



Cisco ASR 5000 Series Mobility Management Entity Administration Guide

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About this Guide

This document pertains to features and functionality that run on and/or that are related to the Cisco® ASR 5000 Chassis, formerly the Starent Networks ST40.

Conventions Used

The following tables describe the conventions used throughout this documentation.

Icon	Notice Type	Description
	Information Note	Provides information about important features or instructions.
	Caution	Alerts you of potential damage to a program, device, or system.
	Warning	Alerts you of potential personal injury or fatality. May also alert you of potential electrical hazards.
	Electro-Static Discharge (ESD)	Alerts you to take proper grounding precautions before handling a product.

Typeface Conventions	Description
Text represented as a <code>screen display</code>	This typeface represents displays that appear on your terminal screen, for example: <code>Login:</code>
Text represented as <code>commands</code>	This typeface represents commands that you enter, for example: <code>show ip access-list</code> This document always gives the full form of a command in lowercase letters. Commands are not case sensitive.
Text represented as a <code>command variable</code>	This typeface represents a variable that is part of a command, for example: <code>show card slot_number</code> <code>slot_number</code> is a variable representing the desired chassis slot number.
Text represented as menu or sub-menu names	This typeface represents menus and sub-menus that you access within a software application, for example: Click the File menu, then click New

Command Syntax Conventions	Description
{ <code>keyword</code> or <code>variable</code> }	Required keywords and variables are surrounded by grouped brackets. Required keywords and variables are those components that are required to be entered as part of the command syntax.

Command Syntax Conventions	Description
[keyword or <i>variable</i>]	Optional keywords or variables, or those that a user may or may not choose to use, are surrounded by square brackets.
	<p>With some commands there may be a group of variables from which the user chooses one. These are called alternative variables and are documented by separating each variable with a vertical bar (also known as a pipe filter).</p> <p>Pipe filters can be used in conjunction with required or optional keywords or variables. For example:</p> <pre>{ nonce timestamp }</pre> <p>OR</p> <pre>[count <i>number_of_packets</i> size <i>number_of_bytes</i>]</pre>

Contacting Customer Support

Use the information in this section to contact customer support.

For New Customers: Refer to the support area of <http://www.cisco.com> for up-to-date product documentation or to submit a service request. A valid username and password is required to this site. Please contact your local sales or service representative for additional information.

For Existing Customers with support contracts through Starent Networks: Refer to the support area of <https://support.starentnetworks.com/> for up-to-date product documentation or to submit a service request. A valid username and password is required to this site. Please contact your local sales or service representative for additional information.



IMPORTANT: For warranty and repair information, please be sure to include the Return Material Authorization (RMA) tracking number on the outside of the package.

Chapter 1

MME in LTE/SAE Wireless Data Services

The Cisco® ASR 5000 chassis provides LTE/SAE wireless carriers with a flexible solution that functions as a Mobility Management Entity (MME) in 3GPP Long-Term Evolution/System Architecture Evolution wireless data networks.

This overview provides general information about the MME including:

- [Product Description](#)
- [Product Specification](#)
- [Network Deployment and Interfaces](#)
- [Features and Functionality - Base Software](#)
- [Features and Functionality - Licensed Enhanced Feature Software](#)
- [How MME Works](#)
- [Supported Standards](#)

Product Description

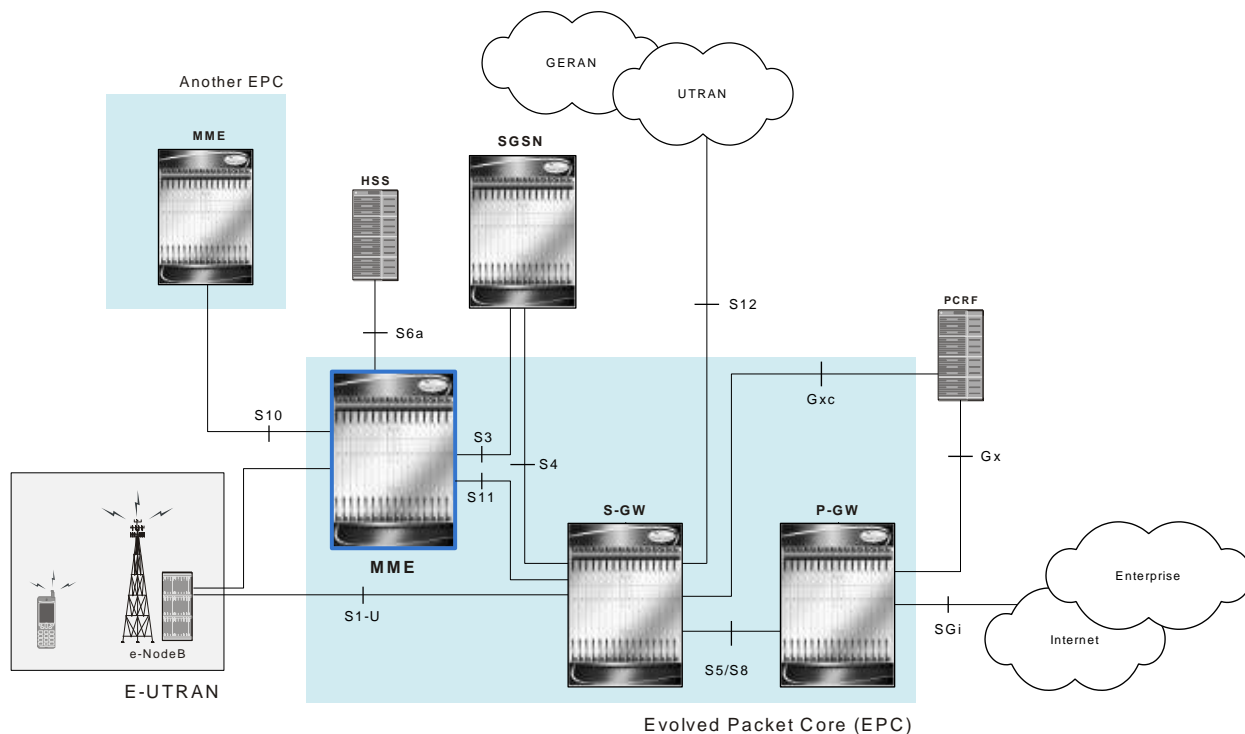
This section describes the MME network function and its position in LTE network.

The MME is the key control-node for the LTE access-network. It works in conjunction with Evolved NodeB (eNodeB), Serving Gateway (SGW) within the Evolved Packet Core (EPC) or LTE/SAE core network to perform the following functions:

- Involved in the bearer activation/deactivation process and is also responsible for choosing the serving gateway (SGW) and for a UE at the initial attach and at time of intra-LTE handover involving Core Network (CN) node relocation
- Provide PDN Gateway (P-GW) selection for subscriber to connect to PDN.
- Provide idle mode UE tracking and paging procedure including retransmissions
- Responsible for authenticating the user (by interacting with the HSS)
- Work as termination point for the Non-Access Stratum (NAS) signaling
- Responsible for generation and allocation of temporary identities to UEs
- It checks the authorization of the UE to camp on the service provider's Public Land Mobile Network (PLMN) and enforces UE roaming restrictions.
- The MME is the termination point in the network for ciphering/integrity protection for NAS signaling and handles the security key management.

Besides above mentioned functions the Lawful interception of signaling is also supported by the MME. The MME also provides the control plane function for mobility between LTE and 2G/3G access networks with the S3 interface terminating at the MME from the SGSN. The MME also terminates the S6a interface towards the home HSS for roaming UEs.

Figure 1. Architecture of LTE/SAE Network



In accordance with 3GPP standard, the MME provides following functions and procedures in LTE/SAE network:

- Non Access Stratum (NAS) signalling
- NAS signalling security
- Inter CN node signalling for mobility between 3GPP access networks (terminating S3)
- UE Reachability in ECM-IDLE state (including control and execution of paging retransmission)
- Tracking Area list management
- PDN GW and Serving GW selection
- MME selection for handover with MME change
- SGSN selection for handover to 2G or 3G 3GPP access networks
- Roaming (S6a towards home HSS)
- Authentication
- Bearer management functions including dedicated bearer establishment
- Lawful Interception of signalling traffic
- Warning message transfer function (including selection of appropriate eNodeB)
- UE Reachability procedures
- Interfaces with MSC for Voice paging
- Interfaces with Gn/Gp SGSN for interconnecting to legacy network
- MAP based Gr interface to legacy HLR



IMPORTANT: Some of the features may not be available in this release. Kindly contact your local Cisco representative for more information on supported features.

Product Specification

This section describes the hardware and software requirement for MME service.

The following information is located in this section:

- [Licenses](#)
- [Hardware Requirements](#)
- [Operating System Requirements](#)

Licenses

The MME is a licensed product. A session use license key must be acquired and installed to use the MME service.

The following licenses are available for this product:

- MME Software Bundle License, 10K Sessions, 600-00/01-7646
- MME Software Base License, 1K Sessions, 600-00/01-7648

For more information on supported features, refer *Features and Functionality* sections.

Hardware Requirements

Information in this section describes the hardware required to enable the MME service.

Platforms

The MME service operates on the following platform(s):

- ASR 5000

System Hardware Components

The following application and line cards are required to support MME services on the system:

- **System Management Cards (SMC):** Provides full system control and management of all cards within the ASR 5000 platform. Up to two SMC can be installed; one active, one redundant.
- **Packet Services Cards (PSC/PSC2):** Within the ASR 5000 platform, PSCs/PSC2s provide high-speed, multi-threaded EPS Bearer context processing capabilities for MME services. Up to 14 PSCs/PSC2s can be installed, allowing for multiple active and/or redundant cards.

- **Switch Processor Input/Outputs (SPIOs):** Installed in the upper-rear chassis slots directly behind the SPCs/SMCs, SPIOs provide connectivity for local and remote management, central office (CO) alarms. Up to two SPIOs can be installed; one active, one redundant.
- **Line Cards:** The following rear-loaded line cards are currently supported by the system:
 - **Ethernet 10/100 and/or Ethernet 1000 Line Cards:** Installed directly behind PSCs, these cards provide the physical interfaces to elements in the LTE/SAE network. Up to 26 line cards should be installed for a fully loaded system with 13 active PSCs/PSC2, 13 in the upper-rear slots and 13 in the lower-rear slots for redundancy. Redundant PSCs/PSC2s do not require line cards.
 - **Quad Gig-E Line Cards (QGLCs):** The 4-port Gigabit Ethernet line card is used in the ASR 5000 system only and is commonly referred to as the Quad-GigE Line Card or the QGLC. The QGLC is installed directly behind its associated PSC/PSC2 to provide network connectivity to the packet data network.
 - **10 Gig-E Line Cards(XGLCs):** The 10 Gigabit Ethernet Line Card is used in the ASR 5000 system only and is commonly referred to as the XGLC. The XGLC supports higher speed connections to packet core equipment, increases effective throughput between the ASR 5000 and the packet core network, and reduces the number of physical ports needed on the ASR 5000.

The one-port XGLC supports the IEEE 802.3-2005 revision which defines full duplex operation of 10 Gigabit Ethernet.

The XGLC is configured and monitored via the System Management Card (SMC) over the system's control bus. Both SMCs must be active to maintain maximum forwarding rates.
- **Redundancy Crossbar Cards (RCCs):** Installed in the lower-rear chassis slots directly behind the SPCs/SMCs, RCCs utilize 5 Gbps serial links to ensure connectivity between Ethernet 10/100/Ethernet 1000/Quad Gig-E/10 Gig-E line cards and every PSC/PSC2 in the system for redundancy. Two RCCs can be installed to provide redundancy for all line cards and PSCs/PSC2a.



IMPORTANT: Additional information pertaining to each of the application and line cards required to support LTE/SAE services is located in the *Hardware Platform Overview* chapter of the *Product Overview Guide*.

Operating System Requirements

The MME is available for ASR 5000 platforms running StarOS™ Release 9.0 or later.

Network Deployment and Interfaces

This section describes the supported interfaces and deployment scenario of MME in LTE/SAE network.

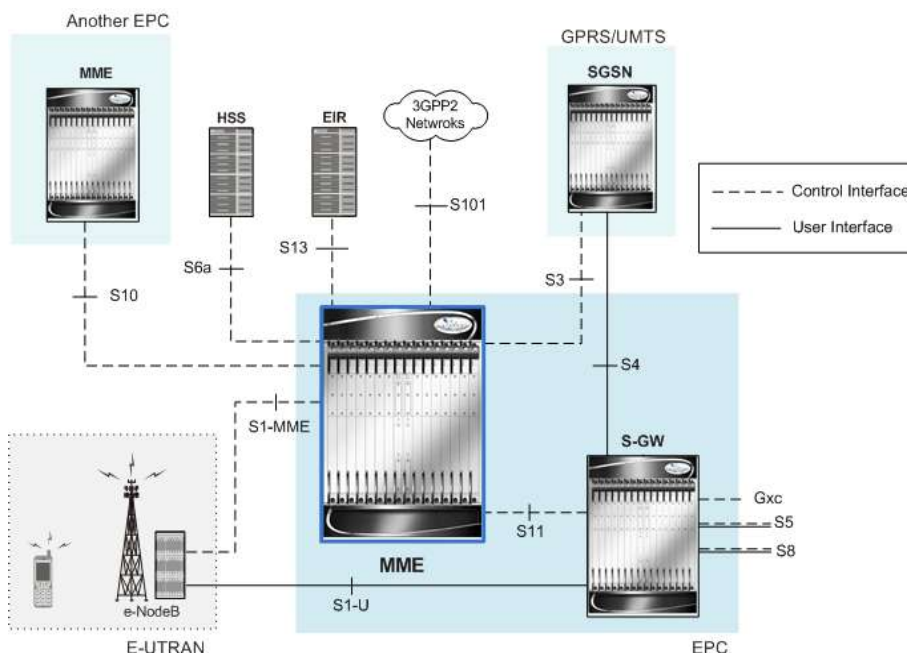
The following information is provided in this section:

- [MME in the LTE/SAE Network](#)
- [Supported Interfaces](#)

MME in the LTE/SAE Network

The following figure displays simplified network views of the MME in an LTE/SAE network with GPRS/UMTS network as neighboring network.

Figure 2. The MME in LTE/SAE Networks and Interfaces



Supported Interfaces

In support of both mobile and network originated subscriber UE contexts, the system MME provides the following network interfaces:

- **S1-MME Interface:** This interface is the reference point for the control plane protocol between eNodeB and MME. S1-MME uses S1- Application Protocol (S1-AP) over Stream Control Transmission Protocol (SCTP) as the transport layer protocol for guaranteed delivery of signaling messages between MME and eNodeB (S1).

This is the interface used by the MME to communicate with eNodeBs on the same LTE Public Land Mobile Network (PLMN). This interface serves as path for establishing and maintaining subscriber UE contexts.

One or more S1-MME interfaces can be configured per system context.

- **S3 Interface:** This is the interface used by the MME to communicate with SGSNs on the same Public PLMN for interworking between GPRS/UMTS and LTE network access technology. This interface serves as both the signalling and data path for establishing and maintaining subscriber UE contexts.

The MME communicates with SGSNs on the PLMN using the GPRS Tunnelling Protocol (GTP). The signalling or control aspect of this protocol is referred to as the GTP Control Plane (GTPC) while the encapsulated user data traffic is referred to as the GTP User Plane (GTPU).

One or more S3 interfaces can be configured per system context.

- **S6a Interface:** This is the interface used by the MME to communicate with the Home Subscriber Server (HSS). The HSS is responsible for transfer of subscription and authentication data for authenticating/authorizing user access and UE context authentication. The MME communicates with the HSSs on the PLMN using Diameter protocol.

One or more S6a interfaces can be configured per system context.

- **S10 Interface:** This is the interface used by the MME to communicate with MME in same PLMN or on different PLMNs. This interface is also used for MME relocation and MME to MME information transfer or handoff.

One or more S10 interfaces can be configured per system context.

Note: This interface will be supported in future release.

- **S11 Interface:** This interface provides communication between MME and Serving Gateways (SGW) for information transfer using GTPv2 protocol.

One or more S11 interfaces can be configured per system context.

- **S13 Interface:** This interface provides communication between MME and Equipment Identity Register (EIR). This interface is not supported in this release.

One or more S13 interfaces can be configured per system context.

Note: This interface will be supported in future release.

- **S101 Interface:** This interface provides communication between MME and High Rate Packet Data (HRPD) access node in a 3GPP2 network. It uses an application layer protocol S101-AP to enable interactions between Evolved Packet System (EPS) and HRPD access node to allow for pre-registration and handover signalling with the target system. The S101 interface supports procedures for pre-registration, session maintenance, and active handoffs between E-UTRAN and HRPD networks.

One or more S101 interfaces can be configured per system context.

Note: This interface will be supported in future release.

- **DNS Interface:** MME supports DNS interface to locate the S-GW in EPS core network. The MME uses the Tracking Area List as fully qualified domain name (FQDN) to locate the address of the S-GW to establish the call with.

One or more DNS interface can be configured per system context.

- **Gr Interface:** This is the interface used by the MME to communicate with the Home Location Register (HLR) via a eGTP-to-MAP (Mobile Application Part) protocol convertor. This interface is used for network initiated UE contexts.

For network initiated UE contexts, the MME will communicate with the protocol convertor using eGTP. The convertor, in turn, will communicate with the HLR using MAP over Signalling System 7 (SS7).

One or more Gr interfaces can be configured per system context.

Note: This interface will be supported in future release.



IMPORTANT: MME Software also supports additional interfaces. For more information on additional interfaces, refer *Features and Functionality - Licensed Enhanced Feature Software* section.

Features and Functionality - Base Software

This section describes the features and functions supported by default in base software on MME service and do not require any additional license to implement the functionality with the MME service.



IMPORTANT: To configure the basic service and functionality on the system for MME service, refer configuration examples provide in *MME Administration Guide*.

Following features and supports are discussed in this section:

- [Subscriber Session Management Features](#)
- [Session and Quality of Service Management](#)
- [Network Access Control Functions](#)
- [Network Entity Management](#)
- [Network Operation Management Functions](#)
- [System Management Features](#)

Subscriber Session Management Features

This section describes following features:

- [EPS Bearer Context Support](#)
- [NAS Protocol Support](#)
- [EPS GTPv2 Support on S11 Interface](#)
- [Subscriber Level Session Trace](#)

EPS Bearer Context Support

Provides support for subscriber default and dedicated Evolved Packet System (EPS) bearer contexts in accordance with the following standards:

- **3GPP TS 36.412 V8.4.0 (2008-12):** 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Access Network (E-UTRAN); S1 signaling transport (Release 8)
- **3GPP TS 36.413 V8.4.0 (2008-12):** 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (Release 8)
- IETF RFC 4960, Stream Control Transmission Protocol, December 2007

EPS bearer context processing is based on the APN that the subscriber is attempting to access. Templates for all of the possible APNs that subscribers will be accessing must be configured within the system. Up to 1024 APNs can be configured on the system.

Each APN template consists of parameters pertaining to how UE contexts are processed such as the following:

- PDN Type:IPv4, IPv6, or IPv4v6
- EPS Bearer Context timers
- Quality of Service

A total of 11 EPS bearer per subscriber are supported. These could be all dedicated, or 1 default and 10 dedicated or any combination of default and dedicated context. Note that there must be at least one default EPS Bearer context in order for dedicated context to come up.

NAS Protocol Support

MME provides this protocol support between the UE and the MME. The NAS protocol includes following elementary procedures for EPS Mobility Management (EMM) and EPS Session Management (ESM):

EPS Mobility Management (EMM)

This feature used to support the mobility of user equipment, such as informing the network of its present location and providing user identity confidentiality. It also provides connection management services to the session management (SM) sublayer.

An EMM context is established in the MME when an attach procedure is successfully completed. The EMM procedures are classified as follows:

- **EMM Common Procedures:** An EMM common procedure can always be initiated when a NAS signalling connection exists.

Following are the common EMM procedure types:

- Globally Unique Temporary Identity (GUTI) reallocation
- Authentication and security mode
- Identification
- EMM information
- **EMM Specific Procedures:** This procedure provides Subscriber Detach or de-registration procedure.
- **EMM Connection Management Procedures:** This procedure provides connection management related function like Paging procedure.

EPS Session Management (ESM)

This feature is used to provide the subscriber session management for bearer context activation, deactivation, modification, and update procedures.

EPS GTPv2 Support on S11 Interface

Support for the EPS GTPv2 on S11 interface in accordance with the following standards:

- **3GPP TS 29.274 V8.1.0 (2009-03):** 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3 (Release 8)

The system supports the use of GTPv2 for EPS signalling context processing.

