGISTER sent from the S-CSCF to the third party server. This methodology, presented in 3GPP TS 23.218 and 29.228, uses an optional iFC extension ("IncludeRegisterRequest" and "IncludeRegisterResponse") that tells the third party server to expect the entire original REGISTER request and/or REGISTER 200OK in the mime of the third party REGISTER.

Implementation details for this methodology include the following:

- There may be further configuration required on the Oracle CSM.
- The Oracle CSM does not embed original registration requests or responses to any third party server outside its trust domain.
- The HSS or configured iFCs must be preconfigured for embedded third party registrations.

An HSS confiuration may not support the optional "IncludeRegisterRequest" and "IncludeRegisterResponse". For these cases, there is a Oracle CSM configuration option that allows you to control this inclusion, as follows:

- If the iFCs specify inclusion in an environment where you do not want it, you can set a registrar option to never include the original REGISTER
- If the iFCs do not specify inclusion in an environment where you want it, you can set a registrar option to always include the original REGISTER.

You can set these options for either the third party register, the 200 OK, or both.

ACLI Instructions - Third Party Registration via iFCs

Session Agent

To create a session agent to represent the third party server:

1. In Superuser mode, type configure terminal and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type session-router and press Enter to access the session router path.

   ```
   ORACLE(configure)# session-router
   ```

3. Type session-agent and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

   ```
   ORACLE(session-router)# session-agent
   ORACLE(session-agent)#
   ```

4. hostname—Enter the name for this session agent.

5. ip-address—Enter the IP address for this session agent. This value must be the same as the registrar-host parameter in the third party regs configuration element to which this session agent definition corresponds.

   Continue configuring this session agent's parameters. Not all session agent functionality is applicable to the Oracle CSM.

6. Type done when finished.

SIP Registrar

Option to set the SIP Registrar to perform embedded REGISTRATION support for third party registration:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-registrar and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-registrar
ORACLE(sip-registrar)#
```

4. Type select and choose the number of the pre-configured SIP registrar configuration element you want to configure.

```
ORACLE(sip-registrar)# select
name:
1: registrar1
selection:1
ACMEPACKET(sip-registrar)#
```

5. option +include-register-request—Set this option to control SIP REGISTER embedding in the third party registration.

```
ORACLE(sip-registrar)#options +include-register-request=true
```

   Set this option to true to always embed the original REGISTER in the third party registration.

   In some cases, the include may already be specified by the iFCs, even though you do not want it used. In these cases, configure the option to false

```
ORACLE(sip-registrar)#options +include-register-request=false
```

6. option +include-register-response—Set this option to control SIP REGISTER 200 OK embedding in the third party registration the S-CSCF sends to the AS.

```
ORACLE(sip-registrar)#options +include-register-response=true
```

   Set this option to true to always embed the original REGISTER in the third party registration 200 OK.

   In some cases, the include may already be specified by the iFCs, even though you do not want it used. In these cases, configure the option to false.

```
ACMEPACKET(sip-registrar)#options +include-register-response=false
```

7. Type done when finished.

Third Party Registration via ACLI Configuration

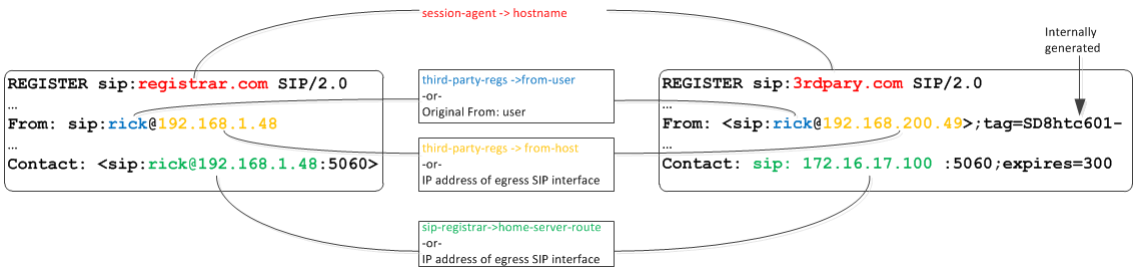
This section specifies the differences between Oracle CSM third party registration support via iFC as oppsed to via ACLI configuration.

As is true of the method described above, third party registration is generated by the Oracle CSM on behalf of the user in the To: header of REGISTER request.

When third party registration is generated by ACLI configuration on the Oracle CSM, the registration messages are generated as follows:

- The request URI of the new REGISTER message uses the value of the hostname parameter in the session agent configuration element.
- The From: header of the new REGISTER message uses the value of the from-user parameter in the third party regs configuration element as the user portion of the URI. If the from-user parameter is left blank, the Oracle CSM uses the user in the original From: header.
- The From: header of the new REGISTER message uses the value of the from-host parameter in the third party regs configuration element as the host portion of the URI. If the from-host parameter is left blank, the Oracle CSM uses the IP address of the egress SIP interface as the host portion of the from header.
- The Contact: header of the new REGISTER message uses the home server route parameter in the sip registrar configuration element. If the home server route parameter is left blank, the Oracle CSM uses the IP address of the egress interface.

See the following diagram:



Third Party Registration Server States

If the third party server does not respond to a REGISTER request, the Oracle CSM adheres to standard SIP session agent retransmission/ timeout procedures. If the third party server is set to out of service, the Oracle CSM attempts connectivity retry procedures. The retry procedures dictate that the Oracle CSM periodically send a REGISTER message to the third party server to check if connectivity has come back. The time interval for checking connectivity to a third party server is set with the retry interval parameter. Retries continue forever or until the third party server responds. The retry mechanism may be disabled by setting the retry interval parameter to 0.

Note: When using the ACLI generated third party registration method, the time interval for checking connectivity to a third party server is set with the retry interval parameter in the third party regs configuration element.

When a third party server is out of service, the Oracle CSM maintains a queue of outstanding third party registration requests. When the third party server returns to service, the Oracle CSM gracefully flushes the queue of outstanding requests. This prevents a registration flood from being directed at the third party server .

Third Party Registration Expiration

The REGISTER message sent from the Oracle CSM to the third party server uses the Expires: value returned from the User Subscriber Database or HSS. The third party server sends a 200 OK message containing Contact bindings and an expires value chosen by the third party server itself. The Oracle CSM checks each contact address to determine if it created it. For those addresses it created (as SD-Contacts), the Expires value from the 200 OK is used as the final value.

Once the expires timer has reached half the expires period as returned from the third party server, the Oracle CSM refreshes the registration.

If the third party server responds to a REGISTER Request with a 423 (Interval Too Brief) response, the Oracle CSM updates the contact's expiration interval to the Min-Expires value of the 423 response. It then submits a new REGISTER Request with the updated expires value.

Defining Third Party Servers

To send third party registrations that are generated via ACLI configuration to a third party server, three configuration elements are required. The primary configuration element is the third party regs. One or more may be configured in order to send the REGISTER message to multiple registration servers. You need to configure a name and set the state to enabled. The registrar host must be configured to indicate the value to insert into the Oracle CSM-generated request URI in the REGISTER message.

Note: It is recommended that the list of third party registration servers be restricted to a maximum of 3.

A session agent needs to represent the third party server. Create a session agent as the third party server and note its name. Next, configure the registrar-host parameter with a session agent hostname in the third-party-reg configuration element. This specifies the session agent to be used as the registrar.

Finally, the address of the third party server must be added to the third-party-registrars parameter in the sip-registrar configuration element. This does not supercede any core Oracle CSM Registrar functionality. It informs the Oracle CSM of the third party server to send messages to after initial registration. Thus the value configured here must exist in the third-party-regs configuration element's registrar-host parameter list.

ACLI Instructions - Third Party Server Configuration

Recall that the configuration below is only required for scenarios in which the iFC does not explicity specify registration for the servers you configure below.

Third Party Registrar

To configure a third party server:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type third-party-regs and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# third-party-regs
ACMEPACKET(third-party-regs)#
```

4. state—Set this to enabled to use this configuration.
5. registrar-host—Set this value to the complementary session agents' hostname parameter to include those session agents as third party servers. This parameter may be modified like an options parameter. This value also appears in the request URI of the outgoing REGISTER message being sent to the third party server.
6. from-user—Configure this parameter to be the user portion of the From: header of the outgoing REGISTER message being sent to the third party server. Leaving this blank sets the user portion that in the original From: header
7. from-host—Configure this parameter to be the host portion of the From: header of the outgoing REGISTER message being sent to the third party server. Leaving this blank sets the host portion to the Oracle CSM's egress SIP interface.
8. retry-interval—Enter the number of seconds the Oracle CSM waits before retrying a third party server after a failed registration. Enter 0 to disable this feature.
9. Type done when finished.

SIP Registrar

To indicate to a local SIP Registrar when and what third party server to send third party registrations to:

1. In Superuser mode, type configure terminal and press Enter.

```
ORACLE# configure terminal
```

2. Type session-router and press Enter to access the session router path.

```
ORACLE(configure)# session-router
```

3. Type sip-registrar and press Enter. The system prompt changes to let you know that you can begin configuring individual parameters.

```
ORACLE(session-router)# sip-registrar
ACMEPACKET(sip-registrar)#
```

4. Type select and choose the number of the pre-configured SIP registrar configuration element you want to configure.

```
ORACLE(sip-registrar)# select
name:
1: registrar1
selection:1
ACMEPACKET(sip-registrar)#
```

5. home-server-route—Enter the value to insert into the REGISTER message's request URI as sent to the third party server. Leaving this blank uses the AoR (or To: header) in the original REGISTER message.
6. third-party-registrars—Enter the name of a third party regs configuration element registrar-host parameter to send third part registrations associated with that SIP registrar.
7. Type done when finished.

5

RADIUS Accounting of REGISTERs

CDR Generation for REGISTER Events

The Oracle CSM can generate RADIUS CDRs, per Contact's event, for registration, refresh registration, and registration removal. A single REGISTER message can generate multiple RADIUS CDRs since that message may contain multiple contacts.

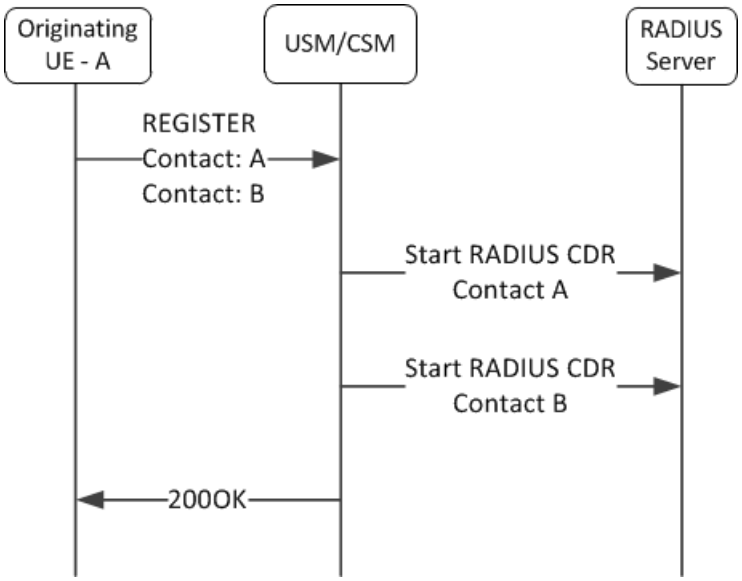
To enable CDR generation for received REGISTERs, you set the generate event parameter in the account-config configuration element to register or local-register. The register value may exist with other events such as invite.

REGISTER Scenarios

RADIUS CDRs are generated for each registration change per Contact. There are 5 main scenarios which cover CDR creation.

