CSFB and SMS over SGs Interface

Circuit Switched Fallback (CSFB) provides an interim solution for enabling telephony and short message service (SMS) for LTE operators that do not plan to deploy IMS packet switched services at initial service launch.

Feature Description

Circuit Switched Fallback (CSFB) enables the UE to camp on an EUTRAN cell and originate or terminate voice calls through a forced switch over to the circuit switched (CS) domain or other CS-domain services (e.g., Location Services (LCS) or supplementary services). Additionally, SMS delivery via the CS core network is realized without CSFB. Since LTE EPC networks were not meant to directly anchor CS connections, when any CS voice services are initiated, any PS based data activities on the E-UTRAN network will be temporarily suspended (either the data transfer is suspended or the packet switched connection is handed over to the 2G/3G network).

CSFB provides an interim solution for enabling telephony and SMS services for LTE operators that do not plan to deploy IMS packet switched services at initial service launch.

CSFB function is realized by reusing Gs interface mechanisms, as defined in 3GPP TS 29.018, on the interface between the MME in the EPS and the VLR. This interface is called the SGs interface. The SGs interface connects the databases in the VLR and the MME.

Important This feature requires that a valid license key be installed. Contact your Cisco Account or Support representative for information on how to obtain a license.

Supported Features

The following CSFB features are supported:

- Release 8 and Release 9 Specification Support
- SGs-AP Encode/Decode of all messages
- SGs-AP Procedure Support

    - Paging
    - Location Update
    - Non-EPS Alert
    - Explicit IMSI Detach
    - Implicit IMSI Detach
    - VLR Failure
    - HSS Failure
    - MM Information
    - NAS Message Tunneling
    - Service Request
    - MME Failure
- SMS
- Mobile Originating Voice Call
- Mobile Terminating Voice Call
- Gn/Gp Handover
- S3 Handover
- Basic and Enhanced TAI to LAI Mapping
- Basic LAI to VLR Mapping
- VLR association distribution among multiple MMEMGRs
- IMSI Paging Procedure
- SCTP Multi-homing for SGs interface
- IPv6 Transport for SGs interface
- SNMP Trap Support (Service/VLR association)
- Operator Policy Support
    - SMS-only
    - Disallow CSFB
    - Reject EPS if IMSI attach fails
    - Reject EPS if VoIMS and no CSFB
    - CSFB Not Preferred
    - Configurable RFSP based on UE Usage and and Voice Domain Preference
- PS Suspend/Resume over S11 (Release 8)
- PS Suspend/Resume over S3/S11 (Release 9)
- Support for SGs AP Timers: TS6-1, ts8, ts9, ts10, ts12-1, ts12-2, ts-13

- Idle mode Signaling Reduction (ISR)
- Multiple Association Support
- SNMP Trap Support
  - **VLRAssocDown** - sent when an SCTP association to a VLR is down.
  - **VLRDown** - sent when **all** SCTP associations to a VLR are down.
  - **VlrAllAssocDown** - sent when **all** associations to **all** VLRs are down.
- Support for Passive VLR Offload: See *VLR Management*.
- Support for Active VLR Offload: See *VLR Management*.
- UE Detach on VLR Failure: See *VLR Management*.
- UE Detach on VLR Recovery: See *VLR Management*.

DSCP Marking for SGs Interface

SGs services provides the Differentiated Services Code Point (DSCP) marking functionality. DSCP marking helps in packet traffic management. DSCP marking can be performed on both IPv4 and IPv6 packets leaving the SGs interface.

Either the pre-defined DSCP values can be used for marking, or any arbitrary value ranging from 0x01 to 0x3F can be assigned. The default DSCP value is 0x00 or be (Best Effort). The default DSCP value is automatically set when the configuration is disabled.

```
config
  context context_name
    sgs-service service_name
      [no] ip qos-dscp dscp_value
      end
```

- ip defines the Internet Protocol parameters for the packets leaving through the SGs interface.
- qos-dscp designates the Quality of Service - Differentiated Services Code Point value to the packet leaving through the SGs interface.
- *dscp_value* is a value assigned to the packet for DSCP marking. The value can be a pre-defined DSCP value or an arbitrary value ranging from 0x01 to 0x3F.