When the GTPv2 protocol is used, accounting messages are sent to the charging gateways (CGs) over the Ga interface. The Ga interface and GTPv2 functionality are typically configured within the system's source context. As specified by the standards, a CDR is not generated when a session starts. CDRs are generated according to the interim triggers configured using the charging characteristics configured for the MME, and a CDR is generated when the session ends. For interim accounting, STOP/START pairs are sent based on configured triggers.

GTP version 2 is always used. However, if version 2 is not supported by the CGF, the system reverts to using GTP version 1. All subsequent CDRs are always fully-qualified partial CDRs. All CDR fields are R4.

Whether or not the MME accepts charging characteristics from the SGSN can be configured on a per-APN basis based on whether the subscriber is visiting, roaming or, home.

By default, the MME always accepts the charging characteristics from the SGSN. They must always be provided by the SGSN for GTPv1 requests for primary EPS Bearer contexts. If they are not provided for secondary EPS Bearer contexts, the MME re-uses those from the primary.

If the system is configured to reject the charging characteristics from the SGSN, the MME can be configured with its own that can be applied based on the subscriber type (visiting, roaming, or home) at the APN level. MME charging characteristics consist of a profile index and behavior settings. The profile indexes specify the criteria for closing accounting records based specific criteria.



IMPORTANT: For more information on GTPv2 configuration, refer *eGTP Service Configuration* in *MME Service Administration Guide*.

Subscriber Level Session Trace

The Subscriber Level Trace provides a 3GPP standards-based session-level trace function for call debugging and testing new functions and access terminals in an LTE environment.

In general, the Session Trace capability records and forwards all control activity for the monitored subscriber on the monitored interfaces. This is typically all the signaling and authentication/subscriber services messages that flow when a UE connects to the access network.

As a complement to Cisco's protocol monitoring function, the MME supports 3GPP standards based session level trace capabilities to monitor all call control events on the respective monitored interfaces including S6a, S1-MME and S11. The trace can be initiated using multiple methods:

- Management initiation via direct CLI configuration
- Management initiation at HSS with trace activation via authentication response messages over S6a reference interface
- Signaling based activation through signaling from subscriber access terminal

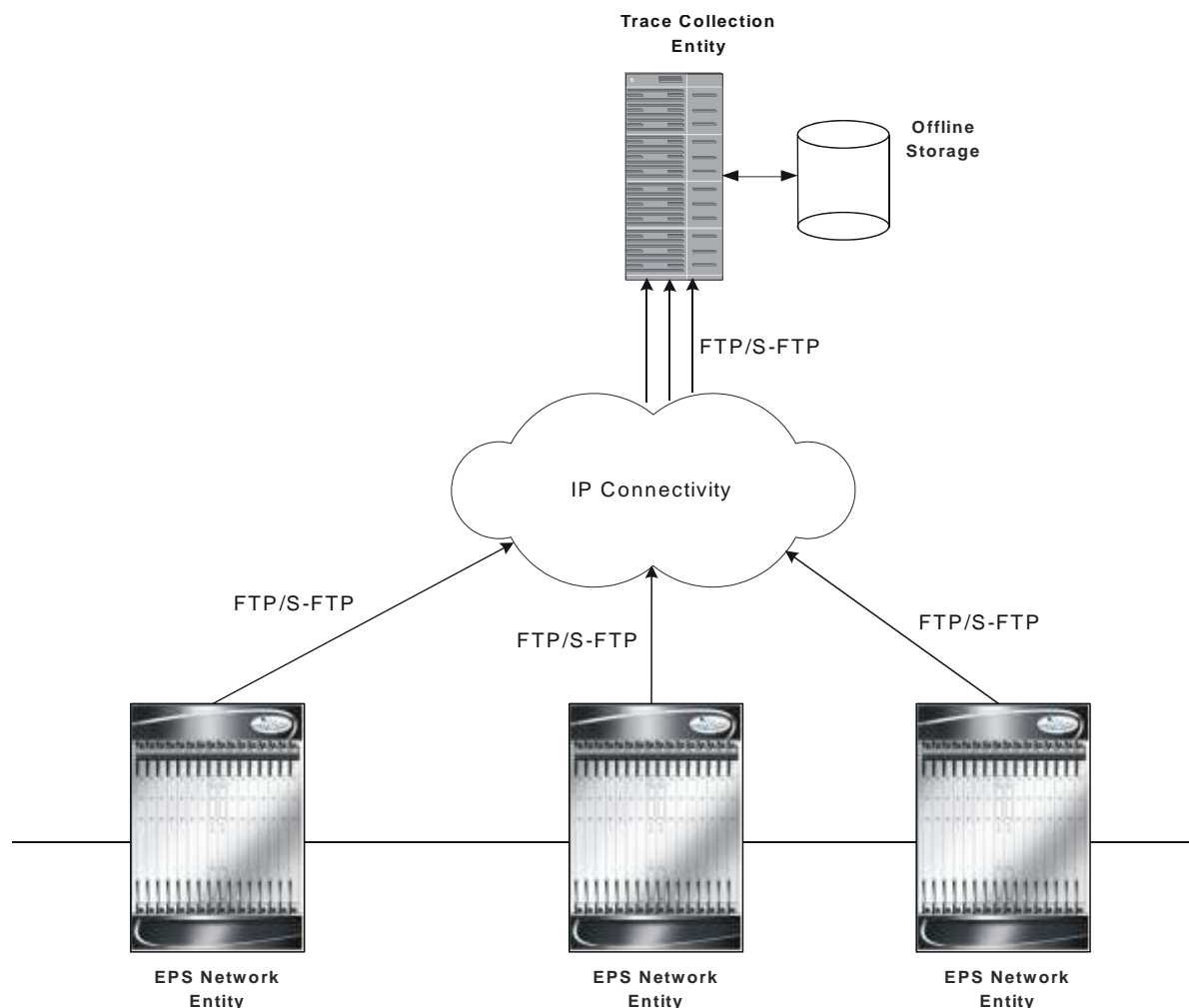
The session level trace function consists of trace activation followed by triggers. The time between the two events is treated much like Lawful Intercept where the EPC network element buffers the trace activation instructions for the provisioned subscriber in memory using camp-on monitoring. Trace files for active calls are buffered as XML files using non-volatile memory on the local dual redundant hard drives. The Trace Depth defines the granularity of data to be traced. Six levels are defined including Maximum, Minimum and Medium with ability to configure additional levels based on vendor extensions.

All call control activity for active and recorded sessions is sent to an off-line Trace Collection Entity (TCE) using a standards-based XML format over a FTP or secure FTP (SFTP) connection.

Note: In the current release the IPv4 interfaces are used to provide connectivity to the TCE. Trace activation is based on IMSI or IMEI and only *Maximum Trace Depth* is supported in this release.

The following figure shows a high-level overview of the session-trace functionality and deployment scenario:

Figure 3. Session Trace Function and Interfaces



For more information on this feature, refer *Configuring Subscriber Session Tracing* chapter in *MME Service Administration Guide*.

Session and Quality of Service Management

This support provides a foundation for contributing towards improved Quality of User Experience (QoE) by enabling deterministic end-to-end forwarding and scheduling treatments for different services or classes of applications pursuant

to their requirements for committed bandwidth resources, jitter and delay. In this way, each application receives the service treatment that users expect.

The MME Operator Policy configuration allows the specification of QoS for each traffic class that can either be used as a default or as an over ride to the HSS settings.

In LTE-EPC 4G architectures, QoS management is network controlled via dynamic policy interactions between the PCRF and PDN GW. EPS bearer management is used to establish, modify or remove dedicated EPC bearers in order to provide service treatments tied to the needs of specific applications/service data flows. The service priority is provisioned based on QoS Class Identifiers (QCI) in the Gx policy signaling. PCRF signaling interaction may also be used to establish or modify the APN-AMBR attribute assigned to the default EPS bearer.

When it is necessary to set-up a dedicated bearer, the PDN GW initiates the Create Dedicated Bearer Request which includes the IMSI (permanent identity of mobile access terminal), Traffic Flow Template (TFT - 5-tuple packet filters) and S5 Tunnel Endpoint ID (TEID) information that is propagated downstream via the SGW over the S11 interface to the MME. The Dedicated Bearer signaling includes requested QoS information such as QCI, Allocation and Retention Priority (ARP), Guaranteed Bit Rate (GBR - guaranteed minimum sending rate) and Maximum Bit Rate (MBR - maximum burst size).

The MME allocates a unique EPS bearer identity for every dedicated bearer and encodes this information in a Session Management Request that includes Protocol Transaction ID (PTI), TFT's and EPS bearer QoS parameters. The MME signals the Bearer Setup Request in the S1-MME message toward the neighboring eNodeB.

Network Access Control Functions

These functions enable secure user and device level authentication between the authenticator component of the MME and a 3GPP HSS / AuC and Diameter-based S6a interface support.

This section describes following features:

- [Authentication and Key Agreement \(AKA\)](#)
- [HSS Support Over S6a Interface](#)

Authentication and Key Agreement (AKA)

MME provides EPS Authentication and Key Agreement mechanism for user authentication procedure over the E-UTRAN. The Authentication and Key Agreement (AKA) mechanism performs authentication and session key distribution in networks. AKA is a challenge- response based mechanism that uses symmetric cryptography. AKA is typically run in a Services Identity Module.

The AKA is the procedure that take between the user and network to authenticate themselves towards each other and to provide other security features such as integrity and confidentiality protection.

In a logical order this follows the following procedure:

1. Authentication: Performs authentication by, identifying the user to the network; and identifying the network to the user.
2. Key agreement: Performs key agreement by, generating the cipher key; and generating the integrity key.
3. Protection: When the AKA procedure is performed it protects, the integrity of messages; confidentiality of signalling data; and confidentiality of user data

HSS Support Over S6a Interface

Provides a mechanism for performing Diameter-based authorization, authentication, and accounting (AAA) for subscriber bearer contexts based on the following standards:

- **3GPP TS 23.401 V8.1.0 (2008-03)**: 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 8)
- **3GPP TS 29.272 V8.1.1 (2009-01)**: 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol (Release 8)
- **3GPP TS 33.401 V8.2.1 (2008-12)**: 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; 3GPP System Architecture Evolution (SAE): Security Architecture; (Release 8)
- RFC 3588, Diameter Base Protocol, December 2003

The S6a protocol is used to provide AAA functionality for subscriber EPS Bearer contexts through Home Subscriber Server (HSS).

During the initial attachment procedures the MME sends to the USIM on AT via the HSS the random challenge (RAND) and an authentication token AUTN for network authentication from the selected authentication vector. At receipt of this message, the USIM verifies that the authentication token can be accepted and if so, produces a response. The AT and HSS in turn compute the Cipher Key (CK) and Integrity Key (IK) that are bound to Serving Network ID. During the attachment procedure the MME requests a permanent user identity via the S1-MME NAS signaling interface to eNodeB and inserts the IMSI, Serving Network ID (MCC, MNC) and Serving Network ID it receives in an Authentication Data Request to the HSS. The HSS returns the Authentication Response with authentication vectors to MME. The MME uses the authentication vectors to compute the cipher keys for securing the NAS signaling traffic.

At EAP success, the MME also retrieves the subscription profile from the HSS which includes QoS information and other attributes such as default APN name and SGW/PGW fully qualified domain names.

Among the AAA parameters that can be configured are:

- Authentication of the subscriber with HSS
- Subscriber location update/location cancel
- Update subscriber profile from the HSS
- Priority to dictate the order in which the servers are used allowing for multiple servers to be configured in a single context
- Routing Algorithm to dictate the method for selecting among configured servers. The specified algorithm dictates how the system distributes AAA messages across the configured HSS servers for new sessions. Once a session is established and an HSS server has been selected, all subsequent AAA messages for the session will be delivered to the same server.

Network Entity Management

This section describes following features:

- [MME Selection](#)
- [Packet Data Network Gateway \(P-GW\) Selection](#)
- [Serving Gateway \(S-GW\) Selection](#)

- [3GPP R8 Identity Support](#)
- [Tracking Area List Management](#)
- [Reachability Management](#)

MME Selection

The MME selection function selects an available MME for serving a UE. This feature is needed for MME selection for handover with minimal MME changes.

MME selection chooses an available MME for serving a UE. Selection is based on network topology, i.e. the selected MME serves the UE's location and in case of overlapping MME service areas, the selection function may prefer MME's with service areas that reduce the probability of changing the MME.

Packet Data Network Gateway (P-GW) Selection

Provides a straightforward method based on a default APN provided during user attachment and authentication to assign the P-GW address in the VPLMN or HPLMN. The MME also has the capacity to use a DNS transaction to resolve an APN name provided by a UE to retrieve the PDN GW address.

P-GW selection allocates a P-GW that provides the PDN connectivity for the 3GPP access. The function uses subscriber information provided by the HSS and possibly additional criteria. For each of the subscribed PDNs, the HSS provides:

- an IP address of a PDN GW and an APN, or
- an APN and an indication for this APN whether the allocation of a PDN GW from the visited PLMN is allowed or whether a PDN GW from the home PLMN shall be allocated.

The HSS also indicates the default APN for the UE. To establish connectivity with a PDN when the UE is already connected to one or more PDNs, the UE provides the requested APN for the PDN GW selection function.

If the HSS provides an APN of a PDN and the subscription allows for allocation of a PDN GW from the visited PLMN for this APN, the PDN GW selection function derives a PDN GW address from the visited PLMN. If a visited PDN GW address cannot be derived, or if the subscription does not allow for allocation of a PDN GW from the visited PLMN, then the APN is used to derive a PDN GW address from the HPLMN.

Serving Gateway (S-GW) Selection

The Serving GW selection function selects an available Serving GW to serve a UE. This feature reduces the probability of changing the Serving Gateway and a load balancing between Serving Gateways. The MME uses DNS procedure to for S-GW selection.

S-GW selection chooses an available S-GW to serve a UE. The selection is based on network topology, i.e. the selected S-GW serves the UE's location and in the case of overlapping S-GW service areas, the selection may prefer S-GWs with service areas that reduce the probability of changing the Serving GW. If a subscriber of a GTP only network roams into a P-MIP network, the PDN GWs selected for local breakout supports the P-MIP protocol, while P-GWs for home routed traffic use GTP. This means the S-GW selected for such subscribers may need to support both GTP and PMIP, so that it is possible to set up both local breakout and home routed sessions for these subscribers.

3GPP R8 Identity Support

Provides the identity allocation of following type:

- EPS Bearer Identity
 - Globally Unique Temporary UE Identity (GUTI)
 - Tracking Area Identity (TAI)
 - MME S1-AP UE Identity (MME S1-AP UE ID)
- **EPS Bearer Identity:** An EPS bearer identity uniquely identifies EPS bearers within a user session for attachment to the E-UTRAN access and EPC core networks. The EPS Bearer Identity is allocated by the MME. There is a one to one mapping between EPS Radio Bearers via the E-UTRAN radio access network and EPS Bearers via the S1-MME interface between the eNodeB and MME. There is also a one-to-one mapping between EPS Radio Bearer Identity via the S1 and X2 interfaces and the EPS Bearer Identity assigned by the MME.
 - **Globally Unique Temporary UE Identity (GUTI):** The MME allocates a Globally Unique Temporary Identity (GUTI) to the UE. A GUTI has; 1) unique identity for MME which allocated the GUTI; and 2) the unique identity of the UE within the MME that allocated the GUTI.

Within the MME, the mobile is identified by the M-TMSI.

The Globally Unique MME Identifier (GUMMEI) is constructed from MCC, MNC and MME Identifier (MMEI). In turn the MMEI is constructed from an MME Group ID (MMEGI) and an MME Code (MMEC).

The GUTI is constructed from the GUMMEI and the M-TMSI.

For paging, the mobile is paged with the S-TMSI. The S-TMSI is constructed from the MMEC and the M-TMSI.

The operator needs to ensure that the MMEC is unique within the MME pool area and, if overlapping pool areas are in use, unique within the area of overlapping MME pools.

The GUTI is used to support subscriber identity confidentiality, and, in the shortened S-TMSI form, to enable more efficient radio signaling procedures (e.g. paging and Service Request).

- **Tracking Area Identity (TAI):** Provides the function to assign the TAI list to the mobile access device to limit the frequency of Tracking Area Updates in the network. The TAI is the identity used to identify the tracking area or group of cells in which the idle mode access terminal will be paged when a remote host attempts to reach that user. The TAI consists of the Mobile Country Code (MCC), Mobile Network Code (MNC) and Tracking Area Code (TAC).
- **MME S1-AP UE Identity (MME S1-AP UE ID):** This is the temporary identity used to identify a UE on the S1-MME reference point within the MME. It is unique within the MME per S1-MME reference point instance.

Tracking Area List Management

Provides the functions to allocate and reallocate a Tracking Area Identity (TAI) list to the UE to minimize the Tracking Area updates.

The MME assigns the TAI list to a UE so as to minimize the TA updates that would be sent by the UE. The TAI list should not be very long as this would mean that the paging load would be high. There is a trade-off between paging load and Tracking Area Update procedures number.

To avoid ping-pong effect, the MME includes the last visited TAI (provided that the TA is handled by the MME) in the TAI list assigned to the UE.

The tracking area list assigned to different UEs moving in from the same tracking area should be different so as to avoid Tracking Area Update message overflow.

Reachability Management

It provides a mechanism to track a UE which is in idle state for EPS connection management.

To reach a UE in idle state the MME initiates paging to all eNodeBs in all tracking areas in the TA list assigned to the UE. The EPS session manager have knowledge about all the eNodeB associations to the MME and generates a list of eNodeBs that needs to be paged to reach a particular UE.

The location of a UE in ECM-IDLE state is known by the network on a Tracking Area List granularity. A UE in ECM-IDLE state is paged in all cells of the Tracking Areas in which it is currently registered. The UE may be registered in multiple Tracking Areas. A UE performs periodic Tracking Area Updates to ensure its reachability from the network.

Network Operation Management Functions

This section describes following features:

- [Overload Management in MME](#)
- [Radio Resource Management Functions](#)
- [Mobile Equipment Identity Check](#)
- [Multiple PDN Support](#)

Overload Management in MME

Provides mechanism to handle overload/congestion situation. It can use the NAS signalling to reject NAS requests from UEs on overload or congestion.

MME restricts the load that its eNodeBs are generating on it. This is achieved by the MME invoking the S1 interface overload procedure as per 3GPP TS 36.300 and 3GPP TS 36.413 to a proportion of the eNodeB's with which the MME has S1 interface connections.

Hardware and/or software failures within an MME may reduce the MME's load handling capability. Typically such failures result in alarms which alert the operator or Operation and Maintenance system.

For more information on congestion control management, refer Configuring Congestion Control chapter in MME Administration Guide.



CAUTION: Only if the operator or Operation and Maintenance system is sure that there is spare capacity in the rest of the pool, the operator or Operation and Maintenance system might use the load re-balancing procedure to move some load off an MME. However, extreme care is needed to ensure that this load re-balancing does not overload other MMEs within the pool area (or neighboring SGSNs) as this might lead to a much wider system failure.

Radio Resource Management Functions

Benefits

Radio resource management functions are concerned with the allocation and maintenance of radio communication paths, and are performed by the radio access network.

Description

To support radio resource management in E-UTRAN the MME provides the RAT/Frequency Selection Priority (RFSP) parameter to an eNodeB across S1. The RFSP is a 'per UE' parameter that is used by the E-UTRAN to derive UE specific cell reselection priorities to control idle mode camping. The RFSP can also be used by the E-UTRAN to decide on redirecting active mode UEs to different frequency layers or RATs.

The MME receives the RFSP from the HSS during the attach procedure. For non-roaming subscribers the MME transparently forwards the RFSP to the eNodeB across S1. For roaming subscribers the MME may alternatively send an RFSP value to the eNodeB across S1 that is based on the visited network policy, e.g. an RFSP pre-configured per Home-PLMN, or a single RFSP values to be used for all roamers independent of the Home-PLMN.

Mobile Equipment Identity Check

The Mobile Equipment Identity Check Procedure permits the operator(s) of the MME and/or the HSS and/or the PDN-GW to check the Mobile Equipment's identity with EIR.

The ME Identity is checked by the MME passing it to an Equipment Identity Register (EIR) and then the MME analyzes the response from the EIR in order to determine its subsequent actions; like rejecting/attaching a UE.

Multiple PDN Support

It provides multiple PDN connectivity support for UE initiated service request.

The MME supports an UE-initiated connectivity establishment to separate PDN GWs or single PDN GW in order to allow parallel access to multiple PDNs. Up to 11 PDNs are supported per subscriber.

