Mobility Management Entity Configuration

This chapter provides configuration information for the Mobility Management Entity (MME).

Because each wireless network is unique, the system is designed with a variety of parameters allowing it to perform in various wireless network environments. In this chapter, only the minimum set of parameters are provided to make the system operational. Optional configuration commands specific to the MME product are located in the *Command Line Interface Reference*.

Important At least one packet processing card must be made active prior to service configuration. Information and instructions for configuring a packet processing card to be active can be found in the *System Settings* chapter of the *System Administration Guide*.

Important Before you plan or modify your MME's configuration, we recommend that you review *Appendix A: Engineering Rules* for the engineering rules and configuration limits hardcoded into the system.

Caution While configuring any base-service or enhanced feature, it is highly recommended to avoid conflicting or blocked IP addresses and port numbers when binding or assigning these to your configuration. In association with some service steering or access control features, the use of inappropriate port numbers may result in communication loss. Refer to the respective feature configuration document carefully before assigning any port number or IP address for communication with internal or external networks.

Important Information about all commands in this chapter can be found in the *Command Line Interface Reference*.

Configuring the System as a Standalone MME (base configuration)

This section provides a high-level series of steps and associated configuration file examples for configuring the system to perform as an MME in a test environment. This section also includes suggestions about the types of information that are needed to be able to configure the MME, as well as information about how the MME works based on some of the possible configurations.

The configurations in this section assume the following:

- A single context (other than the Local context) for all interfaces and services
- Static S-GW/P-GW selection (MME Policy configuration)

Information Required

The following sections describe the minimum amount of information required to configure and make the MME operational on the network. To make the process more efficient, it is recommended that this information be available prior to configuring the system.

There are additional configuration parameters that are not described in this section. These parameters deal mostly with fine-tuning the operation of the S-GW in the network. Information on these parameters can be found in the appropriate sections of the *Command Line Interface Reference*.

Required MME Context Configuration Information

The following table lists the information that is required to configure the MME context.

Table 1: Required Information for MME Context Configuration

Required Information	Description
MME context name	An identification string from 1 to 79 characters (alpha and/or numeric) by which the MME context is recognized by the system.
S1-MME Interface Configuration (To/from eNodeB)	
Interface name	An identification string between 1 and 79 characters (alpha and/or numeric) by which the interface is recognized by the system. Multiple names are needed if multiple interfaces will be configured.
IP address and subnet	IPv4 or IPv6 address assigned to the S1-MME interface. This address will be used for binding the SCTP (local bind address(es)) to communicate with the eNodeBs using S1-AP. Multiple addresses and subnets are needed if multiple interfaces will be configured.

Required Information	Description
Physical port number	The physical port to which the interface will be bound. Ports are identified by the chassis slot number where the line card resides followed by the number of the physical connector on the card. For example, port 17/1 identifies connector number 1 on the card in slot 17. A single physical port can facilitate multiple interfaces.
S11 Interface Configuration (To/from S-GW)	
Interface name	An identification string between 1 and 79 characters (alpha and/or numeric) by which the interface is recognized by the system. Multiple names are needed if multiple interfaces will be configured.
IP address and subnet	IPv4 address assigned to the S11 interface. Multiple addresses and subnets are needed if multiple interfaces will be configured.
Physical port number	The physical port to which the interface will be bound. Ports are identified by the chassis slot number where the line card resides followed by the number of the physical connector on the card. For example, port 17/1 identifies connector number 1 on the card in slot 17. A single physical port can facilitate multiple interfaces.
S6a Interface Configuration (To/from HSS)	
Interface name	An identification string between 1 and 79 characters (alpha and/or numeric) by which the interface is recognized by the system. Multiple names are needed if multiple interfaces will be configured.
IP address and subnet	IPv4 or IPv6 addresses assigned to the S6a interface. Multiple addresses and subnets are needed if multiple interfaces will be configured.
Physical port number	The physical port to which the interface will be bound. Ports are identified by the chassis slot number where the line card resides followed by the number of the physical connector on the card. For example, port 17/1 identifies connector number 1 on the card in slot 17. A single physical port can facilitate multiple interfaces.
S6a Diameter Endpoint Configuration	
End point name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the S6a Diameter endpoint configuration is recognized by the system.

Required Information	Description
Origin realm name	An identification string between 1 through 127 characters. The realm is the Diameter identity. The originator's realm is present in all Diameter messages and is typically the company or service name.
Origin host name	An identification string from 1 to 255 characters (alpha and/or numeric) by which the S6a origin host is recognized by the system.
Origin host address	The IP address of the S6a interface.
Peer name	The S6a endpoint name described above.
Peer realm name	The S6a origin realm name described above.
Peer address and port number	The IP address and port number of the HSS.
Route-entry peer	The S6a endpoint name described above.
S13 Interface Configuration (To/from EIR)	
Interface name	An identification string between 1 and 79 characters (alpha and/or numeric) by which the interface is recognized by the system. Multiple names are needed if multiple interfaces will be configured.
IP address and subnet	IPv4 or IPv6 addresses assigned to the S13 interface. Multiple addresses and subnets are needed if multiple interfaces will be configured.
Physical port number	The physical port to which the interface will be bound. Ports are identified by the chassis slot number where the line card resides followed by the number of the physical connector on the card. For example, port 17/1 identifies connector number 1 on the card in slot 17. A single physical port can facilitate multiple interfaces.
S13 Diameter Endpoint Configuration	
End point name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the S13 Diameter endpoint configuration is recognized by the system.
Origin realm name	An identification string between 1 through 127 characters. The realm is the Diameter identity. The originator's realm is present in all Diameter messages and is typically the company or service name.
Origin host name	An identification string from 1 to 255 characters (alpha and/or numeric) by which the S13 origin host is recognized by the system.

Required Information	Description
Origin host address	The IP address of the S13 interface.
Peer name	The S13 endpoint name described above.
Peer realm name	The S13 origin realm name described above.
Peer address and port number	The IP address and port number of the EIR.
Route-entry peer	The S13 endpoint name described above.
MME Service Configuration	
MME service name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the MME service can be identified on the system. It is configured in the Context configuration mode. Multiple names are needed if multiple MME services will be configured.
PLMN identifier	The identifier of Public Land Mobile Network (PLMN) of which MME belongs to. PLMN identifier is consisting of MCC and MNC.
MME identifier	The identifier of MME node. The MME Id is consisting of MME group and MME code.
TAI management database name	An identification string from 1 to 64 characters (alpha and/or numeric) by which the TAI management database service can be associated with the MME service. This is required for static S-GW selection. Refer to the *Required MME Policy Configuration Information* section below.
P-GW IP address	IPv4 or IPv6 address of a PDN Gateway (P-GW). This is required for static S-GW/P-GW selection.
eGTP Service Configuration	
eGTP service name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the eGTP service can be associated with MME system. Multiple names are needed if multiple eGTP services will be used.
Interface type	Identifies the type of interface to which the eGTP service is bound. This interface type is "interface-mme".
GTP-C binding IP address	The IPv4 address of the S11 interface.
HSS Peer Service Configuration	

Required Information	Description
HSS peer service name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the HSS peer service is recognized by the system. Multiple names are needed if multiple HSS peer services will be used.
Diameter HSS peer	The name for a pre-configured Diameter endpoint, configured on system to associate with this MME service to access an HSS and an EIR. This is the S6a Diameter endpoint name.

