SGSN-MME Combo Optimization

This section describes Combo Optimization available for a co-located SGSN-MME node. It also provides detailed information on the following:

- Feature Description, on page 1
- How It Works, on page 2
- Configuring the Combo Optimization, on page 5
- Monitoring and Troubleshooting Combo Optimization , on page 6

Feature Description

The SGSN and MME can be enabled simultaneously in the same chassis and, though co-located, they each behave as independent nodes. This Combo Optimization feature enables the co-located SGSN and MME to co-operate with each other in order to achieve lower memory and CPU utilizations and to reduce signaling towards other nodes in the network. When functioning as mutually-aware co-located nodes, the SGSN and the MME can share UE subscription data between them.

Important This feature is supported by both the S4-SGSN and the Gn-SGSN. For the feature to apply to a Gn-SGSN, the Gn-SGSN must be configured to connect to an HSS. Combo Optimization for an SGSN-MME node is a licensed Cisco feature. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys section of the Software Management Operations chapter in the System Administration Guide*.

Overview

The load on S6d/S6a interfaces towards an HSS is reduced effectively by utilizing the resources in a co-located SGSN-MME node scenario. Requests for subscription data in Update Location Request (ULR) are skipped by setting the 'skip-subscriber-data' bit in the ULR flags this, in turn, reduces the load on the HSS. The Skip Subscriber Data AVP is used and the subscriber data is shared across the SGSN and the MME services.

As per 3GPP TS 29.272, setting the 'skip-subscriber-data' bit in the ULR indicates that the HSS may skip sending subscription data in Update Location Answer (ULA) to reduce signaling. If the subscription data has changed in the HSS after the last successful update of the MME/SGSN, the HSS ignores this bit and sends the updated subscription data. If the HSS skips sending the subscription data, then the GPRS-Subscription-Data-Indicator flag can be ignored.

Important The SGSN supported the Skip-Subscription-Data bit prior to Release 18.0. Support for this functionality was added to the MME in Release 18.0.

Ensuring that packets are routed internally reduces network latency for S3/Gn interface messages. This is achieved by configuring the SGTP and EGTP services in the same context for the SGSN and the MME configurations.

For outbound Inter-RAT SRNS Relocations, the MME gives preference to the co-located SGSN, irrespective of the order/priority or preference/weight configured for the SGSN entry in DNS Server. When Inter-RAT handovers take place between the co-located MME and the SGSN, the new call arrives at the same Session Manager that hosted the call in the previous RAT. If the subscription data is available for a given UE at the co-located SGSN, then the MME does not need to request this data from the HSS and provides UE subscription data obtained from the SGSN. This optional function can be turned on or off through the MME Service configuration.

Combo Optimization is available for subscribers with an EPC-enabled UE and an EPC subscription configured at the HSS. During handoff from 4G to 3G or 4G to 2G, the EPC subscription will be copied from the MME. Combo Optimization is also applicable for Non-EPC subscribers if core-network-interface is selected as S4 for the EPS-subscription.