System Management Features

This section describes following features:

- [Management System Overview](#)
- [Bulk Statistics Support](#)
- [Threshold Crossing Alerts \(TCA\) Support](#)
- [NAS Signalling Security](#)

Management System Overview

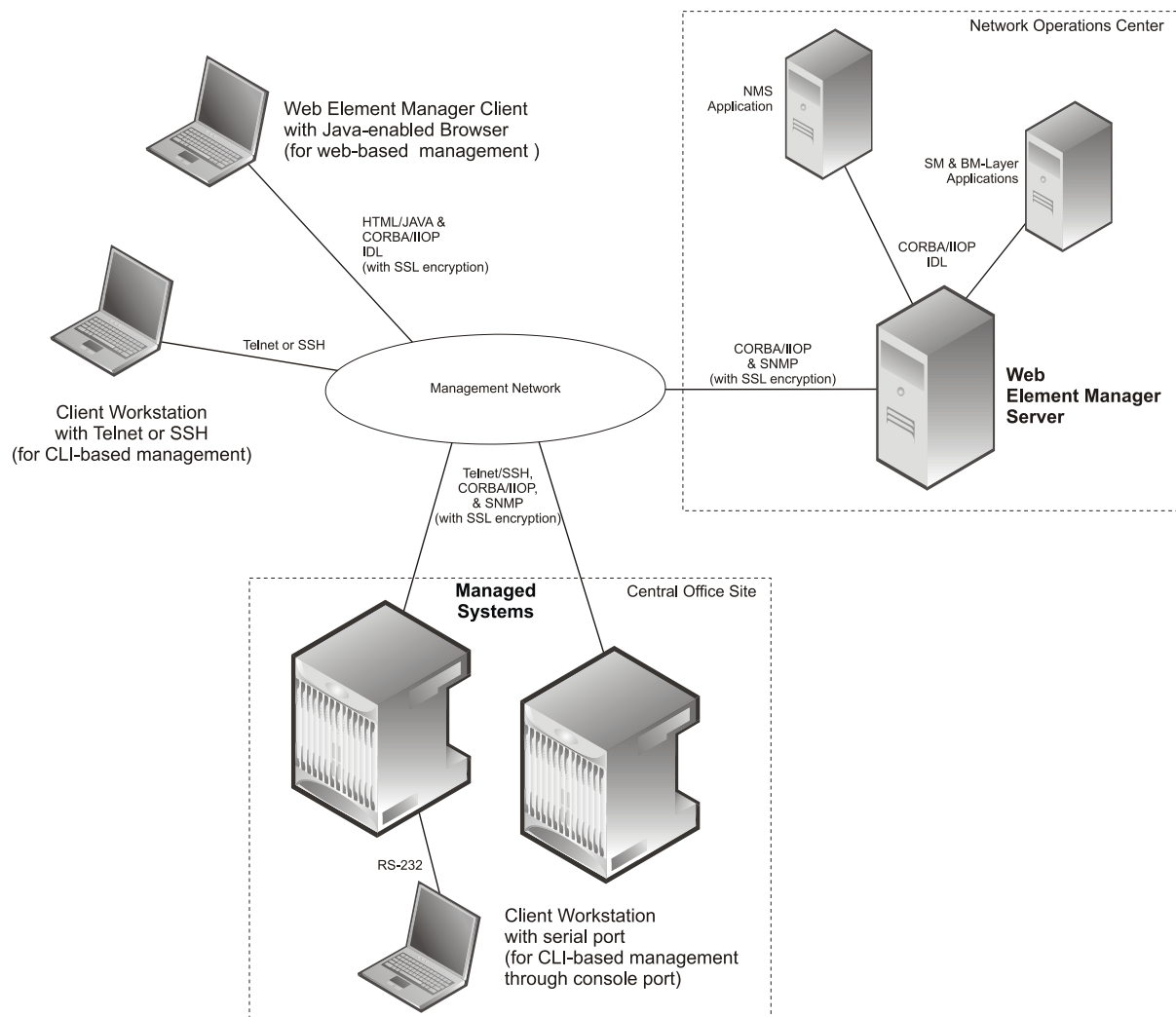
The system's management capabilities are designed around the Telecommunications Management Network (TMN) model for management - focusing on providing superior quality network element (NE) and element management system (Web Element Manager) functions. The system provides element management applications that can easily be integrated, using standards-based protocols (CORBA and SNMPv1, v2), into higher-level management systems - giving wireless operators the ability to integrate the system into their overall network, service, and business management systems. In addition, all management is performed out-of-band for security and to maintain system performance.

Operation and Maintenance module of ASR 5000 offers comprehensive management capabilities to the operators and enables them to operate the system more efficiently. There are multiple ways to manage the system either locally or remotely using its out-of-band management interfaces.

These include:

- Using the command line interface (CLI)
- Remote login using Telnet, and Secure Shell (SSH) access to CLI through SPIO card's Ethernet management interfaces
- Local login through the Console port on SPIO card using an RS-232 serial connection
- Using the Web Element Manager application
- Supports communications through 10 Base-T, 100 Base-TX, 1000 Base-TX, or 1000
- Base-SX (optical gigabit Ethernet) Ethernet management interfaces on the SPIO
- Client-Server model supports any browser (i.e. Microsoft Internet Explorer v5.0 and above or Netscape v4.7 or above, and others)
- Supports Common Object Request Broker Architecture (CORBA) protocol and Simple Network Management Protocol version 1 (SNMPv1) for fault management
- Provides complete Fault, Configuration, Accounting, Performance, and Security (FCAPS) capabilities
- Can be easily integrated with higher-level network, service, and business layer applications using the Object Management Group's (OMG's) Interface Definition Language (IDL)

The following figure demonstrates these various element management options and how they can be utilized within the wireless carrier network.

Figure 4. Element Management Methods

IMPORTANT: MME management functionality is enabled by default for console-based access. For GUI-based management support, refer *Web Element Management System*.

IMPORTANT: For more information on command line interface based management, refer *Command Line Interface Reference*.

Bulk Statistics Support

The system's support for bulk statistics allows operators to choose to view not only statistics that are of importance to them, but also to configure the format in which it is presented. This simplifies the post-processing of statistical data since it can be formatted to be parsed by external, back-end processors.

When used in conjunction with the Web Element Manager, the data can be parsed, archived, and graphed.

The system can be configured to collect bulk statistics (performance data) and send them to a collection server (called a receiver). Bulk statistics are statistics that are collected in a group. The individual statistics are grouped by schema. Following is a partial list of supported schemas:

- **System:** Provides system-level statistics
- **Card:** Provides card-level statistics
- **Port:** Provides port-level statistics
- **MME:** Provides MME service statistics
- **GTPC:** Provides GPRS Tunneling Protocol - Control message statistics
- **GTPU:** Provides GPRS Tunneling Protocol - User message statistics

The system supports the configuration of up to 4 sets (primary/secondary) of receivers. Each set can be configured with to collect specific sets of statistics from the various schemas. Statistics can be pulled manually from the chassis or sent at configured intervals. The bulk statistics are stored on the receiver(s) in files.

The format of the bulk statistic data files can be configured by the user. Users can specify the format of the file name, file headers, and/or footers to include information such as the date, chassis host name, chassis uptime, the IP address of the system generating the statistics (available for only for headers and footers), and/or the time that the file was generated.

When the Web Element Manager is used as the receiver, it is capable of further processing the statistics data through XML parsing, archiving, and graphing.

The Bulk Statistics Server component of the Web Element Manager parses collected statistics and stores the information in the PostgreSQL database. If XML file generation and transfer is required, this element generates the XML output and can send it to a Northbound NMS or an alternate bulk statistics server for further processing.

Additionally, if archiving of the collected statistics is desired, the Bulk Statistics server writes the files to an alternative directory on the server. A specific directory can be configured by the administrative user or the default directory can be used. Regardless, the directory can be on a local file system or on an NFS-mounted file system on the Web Element Manager server.

Threshold Crossing Alerts (TCA) Support

Thresholding on the system is used to monitor the system for conditions that could potentially cause errors or outage. Typically, these conditions are temporary (i.e high CPU utilization, or packet collisions on a network) and are quickly resolved. However, continuous or large numbers of these error conditions within a specific time interval may be indicative of larger, more severe issues. The purpose of thresholding is to help identify potentially severe conditions so that immediate action can be taken to minimize and/or avoid system downtime.

The system supports Threshold Crossing Alerts for certain key resources such as CPU, memory, number of sessions etc. With this capability, the operator can configure threshold on these resources whereby, should the resource depletion cross the configured threshold, a SNMP Trap would be sent.

The following thresholding models are supported by the system:

- **Alert:** A value is monitored and an alert condition occurs when the value reaches or exceeds the configured high threshold within the specified polling interval. The alert is generated then generated and/or sent at the end of the polling interval.
- **Alarm:** Both high and low threshold are defined for a value. An alarm condition occurs when the value reaches or exceeds the configured high threshold within the specified polling interval. The alert is generated then generated and/or sent at the end of the polling interval.

Thresholding reports conditions using one of the following mechanisms:

- **SNMP traps:** SNMP traps have been created that indicate the condition (high threshold crossing and/or clear) of each of the monitored values.

Generation of specific traps can be enabled or disabled on the chassis. Ensuring that only important faults get displayed. SNMP traps are supported in both Alert and Alarm modes.

- **Logs:** The system provides a facility called threshold for which active and event logs can be generated. As with other system facilities, logs are generated. Log messages pertaining to the condition of a monitored value are generated with a severity level of WARNING.

Logs are supported in both the Alert and the Alarm models.

- **Alarm System:** High threshold alarms generated within the specified polling interval are considered “outstanding” until a the condition no longer exists or a condition clear alarm is generated. “Outstanding” alarms are reported to the system's alarm subsystem and are viewable through the Alarm Management menu in the Web Element Manager.

The Alarm System is used only in conjunction with the Alarm model.



IMPORTANT: For more information on threshold crossing alert configuration, refer *Thresholding Configuration Guide*.

NAS Signalling Security

It provides integrity protection and encryption of NAS signalling. The NAS security association is between the UE and the MME.

The MME uses the NAS security mode command procedure to establish a NAS security association between the UE and MME, in order to protect the further NAS signalling messages.

The MME implements AES algorithm (128-EEA1 and 128-EEA2) for NAS signalling ciphering and SNOW 3G algorithm (128-EIA1 and 128-EIA2) for NAS signalling integrity protection.

- 128-EIA1= SNOW 3G
- 128-EIA2= AES

Features and Functionality - Licensed Enhanced Feature Software

This section describes the optional enhanced features and functions for MME service.



IMPORTANT: Some of the following features require the purchase of an additional license to implement the functionality with the MME service.

This section describes following enhanced features:

- [Session Recovery Support](#)
- [IPv6 Support](#)
- [IP Security \(IPSec\)](#)
- [Lawful Intercept](#)
- [MME Inter-Chassis Session Recovery](#)
- [Web Element Management System](#)

Session Recovery Support

The Session Recovery feature provides seamless failover and reconstruction of subscriber session information in the event of a hardware or software fault within the system preventing a fully connected user session from being disconnected.

This feature is also useful for Software Patch Upgrade activities. If session recovery feature is enabled during the software patch upgrading, it helps to permit preservation of existing sessions on the active PSC during the upgrade process.

Session recovery is performed by mirroring key software processes (e.g. session manager and AAA manager) within the system. These mirrored processes remain in an idle state (in standby-mode), wherein they perform no processing, until they may be needed in the case of a software failure (e.g. a session manager task aborts). The system spawns new instances of “standby mode” session and AAA managers for each active control processor (CP) being used.

Additionally, other key system-level software tasks, such as VPN manager, are performed on a physically separate packet processing card to ensure that a double software fault (e.g. session manager and VPN manager fails at same time on same card) cannot occur. The packet processing card used to host the VPN manager process is in active mode and is reserved by the operating system for this sole use when session recovery is enabled.

The additional hardware resources required for session recovery include a standby system processor card (SPC) and a standby packet processing card.

There are two modes for Session Recovery.

- **Task recovery mode:** Wherein one or more session manager failures occur and are recovered without the need to use resources on a standby packet processing card. In this mode, recovery is performed by using the mirrored “standby-mode” session manager task(s) running on active packet processing cards. The “standby-

mode” task is renamed, made active, and is then populated using information from other tasks such as AAA manager.

- **Full packet processing card recovery mode:** Used when a PSC or PSC2 hardware failure occurs, or when a packet processing card migration failure happens. In this mode, the standby packet processing card is made active and the “standby-mode” session manager and AAA manager tasks on the newly activated packet processing card perform session recovery.

Session/Call state information is saved in the peer AAA manager task because each AAA manager and session manager task is paired together. These pairs are started on physically different packet processing cards to ensure task recovery.



IMPORTANT: For more information on session recovery support, refer *Session Recovery* chapter in *System Enhanced Feature Configuration Guide*.

License

600-00-7513, 600-00-7546, 600-00-7552, 600-00-7554

IPv6 Support

This feature allows IPv6 subscribers to connect via the GPRS/UMTS infrastructure in accordance with the following standards:

- RFC 2460: Internet Protocol, Version 6 (IPv6) Specification
- RFC 2461: Neighbor Discovery for IPv6
- RFC 2462: IPv6 Stateless Address Autoconfiguration
- RFC 3314: Recommendations for IPv6 in 3GPP Standards
- RFC 3316: Internet Protocol Version 6 (IPv6) for Some Second and Third Generation Cellular Hosts
- RFC 3056: Connection of IPv6 domains via IPv4 clouds
- 3GPP TS 23.060: General Packet Radio Service (GPRS) Service description
- 3GPP TS 27.060: Mobile Station Supporting Packet Switched Services
- 3GPP TS 29.061: Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based Services and Packet Data Networks (PDN)

The MME allows an APN to be configured for IPv6 EPS Bearer contexts. Also, an APN may be configured to simultaneously allow IPv4 EPS Bearer contexts.

The MME supports IPv6 stateless dynamic auto-configuration. The mobile station may select any value for the interface identifier portion of the address. The link-local address is assigned by the MME to avoid any conflict between the mobile station link-local address and the MME address. The mobile station uses the interface identifier assigned by the MME during the stateless address auto-configuration procedure. Once this has completed, the mobile can select any interface identifier for further communication as long as it does not conflict with the MME's interface identifier that the mobile learned through router advertisement messages from the MME.

Control and configuration of the above is specified as part of the APN configuration on the MME, e.g., IPv6 address prefix and parameters for the IPv6 router advertisements. RADIUS VSAs may be used to override the APN configuration.

Following IPv6 EPS Bearer context establishment, the MME can perform either manual or automatic 6to4 tunneling, according to RFC 3056, Connection of IPv6 Domains Via IPv4 Clouds.

License Keys: IPv6, part numbers 600-00-7521, 600-00-7576

License

600-00-7521, 600-00-7576

IP Security (IPSec)

IP Security provides a mechanism for establishing secure tunnels from mobile subscribers to pre-defined endpoints (i.e. enterprise or home networks) in accordance with the following standards:

- RFC 2401, Security Architecture for the Internet Protocol
- RFC 2402, IP Authentication Header (AH)
- RFC 2406, IP Encapsulating Security Payload (ESP)
- RFC 2409, The Internet Key Exchange (IKE)
- RFC-3193, Securing L2TP using IPSEC, November 2001

IP Security (IPSec) is a suite of protocols that interact with one another to provide secure private communications across IP networks. These protocols allow the system to establish and maintain secure tunnels with peer security gateways. IPSec can be implemented on the system for the following applications:

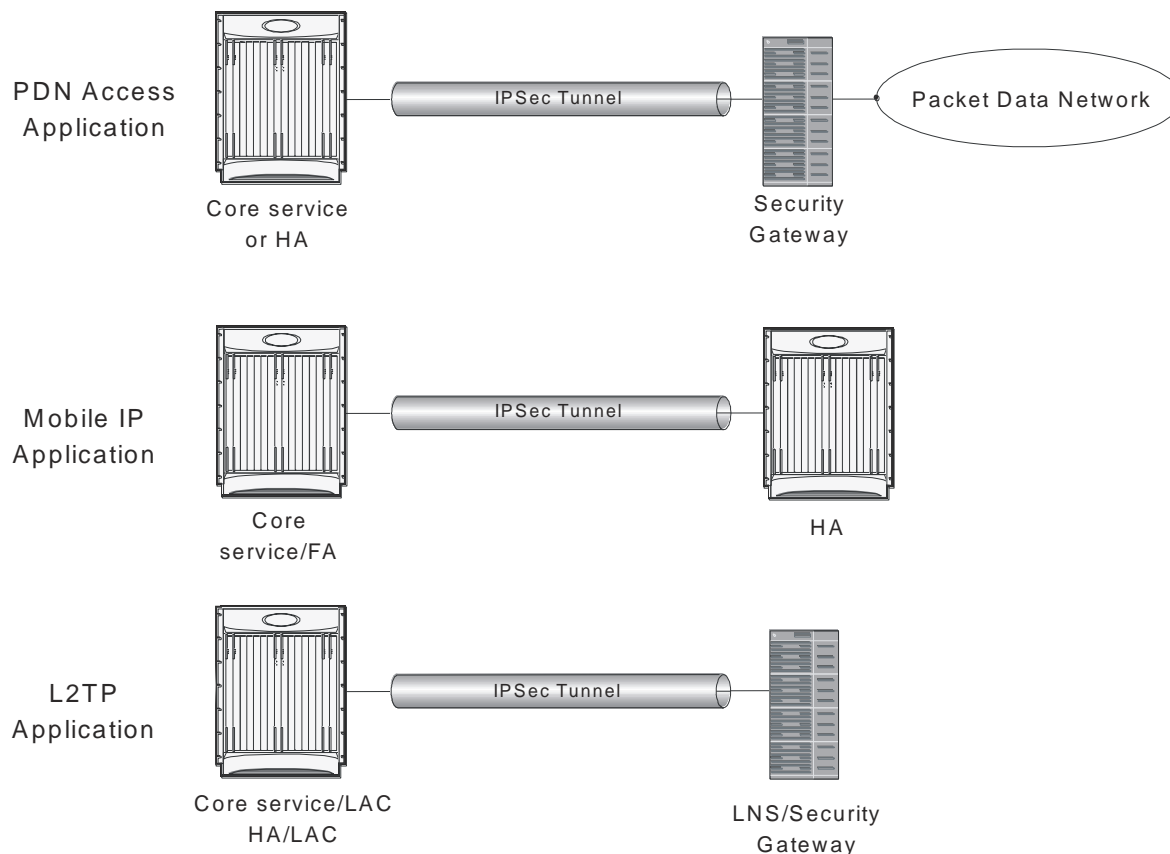
- **PDN Access:** Subscriber IP traffic is routed over an IPSec tunnel from the system to a secure gateway on the packet data network (PDN) as determined by access control list (ACL) criteria.
- **Mobile IP:** Mobile IP control signals and subscriber data is encapsulated in IPSec tunnels that are established between foreign agents (FAs) and home agents (HAs) over the Pi interfaces.



IMPORTANT: Once an IPSec tunnel is established between an FA and HA for a particular subscriber, all new Mobile IP sessions using the same FA and HA are passed over the tunnel regardless of whether or not IPSec is supported for the new subscriber sessions. Data for existing Mobile IP sessions is unaffected.

- **L2TP:** L2TP-encapsulated packets are routed from the system to an LNS/secure gateway over an IPSec tunnel.

The following figure shows IPSec configurations.

Figure 5. IPSec Applications

IMPORTANT: For more information on IPSec support, refer *IP Security* chapter in *System Enhanced Feature Configuration Guide*.

License

600-00-7507

Lawful Intercept

Provides a standards-based architecture for lawful monitoring and interception of subscriber call control events as mandated by a warrant from a law enforcement agency.

In accordance with 3GPP TS 33.108 Release 8 requirements the Cisco MME supports the Lawful Intercept Access Function for intercepting control plane traffic pursuant to a court ordered subpoena. Lawful Intercept involves the process of mirroring subscriber call control or call content based on a request from a law enforcement agency to a telecom service provider.

In this release the MME support the X1 provisioning interface and X2 interface for mirroring Intercept Related Information (IRI) to an upstream Delivery Function/Mediation server. Intercept targets can be provisioned using subscriber information including MSISDN, IMSI and MEI. The Cisco MME supports secure provisioning via remote CLI over SSH connections from a DF mediation server. Our solution is currently interoperable with leading third party solutions.