Required MME Policy Configuration Information

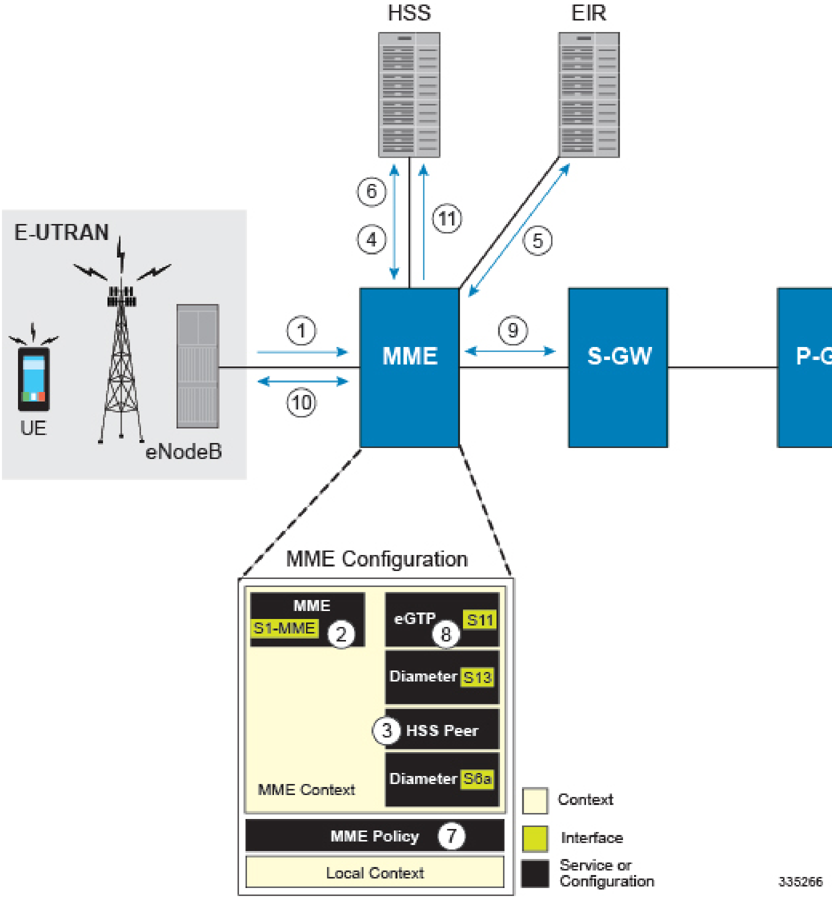
The following table lists the information that is required to configure the MME Policy on an MME.

Table 2: Required Information for MME Policy Configuration

Required Information	Description
Tracking Area Identifier (TAI) management database name	An identification string from 1 to 64 characters (alpha and/or numeric) by which the TAI management database is recognized by the system.
Tracking Area Identifier (TAI) management object name	An identification string from 1 to 64 characters (alpha and/or numeric) by which the TAI management object is recognized by the system.
MCC, MNC, and TAC	The Mobile Country Code, Mobile Network Code, and Tracking Area Code for the S-GW this management object represents.
S-GW IP address	The IPv4 or IPv6 address of the S-GW this management object represents.

How This Configuration Works

The following figure and supporting text describe how this configuration with a single context is used by the system to process a subscriber call originating from the GTP LTE network.



1 The eNodeB forwards an Attach Request message from the UE to the MME containing the IMSI, last visited TAI (if available), the UE's core network capability, the PDN Type, and the Attach Type.

2 The MME service receives the Attach Request message and references the HSS peer service for authentication and location resolution.

3 The HSS peer service configuration specifies the Diameter configuration and S6a interface to use to communicate with the HSS and the Diameter configuration and S13 interface to use to communicate with the Equipment Identity Register (EIR).

4 Assuming that the MME has no previous security context, it sends an S6a Authentication Request to the HSS and uses the authentication vectors received in the response to complete the authentication procedure with UE.

5 After authentication, the MME proceeds to do a security setup with the UE. During this procedure, the ME identity is transferred to the MME which then queries the EIR.

6 The MME then sends an Update Location Request to the HSS and obtains relevant subscription data for the IMSI in the response.

7 The MME policy is accessed to determine the S-GW and P-GW to which the UE should be attached.

8 The MME uses the S11 interface bound to the eGTP service to communicate with the S-GW specified by the MME policy configuration.

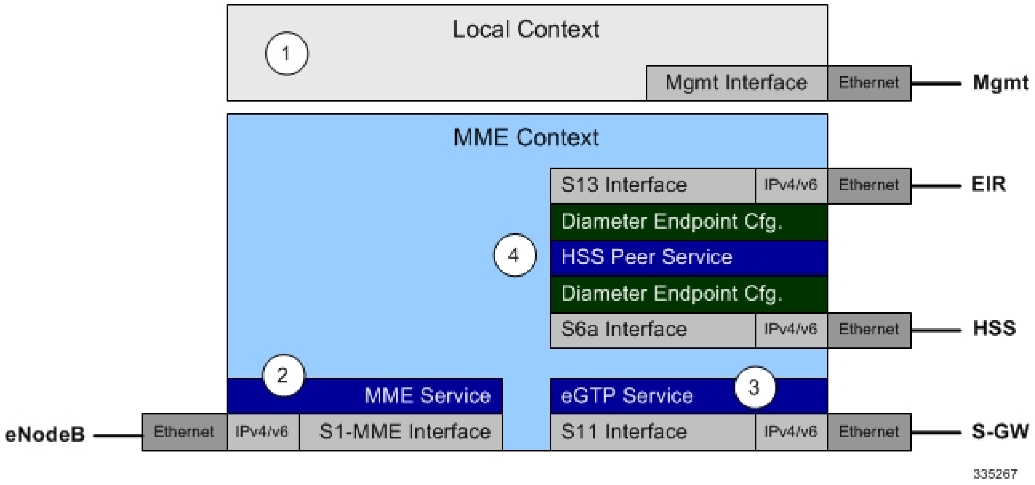
9 The MME then sends a Create Session Request to S-GW which is also forwarded to the specified P-GW (assuming GTP-S5/S8) P-GW establishes the S5/S8 GTPU bearers and then responds with a Create-Session-response which is forwarded to the MME by the S-GW. The S-GW includes the relevant S1-U bearer information.