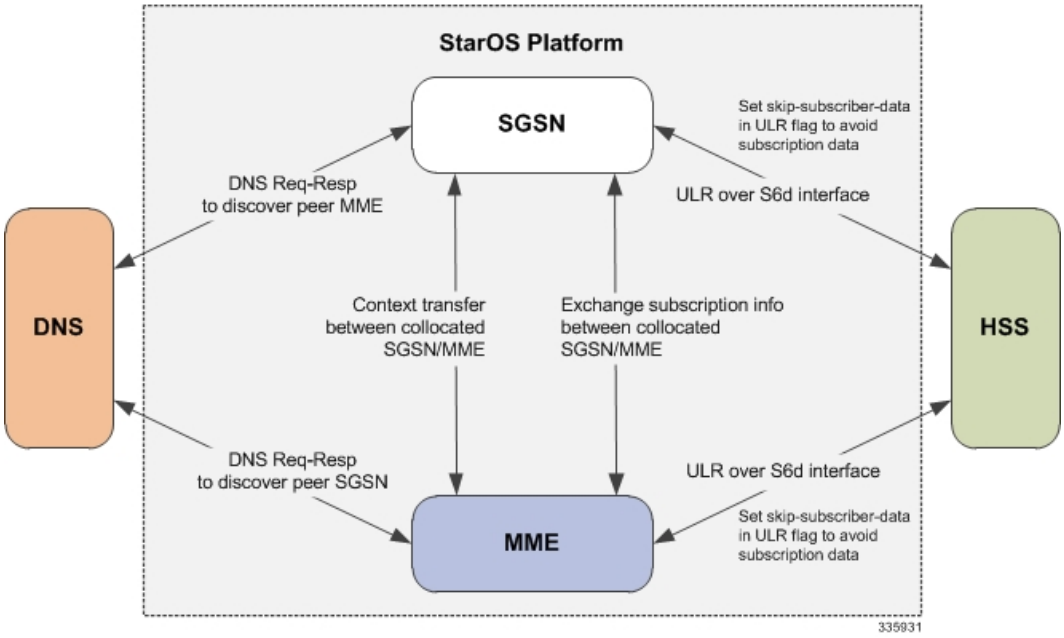
How It Works

Subscriber Movement from MME to SGSN: Subscription information is first fetched by the MME. On subscriber movement to a co-located SGSN, the SGSN sends a ULR with "skip-subscriber-data" flag set and the HSS sends a ULA (with or without subscription data depending on time of MME update).

Subscriber Movement from SGSN to MME: Subscription information is first fetched by the SGSN. On subscriber movement to a co-located MME, the MME sends a ULR with "skip-subscriber-data" flag set and the HSS sends a ULA (with or without subscription data depending on time of SGSN update).

Architecture

Figure 1: SGSN-MME Combo Node



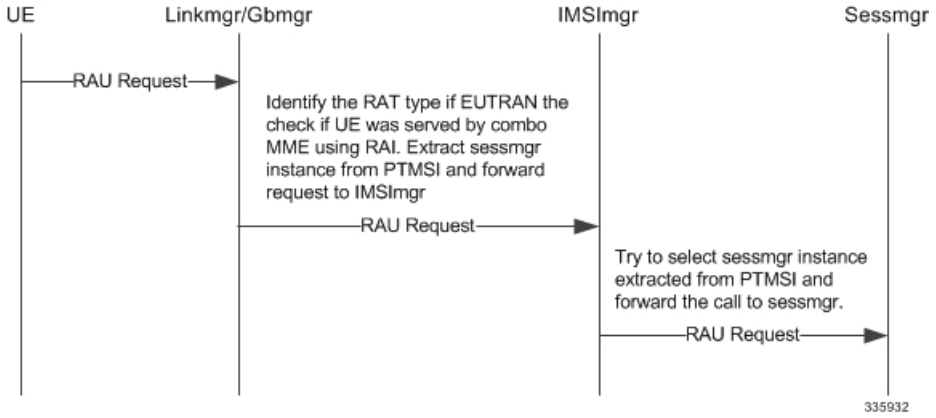
The above diagram displays the interworking of various modules when the Combo Optimization feature is enabled in a co-located SGSN-MME setup.

When the subscriber does RAU from MME to SGSN, or vice versa, a DNS query is initiated to fetch the address of the peer node. Based on the IP address obtained, the peer MME or SGSN is selected. When a DNS response is received with a list of peer SGSN addresses, the MME matches the configured EGTP/SGTP SGSN service address in the system and uses it for the S3/Gn UE Context Transfer procedures. If a DNS response is not received and a locally configured EGTP/SGTP SGSN service is present as a peer-SGSN, the peer-SGSN will be selected. Context transfer and copying of subscription information happens internally between the SGSN and the MME nodes. The SGSN maintains the s6d interface towards the HSS and the MME maintains the S6a interface towards the HSS. All network-initiated messages are sent separately towards the SGSN and the MME nodes respectively.

Flows

This section includes various diagrams that illustrate the session manager (SessMgr) selection logic during RAU, SRNS, and Attach procedures:

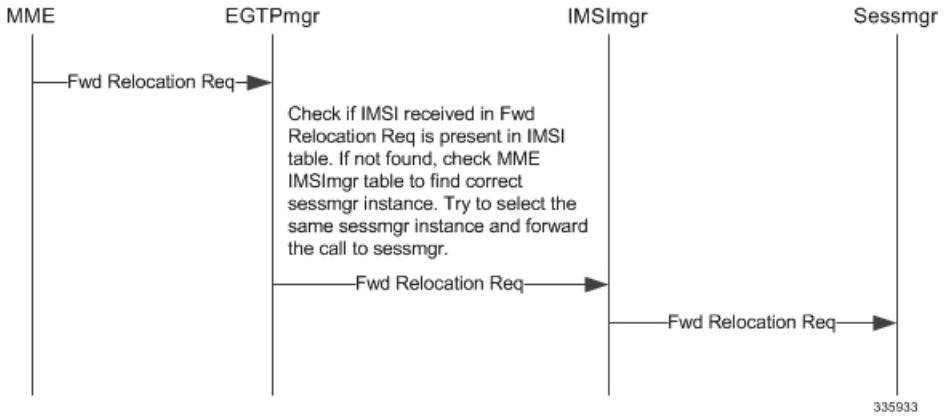
Figure 2: Selection of SessMgr Instance during RAU from MME to SGSN



Listed below is the SessMgr instance selection logic during a RAU procedure from the MME to SGSN:

1. A RAU request from UE is forwarded to the LinkMgr or GbMgr.
2. The LinkMgr identifies if the RAU is local and extracts the SessMgr instance from the PTMSI and forwards the request to IMSIMgr.
3. The IMSIMgr tries to select the SessMgr instance extracted from the PTMSI and forwards the request to the selected SessMgr.