The intercepted call control data is encoded in a Cisco proprietary message header format using an optional TLV field to pack the IRI information. The message header includes other identifying information including sequence numbers, timestamps and session & correlation numbers to correlate session and bearer related information with interception on other EPC elements. The MME can intercept any of the following IRI information:

- Subscriber attachments
- Subscriber detachments
- Tracking Area Updates
- UE requested PDN connectivity
- UE requested PDN disconnection



IMPORTANT: For more information on Lawful Intercept support, refer *Lawful Intercept Configuration Guide*.

License

Lawful Intercept is included with purchase of MME bundle

MME Inter-Chassis Session Recovery

The ASR-5000 provides industry-leading carrier class redundancy. The system protects against all single points of failure (hardware and software) and attempts to recover to an operational state when multiple simultaneous failures occur.

The system provides several levels of system redundancy:

- Under normal N+1 packet processing card hardware redundancy, if a catastrophic packet processing card failure occurs all affected calls are migrated to the standby packet processing card if possible. Calls which cannot be migrated are gracefully terminated with proper call-termination signaling and accounting records are generated with statistics accurate to the last internal checkpoint
- If the Session Recovery feature is enabled, any total packet processing card failure will cause a packet processing card switchover and all established sessions for supported call-types are recovered without any loss of session.

Even though ASR 5000 provides excellent intra-chassis redundancy with these two schemes, certain catastrophic failures which can cause total chassis outages, such as IP routing failures, line-cuts, loss of power, or physical destruction of the chassis, cannot be protected by this scheme. In such cases, the MME Inter-Chassis Session Recovery feature provides geographic redundancy between sites. This has the benefit of not only providing enhanced subscriber experience even during catastrophic outages, but can also protect other systems such as the RAN from subscriber re-activation storms.

The Interchassis Session Recovery feature allows for continuous call processing without interrupting subscriber services. This is accomplished through the use of redundant chassis. The chassis are configured as primary and backup with one being active and one in recovery mode. A checkpoint duration timer is used to control when subscriber data is sent from the active chassis to the inactive chassis. If the active chassis handling the call traffic goes out of service, the inactive chassis transitions to the active state and continues processing the call traffic without interrupting the subscriber session. The chassis determines which is active through a propriety TCP-based connection called a redundancy link. This link is used to exchange Hello messages between the primary and backup chassis and must be maintained for proper system operation.

- **Interchassis Communication**

Chassis configured to support Interchassis Session Recovery communicate using periodic Hello messages. These messages are sent by each chassis to notify the peer of its current state. The Hello message contains information about the chassis such as its configuration and priority. A dead interval is used to set a time limit for a Hello message to be received from the chassis' peer. If the standby chassis does not receive a Hello message from the active chassis within the dead interval, the standby chassis transitions to the active state. In situations where the redundancy link goes out of service, a priority scheme is used to determine which chassis processes the session. The following priority scheme is used:

- router identifier
- chassis priority
- SPIO MAC address

- **Checkpoint Messages**

Checkpoint messages are sent from the active chassis to the inactive chassis. Checkpoint messages are sent at specific intervals and contain all the information needed to recreate the sessions on the standby chassis, if that chassis were to become active. Once a session exceeds the checkpoint duration, checkpoint data is collected on the session. The checkpoint parameter determines the amount of time a session must be active before it is included in the checkpoint message.



IMPORTANT: For more information on inter-chassis session recovery support, refer *Interchassis Session Recovery* chapter in *System Enhanced Feature Configuration Guide*.

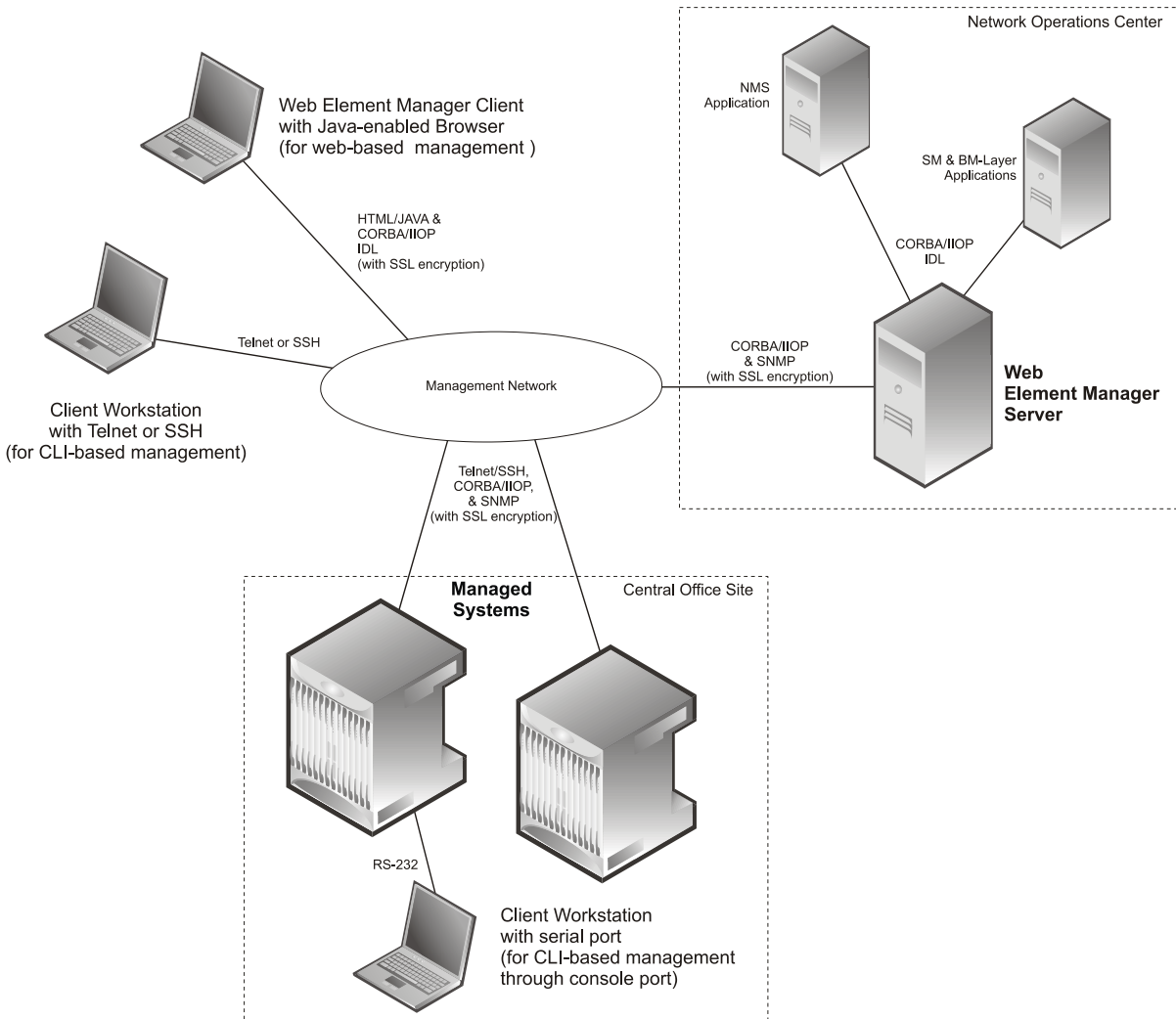
Web Element Management System

Provides a graphical user interface (GUI) for performing fault, configuration, accounting, performance, and security (FCAPS) management.

The Web Element Manager is a Common Object Request Broker Architecture (CORBA)-based application that provides complete fault, configuration, accounting, performance, and security (FCAPS) management capability for the system.

For maximum flexibility and scalability, the Web Element Manager application implements a client-server architecture. This architecture allows remote clients with Java-enabled web browsers to manage one or more systems via the server component which implements the CORBA interfaces. The server component is fully compatible with the fault-tolerant Sun® Solaris® operating system.

The following figure demonstrates these various element management options and how they can be utilized within the wireless carrier network.

Figure 6. Element Management Methods

IMPORTANT: MME management functionality is enabled by default for console-based access. For GUI-based management support, refer *Web Element Management System*.

How MME Works

This section provides information on the function and procedures of the MME in an EPC network and presents message flows for different stages of session setup.

The following procedures are supported in this release:

- EPS Bearer Context Processing
- Purge Procedure
- Paging Procedure
- Subscriber Session Processing
- Connection Setup and Registration Procedures
 - Subscriber Registration Setup Procedure
- UE De-registration Procedures
 - User-initiated Subscriber De-registration Setup Procedure
- Service Request Procedure
 - User-initiated Service Request Procedure

EPS Bearer Context Processing

EPS Bearer context processing is based on the APN that the subscriber is attempting to access. Templates for all of the possible APNs that subscribers will be accessing must be configured within the P-GW system.

Each APN template consists of parameters pertaining to how EPS Bearer contexts are processed such as the following:

- **PDN Type:** The system supports IPv4, IPv6, or IPv4v6.
- **Timeout:** Absolute and idle session timeout values specify the amount of time that an MS can remain connected.
- **Quality of Service:** Parameters pertaining to QoS feature support such as for Traffic Policing and traffic class.

A total of 11 EPS bearer contexts are supported per subscriber. These could be all dedicated, or 1 default and 10 dedicated or any combination of default and dedicated context. Note that there must be at least one default EPS bearer context in order for dedicated context to come up.

Purge Procedure

The purge procedure is employed by the Cisco MME to inform the concerned node that the MME has removed the EPS bearer contexts of a detached UE. This is usually invoked when the number of records exceeds the maximum capacity of the system.

Paging Procedure

Paging is initiated when there is data to be sent to an idle UE to trigger a service request from the UE. Once the UE reaches connected state, the data is forwarded to it.

Paging retransmission can be controlled by configuring a paging-timer and retransmission attempts on system.

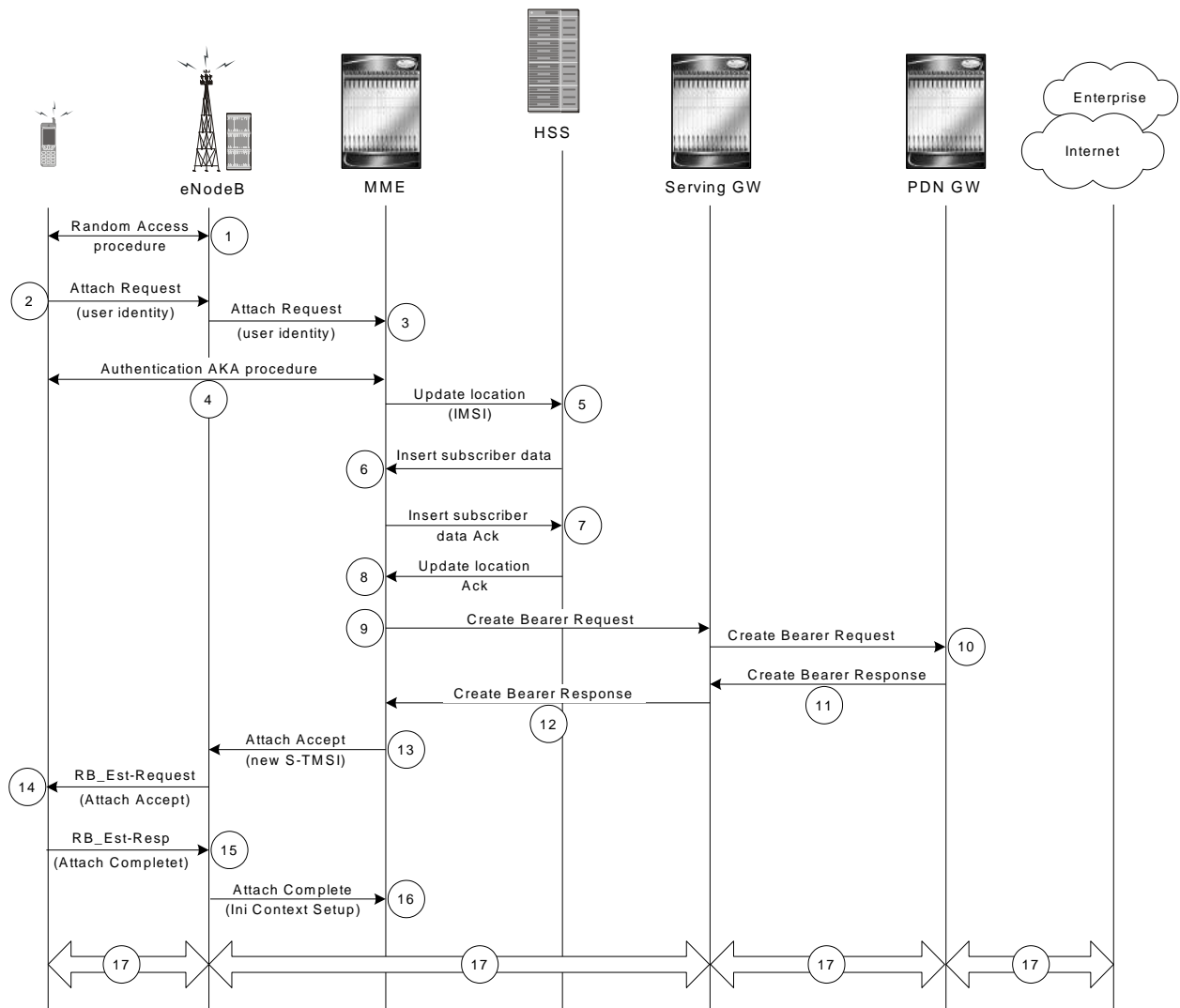
Subscriber Session Processing

This section provides information on how LTE/SAE subscriber data sessions are processed by the system MME. The following procedures are provided:

- **User-initiated Transparent IP:** An IP EPS Bearer context request is received by the MME from the UE for a PDN. The subscriber is provided basic access to a PDN without the MME authenticating the subscriber. Either a static or dynamic IP address can be assigned to the MS in this scenario.
- **User-initiated Non-transparent IP:** An IP EPS Bearer context request is received by the MME from the UE for a PDN. The MME provides subscriber authentication services for the data session. Either a static or dynamic IP address can be assigned to the MS in this scenario.
- **Network-initiated:** An IP EPS Bearer context request is received by the MME from the PDN for a specific subscriber. If configured to support network-initiated sessions, the MME, will initiate the process of paging the MS and establishing a EPS Bearer context.

Subscriber Registration Setup Procedure

The following figure and the text that follows describe the message flow for a successful user-initiated subscriber registration setup procedure.

Figure 7. Subscriber Registration Setup Message Flow

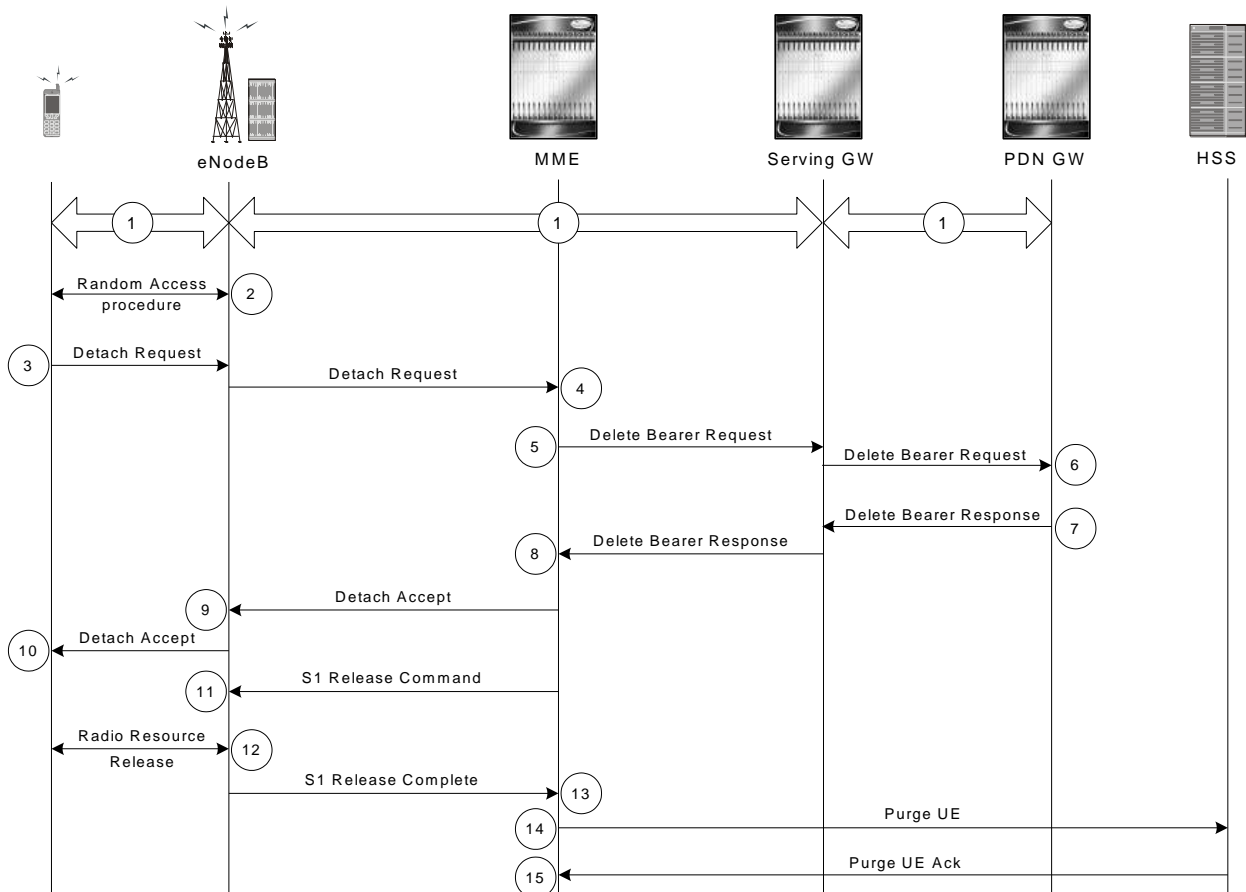
1. UE and eNodeB performs Random Access procedure.
2. After Random Access procedure completion, UE sends Attach Request with user identity to eNodeB.
3. The eNodeB forwards the Attach Request to MME
4. MME starts Authentication procedure with eNodeB and UE.
5. Once UE get authenticated MS sends Update Location Request to HSS with user IMSI derived during Authentication procedure.
6. Once user get validated at HSS with IMSI, HSS sends Insert Subscriber Data Request to MME providing subscriber profile and service subscription information to MME.
7. MME sends Create Bearer Request to Serving Gateway.
8. The S-GW forwards the request to P-GW.
9. P-GW reserves the EPS bearer and sends Create Bearer Response to the S-GW and establishes the EPS bearer with S-GW for this user.
10. Once S-GW receives the Create Bearer Response from P-GW it reserves the EPS bearer and sends Create Bearer Response to the MME and establishes the EPS bearer with MME for this user.

11. MME sends Attach Accept Response to eNodeB with new S-TMSI for this user.
12. The eNodeB sends Radio Bearer Establish Request as Attach Accept Response to UE to establish Radio bearer with UE.
13. UE sends Radio Bearer Establish Response as Attach Complete Response to eNodeB.
14. The eNodeB sends Attach Complete Response to MME with Initial EPS Bearer Context Setup procedure.
15. EPS Bearer established between UE and PDN through eNodeB, S-GW, and P-GW and subscriber session starts.

User-initiated Subscriber De-registration Setup Procedure

The following figure and the text that follows describe the message flow for a user-initiated subscriber de-registration procedure.

Figure 8. Subscriber De-registration Setup Message Flow



1. Subscriber session established between UE, eNodeB, S-GW, and P-GW.
2. *Optional.* If UE in idle or dormant mode it will initiate Random Access procedure.
3. UE initiates detach procedure and sends Detach Request to eNodeB.
4. eNodeB forwards the UE Detach Request to MME.
5. MME sends the Delete Session Request to S-GW for this subscriber.
6. S-GW forwards the Delete Session Request to P-GW for this subscriber.
7. P-GW deletes the EPS bearer for this subscriber and sends the Delete Session Response to S-GW.

8. S-GW deletes the UE context for this subscriber and sends the Delete Session Response to MME.
9. MME removes the subscriber context and sends the Detach Response to eNodeB.
10. MME sends S1 Release Command to eNodeB.
11. eNodeB forwards the Detach Accept to UE.
12. eNodeB starts Radio Release procedure with UE.
13. Once Radio Release procedure completed with UE, eNodeB sends S1 Release Complete response to MME and S1 link released for this UE.
14. Once S1 link released for subscriber, MME sends the Purge UE Request to HSS.
15. HSS clears all UE data and sends the Purge UE Ack to MME and subscriber de-registered.