10 The MME then sends a NAS Attach Accept embedded in the S1 Init Ctxt Setup request to the eNodeB. The Attach Accept contains the IP address allocated to the PDN and the temporary identifier (GUTI) assigned to the UE. The MME waits for positive acknowledgment from both the eNodeB (Init Ctxt Setup response) and UE (Attach Complete). The Init Ctxt Setup Response contains the S1-U bearer endpoint information. The MME then uses the S11 Modify Bearer Request to update the eNodeB endpoints with the S-GW. The receipt of the S11 Modify Bearer Response completes the end-to-end bearer setup.

11 The MME then uses the S6a Notify Request to update the HSS with the APN and P-GW identity.

MME Configuration

To configure the system to perform as a standalone eGTP S-GW, review the following graphic and subsequent steps.



Step 1 Set system configuration parameters such as activating PSCs by applying the example configurations found in the *System Administration Guide*.

Step 2 Create the MME context, service, and all interfaces, and bind the S1-MME interface to an IP address by applying the example configuration in the section.

Step 3 Create the eGTP service and associate it with the S11 interface by applying the example configuration in the section.

Step 4 Create the HSS peer service and associate it with the S6a interface and S13 interface by applying the example configuration in the section.

Step 5 Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode command **save configuration**. For additional information on how to verify and save configuration files, refer to the *System Administration Guide* and the *Command Line Interface Reference*.

Creating and Configuring the MME Context and Service

Use the following example to configure the MME context and all supported interfaces:

```
configure
   context mme_context_name -noconfirm
      interface s1-mme_intf_name
         ip address ipv4_address
         exit
      interface s11_intf_name
         ip address ipv4_address
         exit
      interface s6a_intf_name
         ip address ipv4_address
         exit
      interface s13_intf_name
         ip address ipv4_address
         exit
      mme-service mme_svc_name -noconfirm
         mme-id group-id grp_id mme-code mme_code
         plmn-id mcc mcc_value mnc mnc_value
         network-sharing plmnid mcc mcc_value mnc mnc_value mme-id group-id id mme-code code
         associate egtp-service egtp-service_name context mme_context_name
         associate hss-peer-service hss_peer_service_name context mme_context_name
         policy attach imei-query-type imei-sv verify-equipment-identity
         pgw-address pgw_ip_address
         bind s1-mme ipv4-address ip_address
         exit
      exit
   port ethernet slot_number/port_number
      no shutdown
      bind interface s1-mme_intf_name mme_context_name
      end
```

Notes:

- All interfaces in this configuration can also be specified as IPv6 addresses using the **ipv6 address** command.
- Multi-homing is supported on the S1-MME and S6a interfaces. For more information on configuring multi-homing for the S1-MME and/or S6a interface(s), refer to Configuring SCTP Multi-homing Support, on page 23.
- A maximum of 256 services (regardless of type) can be configured per system.
- The **bind s1-mme** command can also be specified as an IPv6 address using the **ipv6-address** keyword.
- The **network-sharing** command is used to configure an additional PLMN ID for this MME service.
- The eGTP service is configured in the following section.
- The HSS peer service is configured in the configuration sequence for Creating and Configuring the HSS Peer Service and Interface Associations, on page 10.

- In the above example, the mobile equipment identity (IMEI) is checked during the attach procedure. This is configured in the **policy attach** command. Another option is to check IMEI during the tracking area update (TAU). This can be accomplished instead of, or, in addition to, the EIR query during the attach procedure. To check during the TAU, use the **policy tau** command.
- The **pgw-address** command is used to statically configure P-GW discovery.

Creating and Configuring the eGTP Service and Interface Association

Use the following example to create an eGTP service and associate it with the S11 interface.

```
configure
     context  mme_context_name
          egtp-service  egtp_service_name
               interface-type interface-mme
                gtpc bind ipv4-address  s11_infc_ip_address
               exit
          exit
     port ethernet  slot_number/port_number
          no shutdown
          bind interface  s11_interface_name  mme_context_name
          end
```

Notes:

- The **gtpc bind** command can be specified as an IPv6 address using the **ipv6-address** keyword. The interface specified for S11 communication must also be the same IPv6 address.

Creating and Configuring the HSS Peer Service and Interface Associations

Use the following example to create and configure the HSS peer service:

```
configure
     context  mme_context_name
          hss-peer-service hss_peer_service_name
               diameter hss-endpoint  hss_endpoint_name  eir-endpoint  eir-endpoint_name
               exit
          exit
          diameter endpoint  hss-endpoint_name
                    origin realm  realm_name
                    origin host  name  address  S6a_interface_address
                    peer  peer_name  realm  realm_name  address  hss_ip_address
                    route-entry realm  realm_name  peer  peer_name
                    exit
          diameter endpoint  eir-endpoint_name
                    origin realm  realm_name
                    origin host  name  address  S13_interface_address
                    peer  peer_name  realm  realm_name  address  eir_ip_address
                    route-entry realm  realm_name  peer  peer_name
                    exit
          port ethernet  slot_number/port_number
                    no shutdown
                    bind interface  s6a_interface_name  mme_context_name
                    exit
          port ethernet  slot_number/port_number
```

```
        no shutdown
        bind interface s13_interface_name mme_context_name
        end
```

Notes:

- The **origin host** and **peer** commands can accept multiple IP addresses supporting multi-homing on each endpoint. For information on configuring SCTP multi-homing for the S6a interface, refer to Configuring SCTP Multi-homing Support, on page 23.

Caution On a PSC2 setup, all diamproxy tasks might go in to a warning state if the number of hss-peer-services configured are more than 64 since the memory usage may exceed the allocated value.

Configuring Dynamic Destination Realm Construction for Foreign Subscribers

For a foreign subscriber, the MME does not know the HSS nodes in all the foreign PLMNs. In this case the MME routes S6a/S6d requests directed to foreign PLMNs via a Diameter Routing Agent (DRA) using only the destination realm. The DRA in turn routes the request to the correct HSS based on the destination realm. In order to accomplish this, the MME needs to dynamically construct requests to the DRA/HSS with a Destination Realm representing the foreign PLMN of the UE.