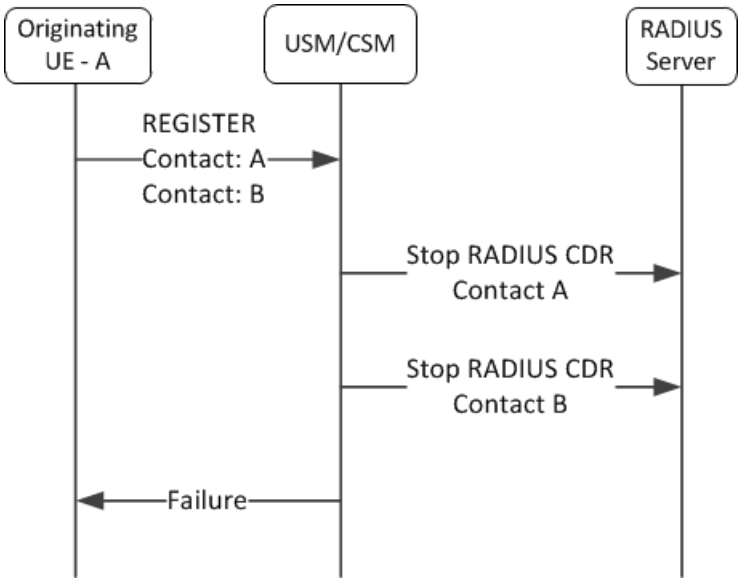
Initial REGISTER

One or more RADIUS Start CDRs are sent to the RADIUS server for each contact in a successful REGISTER message before the Oracle CSM replies to the endpoint with a 200 OK.



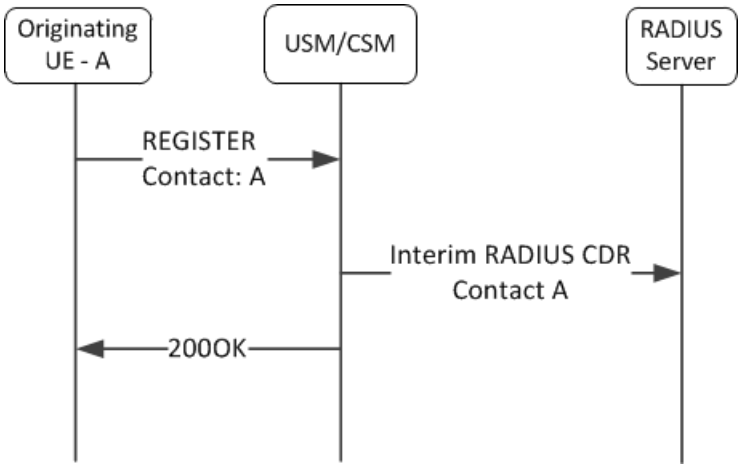
Failed REGISTER

One or more RADIUS Stop CDRs are sent to the RADIUS server for each contact in an unsuccessful REGISTER message before the Oracle CSM replies to the endpoint with a SIP Final Response (4xx or 5xx) message.



REGISTER Refresh

One or more RADIUS Interim CDRs are sent to the RADIUS server for each contact in a successful reREGISTER message before the Oracle CSM replies to the endpoint with a 200 OK. This happens when a database query is made and succeeds.

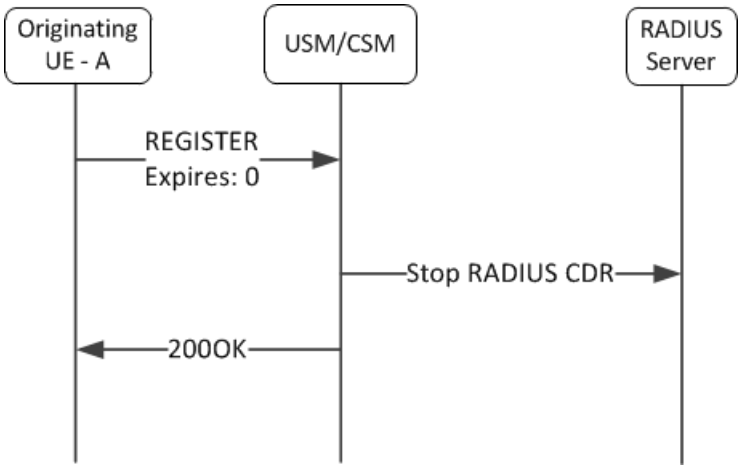


Failed REGISTER Refresh

One or more RADIUS Interim CDRs are sent to the RADIUS server for each contact in an unsuccessful reREGISTER message before the Oracle CSM replies to the endpoint with a SIP Final Response (4xx or 5xx) message.

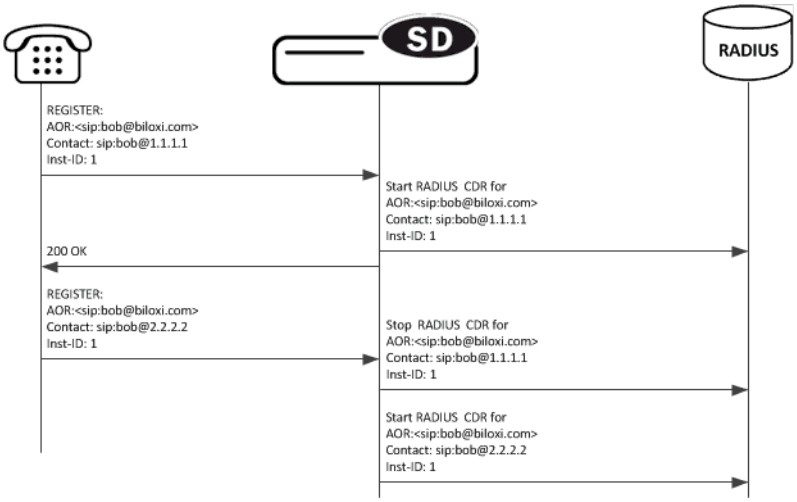
deREGISTER

One or more RADIUS Stop CDRs are sent to the RADIUS server for the contacts in a deREGISTER message before the Oracle CSM replies to the endpoint with a 200 OK. The Oracle CSM interprets an expires=0 parameter in a Contact: header as only removing the registration (and sending a corresponding stop record) for that contact, or an Expires: 0 header prompts Stop RADIUS records for all contacts.



Registration Update

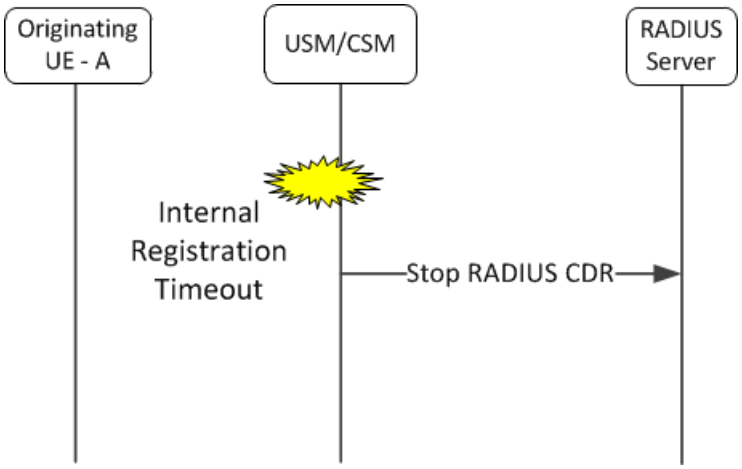
For each Contact's registration update with an existing Instance-ID and AoR, the Oracle CSM sequentially sends a RADIUS Stop CDR for the original contact address and then a RADIUS Start CDR for the new contact address.



Similarly, when the Oracle CSM receives a REGISTER for an existing Contact and AoR but with a different Instance-ID, the registration is updated by the Oracle CSM. The same corresponding stop and start CDRs are sent to the RADIUS server.

Internal Deregistration

When a condition occurring within the Oracle CSM causes a contact's registration to be removed, a RADIUS Stop CDR is sent to the RADIUS server. In such a case, generally no indication is sent to the UA. Examples are if the registration times out, or if the contact is manually removed at the ACLI.



REGISTER VSA Format

The following table lists new VSAs introduced with this feature.

Parameter Name	Dictionary Index	Data Type	Valid Records	Definition
Acme-SIP-Method-Type	235	String	Start, Interim, Stop	This is the SIP method type that is associated to the CDR. Possible values are INVITE, BYE, or REGISTER.
Acme-Domain-Name	236	String	Start, Interim, Stop	This is domain name of the request URI.
Acme-SIP-Contact	237	String	Start, Interim, Stop	This is contact from SIP message. This is not the entire contact header.
Acme-SIP-Expires	238	Integer	Start, Interim	This is the expires value of the Expires: header from the sip message.
Acme-Reason-Phrase	239	String	Interim, Stop	This is the Oracle CSM reason code. This will not be set for all Stop and Interim

The following table lists the new definitions of existing VSAs when CDRs are created on REGISTER messages.

Parameter Name	Dictionary Index	Data Type	Valid Records	Definition
Acme-SIP-Status	71	String	Interim	
Acct-Session-Id	44	String	Start, Interim, Stop	This is the a unique string assigned to the contact. The string is made up of the system name concatenated with a timestamp and an 8 digit hex number. It is of form <system name>-<timestamp>-<number>.
Called-Station-Id		String	Start, Interim, Stop	When in a stop record, this value is populated when an internal reason

Parameter Name	Dictionary Index	Data Type	Valid Records	Definition
				causes the stop record to be generated. in this case it is the AoR.

The following pairs of Acme-Disconnect-Initiator and Acme-Disconnect-Cause VSAs, as presented in a RADIUS stop CDR that corresponds to a REGISTER message are defined in the Reason column.

Reason	Acme-Disconnect-Initiator	Acme-Disconnect-Cause
UA requested deregistration	1 - CALLING_PARTY_DISCONNECT	1-PW_CAUSE_USER_REQUEST
Contact Times Out	3 - INTERNAL_DISCONNECT	4 -PW_CAUSE_IDLE_TIMEOUT
REGISTER error on establishment.	1 - CALLING_PARTY_DISCONNECT	17-PW - CAUSE_USER_ERROR
RTR from HSS specifies user's private ID	3 - INTERNAL_DISCONNECT	20 - PW_CAUSE_RTR_REQUEST_PRIV
RTR from HSS specifies user's public ID	3 - INTERNAL_DISCONNECT	21 - PW_CAUSE_RTR_REQUEST_PUB
Contact's registration is removed via ACLI command	3 - INTERNAL_DISCONNECT	1-PW_CAUSE_USER_REQUEST
Reuse of ID by a different Contact	3 - INTERNAL_DISCONNECT	22-PW_CAUSE_REUSE_ID

CDR Generation Configuration

To add CDR generation on REGISTER messages:

1. In Superuser mode, type configure terminal and press Enter.

   ```
   ORACLE# configure terminal
   ```

2. Type session-router and press Enter.

   ```
   ORACLE(configure)# session-router
   ```

3. Type account-config and press Enter.

   ```
   ORACLE(session-router)# account-config
   ```

   From this point, you can reach the individual parameters for duplicate RADIUS attribute prevention and for RADIUS attribute selection.

4. generate-events—Set this parameter to register and/or local-register.
5. Save and activate your configuration.

Example CDRs

The following examples list when basic registrations create CDRs.

Initial Registration CDR

A Start CDR is created for an initial REGISTER received on the Oracle CSM's 192.168.101.20 interface from 192.168.12.12.

REGISTER message:

```
REGISTER sip:registrar.biloxi.com SIP/2.0
Via: SIP/2.0/UDP bobspc.biloxi.com:5060;branch=z9hG4bKnashds7
Max-Forwards: 70
To: Bob <sip:bob@biloxi.com>
From: Bob <sip:bob@biloxi.com>;tag=456248
Call-ID: 843817637684230@998sdasdh09
User-Agent: Softphone Beta1.5
Authorization: Digest username="Bob", realm=" biloxi.com",
    nonce="84a4cc6f3082121f32b42a2187831a9e",
    response="7587245234b3434cc3412213e5f113a5432"
CSeq: 1826 REGISTER
Contact: <sip:bob@192.168.12.12>
Expires: 7200
Content-Length: 0
```

Start CDR Message, selected attributes:

```
NAS-Identifier = "abc123"
    Acct-Status-Type = Start
    NAS-IP-Address = 172.16.101.20
    NAS-Port = 5060
    Acct-Session-Id = "Iapetus-C00000001"
    Acme-Session-Ingress-CallId = "843817637684230@998sdasdh09"
    Acme-Session-Protocol-Type = "SIP"
    Calling-Station-Id = " Bob <sip:bob@biloxi.com>;tag=456248"
    Called-Station-Id = " Bob <sip:bob@biloxi.com>"
    Acme-Ingress-Network-Interface-Id = "M00"
    Acme-Ingress-Vlan-Tag-Value = 0
    Acme-Session-Ingress-Realm = "net192"
    Acme-Firmware-Version = "SCX6.3.3 F-1 GA (WS Build 18)"
    Acme-Local-Time-Zone = "Time Zone Not Set"
    Acme-Ingress-Local-Addr = "192.168.101.20:5060"
    Acme-Ingress-Remote-Addr = "192.168.12.12:5060"
Acme-SIP-Method-Type = "REGISTER"
Acme-Domain-Name = "registrar.biloxi.com"
Acme-SIP-Contact = "sip:bob@192.168.12.12"
Acme-SIP-Expires = 7200
    Acme-CDR-Sequence-Number = 1
    Client-IP-Address = 172.30.70.121
    Acct-Unique-Session-Id = "51a15d4381d9fe38"
    Timestamp = 1329241213
```

Interim Registration CDR

An interim CDR is created for a REGISTER refresh received on the Oracle CSM's 192.168.101.20 interface from 192.168.12.12.