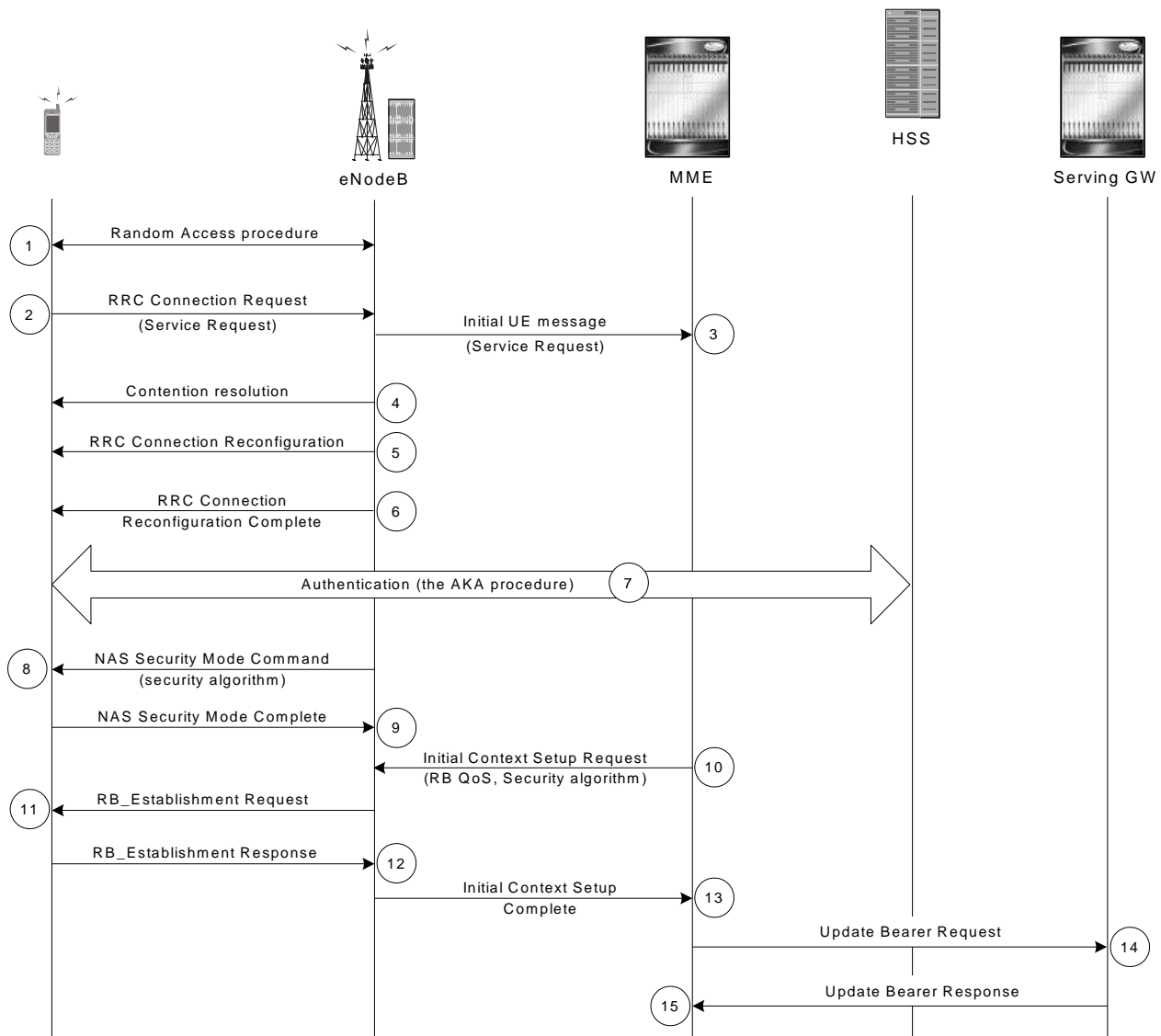
Service Request Procedure

The Service Request procedure is used by the UE in the ECM Idle state to establish a secure connection to the MME as well as request resource reservation for active contexts. The MME allows configuration of the following service request procedures:

- Prohibition of services
- Enforce identity check

User-initiated Service Request Procedure

The following figure and the text that follows describe the message flow for a successful user-initiated subscriber registration setup procedure.

Figure 9. User-initiated Service Request Message Flow

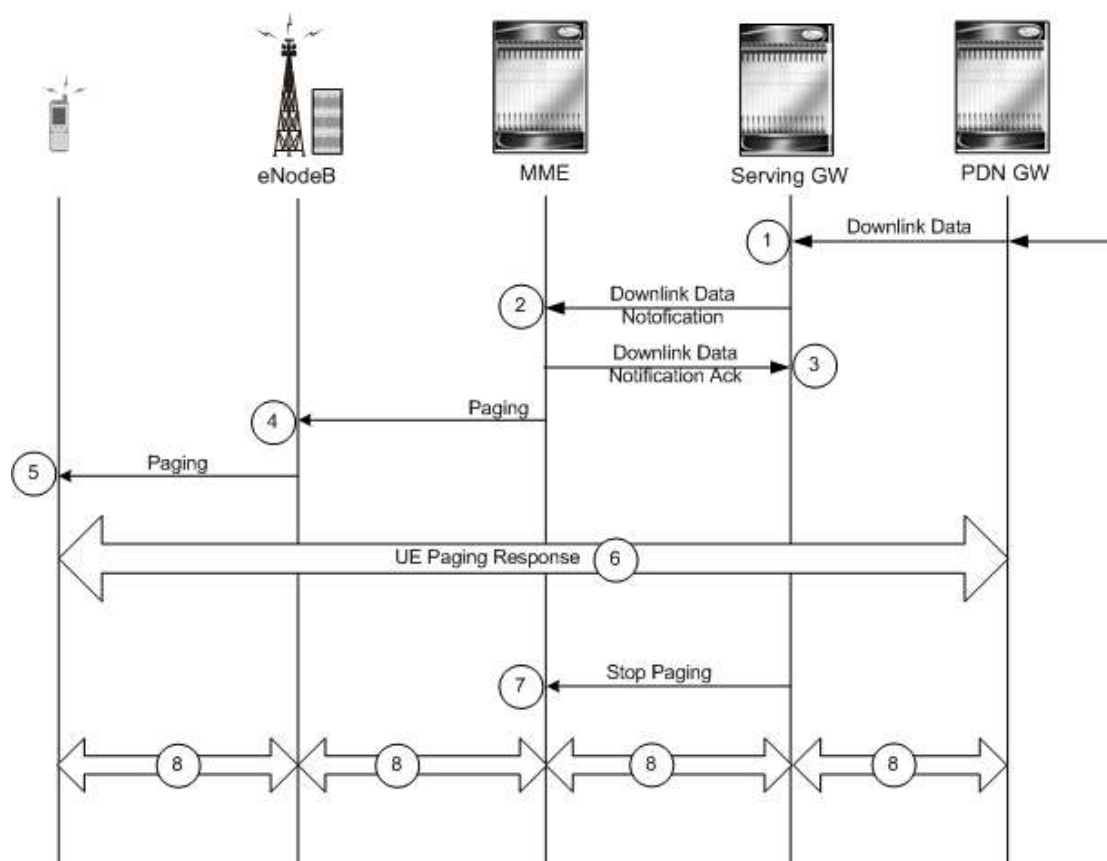
1. UE and eNodeB performs Random Access procedure.
2. UE sends service request (RRC Connection Request) to eNodeB.
3. eNodeB forwards Service request in Initial UE message to MME.
4. eNodeB performs contention resolution with UE.
5. eNodeB starts RRC connection reconfiguration.
6. eNodeB sends RRC Connection Request Complete and Reconfiguration Complete message to UE.
7. Authentication procedure starts between UE, MME and HSS.
8. eNodeB sends NAS Security Mode Command to UE with selected algorithm.
9. UE sends NAS Security Mode Complete Command to eNodeB.
10. MME sends initial Context Setup Request to eNodeB with radio bearer QoS, security algorithm etc.
11. eNodeB sends RB_Establishment Request to UE.
12. UE sends RB_Establishment Response to eNodeB and radio bearer established.
13. eNodeB sends initial Context Setup Request Response to MME.
14. MME sends Modify Bearer Request to S-GW.

15. S-GW modify the session for this UE and sends Modify Bearer Request response to MME.

Network-initiated Service Request Procedure

The following figure and the text that follows describe the message flow for a successful network-initiated service request procedure.

Figure 10. Network-initiated Service Request Message Flow



1. Downlink data received on S-GW from PDN for targeted UE.
2. S-GW sends Downlink Data notification to MME for a targeted UE.
3. MME sends Downlink Data notification acknowledgement to S-GW.
4. MME send Paging request to eNodeB for targeted UE.
5. eNodeB broadcasts Paging request in its coverage area for UE.
6. Once identified UE located S-GW and eNodeB starts messaging through UE Paging response.
7. S-GW sends Stop Paging message to MME.
8. Data downlink starts between identified UE and PDN.

Supported Standards

The MME complies with the following standards for 3GPP LTE/EPS wireless networks.

- [3GPP References](#)
- [IETF References](#)
- [Object Management Group \(OMG\) Standards](#)

3GPP References

- 3GPP TS 23.122 V8.4.0 (2008-12): 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode (Release 8)
- 3GPP TS 23.401 V8.1.0 (2008-03): 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 8)
- 3GPP TS 24.301 V8.0.0 (2008-12): 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (Release 8)
- 3GPP TR 24.801 V8.0.1 (2008-10): 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 3GPP System Architecture Evolution; CT WG1 Aspects (Release 8)
- 3GPP TS 29.274 V8.1.0 (2009-03): 3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3 (Release 8)
- 3GPP TS 33.401 V8.2.1 (2008-12): 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; 3GPP System Architecture Evolution (SAE): Security Architecture; (Release 8)
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- RFC-1157, Simple Network Management Protocol (SNMP) Version 1, May 1990
- RFC-1212, Concise MIB Definitions, March 1991
- RFC-1213, Management Information Base for Network Management of TCP/IP-based Internets: MIB-II, March 1991
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Object Management Group (OMG) Standards

- CORBA 2.6 Specification 01-09-35, Object Management Group

Chapter 2

Understanding the Service Operation

The system provides wireless carriers with a flexible solution for providing Mobility Management Entity (MME) functionality for LTE networks.

The system functioning as a MME is capable of supporting the following types of subscriber data sessions:

- **UE-initiated:** The subscriber is provided basic access to a packet data network (PDN) without the MME authenticating the subscriber. Either a static or dynamic IP address can be assigned to the MS in this scenario.
- **Network-initiated:** An IP Packet Data Unit (PDP) is received by the MME from the PDN for a specific subscriber. If configured to support network-initiated sessions, the MME, will initiate the process of paging the UE and establishing a EPS bearer context.

Prior to connecting to the command line interface (CLI) and beginning the system's configuration, there are important things to understand about how the system supports these applications. This chapter provides terminology and background information that must be considered before attempting to configure the system.

Terminology

This section defines some of the terms used in the chapters that follow.

Contexts

A context is a logical grouping or mapping of configuration parameters that pertain to various physical ports, logical IP interfaces, and services. A context can be thought of as a virtual private network (VPN).

The system supports the configuration of multiple contexts. Each is configured and operates independently from the others. Once a context has been created, administrative users can then configure services, logical IP interfaces, subscribers, etc. for that context. Administrative users would then bind the logical interfaces to physical ports.

Contexts can also be assigned domain aliases, wherein if a subscriber's domain name matches one of the configured alias names for that context, then that context is used.

Contexts on the system can be categorized as follows:

- **Source context:** Also referred to as the “ingress” context, this context provides the subscriber's point-of-entry in the system. It is also the context in which services are configured. For example, in a LTE network, the radio network containing the eNodeB would communicate with the MME via S1-MME interfaces configured within the source context as part of the MME service.
- **Destination context:** Also referred to as the “egress” context, this context is where a subscriber is provided services (such as access to the EPC) as defined by access point name (APN) configuration templates on S11 or S5/S8 interface. For example, the system's destination context would be configured with the interfaces facilitating subscriber data traffic to/from the EPC (S-GW/P-GW), a VPN, or other PDN.
- **AAA context:** This context provides AAA functionality for subscriber EPS bearer contexts and/or administrative user sessions and contains the policies and logical interfaces for communicating with HSS on S6a/S6b interface. Preferably MME-HSS service configured in AAA context.

HSS-based authentication functionality for administrative user sessions can either be configured in the local context or in the same context used for subscriber accounting.



IMPORTANT: To ensure scalability, accounting functionality for subscriber sessions should not be configured in the local context.

For subscriber authentication, this functionality must be configured in the same system context as the MME service.

For administrative users, authentication functionality can either be configured in the local context or be authenticated in the same context as subscribers.

- **Local context:** This is the default context on the system used to provide out-of-band management functionality. The local context is described in the Command Line Reference.

Logical Interfaces

Prior to allowing the flow of user data, the port must be associated with a virtual circuit or tunnel called a logical interface. A logical interface within the system is defined as the logical assignment of a virtual router instance that provides higher-layer protocol transport, such as Layer 3 IP addressing. Interfaces are configured as part of the VPN context and are independent from the physical port that will be used to bridge the virtual interfaces to the network.

Logical interfaces are assigned to IP addresses and are bound to a specific port during the configuration process. Logical interfaces are also associated with services through bindings. Services are bound to an IP address that is configured for a particular logical interface. When associated, the interface takes on the characteristics of the functions enabled by the service. For example, if an interface is bound to a MME service, it will function as an S1-MME interface between the MME service and the eNodeB. Services are defined later in this section.

There are several types of logical interfaces that must be configured to support the service as described below:

- **S1-MME Interface:** This interface is the reference point for the control plane protocol between eNodeB and MME. S1-MME uses S1- Application Protocol (S1-AP) over Stream Control Transmission Protocol (SCTP) as the transport layer protocol for guaranteed delivery of signaling messages between MME and eNodeB (S1).

This is the interface used by the MME to communicate with eNodeBs on the same LTE Public Land Mobile Network (PLMN). This interface serves as path for establishing and maintaining subscriber EPS bearer contexts.

One or more S1-MME interfaces can be configured per system context. S1-MME interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S3 Interface:** This is the interface used by the MME to communicate with SGSNs on the same Public PLMN for interworking between GPRS/UMTS and LTE network access technology. This interface serves as both the signalling and data path for establishing and maintaining subscriber EPS bearer contexts.

The MME communicates with SGSNs on the PLMN using the Evolved GPRS Tunnelling Protocol (e-GTP). The signalling or control aspect of this protocol is referred to as the GTP Control Plane (GTP-C) while the encapsulated user data traffic is referred to as the GTP User Plane (GTP-U).

One or more S3 interfaces can be configured per system context. S3 interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S6a Interface:** This is the interface used by the MME to communicate with the Home Subscriber Server (HSS). The HSS is responsible for transfer of subscription and authentication data for authenticating/authorizing user access and EPS bearer context authentication. The MME communicates with the HSSs in the PLMN using Diameter protocol.

One or more S6a interfaces can be configured per system context. S6a interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S10 Interface:** This is the interface used by the MME to communicate with MME in same PLMN or on different PLMNs. This interface is also used for MME relocation and MME to MME information transfer or handoff.

One or more S10 interfaces can be configured per system context. S10 interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S11 Interface:** This interface provides communication between MME and Serving Gateways (SGW) for information transfer.

One or more S11 interfaces can be configured per system context. S11 interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S13 Interface:** This interface provides communication between MME and Equipment Identity Register (EIR). This interface is not supported in this release.

One or more S13 interfaces can be configured per system context. S13 interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **S101 Interface:** This interface provides communication between MME and High Rate Packet Data (HRPD) access node in a 3GPP2 network. It uses an application layer protocol S101-AP to enable interactions between Evolved Packet System (EPS) and HRPD access node to allow for pre-registration and handover signalling with the target system. The S101 interface supports procedures for pre-registration, session maintenance, and active handoffs between E-UTRAN and HRPD networks.

One or more S101 interfaces can be configured per system context. S101 interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

- **DNS Interface:** MME supports DNS interface to locate the S-GW in EPS core network. The MME uses the Tracking Area List as fully qualified domain name (FQDN) to locate the address of the S-GW to establish the call with.
- **Gr Interface:** This is the interface used by the MME to communicate with the Home Location Register (HLR) via a eGTP-to-MAP (Mobile Application Part) protocol convertor. This interface is used for network initiated EPS bearer contexts.

For network initiated EPS bearer contexts, the MME will communicate with the protocol convertor using eGTP. The convertor, in turn, will communicate with the HLR using MAP over Signalling System 7 (SS7).

One or more Gr interfaces can be configured per system context. Gr interfaces are bound to ports on either the Ethernet 10/100 or Ethernet 1000 Line Cards or on the four-port Quad Gig-E Line Card (QGLC).

Bindings

A binding is an association between “elements” within the system. There are two types of bindings: static and dynamic.

Static binding is accomplished through the configuration of the system. Static bindings are used to associate:

- A specific logical interface (configured within a particular context) to a physical port. Once the interface is bound to the physical port, traffic can flow through the context just as if it were any physically defined circuit. Static bindings support any encapsulation method over any interface and port type.
- A service to an IP address assigned to a logical interface within the same context. This allows the interface to take on the characteristics (i.e., support the protocols) required by the service. For example, a MME service bound to a logical interface will cause the logical interface to take on the characteristics of an S1-MME interface within an LTE network.

Dynamic binding associates a subscriber to a specific egress context based on the configuration of their profile or system parameters. This provides a higher degree of deployment flexibility as it allows a wireless carrier to support multiple services and facilitates seamless connections to multiple networks.

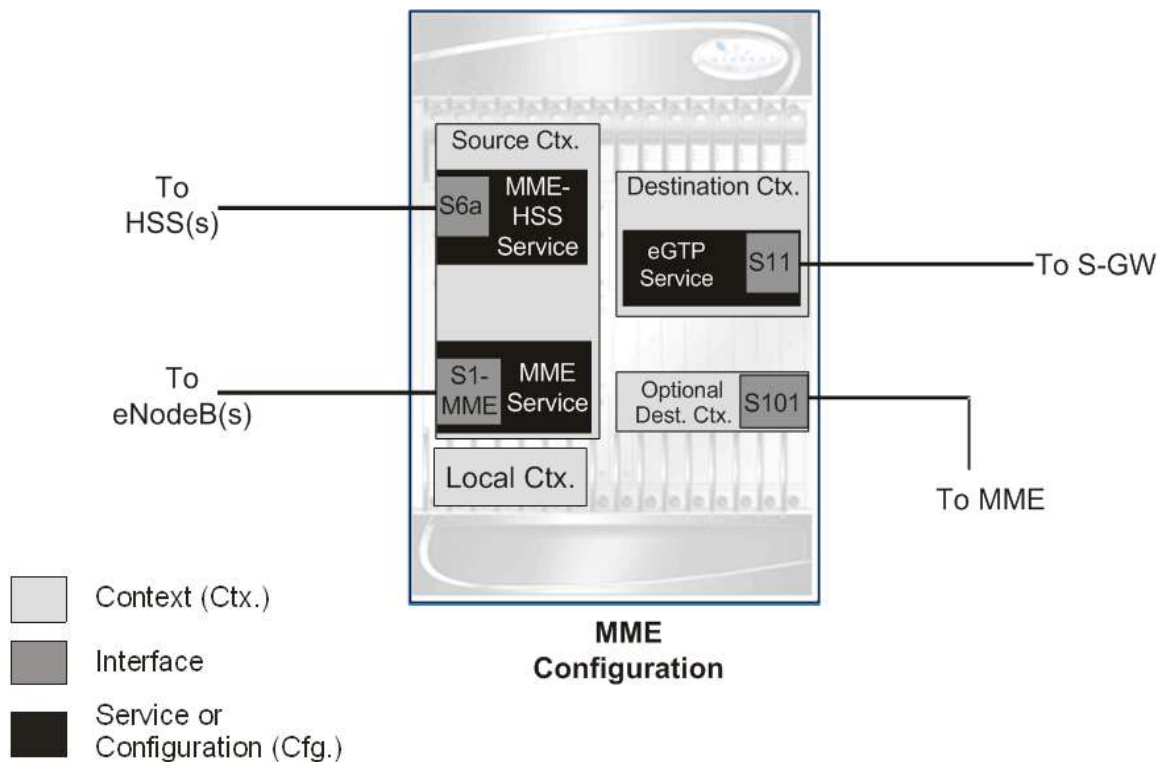
Services

Services are configured within a context and enable certain functionality. The following services can be configured on the system:

- **MME services:** MME services are configured to support both mobile-initiated and network-requested EPS bearer contexts. The MME service must be bound to a logical interface within the same context. Once bound, the interface takes on the characteristics of an S1-MME interface. Multiple services can be bound to the same logical interface. Therefore, a single physical port can facilitate multiple S1-MME interfaces.
- **MME-HSS services:** MME-HSS services are configured to support HSS (AAA) functionality with HSS for EPS bearer contexts. The MME-HSS service must be bound to a logical interface within the same or AAA context. Once bound, the interface takes on the characteristics of an S6a interface. Multiple services can be bound to the same logical interface. Therefore, a single physical port can facilitate multiple S6a interfaces.
- **eGTP services:** eGTP services are configured to connect S-GW over S11 interface with MME for EPS bearer contexts. The eGTP service must be bound to a logical interface within the same or destination context. Once bound, the interface takes on the characteristics of an S11 interface. Multiple services can be bound to the same logical interface. Therefore, a single physical port can facilitate multiple S11 interfaces.