The MME can be configured to derive the EPC Home Network Realm/Domain based on the user's IMSI (MNC and MCC values) and use it as the Destination Realm in all diameter messages.

For home subscribers, the MME will always use the configured peer realm as destination-realm, regardless if dynamic-destination-realm is enabled.

Because MNCs can be 2 or 3 digits long, to provide the ability for an operator to configure the MCC and MNC of foreign PLMNs, the operator policy of the subscriber map is used to determine the MNC value and the length of the MNC. The following steps outline how this configuration can be implemented.

First, enable the dynamic destination realm functionality for the HSS Peer Service:

```
configure
   context ctxt_name
      hss-peer-service HSS1
         dynamic-destination-realm
         end
```

Then configure the foreign PLMNs in the LTE subscriber map. For example:

```
configure
   lte-policy
      subscriber map SM1
         precedence 10 match-criteria imsi mcc 232 mnc 11 operator-policy-name OP.HOME
         precedence 20 match-criteria imsi mcc 374 mnc 130 msin first 700000000 last 800000000
operator-policy-name OP.ROAMING
         end
```

Then associate the subscriber map to the MME Service. For example:

```
configure
   context ingress
      mme-service mmesvc
         associate subscriber-map SM1
         end
```

A static route entry must also be added in the diameter endpoint configuration for each foreign realm. For example:

```
configure
   context ingress
      diameter endpoint s6a1
         peer HSS1 realm HSS-Realm1 address ip-address sctp
         route-entry realm epc.mnc045.mcc123.3gppnetwork.org peer HSS1
         end
```

With this sample configuration, an MNC of length 2 and value of 11 is matched with first operator policy (OP.HOME), and an MNC length of 3 and value of 130 is matched with the second operator policy (OP.ROAMING). With this configuration, the MME will find the MNC based on the operator policy for the foreign subscriber.

If there is no matching entry present in the operator policy, the MME will use the global static table to decide the MNC length and pass that information to Diameter layer to construct the dynamic realm. The following list of MCCs are all considered as 3 digit MNCs. All other MCCs are considered 2 digit MNCs.

302	334	354	405
310	338	356	708
311	342	358	722
312	344	360	732
316	346	365	
	348	376	

The **show hss-peer-service service name** command displays this configuration in the **Destination Realm** field, either **Configured Peer Realm** (default), or **Dynamic Realm**.

```
Request Auth-vectors            : 1
Notify Request Message          : Enable
Destination Realm               : Dynamic Realm
```

Configuring Optional Features on the MME

The configuration examples in this section are optional and provided to cover the most common uses of the MME in a live network. The intent of these examples is to provide a base configuration for testing.

Configuring Differentiation Between HeNB-GW and eNodeBs

The MME can be configured to distinguish the Home eNodeB Gateway (HeNB-GW) from other eNodeBs. This is required to support S1 handovers to Home eNodeBs connected via a HeNB-GW.

As per 3GPP TS 36.300, section 4.6.2, the TAI used in a HeNB-GW should not be reused in another HeNB-GW. The global eNodeB id of the HeNB-GW can now be configured within the lte-policy configuration mode.

In case of S1-based handovers to Home eNodeBs served by a HeNB-GW, the lookup at MME for the target eNodeB based on global ENB id will fail, as MME is aware of only the HeNB-GW. In those cases additional lookup needs to be done based on TAI to find the HeNB-GW serving the Home eNodeB.

This feature allows operators to configure the global eNodeB ids of HeNB-GWs in the MME service. The MME uses this information to perform HeNB-GW related functions.

The following steps create an HeNB-GW management database, configures a single Global eNodeB ID and TAI within the management database, and associates the HeNB-GW management database with the MME service:

```
configure
   lte-policy
      mme  henbgw  mgmt-db  db_name
         henbgw-global-enbid mcc mcc_value mnc mnc_value enbid enbid_value
         end
configure
   context  ctxt_name
      mme-service  svc_name
         associate henbgw-mgmt-db db_name
         end
```

Notes:

- A maximum of 8 HeNB-GWs can be configured within the HeNB-GW management database.
- The **show lte-policy henbgw-mgmt-db name** *db_name* command displays configuration information about the specified HeNB-GW management database.
- The **show mme-service enodeb-association full** command displays whether the eNodeB is an HeNB-GW by including "(HeNB-GW)" in the output of the **eNodeB Type** field.

Configuring Dual Address Bearers

This example configures support for IPv4/v6 PDNs.

Use the following configuration example to enable support on the MME for dual-address bearers:

```
configure
   context  mme_context_name  -noconfirm
      mme-service  mme_svc_name
         policy network dual-addressing-support
         end
```

Configuring Dynamic Peer Selection

The configuration in this section replaces static configurations on the MME for the following peer components: MME, P-GW, S-GW, SGSN.

Use the following example to configure dynamic P-GW, S-GW, and peer MME selection through a DNS interface:

```
configure
   context mme_context_name  -noconfirm
      interface  dns_intf_name
         ip address ipv4_address
         exit
      ip domain-lookup
      ip name-servers  dns_ip_address
      dns-client  name
```

```
        bind address dns_intf_ip_address
        exit
    mme-service mme_svc_name
        dns pgw
        dns sgw
        dns peer-mme
        dns peer-sgsn
        end
```

Notes:

- For the **dns pgw**, **dns sgw**, **dns peer-mme**, and **dns peer-sgsn** commands, the DNS client service must exist in the same context as the MME service. If the DNS client resides in a different context, the **context** command and *ctx_name* variable must be added to the command(s).
- If you have associated a tai-mgmt-db with a call-control-profile, and DNS is to be used for S-GW lookups, the DNS configuration must be configured within the same call-control-profile using the **dns-sgw** command present within the call-control-profile configuration mode.

Configuring Emergency Session Support

The configuration example in this section enables emergency bearer session support on the MME.