REGISTER message:

```
REGISTER sip:registrar.biloxi.com SIP/2.0
Via: SIP/2.0/UDP bobspc.biloxi.com:5060;branch=z9hG4bKnashds7
Max-Forwards: 70
To: Bob <sip:bob@biloxi.com>
From: Bob <sip:bob@biloxi.com>;tag=456248
Call-ID: 843817637684230@998sdasdh09
User-Agent: Softphone Beta1.5
Authorization: Digest username="Bob", realm=" biloxi.com",
    nonce="84a4cc6f3082121f32b42a2187831a9e",
    response="7587245234b3434cc3412213e5f113a5432"
CSeq: 1826 REGISTER
Contact: <sip:bob@192.168.12.12>
Expires: 7200
Content-Length: 0
```

Interim CDR Message, selected attributes:

```
NAS-Identifier = "abc123"
    Acct-Status-Type = Interim-Update
    NAS-IP-Address = 172.16.101.20
    NAS-Port = 5060
    Acct-Session-Id = " Iapetus-C00000001"
    Acme-Session-Ingress-CallId = "84381763768423O@998sdasdh09"
    Acme-Session-Protocol-Type = "SIP"
    Calling-Station-Id = " Bob <sip:bob@biloxi.com>;tag=456248"
    Called-Station-Id = " Bob <sip:bob@biloxi.com>"
    Acme-Ingress-Network-Interface-Id = "M00"
    Acme-Ingress-Vlan-Tag-Value = 0
    Acme-Session-Ingress-Realm = "net192"
    Acme-Firmware-Version = "SCX6.3.3 F-1 GA (WS Build 18)"
    Acme-Local-Time-Zone = "Time Zone Not Set"
    Acme-Ingress-Local-Addr = "192.168.101.20:5060"
    Acme-Ingress-Remote-Addr = "192.168.12.12:5060"
Acme-SIP-Method-Type = "REGISTER"
Acme-Domain-Name = "registrar.biloxi.com"
Acme-SIP-Contact = "sip:bob@192.168.12.12"
Acme-SIP-Expires = 7200
Acme-SIP-Status = "200"
Acme-Reason-Phrase = "OK"
    Acme-CDR-Sequence-Number = 1
    Client-IP-Address = 172.30.70.121
    Acct-Unique-Session-Id = "51a15d4381d9fe38"
    Timestamp = 1329241213
```

STOP CDR on REGISTER message

Stop CDRs are generated for REGISTER messages with Expires of 0 from a user agent, a failed initial registration, or Oracle CSM removing the registration. A Stop CDR can take one of two forms:

1. The Stop CDR is generated as part of receiving a response to a REGISTER message.
2. The Stop CDR is generated as part of an internal event such as a Contact timing out.

   REGISTER message:

   The following REGISTER contains an expires of 0 received on interface 192.168.101.20 from 192.168.12.12:

   ```
   REGISTER sip:registrar.biloxi.com SIP/2.0
   Via: SIP/2.0/UDP bobspc.biloxi.com:5060;branch=z9hG4bKnashds7
   Max-Forwards: 70
   To: Bob <sip:bob@biloxi.com>
   From: Bob <sip:bob@biloxi.com>;tag=456248
   Call-ID: 84381763768423O@998sdasdh09
   User-Agent: Softphone Beta1.5
   Authorization: Digest username="Bob", realm=" biloxi.com",
       nonce="84a4cc6f3082121f32b42a2187831a9e",
       response="7587245234b3434cc3412213e5f113a5432"
   CSeq: 1826 REGISTER
   Contact: <sip:bob@192.168.12.12>
   Expires: 0
   Content-Length: 0
   ```

   Stop CDR Message, selected attributes:

   ```
   NAS-Identifier = "abc123"
       Acct-Status-Type = Stop
       NAS-IP-Address = 172.16.101.20
       NAS-Port = 5060
       Acct-Session-Id = " Iapetus-C00000001"
       Acme-Session-Ingress-CallId = "84381763768423O@998sdasdh09"
       Acme-Session-Protocol-Type = "SIP"
       Calling-Station-Id = " Bob <sip:bob@biloxi.com>;tag=456248"
   ```

```
    Called-Station-Id = " Bob <sip:bob@biloxi.com>"
    Acme-Ingress-Network-Interface-Id = "M00"
    Acme-Ingress-Vlan-Tag-Value = 0
    Acme-Session-Ingress-Realm = "net192"
    Acme-Firmware-Version = "SCX6.3.3 F-1 GA (WS Build 18)"
    Acme-Local-Time-Zone = "Time Zone Not Set"
    Acme-Ingress-Local-Addr = "192.168.101.20:5060"
    Acme-Ingress-Remote-Addr = "192.168.12.12:5060"
Acme-Disconnect-Initiator = 1
    Acme-Disconnect-Cause = 1
Acme-SIP-Status = "200"
Acme-SIP-Method-Type = "REGISTER"
Acme-Domain-Name = "registrar.biloxi.com"
Acme-SIP-Contact = "sip:bob@192.168.12.12"
Acme-Reason-Phrase = "OK"
Acme-CDR-Sequence-Number = 1
    Client-IP-Address = 172.30.70.121
    Acct-Unique-Session-Id = "51a15d4381d9fe38"
    Timestamp = 1329241213
```

Oracle CSM Initiated Deregistration

Since no SIP Result code is returned to an endpoint when it was internally deregistered by the Oracle CSM, its corresponding VSA is not created and will not appear in the CDR.

No REGISTER message received.

Stop CDR Message, selected attributes:

```
NAS-Identifier = "abc123"
    Acct-Status-Type = Stop
    NAS-IP-Address = 172.16.101.20
    NAS-Port = 5060
    Acct-Session-Id = " Iapetus-C00000001"
    Called-Station-Id = "sip:bob@biloxi.com"
    Acme-Session-Protocol-Type = "SIP"
Acme-Disconnect-Initiator = 3
    Acme-Disconnect-Cause = 4
Acme-SIP-Method-Type = "REGISTER"
Acme-Domain-Name = "registrar.biloxi.com"
Acme-SIP-Contact = "sip:bob@192.168.12.12"
    Acme-CDR-Sequence-Number = 1
    Client-IP-Address = 172.30.70.121
    Acct-Unique-Session-Id = "51a15d4381d9fe38"
    Timestamp = 1329241213
```

Local CDR CSV Orientation

This section lists the order of VSAs (and other statistics) in local CDR files.

Start Record

CSV Placement	Attribute Name	ACME VSA ID
1	Acct-Status-Type	
2	NAS-IP-Address	
3	NAS-Port	
4	Acct-Session-Id	
5	Acme-Session-Ingress-CallId	3

CSV Placement	Attribute Name	ACME VSA ID
6	Acme-Session--Egress-CallId	4
7	Acme-Session-Protocol-Type	43
8	Acme-Session-Forked-Call-Id	171
9	Acme-Session--Generic-Id	40
10	Calling-Station-Id	
11	Called-Station-Id	
12	h323-setup-time	
13	h323-connect-time	
14	Acme-Egress-Network-Interface-Id	139
15	Acme-Egress-Vlan-Tag-Value	140
16	Acme-Ingress-Network-Interface-Id	137
17	Acme-Ingress-Vlan-Tag-Value	138
18	Acme-Session-Egress-Realm	42
19	Acme-Session-Ingress-Realm	41
20	Acme-FlowId_FS1_F	1
21	Acme-FlowType_FS1_F	2
22	Acme-Flow-In-Realm_FS1_F	10
23	Acme-Flow-In-Src-Addr_FS1_F	11
24	Acme-Flow-In-Src-Port_FS1_F	12
25	Acme-Flow-In-Dst-Addr_FS1_F	13
26	Acme-Flow-In-Dst-Port_FS1_F	14
27	Acme-Flow-Out-Realm_FS1_F	20
28	Acme-Flow-Out-Src-Addr_FS1_F	21
29	Acme-Flow-Out-Src-Port_FS1_F	22
30	Acme-Flow-Out-Dst-Addr_FS1_F	23
31	Acme-Flow-Out-Dst-Port_FS1_F	24
32	Acme-FlowID_FS1_R	78
33	Acme-FlowType_FS1_R	79
34	Acme-Flow-In-Realm_FS1_R	80
35	Acme-Flow-In-Src-Addr_FS1_R	81
36	Acme-Flow-In-Src-Port_FS1_R	82
37	Acme-Flow-In-Dst-Addr_FS1_R	83
38	Acme-Flow-In-Dst-Port_FS1_R	84
39	Acme-Flow-Out-Realm_FS1_R	85

CSV Placement	Attribute Name	ACME VSA ID
40	Acme-Flow-Out-Src-Addr_FS1_R	86
41	Acme-Flow-Out-Src-Port_FS1_R	87
42	Acme-Flow-Out-Dst-Addr_FS1_R	88
43	Acme-Flow-Out-Dst-Port_FS1_R	89
44	Acme-FlowID_FS2_F	90
45	Acme-FlowType_FS2_F	91
46	Acme-Flow-In-Realm_FS2_F	92
47	Acme-Flow-In-Src-Addr_FS2_F	93
48	Acme-Flow-In-Src-Port_FS2_F	94
49	Acme-Flow-In-Dst-Addr_FS2_F	95
50	Acme-Flow-In-Dst-Port_FS2_F	96
51	Acme-Flow-Out-Realm_FS2_F	97
52	Acme-Flow-Out-Src-Addr_FS2_F	98
53	Acme-Flow-Out-Src-Port_FS2_F	99
54	Acme-Flow-Out-Dst-Addr_FS2_F	100
55	Acme-Flow-Out-Dst-Port_FS2_F	101
56	Acme-FlowID_FS2_R	112
57	Acme-FlowType_FS2_R	113
58	Acme-Flow-In-Realm_FS2_R	114
59	Acme-Flow-In-Src-Addr_FS2_R	115
60	Acme-Flow-In-Src-Port_FS2_R	116
61	Acme-Flow-In-Dst-Addr_FS2_R	117
62	Acme-Flow-In-Dst-Port_FS2_R	118
63	Acme-Flow-Out-Realm_FS2_R	119
64	Acme-Flow-Out-Src-Addr_FS2_R	120
65	Acme-Flow-Out-Src-Port_FS2_R	121
66	Acme-Flow-Out-Dst-Addr_FS2_R	122
67	Acme-Flow-Out-Dst-Port_FS2_R	123
68	Acme-Session-Charging-Vector	54
69	Acme-Session-Charging-Function_Address	55
70	Acme-Firmware-Version	56
71	Acme-Local-Time-Zone	57
72	Acme-Post-Dial-Delay	58
73	Acme-Primary-Routing-Number	64

CSV Placement	Attribute Name	ACME VSA ID
74	Acme-Originating-Trunk-Group	65
75	Acme-Terminating-Trunk-Group	66
76	Acme-Originating-Trunk-Context	67
77	Acme-Terminating-Trunk-Context	68
78	Acme-P-Asserted-ID	69
79	Acme-Ingress-Local-Addr	74
80	Acme-Ingress-Remote-Addr	75
81	Acme-Egress-Local-Addr	76
82	Acme-Egress-Remote-Addr	77
83	Acme-SIP-Diversion	70
84	Acme-Egress-Final-Routing-Number	134
85	Acme-Session-Ingress-RPH	135
86	Acme-Session-Egress-RPH	136
87	Acme-Custom-VSA-200	200
88	Acme-Custom-VSA-201	201
89	Acme-Custom-VSA-202	202
90	Acme-Custom-VSA-203	203
91	Acme-Custom-VSA-204	204
92	Acme-Custom-VSA-205	205
93	Acme-Custom-VSA-206	206
94	Acme-Custom-VSA-207	207
95	Acme-Custom-VSA-208	208
96	Acme-Custom-VSA-209	209
97	Acme-Custom-VSA-210	210
98	Acme-Custom-VSA-211	211
99	Acme-Custom-VSA-212	212
100	Acme-Custom-VSA-213	213
101	Acme-Custom-VSA-214	214
102	Acme-Custom-VSA-215	215
103	Acme-Custom-VSA-216	216
104	Acme-Custom-VSA-217	217
105	Acme-Custom-VSA-218	218
106	Acme-Custom-VSA-219	219
107	Acme-Custom-VSA-220	220