Figure given below shows the typical relationship between services, interfaces, and contexts within the system for LTE networks.

Figure 11. Service, Interface, and Context Relationship Within the System for LTE Networks



The source context used to service a subscriber session is the same as the context in which the MME service is configured. Each MME service is bound to an IP address in a source context. Once a subscriber has established a EPS bearer context with a MME, the eNodeB continue to use that same EPS bearer context and MME as the subscriber moves about the network.

Destination contexts are selected based on the eGTP service configuration in MME for S-GW and P-GW selection. When the system receives a **Create EPS bearer Context Request** message from the eNodeB, it examines the available S-GW and P-GW that can serve APN provided from UE or HSS or Operator Policy in MME.

The system determines the destination context to use based on a parameter contained within the final MME configuration.

For HSS-based AAA the system uses the source context for AAA. That context may be overridden by configuring a different AAA context to use in the MME service configuration.

Chapter 3

MME Service Configuration Procedures

This chapter is meant to be used in conjunction with the previous chapter that describes the information needed to configure the system to support MME functionality for use in LTE networks.

It is recommended that you identify the options from the previous chapters that are required for your specific deployment. You can then use the procedures in this chapter to configure those options.

This chapter describes following:

- [Information Required to Configure the System](#)
- [MME Service Configuration](#)
- [eGTP Service Configuration](#)
- [MME-HSS Service Configuration](#)
- [Event IDs for MME Service](#)



IMPORTANT: At least one Packet Services Card (PSC/PSC2) must be made active prior to service configuration. Information and instructions for configuring PSCs/PSC2s to be active can be found in the Configuring System Settings chapter of the System Administration Guide.



CAUTION: While configuring any base-service or enhanced feature, it is highly recommended to take care of conflicting or blocked IP addresses and port numbers for binding or assigning. In association with some service steering or access control features, like Access Control List configuration, use of inappropriate port number may result in communication loss. Refer respective feature configuration document carefully before assigning any port number or IP address for communication with internal or external network.

Information Required to Configure the System as an MME

This section provides a high-level series of steps and the associated configuration file examples for configuring the system to perform as an MME node in a test environment. Information provided in this section includes the following:

- [Required Local Context Configuration Information](#)
- [Required MME Context Configuration Information](#)
- [Required eGTP Context Configuration Information](#)
- [Required AAA Context Configuration Information](#)

Required Local Context Configuration Information

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

Table 1. Required Information for Local Context Configuration

Required Information	Description
Management Interface Configuration	
Interface name	An identification string between 1 and 79 characters (alpha and/or numeric) by which the interface will be recognized by the system. Multiple names are needed if multiple interfaces will be configured.
IP address and subnet	IPv4 addresses assigned to the 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.
Gateway IP address	Used when configuring static IP routes from the management interface(s) to a specific network.
Security administrator name	The name or names of the security administrator with full rights to the system.
Security administrator password	Open or encrypted passwords can be used.
Remote access type(s)	The type of remote access that will be used to access the system such as telnetd, sshd, and/or ftpd.

Required MME Context Configuration Information

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

Table 2. 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. Generally it is identified as source context.
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 addresses assigned to the 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.
Gateway IP address	Used when configuring static IP routes from the management interface(s) to a specific network.
S1-MME Interface Configuration (To/from eNodeB)	
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 Context configuration mode. Multiple names are needed if multiple MME services will be configured.
S1-MME interface IP address	IPv4 addresses 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. The MME passes this IP address during setting up the SCTP association with the eNodeB. Multiple addresses and subnets are needed if multiple interfaces will be configured.
S1-MME SCTP Port	The physical port to which the S1-MME interface will be bound. The local SCTP port used to communicate with the eNodeBs over S1-MME interface.
MME Service Configuration	
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.
DNS context	Specify the DNS context to be used to do DNS to find a SGW and PGW address. This is the context where DNS service is configured. If context is omitted, the named service must exist in the same context as the MME service
S-GW address	Specifies the Serving Gateway (S-GW) address to use P-MIP/GTP protocol for S5 and S8 interface and weightage for specific S-GW while selecting S-GW for MME service. Optionally tracking area identifier can be configured for an S-GW.
P-GW address	Specifies the PDN Gateway (P-GW) address to use P-MIP/GTP protocol for S5 and S8 interface and weightage for specific P-GW while selecting P-GW for MME service

Required Information	Description
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. It is configured in Context configuration mode. Multiple names are needed if multiple eGTP services will be used.
MME-HSS service Name	An identification string from 1 to 63 characters (alpha and/or numeric) by which the MME-HSS service can be associated with MME system. It is configured in Context configuration mode. Multiple names are needed if multiple MME-HSS services will be used.
APN name	The name for a pre-configured APN template, configured on system to associate with this MME service to access PDN.
Maximum EPS bearers per subscriber	The maximum number of EPS bearers that a subscriber may simultaneously use to access PDNs through an MME service.
Maximum EPS PDNs per subscriber	The maximum number of PDNs that a subscriber can access simultaneously through an MME service.

Required eGTP Context Configuration Information

The following table lists the information that is required to configure the eGTP context on a an MME.

Table 3. Required Information for eGTP Context Configuration

Required Information	Description
eGTP context name	An identification string from 1 to 79 characters (alpha and/or numeric) by which the eGTP context is recognized by the system. Generally it is identified as destination context.
eGTP Service name	An identification string from 1 to 79 characters (alpha and/or numeric) by which the eGTP service is recognized by the system. This service configured in Context configuration mode.
S11 Interface Configuration (To/from S-GW)	
Type of eGTP interface	Type of eGTP interface required to connect to S-GW and MME.This is of MME type interface.
GTP-C bind address	IPv4 addresses assigned to the S11 interface. Multiple addresses and subnets are needed if multiple S11 interfaces will be configured.

Required AAA Context Configuration Information

The following table lists the information that is required to configure the AAA (MME-HSS) context on an MME.

Table 4. Required Information for AAA Context Configuration

Required Information	Description
MME-HSS context name	An identification string from 1 to 79 characters (alpha and/or numeric) by which the MME-HSS context is recognized by the system. Generally it is identified as AAA context.
MME-HSS Service name	An identification string from 1 to 79 characters (alpha and/or numeric) by which the MME-HSS service is recognized by the system. This service configured in Context configuration mode.
S6a Interface Configuration (to HSS server)	
Diameter 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. This is a preconfigured end-point name in Context configuration mode.
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 IPv4/IPv6 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 IPv6 address and port number of the HSS.
Route-entry peer	The S6a endpoint name described above.

MME Service Configuration

MME services are configured within source contexts and allow the system to function as a MME in the LTE wireless data network.



IMPORTANT: This section provides the minimum instruction set for configuring a MME service that allows the system to process EPS bearer contexts. Commands that configure additional MME service properties are provided in the MME Service Configuration Mode Commands chapter of Command Line Interface Reference.

These instructions assume that you have already configured the system level configuration as described in System Administration Guide.

To configure the system to work as MME service:

- Step 1** Create an interface in source context for S1-MME interface by applying the example configuration in the *S1-MME Interface Configuration* section.
- Step 2** Create the MME service and bind the S1-MME interface to an IP address by applying the example configuration in the *Creating and Binding MME Service* section.
- Step 3** Associate the eNodeB and network parameters for the MME service by applying the example configuration in the *Configuring eNodeB with Network Id Parameters* section.
- Step 4** Associate the eGTP service for S11 interface and MME-HSS service for S6a interface with MME service by applying the example configuration in the *Associating eGTP Service and MME-HSS Service* section.
- Step 5** Configure a DNS service if not configured already to provide DNS query for S-GW and P-GW with MME service by applying the example configuration in the *Configuring DNS Client Service* section.
- Step 6** Configure the security and other session parameters in MME service by applying the example configuration in the *Configuring S-GW and P-GW with MME* section.
- Step 7** Configure the security and other session parameters in MME service by applying the example configuration in the *Configuring Session and Security Parameters for EPS bearer Contexts* section.
- Step 8** Verify your MME configuration by following the steps in the *Verifying MME Configuration* section.
- Step 9** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

S1-MME Interface Configuration

Use the following example to configured the S1-MME interfaces in source context:

```
configure

context <vpn_ctxt_name> -noconfirm

interface <intf_name>
```



```
ip address <ip_address>
end
```

Notes:

- <vpn_ctxt_name> is name of the source context in which MME service is to configure.
- <intf_name> is name of the interface which is to be used for S1-MME reference between MME and eNodeB.

Creating and Binding MME Service

Use the following example to create the MME service and bind it to a local IP address. This example also configures the SCTP port for communication with eNodeB and specifies an identifier for MME service in LTE network:

configure

```
context <vpn_ctxt_name>
  mme-service <mme_svc_name>
    bind s1-mme address <ip_address>
    s1-mme sctp port <port_num>
    mme-id group-id <grp_id> mme-code <mme_code>
  end
```

Notes:

- A maximum of 256 services (regardless of type) can be configured per system.
- <ip_address> is the local IP address of this MME service and should not conflict with any other service.
- <port_num> is the SCTP port on which MME service will listen from eNodeB.

Configuring Network Id Parameters

Use the following example to configure the network parameters.

configure

```
context <vpn_ctxt_name>
  mme-service <mme_svc_name>
    dest-sctp address <ip_address>
    dest-sctp port <port_num>
    plmn-id mcc <mcc_value> mnc <mnc_value>
```

```

core-network id <cn_id>

end

```

Notes:

- <ip_address> is the IP address of eNodeB.
- <port_num> is the SCTP port on which MME service will communicate with eNodeB.
- PLMN Id and Core-network Id indicates the MME's PLMN and core network in LTE network.

Associating eGTP Service and MME-HSS Service

Use the following example to configure the preconfigured eGTP service with S11 interface and MME-HSS service with S6a interface on MME for S-GW and HSS respectively.

```

configure

context <vpn_ctxt_name>

    mme-service <mme_svc_name>

        associate egtp-service <egtp_svc_name> context <egtp_ctxt_name>

        associate mme-hss-service <hss_svc_name> context <aaa_ctxt_name>

    end

```

Notes:

- <egtp_svc_name> is a preconfigured eGTP service configured in the system context <egtp_ctxt_name>. For more information on eGTP service configuration, refer *eGTP Service Configuration* section.
- <hss_svc_name> is a preconfigured MME-HSS service configured in the system context <aaa_ctxt_name>. For more information on MME-HSS service configuration, refer *MME-HSS Service Configuration* section.

Configuring DNS Client Service

Use the following example to configure the DNS Client service on the system to use for locating S-GW and P-GW in LTE network:

```

configure

context <dns_ctxt_name>

    ip domain-lookup

    ip name-server <ns_ip_address>

```

```

dns-client <dns_svc_name>

  bind address <dns_ip_address>

  default resolver { retransmission-interval | number-of-retries }

  default cache { algorithm | size } { central | local }

  default cache ttl { positive | negative }

  round-robin-answers

end

```

Notes:

- A maximum of 256 services (regardless of type) can be configured per system.
- <dns_ctxt_name> is the system context name where DNS client service has to be configured. For more information on DNS client configuration parameters, refer *DNS Client Service Configuration Mode Commands* in *Command Line Interface Reference*.
- <ns_ip_address> is address of the IP name server which will be used to resolve the domain name. For more information on DNS client configuration parameters, refer *DNS Client Service Configuration Mode Commands* in *Command Line Interface Reference*.

Configuring S-GW and P-GW with MME

Use the following example to configure the S-GW and P-GW with this MME service. It also associates the DNS service to be used to locate S-GW and P-GW in EPC:

```

configure

context <vpn_ctxt_name>

  mme-service <mme_svc_name>

    sgw-address <sgw_ip_address> [ s5-s8-protocol pmip ] [ tai tac <tac_value>
[ mcc <mcc_value> mcc <mnc_value> ]] [ weight <value> ]

    pgw-address <pgw_ip_address> [ s5-s8-protocol pmip ] [ weight <value> ]

    dns { pgw | sgw } dns-service <dns_svc_name> context <dns_ctxt_name>

  end

```

Notes:

- <dns_svc_name> is a preconfigured DNS client service as configured in *Configuring DNS Client Service* section.
- Only one DNS client service can be associated with MME service.

Configuring Session and Security Parameters for EPS bearer Contexts

Use the following example to configure the MME sessions and security parameters for EPS bearer context:

```
configure
  context <vpn_ctxt_name>
    mme-service <mme_svc_name>
      apn <apn_name>
      encryption-algorithm-lte priority <value> [ 128-eea0 | 128-eea1 | 128-eea2
]
      integrity-algorithm-lte priority <value> [ 128-eia1 | 128-eia2 ]
      max-bearers per-subscriber <max_bearer>
      max-pdns per-subscriber <max_pdn>
    end
```

Notes:

- <max_bearer> is number of EPS bearers allowed for one subscriber.
- <max_pdn> is number of PDNs allowed to access by one subscriber.
- <apn_name> is name of the APN template to be used for subscriber when APN is not available from HSS or MS for specific subscriber.

Verifying MME Configuration

Step 1 Verify that your MME services were created and configured properly by entering the following command in Exec Mode:

```
show mme-service name <mme_svc_name>
```

The output of this command given below is a concise listing of MME service parameter settings as shown in the sample output displayed. In this example, an MME service called mmesvc was configured and you can see some parameters configured as default.

```
Service name           : mmesvc
Context                : ingress
Status                 : STARTED
Bind                   : Done
```

```

S1-MME IP Address           : 192.20.20.2
Remote IP Address           : 192.20.20.1
S1-MME sctp port            : 25
dest-sctp port              : 25
MME Code                    : 0
MME Group                   : 0
PLMN Id.                    : MCC: 123, MNC: 456
EGTP Context                : egress
EGTP Service                : egtp
MME HSS Context             : ingress
MME HSS Service             : mmel
Max bearers per MS         : 11
Max pdns per MS            : 3
PGW                         : Address :192.70.60.2
                             S5-S8 Protocol : GTP
                             Weight : 100
SGW                         : Address :192.60.60.11
                             S5-S8 Protocol : GTP
                             TAC : 10
                             MCC : 300
                             MNC : 90
                             Weight : 100
APN Name                    : starent.com
PGW DNS Service             : Not defined
SGW DNS Service             : Not defined
Implicit Detach Timeout     : 3600s
Auth Max Retransmissions Count : 4
Identity Max Retransmissions Count : 4
T3412 Timeout               : 6s

```

■ MME Service Configuration

```

T3413 Timeout                : 6s
T3422 Timeout                : 6s
T3423 Timeout                : 6s
T3450 Timeout                : 6s
T3460 Timeout                : 6s
T3470 Timeout                : 6s
Mobile Reachable Timeout     : 4s
Activate Max Retransmissions Count : 4
Deactivate Max Retransmissions Count : 4
T3485 Timeout                : 6s
T3495 Timeout                : 6s
Encryption Algorithms        : Priority : 1 Algorithm : 128-eea2
Integrity Algorithms         : Priority : 1 Algorithm : 128-eia1

```

Step 2 Verify configuration for errors by entering the following command in Exec Mode:

```
show configuration-errors section mme-service
```

The output of this command displays the errors, if any, in MME service configuration.

eGTP Service Configuration

This section provides instructions for configuring eGTP Service to add S11 interface to connect with S-GW with an MME service. This section provides the minimum instruction set for configuring a GTPP accounting support in a MME service. Commands that configure additional GTPP accounting properties are provided in the Command Line Interface Reference.

These instructions assume that you have already configured the system level configuration as described in System Administration Guide and MME service as described in *MME Service Configuration* section of this chapter.

- Step 1** Create an eGTP service by applying the example configuration in the *Creation of eGTP Service and Other Parameter Configuration* section.
- Step 2** Verify your eGTP service and S11 interface configuration by following the steps in the section.
- Step 3** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

Creation of eGTP Service and Other Parameter Configuration

Use the following configuration example to create the eGTP service and other parameters for S11 interface in the eGTP service:

```
configure
context <egtp_ctxt_name>
  subscriber default
  egtp-service <egtp_service_name>
    interface-type interface-mme
    gtpc bind address <mme_ip_address>
    gtpc max-retransmission <retries>
  end
```

Notes:

- A maximum of 256 services (regardless of type) can be configured per system.
- <egtp_ctxt_name> is name of the destination context in which eGTP service is to be configured for S11 interface functionality with S-GW.
- <mme_ip_address> is the local IP address of this MME service and should not conflict with any other service.

Verifying eGTP Service Configuration

Step 1 Verify that your eGTP services and S11 interface were created and configured properly by entering the following command in Exec Mode:

```
show egtp-service name <egtp_svc_name>
```

The output of this command given below is a concise listing of eGTP service parameter settings as shown in the sample output displayed. In this example, an eGTP service called *egtp_svc* was configured and you can see some parameters configured as default.

```
Service name                : egtp_svc
Service-Id                  : 2
Context                      : egtp_mme
Interface Type              : mme
Status                      : STARTED
Restart Counter             : 8
GTPC Retransmission Timeout : 5
GTPC Maximum Request Retransmissions : 4
GTPC Echo                   : Enabled
GTPC Echo Interval         : 60
GTPU Retransmission Timeout : 5
GTPU Maximum Request Retransmissions : 4
GTPU Echo                   : Disabled
GTP-C Bind Address         : 192.20.20.2
```

Step 2 Verify configuration for errors by entering the following command in Exec Mode:

```
show configuration-errors section egtp-service
```

The output of this command displays the errors, if any, in eGTP service configuration.

MME-HSS Service Configuration

This section provides instructions for configuring the MME-HSS service to provide S6a interface functionality on this MME with HSS. Typically this service is configured in the same context as MME service.



IMPORTANT: This section provides the minimum instruction set for configuring MME-HSS service on a system for S11 interface. Commands that configure additional MME-HSS service properties are provided in MME-HSS Configuration Mode Commands chapter of Command Line Interface Reference.

These instructions assume that you have already configured the system level configuration as described in System Administration Guide and MME service as described in section of this guide.

To configure the MME-HSS service properties on a system for an MME service:

- Step 1** Configure Diameter endpoints and other parameters in the same context where MME-HSS is to be configured by applying the example configuration in the *Configuring Diameter AAA Functionality* section provided in *AAA Interface Administration* and Reference.
- Step 2** Create the MME-HSS service by applying the example configuration in the *Creating MME-HSS Service* section.
- Step 3** Associate the Diameter endpoint configured in *step 1* with MME-HSS service configured at the *step 2* by applying the example configuration in the *Associating Diameter Endpoint with MME-HSS Service* section.
- Step 4** Optional. Configure failure handling actions in event of request message failures with HSS on S6a by applying the example configuration in the *Configuring Failure Handling Actions on HSS* section.
- Step 5** Verify your MME-HSS configuration by following the steps in the *Verifying MME-HSS Service Configuration* section.
- Step 6** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

Creating MME-HSS Service

Use the following example to create the HSS-MME service to provide connectivity with HSS on S6a interface:

```
configure
```

```
context <vpn_ctxt_name>
```

```
mme-hss-service <hss_svc_name> -noconfirm
```

```
request timeout <dur>
```

```
end
```

Notes:

- <vpn_ctxt_name> is name of the system context where you want to configure the MME-HSS service for S6a interface with HSS. Typically this can be the same context where MME service is configured.
- A maximum of 256 services (regardless of type) can be configured per system.
- <dur> is the timeout duration in second for application message retransmission between MME and HSS.