Use the following configuration example to enable emergency bearer services on the MME:

```
configure
    lte-policy
        lte-emergency-profile profile_name
            ambr max-ul bitrate max-dl bitrate
            apn apn_name pdn-type type
            pgw ip-address address protocol type weight value
            qos qci qci arp arp_value preemption-capability capability vulnerability type
            ue-validation-level type
            exit
        mme-service mme_svc_name
            associate lte-emergency-profile profile_name
            end
```

Notes:

- A maximum of four LTE emergency profiles can be configured on the system.
- In the **apn** command, the valid PDN types are: **ipv4**, **ipv4v6**, and **ipv6**.
- In the **pgw** command, the valid protocol types are: **both**, **gtp**, and **pmip**. A maximum of four P-GW IP addresses can be configured per profile. An FQDN can also be configured in place of the IP addresses but only one P-GW FQDN can be configured per profile.
- In the **qos** command, the valid preemption capabilities are: **may** and **shall not**. The valid vulnerability types are: **not-preemptable** and **preemptable**.
- The **ue-validation-level** types are: **auth-only**, **full**, **imsi**, and **none**.
- To configure the MME to ignore the IMEI validation of the equipment during the attach procedure in emergency cases, use the following command in the **mme-service** configuration mode:
policy attach imei-query-type imei | imei-sv | none verify-equipment-identity verify-emergency

- To configure the MME to ignore the IMEI validation of the equipment during TAU procedures in emergency cases, use the following command in the **mme-service** configuration mode: **policy tau imei-query-type imei | imei-sv | none verify-equipment-identity verify-emergency**

Configuring Gn/Gp Handover Capability

The example configuration in this section provides 3G to 4G handover capabilities between the MME and a Gn/Gp SGSN. The configuration creates the Gn interface used for control signaling during the handover.

Use the following configuration example to create a Gn interface and configure the control interface on the MME for Gn/Gp handovers:

```
configure
   context mme_context_name -noconfirm
      interface Gn_intf_name
         ip address ipv4_address
         exit
      sgtp-service sgtp_svc_name
         gtpc bind address Gn_intf_ip_address
         exit
      mme-service mme_svc_name
         associate sgtpc-service sgtp_svc_name
         peer-sgsn rai mcc mcc_value mnc mnc_value rac value lac value address ip_address
capability gn
         nri length length plmn-id mcc mcc_value mnc mnc_value
         end
```

Notes:

- The **peer-sgsn** command is used to statically configure a peer SGSN. SGSN selection can also be performed dynamically through the DNS client. For more information about dynamic peer selection, refer to the Configuring Dynamic Peer Selection, on page 13 in this chapter.
- If dynamic peer-SGSN selection is configured, an additional **gtpc** command must be added to the SGTP service: **gtpc dns-sgsn context** *cntxt_name*
- In the absence of an NRI length configuration, the MME treats the NRI as invalid. The MME will use a plain RAI-based FQDN (and not an NRI-based FQDN) for DNS queries made to resolve the source SGSN.

Configuring Inter-MME Handover Support

Use the following example to configure inter-MME handover support:

```
configure
   context mme_context_name -noconfirm
      interface s10_intf_name
         ip address ipv4_address
         exit
      egtp-service egtp_service_name
         interface-type interface-mme
         gtpc bind ipv4-address s10_infc_ip_address
         exit
      exit
```

```
        mme-service mme_svc_name
            peer-mme gummei mcc number mnc number group-id id mme-code code address ipv4_address
            exit
        exit
    port ethernet slot_number/port_number
        no shutdown
        bind interface s10_interface_name mme_context_name
        end
```

Notes:

- The S10 IP address can also be specified as an IPv6 address. To support this, the **ip address** command can be changed to the **ipv6 address** command.
- The **peer-mme** command can also be configured to acquire a peer MME through the use of a TAI match as shown in this command example:
  peer-mme tai-match priority *value* **mcc** *number* **mnc** *number* **tac any address** *ipv4_address*
- The **peer-mme** command is used to statically configure a peer MME. MME selection can also be performed dynamically through the DNS client. For more information about dynamic peer selection, refer to the Configuring Dynamic Peer Selection, on page 13 in this chapter.
- The peer MME IP address can also be specified as an IPv6 address.

Configuring X.509 Certificate-based Peer Authentication

The configuration example in this section enables X.509 certificate-based peer authentication, which can be used as the authentication method for IP Security on the MME.

Important Use of the IP Security feature requires that a valid license key be installed. Contact your local Sales or Support representative for information on how to obtain a license.

The following configuration example enables X.509 certificate-based peer authentication on the MME.

In Global Configuration Mode, specify the name of the X.509 certificate and CA certificate, as follows:

```
configure
    certificate name cert_name pem url cert_pem_url private-key pprivate-keyem url private_key_url
    ca-certificate name ca_cert_name pem url ca_cert_url
    end
```

Notes:

- The **certificate name** and **ca-certificate list ca-cert-name** commands specify the X.509 certificate and CA certificate to be used.
- The PEM-formatted data for the certificate and CA certificate can be specified, or the information can be read from a file via a specified URL as shown in this example.

When creating the crypto template for IPSec in the Context Configuration Mode, bind the X.509 certificate and CA certificate to the crypto template and enable X.509 certificate-based peer authentication for the local and remote nodes, as follows:

```
configure
    context mme_context_name
```

```
crypto template crypto_template_name ikev2-dynamic
     certificate name cert_name
     ca-certificate list ca-cert-name ca_cert_name
     authentication local certificate
     authentication remote certificate
     end
```

Notes:

- A maximum of sixteen certificates and sixteen CA certificates are supported per system. One certificate is supported per service, and a maximum of four CA certificates can be bound to one crypto template.
- The **certificate name** and **ca-certificate list ca-cert-name** commands bind the certificate and CA certificate to the crypto template.
- The **authentication local certificate** and **authentication remote certificate** commands enable X.509 certificate-based peer authentication for the local and remote nodes.

Configuring Dynamic Node-to-Node IP Security on the S1-MME Interface

The configuration example in this section creates an IKEv2/IPSec dynamic node-to-node tunnel endpoint on the S1-MME interface.

Important Use of the IP Security feature requires that a valid license key be installed. Contact your local Sales or Support representative for information on how to obtain a license.

Creating and Configuring an IPSec Transform Set

The following example configures an IPSec transform set which is used to define the security association that determines the protocols used to protect the data on the interface:

```
configure
     context <mme_context_name>
          ipsec transform-set <ipsec_transform-set_name>
               encryption aes-cbc-128
               group none
               hmac sha1-96
               mode tunnel
               end
```

Notes:

- The encryption algorithm, **aes-cbc-128**, or Advanced Encryption Standard Cipher Block Chaining, is the default algorithm for IPSec transform sets configured on the system.
- The **group none** command specifies that no crypto strength is included and that Perfect Forward Secrecy is disabled. This is the default setting for IPSec transform sets configured on the system.
- The **hmac** command configures the Encapsulating Security Payload (ESP) integrity algorithm. The **sha1-96** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IPSec transform sets configured on the system.
- The **mode tunnel** command specifies that the entire packet is to be encapsulated by the IPSec header including the IP header. This is the default setting for IPSec transform sets configured on the system.