CSV Placement	Attribute Name	ACME VSA ID
108	Acme-Custom-VSA-221	221
109	Acme-Custom-VSA-222	222
110	Acme-Custom-VSA-223	223
111	Acme-Custom-VSA-224	224
112	Acme-Custom-VSA-225	225
113	Acme-Custom-VSA-226	226
114	Acme-Custom-VSA-227	227
115	Acme-Custom-VSA-228	228
116	Acme-Custom-VSA-229	229
117	Acme-Custom-VSA-230	230
118	Acme-Flow-Calling-Media-Stop-Time_FS1	231
119	Acme-Flow-Called-Media-Stop-Time_FS1	232
120	Acme-Flow-Calling-Media-Stop-Time_FS2	233
121	Acme-Flow-Called-Media-Stop-Time_FS2	234
122	Acme-FlowMediaType_FS1_F	142
123	Acme-FlowMediaType_FS1_R	143
124	Acme-FlowMediaType_FS2_F	144
125	Acme-FlowMediaType_FS2_R	145
126	Acme-SIP-Method-Type	235
127	Acme-Domain-Name	236
128	Acme-SIP-Contact	237
129	Acme-SIP-Expires	238
130	Acme-CDR-Sequence-Number	59

Interim Record

CSV Placement	Attribute Name	ACME VSA ID
1	Acct-Status-Type	
2	NAS-IP-Address	
3	NAS-Port	
4	Acct-Session-Id	
5	Acme-Session-Ingress-CallId	3
6	Acme-Session--Egress-CallId	4
7	Acme-Session-Protocol-Type	43
9	Acme-Session-Forked-Call-Id	171

CSV Placement	Attribute Name	ACME VSA ID
8	Acme-Session--Generic-Id	40
10	Calling-Station-Id	
11	Called-Station-Id	
12	h323-setup-time	
13	h323-connect-time	
14	Acme-Egress-Network-Interface-Id	139
15	Acme-Egress-Vlan-Tag-Value	140
16	Acme-Ingress-Network-Interface-Id	137
17	Acme-Ingress-Vlan-Tag-Value	138
18	Acme-Session-Egress-Realm	42
19	Acme-Session-Ingress-Realm	41
20	Acme-FlowId_FS1_F	1
21	Acme-FlowType_FS1_F	2
22	Acme-Flow-In-Realm_FS1_F	10
23	Acme-Flow-In-Src-Addr_FS1_F	11
24	Acme-Flow-In-Src-Port_FS1_F	12
25	Acme-Flow-In-Dst-Addr_FS1_F	13
26	Acme-Flow-In-Dst-Port_FS1_F	14
27	Acme-Flow-Out-Realm_FS1_F	20
28	Acme-Flow-Out-Src-Addr_FS1_F	21
29	Acme-Flow-Out-Src-Port_FS1_F	22
30	Acme-Flow-Out-Dst-Addr_FS1_F	23
31	Acme-Flow-Out-Dst-Port_FS1_F	24
32	Acme-Calling-RTCP-Packets-Lost_FS1	32
33	Acme-Calling-RTCP-Avg-Jitter_FS1	33
34	Acme-Calling-RTCP-Avg-Latency_FS1	34
35	Acme-Calling-RTCP-MaxJitter_FS1	35
36	Acme-Calling-RTCP-MaxLatency_FS1	36
37	Acme-Calling-RTP-Packets-Lost_FS1	37
38	Acme-Calling-RTP-Avg-Jitter_FS1	38
39	Acme-Calling-RTP-MaxJitter_FS1	39
40	Acme-Calling-Octets_FS1	28
41	Acme-Calling-Packets_FS1	29
42	Acme-Calling-R-Factor	151

CSV Placement	Attribute Name	ACME VSA ID
43	Acme-Calling-MOS	152
44	Acme-FlowID_FS1_R	78
45	Acme-FlowType_FS1_R	79
46	Acme-Flow-In-Realm_FS1_R	80
47	Acme-Flow-In-Src-Addr_FS1_R	81
48	Acme-Flow-In-Src-Port_FS1_R	82
49	Acme-Flow-In-Dst-Addr_FS1_R	83
50	Acme-Flow-In-Dst-Port_FS1_R	84
51	Acme-Flow-Out-Realm_FS1_R	85
52	Acme-Flow-Out-Src-Addr_FS1_R	86
53	Acme-Flow-Out-Src-Port_FS1_R	87
54	Acme-Flow-Out-Dst-Addr_FS1_R	88
55	Acme-Flow-Out-Dst-Port_FS1_R	89
56	Acme-Called-RTCP-Packets-Lost_FS1	46
57	Acme-Called-RTCP-Avg-Jitter_FS1	47
58	Acme-Called-RTCP-Avg-Latency_FS1	48
59	Acme-Called-RTCP-MaxJitter_FS1	49
60	Acme-Called-RTCP-MaxLatency_FS1	50
61	Acme-Called-RTP-Packets-Lost_FS1	51
62	Acme-Called-RTP-Avg-Jitter_FS1	52
63	Acme-Called-RTP-MaxJitter_FS1	53
64	Acme-Called-Octets_FS1	44
65	Acme-Called-Packets_FS1	45
66	Acme-Called-R-Factor	153
67	Acme-Called-MOS	154
68	Acme-FlowID_FS2_F	90
69	Acme-FlowType_FS2_F	91
70	Acme-Flow-In-Realm_FS2_F	92
71	Acme-Flow-In-Src-Addr_FS2_F	93
72	Acme-Flow-In-Src-Port_FS2_F	94
73	Acme-Flow-In-Dst-Addr_FS2_F	95
74	Acme-Flow-In-Dst-Port_FS2_F	96
75	Acme-Flow-Out-Realm_FS2_F	97
76	Acme-Flow-Out-Src-Addr_FS2_F	98

CSV Placement	Attribute Name	ACME VSA ID
77	Acme-Flow-Out-Src-Port_FS2_F	99
78	Acme-Flow-Out-Dst-Addr_FS2_F	100
79	Acme-Flow-Out-Dst-Port_FS2_F	101
80	Acme-Calling-RTCP-Packets-Lost_FS2	104
81	Acme-Calling-RTCP-Avg-Jitter_FS2	105
82	Acme-Calling-RTCP-Avg-Latency_FS2	106
83	Acme-Calling-RTCP-MaxJitter_FS2	107
84	Acme-Calling-RTCP-MaxLatency_FS2	108
85	Acme-Calling-RTP-Packets-Lost_FS2	109
86	Acme-Calling-RTP-Avg-Jitter_FS2	110
87	Acme-Calling-RTP-MaxJitter_FS2	111
88	Acme-Calling-Octets_FS2	102
89	Acme-Calling-Packets_FS2	103
90	Acme-FlowID_FS2_R	112
91	Acme-FlowType_FS2_R	113
92	Acme-Flow-In-Realm_FS2_R	114
93	Acme-Flow-In-Src-Addr_FS2_R	115
94	Acme-Flow-In-Src-Port_FS2_R	116
95	Acme-Flow-In-Dst-Addr_FS2_R	117
96	Acme-Flow-In-Dst-Port_FS2_R	118
97	Acme-Flow-Out-Realm_FS2_R	119
98	Acme-Flow-Out-Src-Addr_FS2_R	120
99	Acme-Flow-Out-Src-Port_FS2_R	121
100	Acme-Flow-Out-Dst-Addr_FS2_R	122
101	Acme-Flow-Out-Dst-Port_FS2_R	123
102	Acme-Called-RTCP-Packets-Lost_FS2	126
103	Acme-Called--RTCP-Avg-Jitter_FS2	127
104	Acme-Called--RTCP-Avg-Latency_FS2	128
105	Acme-Called--RTCP-MaxJitter_FS2	129
106	Acme-Called-RTCP-MaxLatency_FS2	130
107	Acme-Called-RTP-Packets-Lost_FS2	131
108	Acme-Called-RTP-Avg-Jitter_FS2	132
109	Acme-Called-RTP-MaxJitter_FS2	133
110	Acme-Called-Octets_FS2	124

CSV Placement	Attribute Name	ACME VSA ID
111	Acme-Called-Packets_FS2	125
112	Acme-Session-Charging-Vector	54
113	Acme-Session-Charging-Function_Address	55
114	Acme-Firmware-Version	56
115	Acme-Local-Time-Zone	57
116	Acme-Post-Dial-Delay	58
117	Acme-Primary-Routing-Number	64
118	Acme-Originating-Trunk-Group	65
119	Acme-Terminating-Trunk-Group	66
120	Acme-Originating-Trunk-Context	67
121	Acme-Terminating-Trunk-Context	68
122	Acme-P-Asserted-ID	69
123	Acme-Ingress-Local-Addr	74
124	Acme-Ingress-Remote-Addr	75
125	Acme-Egress-Local-Addr	76
126	Acme-Egress-Remote-Addr	77
127	Acme-SIP-Diversion	70
128	Acme-Intermediate_Time	63
129	Acct-Session-Time	
130	Acme-Egress-Final-Routing-Number	134
131	Acme-Session-Ingress-RPH	135
132	Acme-Session-Egress-RPH	136
133	Acme-Custom-VSA-200	200
134	Acme-Custom-VSA-201	201
135	Acme-Custom-VSA-202	202
136	Acme-Custom-VSA-203	203
137	Acme-Custom-VSA-204	204
138	Acme-Custom-VSA-205	205
139	Acme-Custom-VSA-206	206
140	Acme-Custom-VSA-207	207
141	Acme-Custom-VSA-208	208
142	Acme-Custom-VSA-209	209
143	Acme-Custom-VSA-210	210
144	Acme-Custom-VSA-211	211

CSV Placement	Attribute Name	ACME VSA ID
145	Acme-Custom-VSA-212	212
146	Acme-Custom-VSA-213	213
147	Acme-Custom-VSA-214	214
148	Acme-Custom-VSA-215	215
149	Acme-Custom-VSA-216	216
150	Acme-Custom-VSA-217	217
151	Acme-Custom-VSA-218	218
152	Acme-Custom-VSA-219	219
153	Acme-Custom-VSA-220	220
154	Acme-Custom-VSA-221	221
155	Acme-Custom-VSA-222	222
156	Acme-Custom-VSA-223	223
157	Acme-Custom-VSA-224	224
158	Acme-Custom-VSA-225	225
159	Acme-Custom-VSA-226	226
160	Acme-Custom-VSA-227	227
161	Acme-Custom-VSA-228	228
162	Acme-Custom-VSA-229	229
163	Acme-Custom-VSA-230	230
164	Acme-Flow-Calling-Media-Stop-Time_FS1	231
165	Acme-Flow-Called-Media-Stop-Time_FS1	232
166	Acme-Flow-Calling-Media-Stop-Time_FS2	233
167	Acme-Flow-Called-Media-Stop-Time_FS2	234
168	Acme-FlowMediaType_FS1_F	142
169	Acme-FlowMediaType_FS1_R	143
170	Acme-FlowMediaType_FS2_F	144
171	Acme-FlowMediaType_FS2_R	145
172	Acme-SIP-Method-Type	235
173	Acme-Domain-Name	236
174	Acme-SIP-Contact	237
175	Acme-SIP-Expires	238
176	Acme-SIP-Status	71
177	Acme-Reason-Phrase	239
178	Acme-CDR-Sequence-Number	59