Associating Diameter Endpoint with MME-HSS Service

Use the following example to associate the preconfigured Diameter endpoint configuration with this MME-HSS service and define the Diameter dictionary:

```
configure
  context <vpn_ctxt_name>
    mme-hss-service <hss_svc_name>
      diameter endpoint <diameter_endpoint_name>
      diameter dictionary standard
    end
```

Notes:

- <diameter_endpoint_name> is a preconfigured eGTP service configured at *step 1*.
- For more information on Diameter endpoint configuration, refer *Configuring Diameter AAA Functionality* section provided in *AAA Interface Administration and Reference*.

Configuring Failure Handling Actions on HSS

Use the following example to configure the various actions on event of a request message failure with HSS on S6a interface:

```
configure
  context <vpn_ctxt_name>
    mme-hss-service <hss_svc_name>
      failure-handling {authentication-information-request | check-identity-
request | notify-request | purge-ue-request | update-location-request} {
diameter-result-code <start_error_code> [to <end_error_code>] | request-timeout
} action {continue | retry-and-terminate | terminate }
    end
```

Notes:

- For more information on Diameter endpoint configuration, refer *Configuring Diameter AAA Functionality* section provided in *AAA Interface Administration and Reference*.

Verifying MME-HSS Service Configuration

Step 1 Verify configuration for errors by entering the following command in Exec Mode:

```
show configuration errors section diameter verbose
```

The output of this command is a detailed listing of configuration errors occurred for MME-HSS service.

Step 2 Display the session information of MME-HSS service by entering the following command in Exec Mode:

```
show mme-hss session full all
```

The output of this command is a detailed listing of message statistics on S6a interface grouped in MME-HSS sessions active on an MME-HSS service named *mme-hss1*

MME HSS:

Peer: 0001-sessmgr.megad

Mode:

Callid: 00004e21

NAI: 0001234567

MDN: n/a

Service Name: mme-hss1

State: ACTIVE

Pending Requests: 0

API Requests:

Open:	0	Close:	0
Update Location:	1	Purge UE:	0
Authenticate:	1	Notify:	3
Identity Check:	0	Recoveries:	0
Micro Checkpoint:	0	Full Checkpoint:	0
User Data Query:	5		

API Successes:

Open:	0	Close:	0
-------	---	--------	---

■ MME-HSS Service Configuration

Update Location:	1	Purge UE:	0
Authenticate:	1	Notify:	3
Identity Check:	0	Recoveries:	0
Micro Checkpoint:	0	Full Checkpoint:	0
User Data Query:	0		
API Errors:			
Open:	0	Close:	0
Update Location:	0	Purge UE:	0
Authenticate:	0	Notify:	0
Identity Check:	0	Recoveries:	0
Micro Checkpoint:	0	Full Checkpoint:	0
User Data Query:	0		
Server Requests:			
Update Location:	1	Purge UE:	0
Authenticate:	1	Notify:	3
Identity Check:	0	User Data Req:	0
Server Successes:			
Update Location:	1	Purge UE:	0
Authenticate:	1	Notify:	3
Identity Check:	0	User Data Req:	0
Server Errors:			
Update Location:	0	Purge UE:	0
Authenticate:	0	Notify:	0
Identity Check:	0	User Data Req:	0

Event IDs for MME Service

Identification numbers (IDs) are used to reference events as they occur when logging is enabled on the system. Logs are collected on a per facility basis. Each facility possesses its own range of event IDs as indicated in the following table.



IMPORTANT: Not all event IDs are used on all platforms. It depends on the platform type and the license(s) running.

For more information on logging facility configuration and event id, refer *Configuring and Viewing System Logs* chapter in *System Administration Guide*.

Table 5. System Event Facilities and ID Ranges

Facility	Event ID Range
AAA Client Facility Events	6000-6999
Active Charging Service (ACS) Controller Events	90000-90999
Active Charging Service (ACS) Manager Events	91000-91999
Alarm Controller Facility Events	65000-65999
Card/Slot/Port (CSP) Facility Events	7000-7999
Command Line Interface Facility Events	30000-30999
eGTP-C Facility Events	141000-141999
eGTP-U Facility Events	142000-142999
eGTP Manager Facility Events	143000-143999
Event Log Facility Events	2000-2999
Lawful Intercept Log Facility Events	69000-69999
MME App Facility Events	147000-147999
MME Demux Manager Facility Events	154000-154999
MME-HSS Facility Events	138000-138999
MME Miscellaneous Facility Events	152600-152999
Mobile Access Gateway Manager Facility Events	137500-137999
Mobile IPv6 Facility Events	129000-129999
Network Access Signaling Facility Events	153000-153999
Statistics Facility Events	31000-31999
System Facility Events	1000-1999
System Initiation Task (SIT) Main Facility Events	4000-4999
Threshold Facility Events	61000-61999

■ Event IDs for MME Service

Facility	Event ID Range
Virtual Private Network Facility Events	5000-5999

Chapter 4

Verifying and Saving Your Configuration

This chapter describes how to save the system configuration.

Verifying the Configuration

You can use a number of command to verify the configuration of your feature, service, or system. Many are hierarchical in their implementation and some are specific to portions of or specific lines in the configuration file.

Feature Configuration

In many configurations, specific features are set and need to be verified. Examples include APN and IP address pool configuration. Using these examples, enter the following commands to verify proper feature configuration:

show apn all

The output displays the complete configuration for the APN. In this example, an APN called apn1 is configured.

```
access point name (APN): apn1
authentication context: test
pdp type: ipv4
Selection Mode: subscribed
ip source violation: Checked drop limit: 10
accounting mode: gtp No early PDUs: Disabled
max-primary-pdp-contexts: 1000000 total-pdp-contexts: 1000000
primary contexts: not available total contexts: not available
local ip: 0.0.0.0
primary dns: 0.0.0.0 secondary dns: 0.0.0.0
ppp keep alive period : 0 ppp mtu : 1500
absolute timeout : 0 idle timeout : 0
long duration timeout: 0 long duration action: Detection
ip header compression: vj
data compression: stac mppc deflate compression mode: normal
min compression size: 128
ip output access-group: ip input access-group:
ppp authentication:
allow noauthentication: Enabled imsi
authentication:Disabled
```


Enter the following command to display the IP address pool configuration:

show ip pool

The output from this command should look similar to the sample shown below. In this example, all IP pools were configured in the *isp1* context.

```
context : isp1:
+-----Type: (P) - Public (R) - Private
| (S) - Static (E) - Resource
|
|+----State: (G) - Good (D) - Pending Delete (R)-Resizing
||
| |++--Priority: 0..10 (Highest (0) .. Lowest (10))
| | |
| | | |++-Busyout: (B) - Busyout configured
| | | | |
| | | | | vvvvv Pool Name Start Address Mask/End Address Used Avail
-----
PG00 ipsec 12.12.12.0 255.255.255.0 0 254 PG00
pool1 10.10.0.0 255.255.0.0 0 65534 SG00
vpnpool 192.168.1.250 192.168.1.254 0 5 Total Pool Count: 5
```



IMPORTANT: Many features can be configured on the system. There are show commands specifically for these features. Refer to the *Command Line Interface Reference* for more information.

Service Configuration

Verify that your service was created and configured properly by entering the following command:

show <service_type> <service_name>

The output is a concise listing of the service parameter settings similar to the sample displayed below. In this example, a P-GW service called pgw is configured.

```
Service name : pgw1
Service-Id : 1
Context : test1
```

■ Verifying the Configuration

```

Status : STARTED

Restart Counter : 8

EGTP Service : egtp1

LMA Service : Not defined

Session-Delete-Delay Timer : Enabled

Session-Delete-Delay timeout : 10000(msecs)

PLMN ID List : MCC: 100, MNC: 99

Newcall Policy : None

```

Context Configuration

Verify that your context was created and configured properly by entering the following command:

```
show context name <name>
```

The output shows the active context. Its ID is similar to the sample displayed below. In this example, a context named *test1* is configured.

Context Name	ContextID	State
-----	-----	-----
test1	2	Active

System Configuration

Verify that your entire configuration file was created and configured properly by entering the following command:

```
show configuration
```

This command displays the entire configuration including the context and service configurations defined above.

Finding Configuration Errors

Identify errors in your configuration file by entering the following command:

```
show configuration errors
```

This command displays errors it finds within the configuration. For example, if you have created a service named “service1”, but entered it as “srv1” in another part of the configuration, the system displays this error.

You must refine this command to specify particular sections of the configuration. Add the **section** keyword and choose a section from the help menu:

```
show configuration errors section ggsn-service
```

or

```
show configuration errors section aaa-config
```

If the configuration contains no errors, an output similar to the following is displayed:

```
#####  
  
Displaying Global  
AAA-configuration errors  
#####  
  
Total 0 error(s) in this section !
```

Saving the Configuration

Save system configuration information to a file locally or to a remote node on the network. You can use this configuration file on any other systems that require the same configuration.

Files saved locally can be stored in the SPC's/SMC's CompactFlash or on an installed PCMCIA memory card on the SPC/SMC. Files that are saved to a remote network node can be transmitted using either FTP, or TFTP.

Saving the Configuration on the Chassis

These instructions assume that you are at the root prompt for the Exec mode:

```
[local]host_name#
```

To save your current configuration, enter the following command:

```
save configuration url [-redundant] [-noconfirm] [showsecrets] [verbose]
```

Keyword/Variable	Description
<i>url</i>	<p>Specifies the path and name to which the configuration file is to be stored. <i>url</i> may refer to a local or a remote file. <i>url</i> must be entered using one of the following formats:</p> <ul style="list-style-type: none"> • <code>{ /flash /pcmcia1 /pcmcia2 } [/dir] /file_name</code> • <code>file:/{ /flash /pcmcia1 /pcmcia2 } [/dir] /file_name</code> • <code>tftp://{ ipaddress host_name [:port#] } [/directory] /file_name</code> • <code>ftp://[username [:pwd] @] { ipaddress host_name } [:port#] [/directory] /file_name</code> • <code>sftp://[username [:pwd] @] { ipaddress host_name } [:port#] [/directory] /file_name</code> <p><code>/flash</code> corresponds to the CompactFlash on the SPC/SMC. <code>/pcmcia1</code> corresponds to PCMCIA slot 1. <code>/pcmcia2</code> corresponds to PCMCIA slot 2. <i>ipaddress</i> is the IP address of the network server. <i>host_name</i> is the network server's <i>hostname</i>. <i>port#</i> is the network server's logical port number. Defaults are:</p> <ul style="list-style-type: none"> • tftp: 69 - data • ftp: 20 - data, 21 - control • sftp: 115 - data <p>Note: <i>host_name</i> can only be used if the networkconfig parameter is configured for DHCP and the DHCP server returns a valid <code>nameserver</code>. <i>username</i> is the username required to gain access to the server if necessary. <i>password</i> is the password for the specified username if required. <i>/directory</i> specifies the directory where the file is located if one exists. <i>/file_name</i> specifies the name of the configuration file to be saved. Note: Configuration files should be named with a <code>.cfg</code> extension.</p>
-redundant	<p>Optional: This keyword directs the system to save the CLI configuration file to the local device, defined by the <i>url</i> variable, and then automatically copy that same file to the like device on the Standby SPC/SMC, if available.</p> <p>Note: This keyword will only work for like local devices that are located on both the active and standby SPCs/SMCs. For example, if you save the file to the <code>/pcmcia1</code> device on the active SPC/SMC, that same type of device (a PC-Card in Slot 1 of the standby SPC/SMC) must be available. Otherwise, a failure message is displayed.</p> <p>Note: If saving the file to an external network (non-local) device, the system disregards this keyword.</p>

Keyword/Variable	Description
-noconfirm	Optional: Indicates that no confirmation is to be given prior to saving the configuration information to the specified filename (if one was specified) or to the currently active configuration file (if none was specified).
showsecrets	Optional: This keyword causes the CLI configuration file to be saved with all passwords in plain text, rather than their default encrypted format.
verbose	Optional: Specifies that every parameter that is being saved to the new configuration file should be displayed.



IMPORTANT: The **-redundant** keyword is only applicable when saving a configuration file to local devices. This command does not synchronize the local file system. If you have added, modified, or deleted other files or directories to or from a local device for the active SPC/SMC, then you must synchronize the local file system on both SPCs/SMCs.

To save a configuration file called `system.cfg` to a directory that was previously created called `cfgfiles` on the SPC's/SMC's CompactFlash, enter the following command:

```
save configuration /flash/cfgfiles/system.cfg
```

To save a configuration file called `simple_ip.cfg` to a directory called `host_name_configs` using an FTP server with an IP address of `192.168.34.156` on which you have an account with a username of `administrator` and a password of `secure`, use the following command:

```
save configuration
ftp://administrator:secure@192.168.34.156/host_name_configs/
simple_ip.cfg
```

To save a configuration file called `init_config.cfg` to the root directory of a TFTP server with a hostname of `config_server`, enter the following command:

```
save configuration tftp://config_server/init_config.cfg
```

Chapter 5

Monitoring the Service

This chapter provides information for monitoring service status and performance using the **show** commands found in the Command Line Interface (CLI). These command have many related keywords that allow them to provide useful information on all aspects of the system ranging from current software configuration through call activity and status.

The selection of keywords described in this chapter is intended to provided the most useful and in-depth information for monitoring the system. For additional information on these and other **show** command keywords, refer to the Command Line Interface Reference.

In addition to the CLI, the system supports the sending of Simple Network Management Protocol (SNMP) traps that indicate status and alarm conditions. Refer to the SNMP MIB Reference Guide for a detailed listing of these traps.

Monitoring System Status and Performance

This section contains commands used to monitor the status of tasks, managers, applications and other software components in the system. Output descriptions for most of the commands are located in the Counters and Statistics Reference.

Table 6. System Status and Performance Monitoring Commands

To do this:	Enter this command:
View Subscriber Information	
Display Session Resource Status	
View session resource status	<code>show resources session</code>
Display Subscriber Configuration Information	
View locally configured subscriber profile settings (must be in context where subscriber resides)	<code>show subscribers configuration username subscriber_name</code>
View remotely configured subscriber profile settings	<code>show subscribers aaa-configuration username subscriber_name</code>
View Subscribers Currently Accessing the System	
View a listing of subscribers currently accessing the system	<code>show subscribers all</code>
View information for all ggsn-only subscriber sessions	<code>show subscribers ggsn-only all</code>
View information for a specific subscriber	<code>show subscribers full username username</code>
View Subscriber Counters	
View counters for a specific subscriber	<code>show subscribers counters username subscriber_name</code>
View Recovered Session Information	
View session state information and session recovery status	<code>show subscriber debug-info { callid msid username }</code>
View Session Statistics and Information	
Display Historical Session Counter Information	
View all historical information for all sample intervals	<code>show session counters historical</code>
Display Session Duration Statistics	
View session duration statistics	<code>show session duration</code>
Display Session State Statistics	
View session state statistics	<code>show session progress</code>
Display Session State PCF Statistics	

To do this:	Enter this command:
View session state PCF statistics	<code>show session progress pcf all</code>
Display Session Subsystem and Task StatisticsRefer to the System Software Task and Subsystem Descriptions appendix of the System Administration Guide for additional information on the Session subsystem and its various manager tasks.	
View AAA Manager statistics	<code>show session subsystem facility aaamgr all</code>
View MME Manager statistics	<code>show session subsystem facility mmemgr all</code>
View Session Manager statistics	<code>show session subsystem facility sessmgr all</code>
View Demux Manger status showing detailed statistics for IMSI Manager	<code>show demux-mgr statistics imsimgr full</code>
View MME Application statistics	<code>show logs facility mme-app</code>
View MME HSS Service facility statistics	<code>show logs facility mme-hss</code>
View MME miscellaneous logging facility statistics	<code>show logs facility mme-misc</code>
View MME Demux Manager logging facility statistics	<code>show logs facility mmedemux</code>
View MME Master Manager logging facility statistics	<code>show logs facility mmgr</code>
Display Session Disconnect Reasons	
View session disconnect reasons with verbose output	<code>show session disconnect-reasons</code>
View MME Service Statistics	
Display a MME Service Status	
View all configured MME services session in details	<code>show mme-service all verbose</code>
Display MME Service Session Statistics	
View MME service session statistics in details	<code>show mme-service session full verbose</code>
View MME database statistics for all instances of DB in details	<code>show mme-service db statistics verbose</code>
View individual MME service statistics in concise mode	<code>show mme-service statistics mme-service mme_svc_name</code>
View MME-HSS Statistics	
View MME HSS session summary	<code>show mme-hss session summary all</code>
View MME HSS session statistics	<code>show mme-hss statistics all</code>
View MME HSS session statistics for a specific call id	<code>show mme-hss session full callid call_id</code>
View eGTPC Statistics	
View eGTPC peer information	<code>show egtpc peers interface sgw-egress address ip_address</code>
View eGTPC session information	<code>show egtpc sessions</code>
View eGTPC session statistics	<code>show egtpc statistics</code>
View Subscriber Session Trace Statistics	

To do this:	Enter this command:
View session trace statistics for subscriber with specific trace reference id on an MME	show session trace subscriber reference-id <i>trace_ref_id</i> network-element mme
View Trace Collection Entity connections and statistics for all network elements	show session trace tce-summary

Clearing Statistics and Counters

It may be necessary to periodically clear statistics and counters in order to gather new information. The system provides the ability to clear statistics and counters based on their grouping (MME, MME-HSS, MME DB, etc.).

Statistics and counters can be cleared using the CLI **clear** command. Refer to Command Line Reference for detailed information on using this command.

Chapter 6

Configuring Subscriber Session Tracing

This chapter provides information on subscriber session trace functionality to allow an operator to trace subscriber activity at various points in the network and at various level of details in EPS network. The product Administration Guides provide examples and procedures for configuration of basic services on the system. It is recommended that you select the configuration example that best meets your service model, and configure the required elements for that model, as described in the respective product Administration Guide, before using the procedures in this chapter.



IMPORTANT: The features described in this chapter is an enhanced feature and need enhanced feature license. This support is only available if you have purchased and installed particular feature support license on your chassis.

This chapter discusses following topics for feature support of Subscriber Session Tracing in LTE service:

- [Introduction](#)
- [Supported Standards](#)
- [Supported Networks and Platforms](#)
- [Licenses](#)
- [Subscriber Session Tracing Functional Description](#)
- [Subscriber Session Trace Configuration](#)
- [Verifying Your Configuration](#)

Introduction

The Subscriber Level Trace provides a 3GPP standards-based session-level trace function for call debugging and testing new functions and access terminals in an LTE environment.

In general, the Session Trace capability records and forwards all control activity for the monitored subscriber on the monitored interfaces. This is typically all the signaling and authentication/subscriber services messages that flow when a UE connects to the access network.