Creating and Configuring an IKEv2 Transform Set

The following example configures an IKEv2 transform set:

```
configure
    context <mme_context_name>
        ikev2-ikesa transform-set <ikev2_transform-set_name>
            encryption aes-cbc-128
            group 2
            hmac sha1-96
            lifetime <sec>
            prf sha1
            end
```

Notes:

- The encryption algorithm, **aes-cbc-128**, or Advanced Encryption Standard Cipher Block Chaining, is the default algorithm for IKEv2 transform sets configured on the system.
- The **group 2** command specifies the Diffie-Hellman algorithm as Group 2, indicating medium security. The Diffie-Hellman algorithm controls the strength of the crypto exponentials. This is the default setting for IKEv2 transform sets configured on the system.
- The **hmac** command configures the Encapsulating Security Payload (ESP) integrity algorithm. The **sha1-96** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IKEv2 transform sets configured on the system.
- The **lifetime** command configures the time the security key is allowed to exist, in seconds.
- The **prf** command configures the IKE Pseudo-random Function, which produces a string of bits that cannot be distinguished from a random bit string without knowledge of the secret key. The **sha1** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IKEv2 transform sets configured on the system.

Creating and Configuring a Crypto Template

The following example configures an IKEv2 crypto template:

```
configure
    context <mme_context_name>
        crypto template <crypto_template_name> ikev2-dynamic
            authentication local pre-shared-key key <text>
            authentication remote pre-shared-key key <text>
            ikev2-ikesa transform-set list <name1> . . . <name6>
            ikevs-ikesa rekey
            payload <name> match childsa match ipv4
                ipsec transform-set list <name1> . . . <name4>
                rekey
                end
```

Notes:

- The **ikev2-ikesa transform-set list** command specifies up to six IKEv2 transform sets.
- The **ipsec transform-set list** command specifies up to four IPSec transform sets.

Binding the S1-MME IP Address to the Crypto Template

The following example configures the binding of the S1-MME interface to the crypto template:

```
configure
          context <mme_context_name>
                    mme-service <mme_svc_name>
                              bind s1-mme ipv4-address <address> ipv4-address <address> crypto-template
<enodeb_crypto_template>
                              end
```

Notes:

- The **bind** command in the MME service configuration can also be specified as an IPv6 address using the **ipv6-address** command.
- This example shows the **bind** command using multi-homed addresses. The multi-homing feature also supports the use of IPv6 addresses.

Configuring ACL-based Node-to-Node IP Security on the S1-MME Interface

The configuration example in this section creates an IKEv2/IPSec ACL-based node-to-node tunnel endpoint on the S1-MME interface.

Important Use of the IP Security feature requires that a valid license key be installed. Contact your local Sales or Support representative for information on how to obtain a license.

Creating and Configuring a Crypto Access Control List

The following example configures a crypto ACL (Access Control List), which defines the matching criteria used for routing subscriber data packets over an IPSec tunnel:

```
configure
          context <mme_context_name>
                    ip access-list <acl_name>
                              permit tcp host <source_host_address> host <dest_host_address>
                              end
```

Notes:

- The **permit** command in this example routes IPv4 traffic from the server with the specified source host IPv4 address to the server with the specified destination host IPv4 address.

Creating and Configuring an IPSec Transform Set

The following example configures an IPSec transform set which is used to define the security association that determines the protocols used to protect the data on the interface:

```
configure
          context <mme_context_name>
                    ipsec transform-set <ipsec_transform-set_name>
```

```
                  encryption aes-cbc-128
                  group none
                  hmac sha1-96
                  mode tunnel
                  end
```

Notes:

- The encryption algorithm, **aes-cbc-128**, or Advanced Encryption Standard Cipher Block Chaining, is the default algorithm for IPSec transform sets configured on the system.
- The **group none** command specifies that no crypto strength is included and that Perfect Forward Secrecy is disabled. This is the default setting for IPSec transform sets configured on the system.
- The **hmac** command configures the Encapsulating Security Payload (ESP) integrity algorithm. The **sha1-96** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IPSec transform sets configured on the system.
- The **mode tunnel** command specifies that the entire packet is to be encapsulated by the IPSec header including the IP header. This is the default setting for IPSec transform sets configured on the system.

Creating and Configuring an IKEv2 Transform Set

The following example configures an IKEv2 transform set:

```
configure
   context <mme_context_name>
      ikev2-ikesa transform-set <ikev2_transform-set_name>
         encryption aes-cbc-128
         group 2
         hmac sha1-96
         lifetime <sec>
         prf sha1
         end
```

Notes:

- The encryption algorithm, **aes-cbc-128**, or Advanced Encryption Standard Cipher Block Chaining, is the default algorithm for IKEv2 transform sets configured on the system.
- The **group 2** command specifies the Diffie-Hellman algorithm as Group 2, indicating medium security. The Diffie-Hellman algorithm controls the strength of the crypto exponentials. This is the default setting for IKEv2 transform sets configured on the system.
- The **hmac** command configures the Encapsulating Security Payload (ESP) integrity algorithm. The **sha1-96** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IKEv2 transform sets configured on the system.
- The **lifetime** command configures the time the security key is allowed to exist, in seconds.
- The **prf** command configures the IKE Pseudo-random Function which produces a string of bits that cannot be distinguished from a random bit string without knowledge of the secret key. The **sha1** keyword uses a 160-bit secret key to produce a 160-bit authenticator value. This is the default setting for IKEv2 transform sets configured on the system.

Creating and Configuring a Crypto Map

The following example configures an IKEv2 crypto map:

```
configure
    context <mme_context_name>
        crypto map <crypto_map_name> ikev2-ipv4
            match address <acl_name>
            peer <ipv4_address>
            authentication local pre-shared-key key <text>
            authentication remote pre-shared-key key <text>
            ikev2-ikesa transform-set list  <name1> . . .  <name6>
            payload <name> match ipv4
                lifetime <seconds>
                ipsec transform-set list <name1> . . . <name4>
                exit
            exit
        interface <s1-mme_intf_name>
            ip address <ipv4_address>
            crypto-map <crypto_map_name>
            exit
        exit
    port ethernet <slot_number/port_number>
        no shutdown
        bind interface <s1-mme_intf_name> <mme_context_name>
        end
```

Notes:

- The type of crypto map used in this example is IKEv2-IPv4 for IPv4 addressing. An IKEv2-IPv6 crypto map can also be used for IPv6 addressing.
- The **ipsec transform-set list** command specifies up to four IPSec transform sets.

Configuring Mobility Restriction Support

Mobility or handover restriction is performed by handover restriction lists configured on the MME. These lists restrict inter-RAT, 3G location area, and/or 4G tracking area handovers based on the configuration in the Handover Restriction List Configuration Mode.