Stop Record

CSV Placement	Attribute Name	ACME VSA ID
1	Acct-Status-Type	
2	NAS-IP-Address	
3	NAS-Port	
4	Acct-Session-Id	
5	Acme-Session-Ingress-CallId	3
6	Acme-Session--Egress-CallId	4
7	Acme-Session-Protocol-Type	43
8	Acme-Session-Forked-Call-Id	171
9	Acme-Session--Generic-Id	40
10	Calling-Station-Id	
11	Called-Station-Id	
12	Acct-Terminate-Cause	
13	Acct-Session-Time	
14	h323-setup-time	
15	h323-connect-time	
16	h323-disconnect-time	
17	h323-disconnect-cause	
18	Acme-Egress-Network-Interface-Id	139
19	Acme-Egress-Vlan-Tag-Value	140
20	Acme-Ingress-Network-Interface-Id	137
21	Acme-Ingress-Vlan-Tag-Value	138
22	Acme-Session-Egress-Realm	42
23	Acme-Session-Ingress-Realm	41
24	Acme-FlowId_FS1_F	1
25	Acme-FlowType_FS1_F	2
26	Acme-Flow-In-Realm_FS1_F	10
27	Acme-Flow-In-Src-Addr_FS1_F	11
28	Acme-Flow-In-Src-Port_FS1_F	12
29	Acme-Flow-In-Dst-Addr_FS1_F	13
30	Acme-Flow-In-Dst-Port_FS1_F	14
31	Acme-Flow-Out-Realm_FS1_F	20
32	Acme-Flow-Out-Src-Addr_FS1_F	21
33	Acme-Flow-Out-Src-Port_FS1_F	22

CSV Placement	Attribute Name	ACME VSA ID
34	Acme-Flow-Out-Dst-Addr_FS1_F	23
35	Acme-Flow-Out-Dst-Port_FS1_F	24
36	Acme-Calling-RTCP-Packets-Lost_FS1	32
37	Acme-Calling-RTCP-Avg-Jitter_FS1	33
38	Acme-Calling-RTCP-Avg-Latency_FS1	34
39	Acme-Calling-RTCP-MaxJitter_FS1	35
40	Acme-Calling-RTCP-MaxLatency_FS1	36
41	Acme-Calling-RTP-Packets-Lost_FS1	37
42	Acme-Calling-RTP-Avg-Jitter_FS1	38
43	Acme-Calling-RTP-MaxJitter_FS1	39
44	Acme-Calling-Octets_FS1	28
45	Acme-Calling-Packets_FS1	29
46	Acme-Calling-R-Factor	151
47	Acme-Calling-MOS	152
48	Acme-FlowID_FS1_R	78
49	Acme-FlowType_FS1_R	79
50	Acme-Flow-In-Realm_FS1_R	80
51	Acme-Flow-In-Src-Addr_FS1_R	81
52	Acme-Flow-In-Src-Port_FS1_R	82
53	Acme-Flow-In-Dst-Addr_FS1_R	83
54	Acme-Flow-In-Dst-Port_FS1_R	84
55	Acme-Flow-Out-Realm_FS1_R	85
56	Acme-Flow-Out-Src-Addr_FS1_R	86
57	Acme-Flow-Out-Src-Port_FS1_R	87
58	Acme-Flow-Out-Dst-Addr_FS1_R	88
59	Acme-Flow-Out-Dst-Port_FS1_R	89
60	Acme-Called-RTCP-Packets-Lost_FS1	46
61	Acme-Called-RTCP-Avg-Jitter_FS1	47
62	Acme-Called-RTCP-Avg-Latency_FS1	48
63	Acme-Called-RTCP-MaxJitter_FS1	49
64	Acme-Called-RTCP-MaxLatency_FS1	50
65	Acme-Called-RTP-Packets-Lost_FS1	51
66	Acme-Called-RTP-Avg-Jitter_FS1	52
67	Acme-Called-RTP-MaxJitter_FS1	53

CSV Placement	Attribute Name	ACME VSA ID
68	Acme-Called-Octets_FS1	44
69	Acme-Called-Packets_FS1	45
70	Acme-Called-R-Factor	153
71	Acme-Called-MOS	154
72	Acme-FlowID_FS2_F	90
73	Acme-FlowType_FS2_F	91
74	Acme-Flow-In-Realm_FS2_F	92
75	Acme-Flow-In-Src-Addr_FS2_F	93
76	Acme-Flow-In-Src-Port_FS2_F	94
77	Acme-Flow-In-Dst-Addr_FS2_F	95
78	Acme-Flow-In-Dst-Port_FS2_F	96
79	Acme-Flow-Out-Realm_FS2_F	97
80	Acme-Flow-Out-Src-Addr_FS2_F	98
81	Acme-Flow-Out-Src-Port_FS2_F	99
82	Acme-Flow-Out-Dst-Addr_FS2_F	100
83	Acme-Flow-Out-Dst-Port_FS2_F	101
84	Acme-Calling-RTCP-Packets-Lost_FS2	104
85	Acme-Calling-RTCP-Avg-Jitter_FS2	105
86	Acme-Calling-RTCP-Avg-Latency_FS2	106
87	Acme-Calling-RTCP-MaxJitter_FS2	107
88	Acme-Calling-RTCP-MaxLatency_FS2	108
89	Acme-Calling-RTP-Packets-Lost_FS2	109
90	Acme-Calling-RTP-Avg-Jitter_FS2	110
91	Acme-Calling-RTP-MaxJitter_FS2	111
92	Acme-Calling-Octets_FS2	102
93	Acme-Calling-Packets_FS2	103
94	Acme-FlowID_FS2_R	112
95	Acme-FlowType_FS2_R	113
96	Acme-Flow-In-Realm_FS2_R	114
97	Acme-Flow-In-Src-Addr_FS2_R	115
98	Acme-Flow-In-Src-Port_FS2_R	116
99	Acme-Flow-In-Dst-Addr_FS2_R	117
100	Acme-Flow-In-Dst-Port_FS2_R	118
101	Acme-Flow-Out-Realm_FS2_R	119

CSV Placement	Attribute Name	ACME VSA ID
102	Acme-Flow-Out-Src-Addr_FS2_R	120
103	Acme-Flow-Out-Src-Port_FS2_R	121
104	Acme-Flow-Out-Dst-Addr_FS2_R	122
105	Acme-Flow-Out-Dst-Port_FS2_R	123
106	Acme-Called-RTCP-Packets-Lost_FS2	126
107	Acme-Called--RTCP-Avg-Jitter_FS2	127
108	Acme-Called--RTCP-Avg-Latency_FS2	128
109	Acme-Called--RTCP-MaxJitter_FS2	129
110	Acme-Called-RTCP-MaxLatency_FS2	130
111	Acme-Called-RTP-Packets-Lost_FS2	131
112	Acme-Called-RTP-Avg-Jitter_FS2	132
113	Acme-Called-RTP-MaxJitter_FS2	133
114	Acme-Called-Octets_FS2	124
115	Acme-Called-Packets_FS2	125
116	Acme-Session-Charging-Vector	54
117	Acme-Session-Charging-Function-Address	55
118	Acme-Firmware-Version	56
119	Acme-Local-Time-Zone	57
120	Acme-Post-Dial-Delay	58
121	Acme-Primary-Routing-Number	64
122	Acme-Originating-Trunk-Group	65
123	Acme-Terminating-Trunk-Group	66
124	Acme-Originating-Trunk-Context	67
125	Acme-Terminating-Trunk-Context	68
126	Acme-P-Asserted-ID	69
127	Acme-Ingress-Local-Addr	74
128	Acme-Ingress-Remote-Addr	75
129	Acme-Egress-Local-Addr	76
130	Acme-Egress-Remote-Addr	77
131	Acme-SIP-Diversion	70
132	Acme-Session-Disposition	60
133	Acme-Disconnect-Initiator	61
134	Acme-Disconnect-Cause	62
135	Acme-SIP-Status	71

CSV Placement	Attribute Name	ACME VSA ID
136	Acme-Egress-Final-Routing-Number	134
137	Acme-Session-Ingress-RPH	135
138	Acme-Session-Egress-RPH	136
139	Acme-Refer-Call-Transfer-Id	141
140	Acme-Custom-VSA-200	200
141	Acme-Custom-VSA-201	201
142	Acme-Custom-VSA-202	202
143	Acme-Custom-VSA-203	203
144	Acme-Custom-VSA-204	204
145	Acme-Custom-VSA-205	205
146	Acme-Custom-VSA-206	206
147	Acme-Custom-VSA-207	207
148	Acme-Custom-VSA-208	208
149	Acme-Custom-VSA-209	209
150	Acme-Custom-VSA-210	210
151	Acme-Custom-VSA-211	211
152	Acme-Custom-VSA-212	212
153	Acme-Custom-VSA-213	213
154	Acme-Custom-VSA-214	214
155	Acme-Custom-VSA-215	215
156	Acme-Custom-VSA-216	216
157	Acme-Custom-VSA-217	217
158	Acme-Custom-VSA-218	218
159	Acme-Custom-VSA-219	219
160	Acme-Custom-VSA-220	220
161	Acme-Custom-VSA-221	221
162	Acme-Custom-VSA-222	222
163	Acme-Custom-VSA-223	223
164	Acme-Custom-VSA-224	224
165	Acme-Custom-VSA-225	225
166	Acme-Custom-VSA-226	226
167	Acme-Custom-VSA-227	227
168	Acme-Custom-VSA-228	228
169	Acme-Custom-VSA-229	229

CSV Placement	Attribute Name	ACME VSA ID
170	Acme-Custom-VSA-230	230
171	Acme-Flow-Calling-Media-Stop-Time_FS1	231
172	Acme-Flow-Called-Media-Stop-Time_FS1	232
173	Acme-Flow-Calling-Media-Stop-Time_FS2	233
174	Acme-Flow-Called-Media-Stop-Time_FS2	234
175	Acme-FlowMediaType_FS1_F	142
176	Acme-FlowMediaType_FS1_R	143
177	Acme-FlowMediaType_FS2_F	144
178	Acme-FlowMediaType_FS2_R	145
179	Acme-SIP-Method-Type	235
180	Acme-Domain-Name	236
181	Acme-SIP-Contact	237
182	Acme-Reason-Phrase	239
183	Acme-CDR-Sequence-Number	59

6

References and Debugging

ACLI Configuration Elements

The following sections describe the Oracle CSM's unique configuration elements.

sip-registrar

Parameters

name—Configured name of this sip registrar.

- Default: empty

state—Running status of this policy-director-group.

- Default: enabled
- Values: enabled | disabled

domains—List of registration domains that this Oracle CSM is responsible for. * means all domains. These domains are compared for an exact match with the domain in the request-uri of the REGISTER message. the wildcard '*' can also be entered as part of this parameter. This is entered as the domains separated by a space in quotes. No quotes required if only one domain is being configured. "+" and "-"are used to add to subtract from the list.

- Default: empty

subscriber-database-method—Protocol used to connect to User Subscriber Database server.

- Default: CX
- Values: CX | DDNS | local

subscriber-database-config—The configuration element that defines the server used for retrieving user subscriber data. For Cx deployments it is a home-subscriber-server name. For ENUM deployments it is an enum-config name.

- Default: empty

authentication-profile—Name of the sip-authentication-profile configuration used to retrieve authentication data when an endpoint is not authenticated.

- Default: empty

home-server-route—The value inserted into the Server Name AVP in an MAR message. This should be entered as a SIP URI as per 3gpp TS 24229 & RFC 3261. The host can be FQDN or IPv4 address, and the port portion should be in the 1025 - 65535 range. Examples: SIP:12.12.12.12:5060

- Default: empty

third-party-registrars—The third-party-regs configuration element names where third party REGISTER messages will be forwarded to.

- Default: empty

routing-precedence—Indicates whether INVITE routing lookup should use the user database (via the registrar configuration element) or perform local policy lookup immediately.

- Default: registrar
- Values: registrar | local-policy

egress-realm-id—Indicates the default egress/core realm for SIP messaging.

- Default: empty

location-update-interval—Sets the maximum period in minutes in which the core-side user subscriber database is refreshed, per user.

- Default: 1440
- Values: 0-999999999

ifc-profile—References the ifc-profile configuration element's name that is applied to this sip-registrar.

max-contacts-per-aor—Limit to the number of contacts allowed for a given AOR.

- Default: 0 (disabled)
- Values: 1 - 256

Path

This sip-registrar configuration element is a element in the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **sip-registrar**.

sip-authentication-profile

Parameters

name—Configured name of this sip-authentication profile.

methods—List of SIP methods that prompt authentication. This is entered as the methods separated by a space in quotes. No quotes required if only one method is being configured. "+" and "-"are used to add to subtract from the list.

- Default: empty

anonymous-methods—List of SIP methods that prompt authentication when received from anonymous sources. This is entered as the methods separated by a space in quotes. No quotes required if only one method is being configured. "+" and "-" are used to add or subtract from the list.