The EPC network entities like MME, S-GW, P-GW support 3GPP standards based session level trace capabilities to monitor all call control events on the respective monitored interfaces including S6a, S1-MME and S11 on MME, S5, S8, S11 at S-GW and S5 and S8 on P-GW. The trace can be initiated using multiple methods:

- Management initiation via direct CLI configuration
- Management initiation at HSS with trace activation via authentication response messages over S6a reference interface
- Signaling based activation through signaling from subscriber access terminal



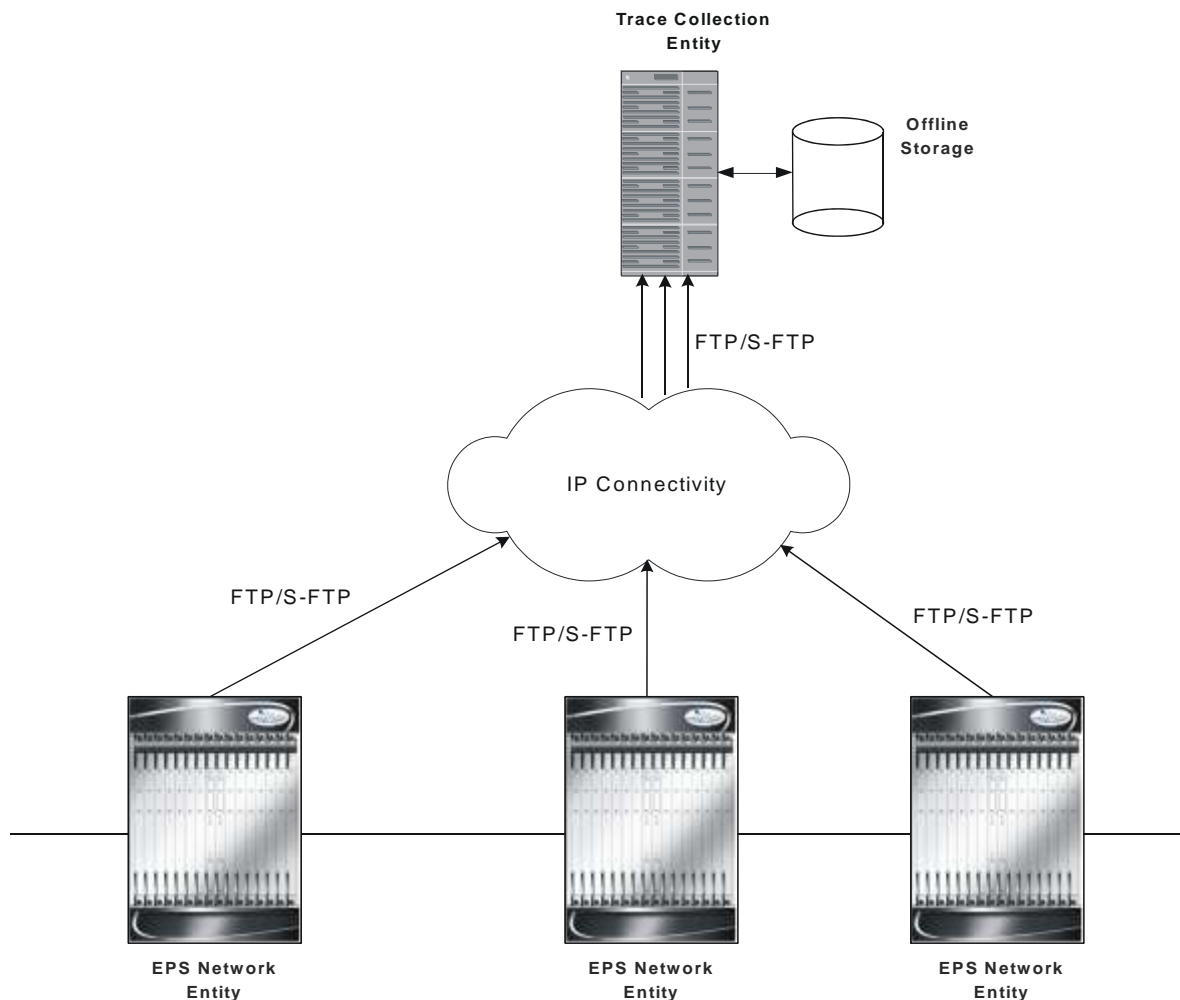
IMPORTANT: Once the trace is provisioned it can be provisioned through the access cloud via various signaling interfaces.

The session level trace function consists of trace activation followed by triggers. The time between the two events is treated much like Lawful Intercept where the EPC network element buffers the trace activation instructions for the provisioned subscriber in memory using camp-on monitoring. Trace files for active calls are buffered as XML files using non-volatile memory on the local dual redundant hard drives on the ASR 5000 platforms. The Trace Depth defines the granularity of data to be traced. Six levels are defined including Maximum, Minimum and Medium with ability to configure additional levels based on vendor extensions.



IMPORTANT: Only Maximum Trace Depth is supported in the current release.

The following figure shows a high-level overview of the session-trace functionality and deployment scenario:

Figure 12. Session Trace Function and Interfaces

All call control activity for active and recorded sessions is sent to an off-line Trace Collection Entity (TCE) using a standards-based XML format over a FTP or secure FTP (SFTP) connection.

Note: In the current release the IPv4 interfaces are used to provide connectivity to the TCE. Trace activation is based on IMSI or IMEI.

Supported Functions

This section provides the list of supported functionality of this feature support:

- Support to trace the control flow through the access network.
 - Trace of specific subscriber identified by IMSI
 - Trace of UE identified by IMEI(SV)

- Ability to specify specific functional entities and interfaces where tracing should occur.
- Scalability and capacity
 - Support up to 32 simultaneous session traces per NE
 - Capacity to activate/deactivate TBD trace sessions per second
 - Each NE can buffer TBD bytes of trace data locally
- Statistics and State Support
- Session Trace Details
- Management and Signaling-based activation models
- Trace Parameter Propagation
- Trace Scope (EPS Only)
 - MME: S1, S3, S6a, S10, S11
 - S-GW: S4, S5, S8, S11, Gxc
 - PDN-GW: S2a, S2b, S2c, S5, S6b, Gx, S8, SGi
- Trace Depth: Maximum, Minimum, Medium (with or without vendor extension)
- XML Encoding of Data as per 3GPP standard 3GPP TS 32.422 V8.6.0 (2009-09)
- Trace Collection Entity (TCE) Support
 - Active pushing of files to the TCE
 - Passive pulling of files by the TCE
- 1 TCE support per context
- Trace Session Recovery after Failure of Session Manager

Supported Standards

Support for the following standards and requests for comments (RFCs) have been added with this interface support:

- 3GPP TS 32.421 V8.5.0 (2009-06): 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Subscriber and equipment trace: Trace concepts and requirements (Release 8)
- 3GPP TS 32.422 V8.6.0 (2009-09): 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Subscriber and equipment trace; Trace control and configuration management (Release 8)
- 3GPP TS 32.423 V8.2.0 (2009-09): 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Subscriber and equipment trace: Trace data definition and management (Release 8)

Supported Networks and Platforms

This feature supports all ASR 5000 Series Platforms with StarOS Release 9.0 or later running MME/S-GW/P-GW service(s) for the core LTE network functions.

Licenses

This is a base feature and available for configuration with default LTE component license(s) on the system:

Subscriber Session Trace Functional Description

This section describes the various functionality involved in tracing of subscriber session on EPC nodes:

Operation

The session trace functionality is separated into two steps - activation and trigger.

Before tracing can begin, it must be activated. Activation is done either via management request or when a UE initiates a signaled connection. After activation, tracing actually begins when it is triggered (defined by a set of trigger events).

Trace Session

A trace session is the time between trace activation and trace de-activation. It defines the state of a trace session, including all user profile configuration, monitoring points, and start/stop triggers. It is uniquely identified by a Trace Reference.

The Trace Reference id is composed of the MCC (3 digits) + the MNC (3 digits) + the trace Id (3 byte octet string).

Trace Recording Session

A trace recording session is a time period in which activity is actually being recorded and traceable data is being forwarded to the TCE. A trace recording session is initiated when a start trigger event occurs and continues until the stop trigger event occurs and is uniquely identified by a Trace Recording Session Reference.

Network Element (NE)

Network elements are the functional component to facilitate subscriber session trace in mobile network.

The term network element refers to a functional component that has standard interfaces in and out of it. It is typically shown as a stand-alone AGW. Examples of NEs are the MME, S-GW, and P-GW.

Currently subscriber session trace is not supported for co-located network elements in EPC network.

Activation

Activation of a trace is similar whether it be via the management interface or via a signaling interface. In both cases, a trace session state block is allocated which stores all configuration and state information for the trace session. In addition, a (S)FTP connection to the TCE is established if one does not already exist (if this is the first trace session established, odds are there will not be a (S)FTP connection already established to the TCE).

If the session to be traced is already active, tracing may begin immediately. Otherwise, tracing activity concludes until the start trigger occurs (typically when the subscriber/UE under trace initiates a connection). A failure to activate a trace (due to max exceeded or some other failure reason) results in a notification being sent to the TCE indicating the failure.

Management Activation

With a management-initiated activation, the WEM sends an activation request directly to the NE where the trace is to be initiated. The NE establishes the trace session and waits for a triggering event to start actively tracing. Depending upon the configuration of the trace session, the trace activation may be propagated to other NEs.

Signaling Activation

With a signaling based activation, the trace session is indicated to the NE across a signaling interface via a trace invocation message. This message can either be piggybacked with an existing bearer setup message (in order to trace all control messages) or by sending a separate trace invocation message (if the user is already active).

Start Trigger

A trace recording session starts upon reception of one of the configured start triggers. Once the start trigger is received, the NE generates a Trace Recording Session Reference (unique to the NE) and begins to collect and forward trace information on the session to the TCE.

List of trigger events are listed in 3GPP standard 3GPP TS 32.422 V8.6.0 (2009-09).

Deactivation

Deactivation of a Trace Session is similar whether it was management or signaling activated. In either case, a deactivation request is received by the NE that contains a valid trace reference results in the de-allocation of the trace session state block and a flushing of any pending trace data. In addition, if this is the last trace session to a particular TCE, the (S)FTP connection to the TCE is released after the last trace file is successfully transferred to the TCE.

Stop Trigger

A trace recording session ends upon the reception of one of the configured stop triggers. Once the stop trigger is received, the NE will terminate the active recording session and attempt to send any pending trace data to the TCE. The list of triggering events can be found in 3GPP standard 3GPP TS 32.422 V8.6.0 (2009-09).

Data Collection and Reporting

Subscriber session trace functionality supports data collection and reporting system to provide historical usage and event analysis.

All data collected by the NE is formatted into standard XML file format and forwarded to the TCE via (S)FTP. The specific format of the data is defined in 3GPP standard 3GPP TS 32.423 V8.2.0 (2009-09).

Trace Depth

The Trace Depth defines what data is to be traced. There are six depths defined: Maximum, Minimum, and Medium all having with and without vendor extension flavors. The maximum level of detail results in the entire control message getting traced and forwarded to the TCE. The medium and minimum define varying subsets of the control messages (specific decoded IEs) to be traced and forwarded. The contents and definition of the medium and minimum trace can be found in 3GPP standard 3GPP TS 32.423 V8.2.0 (2009-09).

Note: Only Maximum Trace Depth is supported in the current release.

Trace Scope

The Trace Scope defines what NEs and what interfaces have the tracing capabilities enabled on them. This is actually a specific list of NE types and interfaces provided in the trace session configuration by the operator (either directly via a management interface or indirectly via a signaling interface).

Network Element Details

Trace functionality for each of the specific network elements supported by this functionality are described in this section.

This section includes the trace monitoring points applicable to them as well as the interfaces over which they can send and/or receive trace configuration.

MME

The MME support tracing of the following interfaces with the following trace capabilities:

Interface Name	Remote Device	Trace Signaling (De)Activation RX	Trace Signaling (De)Activation TX
S1a	eNodeB	N	Y
S3	SGSN	Y	Y
S6a	HSS	Y	N
S10	MME	Y	Y
S11	S-GW	N	Y

S-GW

The S-GW support tracing of the following interfaces with the following trace capabilities:

Interface Name	Remote Device	Trace Signaling (De)Activation RX	Trace Signaling (De)Activation TX
----------------	---------------	-----------------------------------	-----------------------------------

Interface Name	Remote Device	Trace Signaling (De)Activation RX	Trace Signaling (De)Activation TX
S4	SGSN	N	N
S3	P-GW (Intra-PLMN)	N	Y
S6a	P-GW (Inter-PLMN)	N	N
S11	MME	Y	N

P-GW

The PDN-GW support tracing of the following interfaces with the following trace capabilities:

Interface Name	Remote Device	Trace Signaling (De)Activation RX	Trace Signaling (De)Activation TX
S2abc	Various NEs	N	N
S5	S-GW (Intra-PLMN)	Y	N
S6b	AAA Server/Proxy	Y	N
S8	S-GW (Inter-PLMN)	N	N
Gx	Policy Server	Y	N
SGi	IMS	Y	N

Subscriber Session Trace Configuration

This section provides a high-level series of steps and the associated configuration examples for configuring the system to enable the Subscriber Session Trace collection and monitoring function on network elements in LTE/EPC networks.



IMPORTANT: This section provides the minimum instruction set to enable the Subscriber Session Trace functionality to collect session traces on network elements on EPC networks. Commands that configure additional function for this feature are provided in the Command Line Interface Reference.

These instructions assume that you have already configured the system level configuration as described in System Administration Guide and specific product Administration Guide.

To configure the system to support subscriber session trace collection and trace file transport on a system:

- Step 1** Enable the subscriber session trace functionality with NE interface and TCE address at the Exec Mode level on an EPC network element by applying the example configurations presented in the *Enabling Subscriber Session Trace on EPC Network Element* section.
- Step 2** Configure the network and trace file transportation parameters by applying the example configurations presented in the *Trace File Collection Configuration* section.
- Step 3** Save the changes to system configuration by applying the example configuration found in *Verifying and Saving Your Configuration* chapter.
- Step 4** Verify the configuration of Subscriber Session Trace related parameters by applying the commands provided in the *Verifying Your Configuration* section of this chapter.

Enabling Subscriber Session Trace on EPC Network Element

This section provides the configuration example to enable the subscriber session trace on a system at the Exec mode:

```
session trace subscriber network-element {mme | pgw | sgw} {imei
<imei_id> {imsi <imsi_id>} {interface {all | <interface>}} trace-ref
<trace_ref_id> collection-entity <ip_address>
```

Notes:

- *<interface>* is the name of the interfaces applicable for specific NE on which subscriber session traces have to be collected. For more information, refer **session trace subscriber** command in Command Line Interface Reference.
- *<trace_ref_id>* is the configured Trace Id to be used for this trace collection instance. It is composed of MCC (3 digit)+MNC (3 digit)+Trace Id (3 byte octet string).
- *<ip_address>* is the IP address of Trace collection Entity in IPv4 notation.

Trace File Collection Configuration

This section provides the configuration example to configure the trace file collection parameters and protocols to be used to store trace files on TCE through FTP/S-FTP:

```
configure

    session trace [ collection-timer <dur> ] [ network-element { all | mme
| pgw | sgw } ] [ retry-timer <dur> ] [ tce-mode { none | push transport
{ ftp | sftp } path <string> username <name> { encrypted password
<enc_pw> | password <password> } } ]

end
```

Notes:

- *<string>* is the location/path on the trace collection entity (TCE) where trace files will be stored on TCE. For more information, refer **session trace** command in Command Line Interface Reference.

Verifying Your Configuration

This section explains how to display and review the configurations after saving them in a .cfg file as described in Saving Your Configuration chapter of this guide and also to retrieve errors and warnings within an active configuration for a service.



IMPORTANT: All commands listed here are under Exec mode. Not all commands are available on all platforms.

These instructions are used to verify the Subscriber Session Trace configuration.

Step 1 Verify that your subscriber session support is configured properly by entering the following command in Exec Mode:

```
show session trace statistics
```

The output of this command displays the statistics of the session trace instance.

```
Num current trace sessions: 5
Total trace sessions activated: 15
Total Number of trace session activation failures: 2
Total Number of trace recording sessions triggered: 15
Total Number of messages traced: 123
Number of current TCE connections: 2
Total number of TCE connections: 3
Total number of files uploaded to all TCEs: 34
```

Step 2 View the session trace references active for various network elements in an EPC network by entering the following command in Exec Mode:

```
show session trace trace-summary
```

The output of this command displays the summary of trace references for all network elements:

```
MME
    Trace Reference: 310012012345
    Trace Reference: 310012012346
SGW
    Trace Reference: 310012012345
```

Trace Reference: 310012012346

PGW

Trace Reference: 310012012347

Chapter 7

Troubleshooting the Service

This chapter provides information and instructions for using the system command line interface (CLI) for troubleshooting issues that may arise during service operation.

Test Commands

In the event that an issue was discovered with an installed application or line card, depending on the severity, it may be necessary to take corrective action.

The system provides several redundancy and fail-over mechanisms to address issues with application and line cards in order to minimize system downtime and data loss. These mechanisms are described in the sections that follow.

Using the PPP Echo-Test Command

The system provides a mechanism to verify the Point-to-Point Protocol session of a particular subscriber by sending Link Control Protocol (LCP) packets to the mobile node. This functionality can be extremely useful in determining the quality of the air link and delays that may occur.

The command has the following syntax:

```
ppp echo-test { callid call_id | ipaddr ip_address | msid ms_id |
username subscriber_name }
```

Keyword/Variable	Description
callid <i>call_id</i>	Specifies that the test is executed for a subscriber with a specific call identification number (callid). <i>call_id</i> is the specific call identification number that you wish to test.
ipaddr <i>ip_address</i>	Specifies that the test is executed for a subscriber with a specific IP address. <i>ip_address</i> is the specific IP address that you wish to test.
msid <i>ms_id</i>	Specifies that the test is executed for a subscriber with a specific mobile station identification (MSID) number. <i>ms_id</i> is the specific mobile station identification number that you wish to test.
username <i>subscriber_name</i>	Specifies that the test is executed for a subscriber with a specific username. <i>subscriber_name</i> is the specific username that you wish to test.

The following figure displays a sample of this command's output showing a successful PPP echo-test to a subscriber named user2@aaa.

```
USERNAME: user2@aaa MSID: 0000012345 CALLID: 001e8481

Tx/Rx 1/0 RTT(min/max/avg) 0/0/0

USERNAME: user2@aaa MSID: 0000012345 CALLID: 001e8481

Tx/Rx 1/1 RTT(min/max/avg) 77/77/77 (COMPLETE)
```

Using the eGTPC Test Echo Command

This command tests the eGTP service's ability to exchange eGTPC packets with the specified peer which can be useful for troubleshooting and/or monitoring.

The test is performed by the system sending eGTP-C echo request messages to the specified peer(s) and waiting for a response.



IMPORTANT: This command must be executed from within the context in which at least one eGTP service is configured.

The command has the following syntax:

```
egtpc test echo peer-address peer_ip_address src-address
egtp_svc_ip_address
```

Keyword/Variable	Description
peer-address <i>peer_ip_address</i>	Specifies that eGTP-C echo requests will be sent to a specific peer (HSS). <i>ip_address</i> is the address of the HSS receiving the requests.
src-address <i>egtp_svc_ip_address</i>	Specifies the IP address of a S6a interface configured on the system in eGTP service. NOTE: The IP address of the system's S6a interface must be bound to a configured eGTP service prior to executing this command.

The following example displays a sample of this command's output showing a successful eGTPC echo-test from an eGTP service bound to address 192.168.157.32 to an HSS with an address of 192.168.157.2.

```
EGTPC test echo
-----
Peer: 172.10.10.2 Tx/Rx: 1/1 RTT(ms): 2 (COMPLETE) Recovery: 10 (0x0A)
```

Using the DHCP Test Command

This command tests the system's ability to communicate with a Dynamic Host Control Protocol (DHCP) server. Testing is performed on a per-DHCP service basis for either a specific server or all servers the DHCP service is configured to communicate with. This functionality is useful for troubleshooting and/or monitoring.

Once executed, the test attempts to obtain an IP address from the DHCP server(s) and immediately release it.



IMPORTANT: This command must be executed from within the context in which at least one MME service is configured.

The command has the following syntax:

```
dhcp test dhcp-service svc_name [ all | server ip_address ]
```

Keyword/Variable	Description
dhcp-service <i>svc_name</i>	The name of the DHCP service. <i>svc_name</i> can be from 1 to 63 alpha and/or numeric characters in length and is case sensitive.
all	Tests DHCP functionality for all servers.
server <i>ip_address</i>	Tests DHCP functionality for the server.

The following figure displays a sample of this command's output showing a successful DHCP test for a DHCP service called DHCP-Gi to a server with an IP address of 192.168.16.2. The IP address provided during the test was 192.168.16.144.

```
DHCP test status for service <DHCP-Gi>:
```

```
Server address: 192.168.16.2 Status: Tested
```

```
Lease address: 192.168.16.144 Lease Duration: 600 secs.
```


Appendix A

Engineering Rules

This section provides engineering rules or guidelines that must be considered prior to configuring the system for your network deployment.

This appendix describes following engineering rules for MME services:

- [APN Engineering Rules](#)
- [DHCP Service Engineering Rules](#)
- [Lawful Intercept Engineering Rules](#)
- [Service Engineering Rules](#)

APN Engineering Rules

The following engineering rules apply to APNs:

- APNs must be configured within the context used for authentication.
- A maximum of 1,024 APNs per system can be configured.

DHCP Service Engineering Rules

The following engineering rule applies to the DHCP Service:

- Up to 8 DHCP servers may be configured per DHCP service.
- A maximum of 3 DHCP server can be tried for a call.

Lawful Intercept Engineering Rules

The following engineering rules apply to Lawful Intercept on supported MME service:

- A maximum of 20000 Lawful Intercepts can be performed simultaneously.

Service Engineering Rules

The following engineering rules apply to services configured within the system:

- A maximum of 256 services (regardless of type) can be configured per system.



CAUTION: Large numbers of services greatly increase the complexity of management and may impact overall system performance (i.e. resulting from such things as system handoffs). Therefore, it is recommended that a large number of services only be configured if your application absolutely requires it. Please contact your local service representative for more information.

- The total number of entries per table and per chassis is limited to 256.
- Even though service names can be identical to those configured in different contexts on the same system, this is not a good practice. Having services with the same name can lead to confusion, difficulty troubleshooting problems, and make it difficult understanding outputs of show commands.