Understanding the Service Operation

The system provides wireless carriers with a flexible solution for providing Security Gateway (SeGW) and Home-eNodeB Gateway (HeNB-GW) functionality for LTE Femtocell networks.

The system functioning as an HeNB-GW is capable of supporting the following types of subscriber sessions:

- **PS Session over S1AP**: The subscriber is provided packet switch connection with different traffic class on PS session with P-GW in PS.

- **Network-initiated Sessions**: Network-initiated session procedures include Paging, Dedicated Bearers, UE disconnections etc. from CN side on HeNB-GW for a specific subscriber session and in turn HeNB-GW initiates the required procedures with HeNBs and CNs.

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.

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**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.
In HeNB-GW service implementation, the contexts can be classified into source or destination contexts. This is because GTP-U tunnels as well as HeNB-GW Access and Network services can be created over a single context.

The IP addresses as well as interfaces can also under the defined under the same context. These IP addresses are later used to bind with different services including GTP-U, MME and Interfaces including S1-MME for HeNB-GW Access service and Network service.

**Logical Interfaces**

This section describes the logical interface supported on HeNB-GW.

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 an HeNB-GW service, it will function as an S1-MME interface between the HeNB-GW/SeGW service and MME. Services are defined later in this section.

In support of both mobile and network originated subscriber UE contexts, the HeNB-GW provides the following network interface support:

- **S1 Interface**: This interface is the reference point for the control plane protocol between Home eNodeB and HeNB-GW. This interface sets up S1AP association over SCTP as the transport layer protocol for guaranteed delivery of signaling messages between HeNB-GW and Home eNodeB. This is the interface used by the HeNB-GW to communicate with HeNBs on the same Femtocell Access Network. This interface serves as path for establishing and maintaining subscriber UE contexts.

- **S1-MME Interface**: This interface is the reference point for the control plane protocol between E-UTRAN and MME in the LTE Femtocell network. Protocol stack architecture for the S1-MME interface has been described in the Protocol Architecture section of the Overview chapter of this guide.

  The Stream Control Transmission Protocol (SCTP) guarantees the delivery of signalling messages between MME and eNodeB via HeNB-GW.

- **S1-U**: This interface is the reference point between E-UTRAN and Serving Gateway (S-GW). This interface is responsible for the per bearer user plane tunnelling and inter eNodeB path switching during handover. The HeNB-GW functions as a user-plane concentrator along with the control-plane concentration function. This allows the S-GW to view the cluster of femtocells as a single entity. The user-plane aggregation functionality provides support to GTP-U.

- **RADIUS**: This interface is the reference point between a Security Gateway (SeGW) and a 3GPP AAA Server or 3GPP AAA proxy (OCS/CGF/AAA/HSS) over RADIUS protocol for AAA procedures for Femto user.
Important  RADIUS/AAA is only applicable when SeGW is co-located with HeNB-GW.

In the roaming case, the 3GPP AAA Proxy can act as a stateful proxy between the SeGW and 3GPP AAA Server.

The AAA server is responsible for transfer of subscription and authentication data for authenticating/authorizing user access and UE authentication. The SeGW communicates with the AAA on the PLMN using DIAMETER protocol.

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

- **TR-069**: This interface is an application layer protocol which is used for remote configuration of terminal devices, such as DSL modems, HeNBs and STBs. TR-069 provides an auto configuration mechanism between the HeNB and a remote node in the service provider network termed the Auto Configuration Server. The standard also uses a combination of security measures including IKEv2 (Internet Key Exchange v2) and IPsec (IP Security) protocols to authenticate the operator and subscriber and then guarantee the privacy of the data exchanged.

One TR-069 interface can be configured per HeNB node.

### 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 GTP-U service bound to a logical interface will cause the logical interface to take on the characteristics of a GTP interface within an LTE Femtocell 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 and Networks

This section describes the services configured on HeNB-GW to support various functionality.

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

- **HeNB-GW services**: HeNB-GW services are configured in Context Configuration Mode to support both mobile-initiated and network-requested user contexts. The HeNB-GW services must be bound to a logical interface within the same context. There are two HeNB-GW services:
- **HeNB-GW Access Service**: This service is configured under the Context Configuration Mode in order to initialize the HeNB-GW functionality. The configuration of this service controls the functionality of S1-MME interface between HeNB-GW and the HeNBs. This service is bound to a local SCTP end-point address (IP address) to listen the incoming SCTP associations from HeNBs.

- **HeNB-GW Network Service**: This service is also configured in the Context configuration mode to support the HeNB-GW functionalities. The configuration of this service controls the functionality of S1-MME interface between HeNB-GW and MME. One-to-one mapping is maintained between the HeNB-GW Access service and HeNB-GW Network service.

  It is the HeNB-GW Network service where enabling of logical eNodeBs is configured within the HeNB-GW. The Logical eNodeB configuration can be used to support load balancing among different TAI Lists. Each Logical eNodeB can connect up to 8 MMEs from the MME pool and therefore 64 connections are possible to be established between HeNB-GW and MME.

  Important
  
  At least one logical eNodeB configuration is required to start the HeNB-GW Network service. Up to 8 logical eNodeBs can be configured per HeNB-GW Network service.

- **Radio Network PLMN**: The Radio Network PLMN is configured in HeNB-GW Access service to associate PLMNs with HeNB-GW. PLMN configuration is also required at the time of configuring Logical eNodeBs for the HeNB-GW Network service.

- **GTP-U services**: GTP-U services are configured in Context configuration mode in pair of two services; one for GTP-U tunnel support towards HeNB on S1 interface and another for GTP-U tunnel support towards the core network on S1-U interface to communicate with the S-GW respectively. These two GTP-U services are called Access GTP-U service and Network GTP-U service.

  GTP-U service comes in picture specially when the S1-U Relay option is enabled. S1-U relay activation actually allows the data to flow through the GTP-U tunnel via HeNB-GW, otherwise it directly travels from HeNBs to S-GW.

  When S1-U relay is enabled, the HeNB-GW Access service has to be associated with the Network GTP-U service and Access GTP-U service. Also the HeNB-GW Access service has to be associated with the HeNB-GW Network service.

  Important
  
  S1-U Relay is disabled by default. Also when S1-U relay is enabled, both Access and Network GTP-U services need to be in STARTED state for the HeNB-GW access service to be STARTED.