Important Mobility restriction support is only available through the operator policy configuration. For more information on operator policy, refer to the *Operator Policy* chapter in this guide.

Configuring Inter-RAT Handover Restrictions on the MME

Inter-RAT handover restriction configurations on the MME restrict subscribers from participating in handovers to defined radio access network types.

Use the following example to configure this feature:

```
configure
    lte-policy
```

```
        ho-restrict-list <name>
            forbidden inter-rat cdma2000
            end
```

Notes:

- Other forbidden inter-RAT choices are: all, GERAN, and UNTRAN.
- This configuration will only become operational when it is associated with a call control profile. Only one handover restriction list can be associated with a call control profile.

Configuring Location Area Handover Restrictions on the MME

Location area handover restriction lists on the MME restrict subscribers from participating in handovers to specific 3G location area codes.

Use the following example to configure this feature:

```
configure
  lte-policy
    ho-restrict-list name
      forbidden location-area plmnid id
        lac area_code area_code area_code +
        end
```

Notes:

- Up to 16 forbidden location areas can be configured per handover restriction list.
- Up to 128 location area codes can be entered in a single **lac** command line.
- This configuration will only become operational when it is associated with a call control profile. Only one handover restriction list can be associated with a call control profile.

Configuring Tracking Area Handover Restrictions on the MME

Tracking area handover restriction lists on the MME restrict subscribers from participating in handovers to specific 4G tracking area codes.

Use the following example to configure this feature:

```
configure
  lte-policy
    ho-restrict-list name
      forbidden tracking-area plmnid id
        tac area_code [ area_code + ]
        end
```

Notes:

- Up to 16 forbidden tracking areas can be configured per handover restriction list.
- Up to 128 tracking area codes can be entered in a single **tac** command line.
- This configuration will only become operational when it is associated with a call control profile. Only one handover restriction list can be associated with a call control profile.

Configuring S4-SGSN Handover Capability

This configuration example configures an S3 interface supporting inter-RAT handovers between the MME and an S4-SGSN.

Use the following example to configure this feature:

```
configure
   context mme_context_name -noconfirm
      interface s3_interface_name
         ip address ipv4_address
         exit
      mme-service mme_svc_name
         peer-sgsn rai mcc mcc_value mnc mnc_value rac value lac value address ip_address
capability s3
         nri length length plmn-id mcc mcc_value mnc mnc_value
         exit
      exit
   port ethernet slot_number/port_number
      no shutdown
      bind interface s3_interface_name mme_context_name
      end
```

Notes:

- The S3 IP address can also be specified as an IPv6 address. To support this, the **ip address** command can be changed to the **ipv6 address** command.
- The **peer-sgsn** command is used to statically configure a peer SGSN. SGSN selection can also be performed dynamically through the DNS client. For more information about dynamic peer selection, refer to the Configuring Dynamic Peer Selection, on page 13 section in this chapter.
- In the absence of an NRI length configuration, the MME treats the NRI as invalid. The MME will use a plain RAI-based FQDN (and not an NRI-based FQDN) for DNS queries made to resolve the source SGSN.

Configuring SCTP Multi-homing Support

SCTP multi-homing can be configured on the S1-MME interface (to/from eNodeB), the S6a interface (to/from HLR/HSS), and the SGs interface (to/from the MSC/VLR).

Configuring SCTP Multi-homing on the S1-MME Interface

Up to two IPv4 or IPv6 addresses for the S1-MME interface can be entered to allow for SCTP multi-homing.

The configuration example in this section is intended as a replacement for the S1-MME interface configuration located in the section for Creating and Configuring the MME Context and Service, on page 9. Use the following example to configure S1-MME multi-homing between the MME and the eNodeB:

```
configure
   context mme_context_name -noconfirm
      interface s1-mme_intf_name
         ip address ipv4_address
         ip address secondary_ipv4_address
```

```
            exit
        mme-service mme_svc_name
            bind s1-mme ipv4-address ipv4_address ipv4-address secondary_ipv4_address
            exit
        exit
    port ethernet slot_number/port_number
        no shutdown
        bind interface s1-mme_intf_name mme_context_name
        end
```

Notes:

- The S1-MME IP addresses can also be specified as IPv6 addresses using the **ipv6 address** keyword.
- The IP addresses in the **bind s1-mme ipv4-address** command can also be specified as IPv6 addresses using the **ipv6-address** keyword.

Configuring SCTP Multi-homing on the S6a Interface

Up to four IPv4 or IPv6 addresses for the S6a interface can be configured to allow for SCTP multi-homing.

The configuration example in this section is intended as a replacement for the S6a interface configuration located in Creating and Configuring the MME Context and Service, on page 9 section and the Diameter configuration for the S6a interface located in Creating and Configuring the HSS Peer Service and Interface Associations, on page 10 . Use the following example to configure S6a multi-homing between the MME and the HLR/HSS:

```
configure
    context mme_context_name
        interface s6a_intf_name
            ip address s6a_intf_primary_ip_addr ip_mask
            ip address s6a_intf_secondary_ip_addr2 ip_mask secondary
            ip address s6a_intf_secondary_ip_addr3 ip_mask secondary
            exit
        exit
    diameter endpoint hss-endpoint_name
        origin realm realm_name
        origin host name address s6a_intf_primary_ip_addr port number address
s6a_intf_secondary_ip_addr2 port number address s6a_intf_secondary_ip_addr3 port number
        peer peer_name realm realm_name address hss_ip_addr1 port number address hss_ip_addr2
  port number sctp
        route-entry realm realm_name peer peer_name
        exit
    port ethernet slot_number/port_number
        no shutdown
        bind interface s6a_intf_name mme_context_name
        exit
```

Notes:

- The S6a IP addresses can also be specified as IPv6 addresses using the **ipv6 address** keyword.

Configuring S6a SCTP and Application Timers for Multi-homing

In the event of a path failure, the SCTP multi-homing feature requires time to activate the alternate path. Timers associated with the SCTP heartbeat and the application in this instance, a Diameter watchdog request, must be tuned properly to ensure that the application does not timeout before the redundant SCTP path can be activated. The required calculation is based on the two paths configured between the MME and the HSS, the maximum retransmission configuration for the SCTP paths, and the SCTP heartbeat timeout configuration. The configuration of the timers must be identical on both peers.

The recommended SCTP timer values are provided below in the first row for the Diameter application default values that follow the typical case of two paths between the MME and HSS SCTP peers. SCTP HB interval can be in the range of 1 to 10 seconds, since (10 sec x 1 retx x 2 paths = 20 seconds) (30 sec watchdog timeout x 1 retry).

The second row displays the recommended configuration using the same Diameter defaults but providing a SCTP heartbeat timer that reduces heartbeat traffic.