- Default: empty

digest-realm—The value inserted into the digest-realm parameter in an authentication challenge header as sent to UA. (not used for Cx deployments)

- Default: empty

credential-retrieval-method—Protocol used to connect to the server providing authentication data.

- Default: ENUM-TXT

- Values: ENUM-TXT | CX

credential-retrieval-config—The home-subscriber-server name used for retrieving authentication data.

- Default: empty

Path

This sip-authentication-profile configuration element is a element in the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **sip-authentication-profile**.

home-subscriber-server

Parameters

name—Configured name of this home subscriber server.

- Default: empty

state—Running status of this home subscriber server.

- Default: enabled
- Values: enabled | disabled

transport— The layer 4 protocol used to communicate with this home subscriber server.

- Default: tcp
- Values: tcp | sctp

address—This home subscriber server's IP address.

- Default: none
- Values: IP address in IPv4 or IPv6 format

port—This home subscriber server's port.

- Default: 80
- Values: 1-65535

realm—Oracle CSM realm-config name where this home subscriber server exists.

- Default: none

multi-homed-addrs— Specifies one or more local secondary addresses of the SCTP endpoint. This setting is only applicable to SCTP transport. To enter multiple addresses, bracket an address list with parentheses. At least one address is required if transport is set to SCTP.

Multi-homed addresses must be of the same type (IPv4 or IPv6) as that specified by the address parameter. Like the address parameter, these addresses identify SD physical interfaces.

origin-host-identifier—Used to create segment before the dot in the Origin Host AVP.

- Default: none

origin-realm—Populates the value of the Origin Realm AVP. Populates the segment after the dot in the Origin Host AVP.

- Default: none

destination-host-identifier—Used to create segment before the dot in the Destination Host AVP.

- Default: none

watchdog-ka-timer— The interval in seconds of the watchdog/keep-alive messages.

- Default: 0

- Values: 0-65535

num-auth-vector— The number of authentication vectors downloaded from the HSS per MAR.

- Default: 3
- Values: 1-10

Path

This home-subscriber-server configuration element is a element in the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **home-subscriber-server**.

third-party-regs

Parameters

state—Running status of this third party registration configuration element.

- Default: enabled
- Values: enabled | disabled

name—Configured name of this third party registration configuration element.

- Default: none

registrar-host—hostname of the configured session agent that will be third party server. This value is also used in the request-uri that is sent to the third party server.

- Default: none

from-user—The user part of the From URI in the REGISTER Request that is sent to the third party server in the REGISTER message. When this parameter is blank the user part of the From header from the incoming REGISTER Request will be used.

- Default: none

from-host—The host part of the From URI in the REGISTER Request that is sent the third party server in the REGISTER message. When this parameter is blank the Oracle CSM uses the egress hostname/ IP address as the host.

- Default: none
- Values: Format this the same as the "registrar-host" in sip-config.

retry-interval—number of seconds the Oracle CSM waits before retrying a 3rd Party Registration server after a failed registration.

- Default: 32
- Values: 0 - 3600

Path

This third-party-regs configuration element is a element in the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **third-party-regs**.

local-subscriber-table

Parameters

name—A given name for this local subscriber table element. This name is referenced from the sip-registrar configuration element when the credential-retrieval-method is set to local.

filename—The filename of local subscriber table that this element references. If no path is provided, the default location is /code/lst.

secret—PSK used for encrypted passwords. This value is not echoed back to the screen upon viewing the configuration element.

Path

The location of this configuration element is: configure terminatl > session-router > local-subscriber-table.

enum-config

Parameters

name—Name for this enum-config to be referenced from within the system.

top-level-domain—The domain extension used to query the ENUM servers for this configuration.

realm-id—The realm-id is used to determine on which network interface to issue an ENUM query.

enum-servers—List of IP address that service the top level domain.

service-type—The ENUM service types you want supported in this ENUM configuration. Possible entries are E2U +sip and sip+E2U (the default), and the types outlines in RFCs 2916 and 3721.

- Default: E2U+sip,sip+E2U

query-method—the ENUM query distribution strategy

- Default: hunt
- Values: hunt | round-robin

timeout—The total time, in seconds, that should elapse before a query sent to a server (and its retransmissions) will timeout.

- Default: 11

cacheInactivityTimer—Enter the time interval, in seconds, after which you want cache entries created by ENUM requests deleted, if inactive for this interval.

- Default: 3600
- Values: 0-999999999

max-response-size—The maximum size in bytes for UDP datagram responses

- Defaults: 512

health-query-number—The phone number for the ENUM server health query; when this parameter is blank the feature is disabled.

health-query-interval—The interval in seconds at which you want to query ENUM server health.

- Default: 0
- Values: 0-65535

failover-to—Name of the enum-config to which you want to failover.

cache-addl-records—Set this parameter to enabled to add additional records received in an ENUM query to the local DNS cache.

- Default: enabled
- Values: enabled | disabled

include-source-info—Set this parameter to enabled to send source URI information to the ENUM server with any ENUM queries.

- Default: disabled
- Values: enabled | disabled

ttl—This value ets the TTL value (in seconds) for NAPTR entries in the local ENUM cache and populates when sending a NAPTR entry to the ENUM server.

- Default: 0
- Values: 1-2592000

order—This parameter value populates the order field with when sending NAPTR entries to the ENUM server.

- Default: 1
- Values: 0-65535

preference—This parameter value populates the preference field with when sending NAPTR entries to the ENUM server.

- Default: 1
- Values: 0-65535

Path

This enum-config configuration element is a element in the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **enum-config**.

ifc-profile

Parameters

name—A given name for this ifc profile element. This name is referenced from the sip-registrar configuration element's ifc-support parameter.

state—Running status of this ifc-profile.

- Default: enabled
- Values: enabled | disabled

shared-ifc-filename—The name of the file referenced for shared iFC function.

default-ifc-filename—The name of the file referenced for default iFC function. This file may be the same as that used for the shared iFC function.

Path

The location of this configuration element is: **configure terminal** > **session-router** > **ifc-profile**.

regevent-notification-profile

Parameters

name—A given name for this registration event notification profile element. This name is referenced from the sip-registrar configuration element.

min-subscription-duration—The amount of time, in seconds, before the subscription expires, unless it is refreshed.

- Default: 3761 seconds
- Values: 180-6000005 seconds

Path

The location of this configuration element is: **configure terminal** > **session-router** > **regevent-notification-profile**.

hss-group

Parameters

name—Enter the name of the hss-group element. This required entry must follow the Name Format, and it must be unique.

state—Enable or disable the hss-group element.

- Default: enabled
- Values: enabled | disabled

origin-host-identifier—Set this to a string for use in constructing a unique Origin Host AVP.

strategy—Select the HSS allocation options for the hss-group. Strategies determine how HSSs will be chosen by this hss-group element.

- Default: hunt
- Values:
  - hunt—Selects HSSs in the order in which they are listed. For example, if the first server is online, all traffic is sent to the first server. If the first server is offline, the second server is selected. If the first and second servers are offline, the third server is selected. When the Oracle CSM detects that a higher priority HSS is back in service, it routes all subsequent traffic to that HSS.
  - roundrobin—Selects each HSS in the order in which they are listed in the dest list, selecting each HSS in turn, one per session. After all HSSs have been used, the first HSS is used again and the cycle continues.
  - failover—Selects the first sever in the list until failure is detected. Subsequent signaling goes to the next server in the list.

hss-configs—Identify the home-subscriber-servers available for use by this hss-group. This list can contain as many home subscriber servers as is necessary. An hss-config list value must correspond to a valid hss-group name in another group or to a valid hostname of a configured home-subscriber-server.

A value you enter here must correspond to a valid group name for a configured home-subscriber-server or a valid hostname or IP address for a configured home-subscriber-server.

hss-group is an element under the session-router path. The full path from the topmost ACLI prompt is: **configure terminal** > **session-router** > **session-group**.

SNMP MIBs and Traps

The following MIBs and traps are supported for the Oracle CSM. Please consult the Net-Net 4000 S-CX6.3.0 MIB Reference Guide for more SNMP information.

Acme Packet License MIB (ap-license.mib)

The following table describes the SNMP GET query names for the Oracle License MIB (ap-license.mib).

SNMP GET Query Name	Object Identifier Name: Number	Description
Object Identifier Name: apLicenseEntry (1.3.6.1.4.1.9148.3.5.1.1.1)		

SNMP GET Query Name	Object Identifier Name: Number	Description
apLicenseAuthFeature	apLicenseEntry: 1.3.6.1.4.1.9148.3.5.1.1.1.20	If authorization and authentication is allowed for the Oracle CSM, the value is true. If disabled, the value is false.
apLicenseDatabaseRegFeature	apLicenseEntry: 1.3.6.1.4.1.9148.3.5.1.1.1.21	If the Oracle CSM is configured as a registrar, the value is true. If registrar functionality is not enabled, this value is false.
apLicenseDatabaseRegCap	apLicenseEntry: 1.3.6.1.4.1.9148.3.5.1.1.1.22	The database registration contact capacity.

Acme Packet System Management MIB (ap-smgmt.mib)

The following table describes the SNMP GET query names for the Oracle System Management MIB (ap-smgmt.mib).

SNMP GET Query Name	Object Identifier Name: Number	Description
Object Identifier Name: apSysMgmtMIBObjects (1.3.6.1.4.1.9148.3.2.1)		
Object Identifier Name: apSysMgmtGeneralObjects (1.3.6.1.4.1.9148.3.2.1.1)		
apSysSipStatsActiveDatabaseContacts	apSysMgmtGeneralObjects: 1.3.6.1.4.1.9148.3.2.1.1.24.0	Number of database-type contacts in the registration cache.

Enterprise Traps

The following table identifies the proprietary traps that Oracle CSM system supports.

Trap Name: OID	Description
apSysMgmtDatabaseRegCacheCapTrap: 1.3.6.1.4.1.9148.3.2.6.0.76	Generated when the number of database-type contacts stored in the registration cache exceeds the license threshold.
apSysMgmtDatabaseRegCacheCapClearTrap: 1.3.6.1.4.1.9148.3.2.6.0.77	Trap is generated when the number of database-type contacts stored in the registration cache falls below the license threshold.

Oracle USM Show Commands

show sipd endpoint-ip

The show sipd endpoint-ip <user | IP address> command displays information about each endpoint. For a supplied AoR, the Oracle CSM displays all associated contacts (both access and core side), the expiration of each contact entry and associated 3rd Party Registration information. For example:

```
ORACLE# show sipd endpoint-ip 11111
User <sip:111111@172.16.17.100>
  Contact exp=1198
    UA-Contact: <sip:111111@172.16.17.100:5060> UDP keep-acl
         realm=net172 local=172.16.101.13:5060 UA=172.16.17.100:5060
    SD-Contact: <sip:111111-s37q249kvluaa@192.168.101.13:5060> realm=net192
    Call-ID: 1-15822@172.16.17.100'
```

```
Third Party Registration:
   Third Party Reg User=<sip:111111@172.16.17.100> state: REGISTERED
   Expire Secs=298 seqNum= 1 refreshInterval=300
   Call-ID: d355a67277d9158e7901e46a12719663@192.168.101.13
   Third Party Reg User=<sip:111111@172.16.17.100> state: REGISTERED
   Expire Secs=178 seqNum= 1 refreshInterval=180
   Call-ID: 07ebbdebfdf64a48985bb82fa8b4c595@192.168.101.13
```

show sipd third-party

The show sipd third-party command displays the current status of third party servers and statistics for messages. The format is:

```
show sipd third-party <all | name>
```

The name argument allows status to be displayed for just the server specified by the name. Not specifying a name results in status being displayed for all third party servers. For example:

```
ORACLE# show sipd third-party-reg all
3rd Party Registrar   SA State  Requests  200OK  Timeouts    Errors
192.168.17.101            INSV         9      9         0         0
192.168.17.102            INSV        14     14         0         0
```

Column definitions are as follows:

- IP Address —IP Address of third party server
- Status —Session Agent State
- Requests —Register requests sent
- 200 OK —200 OK Responses received
- Timeouts —Requests timed out
- Error —Error Responses

show sipd local-subscription

The ACLI show sipd command includes an argument that provides information about local subscriptions, as shown below.

```
ORACLE# show sipd local-subscription
19:22:18-152
SIP Local Subscription Status  -- Period -- ----- Lifetime -------
                      Active  High   Total Total  PerMax    High
Server Subscription        0     1       1     1       1       1
Message Statistics
SUBSCRIBE
                    --------- Server --------   --------- Client --------
Message/Event       Recent      Total  PerMax   Recent      Total  PerMax
                    ------  ---------  ------   ------  ---------  ------
SUBSCRIBE Requests       2          2       2        0          0       0
Retransmissions          0          0       0        0          0       0
200 OK                   1          1       1        0          0       0
403 Forbidden            1          1       1        0          0       0
Response Retrans         0          0       0        0          0       0
Transaction Timeouts     -          -       -        0          0       0
Locally Throttled        -          -       -        0          0       0
Avg Latency=0.000 for 0
Max Latency=0.000
NOTIFY
                    --------- Server --------   --------- Client --------
Message/Event       Recent      Total  PerMax   Recent      Total  PerMax
                    ------  ---------  ------   ------  ---------  ------
NOTIFY Requests          0          0       0        2          2       2
Retransmissions          0          0       0       10         10      10
200 OK                   0          0       0        1          1       1
Transaction Timeouts     -          -       -        0          0       0
```

```
Locally Throttled        -          -       -        0          0       0
Avg Latency=0.000 for 0
Max Latency=0.000
```

You can extend upon this ACLI show sipd command to include an argument that provides information about registration event package traffic, as shown below.

```
ORACLE# show sipd local-subscription regevent
19:23:08-103
SIP Local Subscription Status -- Period -- ------ Lifetime -----
                      Active High   Total Total  PerMax    High
Server Subscription        0    1       1     1       1       1
Message Statistics
SUBSCRIBE
                    --------- Server --------   --------- Client --------
Message/Event       Recent      Total  PerMax   Recent      Total  PerMax
                    ------  ---------  ------   ------  ---------  ------
SUBSCRIBE Requests       2          2       2        0          0       0
Retransmissions          0          0       0        0          0       0
200 OK                   1          1       1        0          0       0
403 Forbidden            1          1       1        0          0       0
Response Retrans         0          0       0        0          0       0
Transaction Timeouts     -          -       -        0          0       0
Locally Throttled        -          -       -        0          0       0
Avg Latency=0.000 for 0
Max Latency=0.000
NOTIFY
                    --------- Server --------   --------- Client --------
Message/Event       Recent      Total  PerMax   Recent      Total  PerMax
                    ------  ---------  ------   ------  ---------  ------
NOTIFY Requests          0          0       0        2          2       2
Retransmissions          0          0       0       10         10      10
200 OK                   0          0       0        1          1       1
Transaction Timeouts     -          -       -        0          0       0
Locally Throttled        -          -       -        0          0       0
Avg Latency=0.000 for 0
Max Latency=0.000
```

The ACLI show registration sipd command includes an argument that provides information about a specific user's registration(s), as shown below.

```
ORACLE# show registration sipd by-user ra1 detailed
User: sip:ra1@apkt.com
  Registered at:  2013-06-05-19:23:40    Surrogate User: false
  Contact Information:
    Contact:
      Name: sip:ra1@apkt.com
      Valid: true
      Challenged: false
      Registered at: 2013-06-05-19:23:40
      Last Registered at: 2013-06-05-19:23:40
      Expire: 3581
      Local expire: 41
      Half: 1781
      Registrar IP: 0.0.0.0
      Transport: UDP
      Secure: false
      Local IP: 192.168.101.62:5060
      User Agent Info:
        Contact: sip:ra1@192.168.13.1:5060
        Realm: net192
        IP: 192.168.13.1:5060
      SD Info:
        Contact: sip:ra1-1cdstqjt90hve@172.16.101.62:5060
        Realm: net172
```

```
      Call-ID: 1-28361@192.168.13.1
    Associated URI(s):
      URI: sip:ra1@apkt.com
         Filter Criteria:
           Priority: 0
             Filter: None specified
             Application Server: sip:appserv@apkt.com
    Reg Event Subscriptions Terminated locally:
      Number of Subscriptions: 1
```

Subscriber: appserv<sip:appserv@apkt.com>;tag=1 state=active exp=600114

show registration

The show registration command displays cumulative statistics on all current registrations.

```
ORACLE# show registration
15:35:43-177
SIP Registrations        -- Period -- ----- Lifetime ------
                  Active  High   Total Total  PerMax    High
User Entries           0     0       0     0       0       0
Local Contacts         0     0       0     0       0       0
Via Entries            0     0       0     0       0       0
AURI Entries           0     0       0     0       0       0
Free Map Ports         0     0       0     0       0       0
Used Map Ports         0     0       0     0       0       0
Forwards               -     -       0     0       0       0
Refreshes              -     -       0     0       0       0
Rejects                -     -       0     0       0       0
Timeouts               -     -       0     0       0       0
Fwd Postponed          -     -       0     0       0       0
Fwd Rejected           -     -       0     0       0       0
Refr Extension         0     0       0     0       0       0
Refresh Extended       -     -       0     0       0       0
ContactsPerAor Reject  -     -       0     0       0       0
Surrogate Regs         0     0       0     0       0       0
Surrogate Sent         -     -       0     0       0       0
Surrogate Reject       -     -       0     0       0       0
Surrogate Timeout      -     -       0     0       0       0
HNT Entries            0     0       0     0       0       0
Non-HNT Entries        0     0       0     0       0       0
Database Regs          0     0       0     0       0       0
DDNS Entries           0     0       0     0       0       0
CX Entries             0     0       0     0       0       0
LocalDB Entries        0     0       0     0       0       0
Unreg Users            0     0       0     0       0       0
```

You can extend upon the show registration command by adding the sipd by-user <username> detail arguments. The resulting output reflects user registration information including downloaded IFCs. For example:

```
ORACLE# show registration sipd by-user +19999092907 d
Registration Cache (Detailed View)    MON JUN 25 2012  13:47:46
User: sip:+19999092907@mobile.com
  Registered at: 2012-06-25-13:43:50     Surrogate User: false
  Contact Information:
    Contact:
      Name: sip:+19999092907@mobile.com
      Valid: true
      Challenged: false
      Registered at: 2012-06-25-13:43:50
      Last Registered at: 2012-06-25-13:47:30
      Expire: 48
      Local expire: 13
      Registrar IP: 0.0.0.0
      Transport: UDP
```

```
      Secure: false
      Local IP: 155.212.214.175:5060
      User Agent Info:
        Contact: sip:+19999092907@50.76.51.62:5762;transport=udp;acme_nat=
+19999092907+50.76.51.62@10.1.10.20:5762
        Realm: access
        IP: 50.76.51.62:5762
      SD Info:
        Contact: sip:+19999092907-rb8tulsbv3u72@108.108.108.108:5060
        Realm: core
      Call-ID: H_yvkgTAAA@10.1.10.20
    Associated URI(s):
      URI: sip:+19999092907@mobile.com
  Filter Criteria:
    Priority: 0
      Filter: ((case == 'Originating Registered') and (method == INVITE) and
('Accept-Contact'=='+g.app2app')) or
              ((case == 'Originating Registered') and (method == INVITE) and
('Contact'=='+g.app2app')) or
              ((case == 'Originating Registered') and (method == INVITE) and
('P-Message-Auth'=='.*')) or
              ((case == 'Originating Registered') and (method == INVITE) and
('P-Application-ID'=='.*'))
      Application Server: sip:pza.mobile.com:5280
Reg Event Subscriptions Received by Registrar:
Number of Subscriptions : 2
Subscriber: sip:appserv@192.168.13.1:5060; state=active; exp=59978
Subscriber: sip:pcscf@192.168.13.1:5060; state=active; exp=978
```

show home-subscriber-server

The show home-subscriber-server command displays cumulative statistics on all currently configured HSS servers.

show home-subscriber-server [stats <hss-name>| group group-name]

This command allows you to gather a set of information commonly requested by the Oracle TAC when troubleshooting customers.

The show home-subscriber-server command with no arguments displays the status of each HSS as well as the number of transactions and connections per HSS. For example:

```
ORACLE# show home-subscriber-server
Name                 Local-Address        Server-Address       Status
hss1                 192.168.207.21:45463 192.168.200.232:3872 Up
-----------------------------------------
18:53:25-105
HSS Status                  -- Period -- -------- Lifetime --------
                  Active    High   Total      Total  PerMax    High
Client Trans           0       1       4      12152       8       1
Server Trans           0       0       0          7       2       1
Connections            1       1       0         53       2       1
```

Note that the Connections statistic indicates the number of connections after successful CER/CEA handshake.

The table below documents the states the

Field	Description
Active	This status is related to HSS failover and load balancing configurations. The diameter connection is up and being used.
Standby	This status is related to HSS failover and load balancing configurations. The diameter connection is up, but is not being used.
Pending	The Oracle CSM has sent a CER and is waiting for a CEA response.

Field	Description
Inactive	The Oracle CSM has sent a CER but has not received a CEA response.
Down	The Oracle CSM is not attempting to establish a connection with the HSS.

Oracle CSM reports on each HSS.

The show home-subscriber-server command with the stats argument displays the number of transactions and connections per HSS as well as the number of messages exchanged with all HSS servers per message type. For example:

```
ORACLE# show home-subscriber-server stats
veloster2# show home-subscriber-server stats
Name                  Local-Address        Server-Address       Status
hss1                  192.168.207.21:45463 192.168.200.232:3872 Up
----------------------------------------
18:55:03-103
HSS Status                   -- Period -- -------- Lifetime --------
                  Active     High   Total       Total  PerMax    High
Client Trans           1        1       5       12157       8       1
Server Trans           0        0       0           7       2       1
Connections            1        1       0          53       2       1
                                          ---- Lifetime ----
                                  Recent      Total  PerMax
UAR                                    0          3       1
   SUBSEQ_REG (2002)                   0          3       1
SAR                                    0          6       3
   SUCCESS (2001)                      0          6       3
MAR                                    0          4       2
   SUCCESS (2001)                      0          4       2
LIR                                    0          1       1
   SUCCESS (2001)                      0          1       1
RTR                                    0          1       1
   SUCCESS (2001)                      0          1       1
PPR                                    0          1       1
   SUCCESS (2001)                      0          1       1
CER                                    0         55       3
   SUCCESS (2001)                      0         53       2
DWR                                    5      12088       5
   SUCCESS (2001)                      4      12041       5
   ERR_TIMEOUT                         0         46       1
DWR Recv                               0          5       2
   SUCCESS (2001)                      0          5       2
TCP Failures                           0        267       6
```

By entering the name of a specific HSS as an argument, the ACLI displays all HSS data for that server only. For example:

```
ACMESYSTEM# show home-subscriber-server stats hss1
```

The show home-subscriber-server command with the group argument displays the number of transactions and connections per the HSS group you specify in the command. For example:

```
ORACLE# show home-subscriber-server group hss-group1
display grp hss-group1
HSS Status                   -- Period -- -------- Lifetime --------
                  Active     High   Total       Total  PerMax    High
Client Trans           0        0       0           0       0       0
Server Trans           0        0       0           0       0       0
Sockets                0        0       0           0       0       0
Connections            0        0       0           0       0       0
                           ---- Lifetime ----
                      Recent      Total  PerMax
UAR                        0          0       0
```

```
SAR                     0          0       0
MAR                     0          0       0
LIR                     0          0       0
RTR                     0          0       0
PPR                     0          0       0
Sent Requests           0          0       0
Sent Req Accepted       0          0       0
Sent Req Rejected       0          0       0
Sent Req Expired        0          0       0
Sent Req Error          0          0       0
Recv Requests           0          0       0
Recv Req Accepted       0          0       0
Recv Req Rejected       0          0       0
HSS  Errors             0          0       0
```

show http-server

The ACLI show http-server command provides basic OAuth information as shown below. The command without arguments displays basis statistics on all servers.

```
ORACLE# show http-server
Name               Server-Address               Status
sk                 host.httpsrv.com             Up
sk1                192.168.19.1:8886            Up
sk2                192.168.19.1:8887            Up
sk3                192.168.19.1:8889            Up
12:56:41-184
HTTP Status                 -- Period -- -------- Lifetime --------
                 Active    High   Total      Total  PerMax    High
Client Trans          0       0       0          0       0       0
Server Trans          0       0       0          0       0       0
Sockets               0       0       0          0       0       0
Connections           0       0       0          0       0       0
```