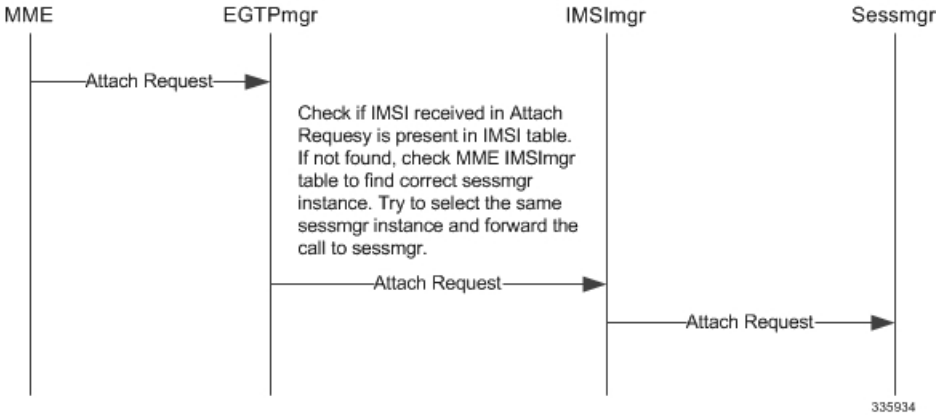
Figure 3: Selection of SessMgr Instance during SRNS



Listed below is the SessMgr instance selection logic during an SRNS procedure:

1. During an SRNS procedure, the MME service sends a Forward Relocation Request to the EGTPCMgr.
2. The EGTPCMgr forwards the request to the IMSIMgr.
3. The IMSIMgr uses the IMSI received in the request message to identify the SessMgr instance and forwards the request to the appropriate SessMgr instance.

Figure 4: Selection of SessMgr Instance during Attach



Listed below is the SessMgr instance selection logic during an Attach procedure:

1. During Attach procedure, the LinkMgr/GbMgr forwards the request to the IMSIMgr.
2. The IMSIMgr first verifies if the IMSI is present in the SGSN's IMSI table. If it is not present, the MME's IMSI table is verified. Once the entry is found the request is forwarded to the appropriate SessMgr.
3. If the entry is not found in either table, then an alternate SessMgr instance is used to process the call.

Limitations

Subscription information is shared between MME and SGSN only when both are connected to an HSS. Combo Optimization is not be applicable if either the MME or the SGSN is connected to an HLR. Though the subscription information is shared between the SGSN and MME services, a separate HSS service and diameter endpoint will be maintained for both the SGSN and the MME. All network-initiated messages are received separately for both the MME and the SGSN. Subscription data is copied based on time-stamp validation.

A small impact on the performance is observed during Inter-RAT handoffs as subscription data is exchanged between the SGSN and the MME. This impact is a limited increase in the number of instructions per handoff per UE depending on the number of APNs configured for the UE in the HSS.

It is necessary that the HSS honors the request from the MME/SGSN and not send subscription data when 'Skip-Subscriber-Data' flag is set in the ULR. However, there are some known and valid cases where the HSS ignores this flag for example, if the UE's subscription data changed since the last time the UE attached in 4G. (Typically, UE subscription data does not change frequently, therefore, HSS overrides are less frequent.)

Configuring the Combo Optimization

This section describes how to configure the Combo Optimization for an SGSN-MME combo node.

By default, Combo Optimization is not enabled. This command both enables or disables Combo Optimization on an SGSN-MME combo node.

```
config
      lte-policy
            [ no ] sgsn-mme subscriber-data-optimization
            end
```

Note:

- **no** as a command prefix disables Combo Optimization.

The following CLI (applicable only to the SGSN in the combo node), under the call-control profile configuration mode, controls requests for GPRS subscription information from the HSS:

```
config
   call-control-profile profile_name
      hss message update-location-request gprs-subscription-indicator [
never | non- epc-ue ]
      end
```

Verifying Combo Optimization Configuration

Execute the following command to verify the configuration of this feature.

show lte-policy sgsn-mme summary

The following field value indicates if data optimization on the SGSN-MME combo node is "Enabled" or "Disabled":

- subscriber-data-optimization

Monitoring and Troubleshooting Combo Optimization

This section provides information on the show commands and bulk statistics available to monitor and troubleshoot Combo Optimization for the SGSN-MME combo node, and for each element separately.