Table 3: SCTP/Application Timer Configuration Values

SCTP Heartbeat Timeout	SCTP Path Max Retransmissions	Diameter Device Watchdog Timeout	Diameter Watchdog Request Max Retries
1-10 range	1	30 (default)	1 (default)
5	1	30 (default)	1 (default)

The following example configures the SCTP and application timers for the S6a SCTP interface supporting multi-homing:

```
configure
   sctp-param-template name
      sctp-max-path-retx value
      timeout sctp-heart-beat value
      exit
   context name
      diameter endpoint endpoint_name
         associate sctp-parameter-template template_name
         device-watchdog-request max-retries retry_count
         watchdog-timeout timeout
         end
```

Notes:

- When no SCTP parameter template is associated with the Diameter endpoint, the following default values are used:

  sctp-max-path-retx *10* (default in the parameter template is 5)

  timeout sctp-heart-beat *30* (default for the parameter template as well)

Configuring SCTP Multi-homing on the SGs Interface

Up to two IPv4 or IPv6 addresses for the SGs interface can be entered to allow for SCTP multi-homing.

Use the following example to configure SGs multi-homing between the MME and the MSC/VLR:

```
configure
   context mme_context_name -noconfirm
      interface s1-mme_intf_name
         ip address ipv4_address
```

```
            ip address  secondary_ipv4_address
            exit
        sgs-service  mme_svc_name
            bind ipv4-address  ipv4_address  ipv4-address secondary_ipv4_address
            exit
        exit
    port ethernet slot_number/port_number
        no shutdown
        bind interface sgs_intf_name  mme_context_name
        end
```

Notes:

- The SGs IP addresses can also be specified as IPv6 addresses using the **ipv6 address** keyword.
- The IP addresses in the **bind ipv4-address** command can also be specified as IPv6 addresses using the **ipv6-address** keyword.

SCTP Parameters for MME

The details on the configurable values for SCTP parameters are provided in the table given below:

Parameter	Minimum value	Maximum value	Granularity
RTO.min	10ms	5s	10ms
RTO.max	500ms	120s	10ms
RTO.initial	RTO.min	RTO.max	10ms
RTO.alpha	1/8	1/8	-
RTO.beta	1/4	1/4	-
Valid.Cookie.Life	5s	120s	1s
HB.interval	1s	300s	1s
SACK period	0ms	500ms	10ms
SACK frequency	1	5	1
MTU size	508 bytes	65535 bytes	1 byte

The details on the default values for SCTP parameters are provided in the table given below:

Parameter	Default value
RTO Alpha	5
RTO Beta	10

Parameter	Default value
Valid Cookie Life	600
Max. associate retransmission value	10
Max. number of outgoing streams	16
Max. number of incoming streams	16
Max. retransmission initiations	5
Max. MTU size	1500
Min. MTU size	508
Start MTU	1500
Max. path retransmission	5
RTO Initital	30
RTO Max	600
RTO Min	10
HB interval	30
HB enable	True
SACK period	2
SACK frequency	2
Bundle valid	True
Bundle enable	False

Configuring Static S-GW Pools

The MME supports static TAI list configuration which allows for the mapping of TAIs, TACs, and S-GWs to facilitate S-GW pooling for UEs moving between TAIs in their TAI lists.

Creating and Configuring a TAI Management Database and Object

This section provides configuration examples for creating and configuring the TAI/S-GW associations for S-GW pooling.

Use the following example to configure this feature on the MME:

```
configure
   lte-policy
      tai-mgmt-db db_name
         tai-mgmt-obj object_name
         tai mcc number mnc number tac value
         sgw-address ipv4_address s5-s8-protocol gtp weight number
         end
```

Notes:

- Up to four databases can be configured on the system.
- Up to 500 management objects can be configured per database.
- Up to 16 TAIs can be configured per management object.
- Up to 16 TACs can be configured per TAI.
- The **sgw-address** variable can also be specified as an IPv6 address.
- Up to 32 S-GW IP addresses can be configured per management object.
- Weights for IPv4 addresses are ignored if IPv6 addresses are present meaning only IPv6 addresses are load-balanced if present.
- The s5-s8-protocol can also be specified as **pmip** or **both** (GTP and PMIP).

Associating a TAI Management Database with an MME Service

In order for an MME service to use a statically configured S-GW pool, it must be associated with the TAI Management Database.

Use the following example to configure the TAI Management Database-to-MME service association:

```
configure
   context mme_context_name
      mme-service mme_svc_name
         associate tai-mgmt-db database_name
         end
```

Notes:

- Only one TAI Management Database can be configured per MME service.
- This association can also be performed in the Call Control Profile Configuration Mode supporting Operator Policy. If both associations are configured, the Operator Policy association is preferred by the system.

Associating a TAI Management Database with a Call Control Profile

MME service can access a statically configured S-GW pool through an Operator Policy instance, specifically through the Call Control Profile.

Use the following example to configure the TAI Management Database-to-MME service association:

```
configure
   call-control-profile name
```

```
        associate tai-mgmt-db database_name
        end
```

Notes:

- Only one TAI Management Database can be configured per Call Control Profile.
- This association can also be performed in the MME Service Configuration Mode. If both associations are configured, the Operator Policy association is preferred by the system.
- If the tai-mgmt-db is associated with a call-control-profile, and DNS is to be used for S-GW lookups, the DNS configuration must be configured within the same call-control-profile using the **dns-sgw** command within the call-control-profile configuration mode.

Configuring UMTS to LTE ID Mapping

UMTS networks are configured with LACs allocated from the reserved space of 32K to 64K. In LTE networks, this space is typically reserved for MME group IDs. To overcome this issue during inter-RAT handovers, the MME can be configured with mappings between LACs and MME group IDs.

Use the following configuration example to map PLMN IDs to MME group IDs:

```
configure
   lte-policy
      network-global-mme-id-mgmt-db
         plmn mcc mcc_value mnc mnc_value mme-group-id-range first id last id
         exit
      exit
   context mme_service_context
      mme-service service_name
         associate network-global-mme-id-mgmt-db
         end
```

Notes:

- Up to 32 mappings can be configured on the system.
- Overlapping ranges can be identified in the output of the **show configuration errors** command.

Configuring User Location Information Reporting Support

This feature allows the MME to query and receive UE location reports from an eNodeB.

Note User Location Information Reporting is a licensed feature and requires the purchase of the ULI Reporting feature license to enable it.

Use the following example to configure User Location Information (ULI) reporting support on the MME:

```
configure
   context mme_context_name
      mme-service mme_svc_name
         location-reporting
         end
```