You can extend upon this command to get detailed global statistics by adding the stats argument to the end of this command.

```
ORACLE# show http-server stats
Name               Server-Address               Status
sk                 host.httpsrv.com             Up
sk1                192.168.19.1:8886            Up
sk2                192.168.19.1:8887            Up
sk3                192.168.19.1:8889            Up
HTTP Status                 -- Period -- -------- Lifetime --------
                 Active    High   Total      Total  PerMax    High
Client Trans          0       0       0          0       0       0
Server Trans          0       0       0          0       0       0
Sockets               1       1       1          1       1       1
Connections           1       1       1          1       1       1
                          ---- Lifetime ----
                   Recent      Total  PerMax
Sent Requests           0          0       0
Sent Req Accepted       0          0       0
Sent Req Rejected       0          0       0
Sent Req Expired        0          0       0
HTTP Errors             0          0       0
```

You can limit this output to a single server by appending the command with the name of that server.

```
ORACLE# show http-server stats http-server1
Name = http-server1
----------------------------------------
Server-Address            Status
192.168.19.1:8886            Up
----------------------------------------
```

```
12:56:41-184
HTTP Status                 -- Period -- -------- Lifetime --------
                  Active    High   Total      Total  PerMax    High
Client Trans           0       0       0          0       0       0
Server Trans           0       0       0          0       0       0
Sockets                0       0       0          0       0       0
Connections            0       0       0          0       0       0
---- Lifetime ----
                     Recent      Total  PerMax
Sent Requests             0          0       0
Sent Req Accepted         0          0       0
Sent Req Rejected         0          0       0
Sent Req Expired          0          0       0
HTTP Errors               0          0       0
```

Supporting Configuration

The following configuration elements which are not mentioned in this guide are required for the Oracle CSM to function. Please refer to the Net-Net 4000 ACLI Configuration Guide for details about configuring all supporting elements.

- network-interface
- physical-interface
- realm-config
- sip-config
- system-config

The following configuration elements are mentioned in this guide briefly and still require configuration:

- local-policy
- session-agent
- sip-interface

Verify Config

The Oracle CSM performs application specific verification checks when you save a config with the save-config ACLI command. These checks are in addition to baseline Net-Net SBC verification checks.

sip authentication profile (CX)

If session-router > sip-authentication-profile > credential-retrieval-method = CX then confirm

session-router > sip-authentication-profile > credential-retrieval-config value =

any existing session-router > home-subscriber-server configuration > name value

Error

If the above check fails:

1. A WARNING is displayed on the ACLI.
2. An INFO log message is generated.

sip authentication profile (ENUM)

If session-router > sip-authentication-profile > credential-retrieval-method = ENUM-TXT then confirm

session-router > sip-authentication-profile > credential-retrieval-config value =

any existing session-router > enum-config > name value

Error

If the above check fails:

1. A WARNING is displayed on the ACLI.
2. An INFO log message is generated.

sip authentication profile (Local)

If session-router > sip-authentication-profile > credential-retrieval-method = local then confirm

session-router > sip-authentication-profile > credential-retrieval-config =

session-router > local-subscriber-table > ame Error

If the above check fails:

1. A WARNING is displayed on the ACLI.
2. An INFO log message is generated.

sip-registrar

If session-router > sip-registrar > subscriber-database-method = DDNS then confirm

session-router > sip-registrar > subscriber-database-config value =

any existing session-router > enum-config > name value

Error

If the above check fails:

1. A WARNING is displayed on the ACLI.
2. An INFO log message is generated.

sip-registrar

If session-router > sip-registrar > authentication-profile is configured, then confirm its value is any existing:

session-router > sip-authentication-profile > name value

Error

If the above check fails:

1. A WARNING is displayed on the ACLI.
2. An INFO log message is generated.

Resource Utilization

The Oracle CSM limits resource utilization to maintain operational stability. Resources managed this way include:

- CPU
- Memory (heap)

CPU Overload Protection

CPU overload protection on the Oracle CSM is system-oriented in terms of defining the percent utilization that triggers an action. Actions are application-specific.

For the Oracle CSM application, if the CPU usage exceeds the configured setting, the system sends a 5xx error in response to any initial dialog request or standalone transactions. The Oracle CSM continues to accept registration refreshes and new transactions within a dialog.

Note: An Oracle CSM configured to operation as an SLRM rejects all messages when CPU utilization exceeds this threshold.

By default the CPU utilization rate is 80%. This value can be changed by the following ACLI command sequence.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-config
ORACLE(sip-config)# options +load-limit=”70”
ORACLE(sip-config)# done
```

Heap Utilization

The Oracle CSM limits memory utilization to maintain operational stability, as follows:

- When heap utilization exceeds 75%, the Oracle CSM no longer accepts new registrations. The Oracle CSM replies to these messages with 5xx messages. The Oracle CSM continues to accept registration refreshes, in-dialog calls and subscriptions.
- When heap utilization exceeds 90%, the Oracle CSM drops all messages.

The user can change these thresholds to higher or lower values to best accommodate their operational environment. The user can also determine current memory utilization using the following command and referring to the heap utilization value, towards the bottom of the command’s output.

```
ORACLE# show platform heap-statistics
```

The user can disable the heap utilization at 75% functionality using the option shown below.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-config
ORACLE(sip-config)# +options disable-memory-overload-protect
ORACLE(sip-config)# done
```

The user can change the default drop-all threshold, from 90% to 80% for example, using the option shown below.

```
ORACLE# configure terminal
ORACLE(configure)# session-router
ORACLE(session-router)# sip-config
ORACLE(sip-config)# +options heap-threshold 80
ORACLE(sip-config)# done
```

A

Oracle Sc Interface Support

The Oracle CSM supports numerous AVPs in its Diameter-based Sc implementation. Currently AVPs belong to:

- The Diameter base AVPs found in RFC3588 and RFC4006.
- For 3GPP AVPs, if not specified by this document, their definition follows corresponding 3GPP specifications.
- Oracle proprietary Sc AVPs, described below.

Sc Interface and Command Codes

The table below provides the codes for the proprietary Sc interface commands.

Specification: Oracle Proprietary

Application-ID: 9999 (Oracle-Acme-Sc)

Vendor-ID:9148

Command-Name	Abbreviation	Code
Service Association Request	SVR	6000
Service Association Answer	SVA	6000
Core Registration Request	CRR	6001
Core Registration Answer	CRA	6001

Diameter AVP Notation

3GPP 32.299 states the following symbols are used in the message format definitions:

- <AVP> indicates a mandatory AVP with a fixed position in the message.
- {AVP} indicates a mandatory AVP in the message.
- [AVP] indicates an optional AVP in the message.
- *AVP indicates that multiple occurrences of an AVP is possible.

This syntax is used to document the Sc Interface messages herein.

Table Explanation

Each row in the following AVP tables contain:

- AVP Name
- AVP Number
- Reference where the AVP was defined
- Type of data format used to express the AVP's data
- If a grouped AVP, the names of the AVPs in the group

CER Message Format

The following table contains the top level AVPs that may be present in a message generated by the Oracle CSM.

AVP	Number	Reference	Type	Grouped
{ Session-Id }	263	Base	UTF8String	
{ Origin-Host }	264	Base	DiameterIdentity	
{ Host-IP-Address}	257	Base	Address	
{ Vendor-Id}	266	Base	Unsigned32	
{ Product-Name }	269	Base	UTF8String	
[Vendor-Specific-Application-ID]	260	Base	Grouped	

CEA Message Format

The following table contains the top level AVPs that may be present in an SLRM-generated CEA message.

AVP	Number	Reference	Type	Grouped
{ Result-Code }	268	Base	Unsigned32	
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	
{ Host-IP-Address }	257	Base	Address	
{ Vendor-Id }	266	Base	Unsigned32	
{ Product-Name }	269	Base	UTF8String	
[Vendor-Specific-Application--ID]	260	Base	Grouped	

DWR Message Format

The following table contains the top level AVPs that may be present in a DWR message.

AVP	Number	Reference	Type	Grouped
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	

DWA Message Format

The following table contains the top level AVPs that may be present in a DWA message.

AVP	Number	Reference	Type	Grouped
{ Result-Code }	268	Base	Unsigned32	
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	196	Base	DiameterIdentity	
[Error-Message]	281	Base	UTF8String	

SVR Message Format

The following table contains the top level AVPs present in a Oracle CSM-generated SVR message.

AVP	Number	Reference	Type	Grouped
{ Vendor-Specific-Application-ID }	260	Base	Grouped	Vendor-Id Auth-Application-ID
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	
{ Srv-Assoc-Id }	4010	Oracle	String	
{ Req-Type }	4000	Oracle	Enumerated	
{ Sc-Proto-Ver }	4005	Oracle	Unsigned32	
{ Soft-Version }	4014	Oracle	String	
{ Srv-Assoc-Exp }	4012	Oracle	Integer	
{ Destination-Realm-AVP }	283	Base	DiameterIdentity	
{ Cluster_Id }	4001	Oracle	Integer	
{ Pct-Used-Cpu }	4002	Oracle	Unsigned32	
{ Pct-Used-Mem }	4003	Oracle	Unsigned32	
{ Eps-Srv-Count}	4004	Oracle	Unsigned32	
[Max-Eps-Supp]	4006	Oracle	Unsigned32	

SVA Message Format

The following table contains the top level AVPs present in an SLRM-generated SVA message.

AVP	Number	Reference	Type	Grouped
{ Vendor-Specific-Application-ID }	260	Base	Grouped	Vendor-Id Auth-Application-ID

AVP	Number	Reference	Type	Grouped
[Result-Code]	268	Base	Unsigned32	
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	
{ Service-Assoc-Id }	4010	Oracle	String	
{ Req-Type }	4000	Oracle	Enumerated	
{ Sc-Proto-Ver }	4005	Oracle	Unsigned32	
{ Soft-Ver }	4014	Oracle	Integer	
{ Srv-Assoc-Exp }	4012	Oracle	Unsigned32	
{ Vendor-Specific-Application-ID }	260	Base	Grouped	Vendor-Id Experimental-Result-Code

CRR Message Format

The core registration request provides and updates the SLRM function with the request from the Oracle CSM to provide service for the ims-core specified as a member of that core's load balanced Oracle CSMs.

AVP	Number	Reference	Type	Grouped
{ Vendor-Specific-Application--ID }	260	Base	Grouped	Vendor-Id Auth-Application-ID
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	
{ Srv-Assoc-Id }	4010	Oracle	String	
{ Core-Reg-Type }	4007	Oracle	Enumerated	
{ Core-Reg-Exp }	4013	Oracle	Integer	
{ Destination-Realm }	283	Base	DiameterIdentity	
{ Core-info }	4008	Base	Grouped	ims-core service-info

CRA Message Format

The core registration answer provides the Oracle CSM with the result of its attempt to register itself for servicing the core specified in the request.

AVP	Number	Reference	Type	Grouped
{ Vendor-Specific-Application-ID }	260	Base	Grouped	Vendor-Id Auth-Application-ID
[Result-Code]	268	Base	Unsigned32	

AVP	Number	Reference	Type	Grouped
{ Origin-Host }	264	Base	DiameterIdentity	
{ Origin-Realm }	296	Base	DiameterIdentity	
{ Core-Reg-Type }	4007	Oracle	Enumerated	
{ Core-Reg-Exp }	4013	Oracle	Unsigned32	
{ Vendor-Specific-Application-ID }	260	Base	Grouped	Vendor-Id Experimental-Result-Code

Proprietary Grouped AVP Format

The following sections display the format of the grouped AVPs related to SLRM.

Core-Info AVP

The core-info AVP resides within the core registration request and answer sequence. It provides the SLRM function a reference with which the SLRM can group Oracle CSMs for load balancing registrations.

AVP	Number	Reference	Type
Core-Info ::= <AVP header>	4009	Oracle	
[Ims-Core]	4008	Oracle	String
[Service-Info]	4015	Oracle	Grouped

Service-Info AVP Format

The Sc interface's service address port AVP is a grouped AVP nested within the core-info AVP. It allows for transmission of multiple service route records within the AVP. This provides the SLRM function with the routes used to access the applicable ims-cores as accessed via this Oracle CSM.

AVP	Number	Reference	Type
Service info ::= <AVP header>	4015	Oracle	String
[service-route]	4011	Oracle	String