Monitoring Commands for the SGSN-MME Combo Node

This section provides information regarding show commands and/or their outputs in support of the Combo Optimization feature on the SGSN-MME Combo Node:

show hss-peer-service statistics all

The following new fields are added to the show output to display the subscription data statistics:

- Subscription-Data Stats
- Skip Subscription Data
- Subscription-Data Not Received

The Skip Subscription Data statistic is incremented when the ULR is sent with the skip-subscription-data flag set. The Subscription-Data Not Received statistic is incremented if the HSS does not send the subscription data in the ULA when skip-subscription-data flag is set in ULR. The difference between the Skip Subscription Data and Subscription-Data Not Received gives us the number of times HSS does not honor the skip-subscription-data flag.

Monitoring Commands for the SGSN

This section provides information regarding show commands and/or their outputs in support of the Combo Optimization feature on the **SGSN**:

show demux-mgr statistics imsimgr all sgsn

The following new fields are added in the show output to display the number of RAU, Attach, PTIMSI attach and Forward relocation requests arriving from a subscriber attached with co-located MME:

- IMSI attach with context in co-located MME
- P-TMSI attach with mapped P-TMSI of co-located MME
- RAU with mapped P-TMSI of co-located MME
- Fwd reloc request from co-located MME

show subscribers sgsn-only summary

The following new field is added in the show output to display the number of subscribers currently sharing subscription information with the MME:

- Total HSS subscribers sharing subscription-info

show subscribers gprs-only summary

The following new field is added in the show output to display the number of subscribers currently sharing subscription information with MME:

- Total HSS subscribers sharing subscription-info

show subscribers sgsn-only full all

The STN-SR , ICS-indicator , Trace-Data and CSG subscription information is now displayed under the **show subscribers sgsn-only full all** output. These AVPs are currently used by MME only .Values are displayed as received from HSS without any format changes.

- Trace Data
- Trace Reference
- Trace Depth
- Trace NE Type List
- Trace Interface List
- Trace Event List
- OMC Id
- Trace Collection Entity
- STN-SR
- ICS-Indicator
- CSG Subscription
- CSG ID
- Expiration Date

show subscribers gprs-only full all

The STN-SR, ICS-indicator, Trace-Data and CSG subscription information is now displayed under the **show subscribers gprs-only full all** output. These AVPs are currently used only by the MME. Values are displayed as received from HSS without any format changes.

- Trace Data
- Trace Reference
- Trace Depth
- Trace NE Type List
- Trace Interface List
- Trace Event List
- OMC Id
- Trace Collection Entity
- STN-SR
- ICS-Indicator
- CSG Subscription
- CSG ID
- Expiration Date

show session subsystem facility aaamgr instance

The following new fields are added in the show output to display the total number of CSG subscription records and Trace data records:

- SGSN: Total Trace data records
- SGSN: Total CSG data records

Monitoring Commands for the MME

This section provides information regarding show commands and/or their outputs in support of the Combo Optimization feature on the **MME**:

show mme-service statistics handover

The following new statistics are added to the show output to display the information about Inter-RAT Optimized Handoffs between the co-located SGSN and MME:

- Inter-RAT Optimized Handoffs Between Co-located MME and SGSN
- Outbound MME to SGSN RAU procedure
- Attempted
- Success
- Failures
- Inbound SGSN to MME TAU procedure
- Attempted
- Success
- Failures
- Outbound MME to SGSN Connected Mode Handover
- Attempted
- Success

- Failures
- Inbound SGSN to MME Connected Mode Handover
- Attempted
- Success
- Failures

Bulk Statistics for Monitoring the MME in an SGSN-MME Combo Node

The following bulk statistics in the MME schema facilitate tracking MME optimization functionality for the SGSN-MME nodes when co-located in the same chassis with the Combo Optimization functionality enabled:

- optimized-out-rau-ho-4gto2g3g-attempted
- optimized-out-rau-ho-4gto2g3g-success
- optimized-out-rau-ho-4gto2g3g-failures
- optimized-in-tau-ho-2g3gto4g-attempted
- optimized-in-tau-ho-2g3gto4g-success
- optimized-in-tau-ho-2g3gto4g-failures
- optimized-out-s1-ho-4gto2g3g-attempted
- optimized-out-s1-ho-4gto2g3g-success
- optimized-out-s1-ho-4gto2g3g-failures
- optimized-in-s1-ho-2g3gto4g-attempted
- optimized-in-s1-ho-2g3gto4g-success
- optimized-in-s1-ho-2g3gto4g-failures