How It Works

EPC core networks are designed for all IP services and as such lack intrinsic support for circuit switched voice and telephony applications. This presents challenges for those operators that do not plan to launch packet switched IMS core networks at initial service deployment. CSFB represents an interim solution to address this problem by enabling dual radio mobile devices (LTE/GSM/UMTS or CDMA1xRTT) to fallback to GSM/UMTS or CDMA1x access networks to receive incoming or place outgoing voice calls. The next section presents highlights of the CSFB procedure.

Preparation Phase

- When the GSM/UMTS/LTE access terminal attaches to the EUTRAN access network, it uses combined attachment procedures to request assistance from the MME to register its presence in the 2G/3G network.

- The MME uses SGs signaling to the MSC/VLR to register on behalf of the AT to the 2G/3G network. The MME represents itself as an SGSN to the MSC and the MSC performs a location update to the SGSN in the target 2G/3G network.
- The MME uses the Tracking Area Identity provided by UE to compute the Location Area Identity it provides to the MSC.

Execution Phase: Mobile Terminated Calls

- When a call comes in at the MSC for the user, the MSC signals the incoming call via the SGs interface to MME.
- If the AT is an active state, the MME forwards the request directly to the mobile. If the user wishes to receive the call the UE instructs the MME to hand over the call to the 2G/3G network. The MME then informs the eNodeB to initiate the handoff.
- If the AT is in dormant state, the MME attempts to page it at every eNodeB within the Tracking Area list to reestablish the radio connection. As no data transfer is in progress, there are no IP data sessions to handover and the mobile switches to its 2G/3G radio to establish the connection with the target access network.
- If the mobile is active and an IP data transfer is in progress at the time of the handover, the data transfer can either be suspended or the packet switched connection can be handed over if the target network supports Dual Transfer Mode. Note that this is typically only supported on UMTS networks.
- Once the access terminal attaches to the 2G/3G cell, it answers the initial paging via the target cell.

Execution Phase: Mobile Originated Calls

- This is very similar to the procedure for Mobile Terminated Calls, except there is no requirement for idle mode paging for incoming calls and the AT has no need to send a paging response to the MSC after it attaches to the target 2G/3G network.

Configuring CSFB over SGs

The configuration example in this section creates an SGs interface and an SGs service for communicating with a Mobile Switching Center/Visitor Location Register (MSC/VLR) for Circuit- Switched Fallback capability.

Important Circuit-Switched Fallback (CSFB) is a licensed feature and requires the purchase of the Circuit Switched Fallback feature license to enable it.

Use the following configuration example to enable CSFB capability on the MME:

```
configure
  lte-policy
    tai-mgnt-db db_name
      tai-mgmt-obj object_name
```

```
            lai mcc number mnc number lac area_code
            tai mcc number mnc number tac  area_code
            end
   context mme_context_name -noconfirm
      interface sgs_intf_name
         ip address ipv4_address
         exit
      sgs-service name -noconfirm
         sctp port port_number
         tac-to-lac-mapping tac value map-to lac value +
         vlr vlr_name { ipv4-address ipv4_address [ ipv4-address ipv4_address ] |
ipv6-address ipv6_address [ ipv6-address ipv6_address ] } port port_number
         pool-area pool_name
            lac area_code +
            hash-value non-configured-value use-vlr vlr_name>
            hash-value range value to value use-vlr vlr_name
            exit
         bind ipv4-address sgs-intf_ipv4_address
         exit
      mme-service service_name
         associate tai-mgmt-db db_name
         associate sgs-service sgs_svc_name
         end
```

Notes:

- The MME will attempt to map a TAI to LAI in the following order:
  - If a TAI Management Database is configured, the MME will first use any TAI to LAI mapping defined within the database.
  - If no TAI Management Database is configured or if no suitable mapping is found within the TAI Management Database, the MME will next attempt to map a specific TAC to a specific LAC as defined in the SGs service according to the **tac-to-lac-mapping** command.
  - Lastly, the MME will attempt to use the default LAC value. This is defined using the **tac-to-lac-mapping** command with the **any-tac** keyword option.
- In this release, the number of TAC to LAC mappings is increased from 512 to 1024 entries.
- For the SGs interface, the **tac-to-lac-mapping** command supports the configuration of multiple TAC-to LAC values in the same configuration line.
- The SGs IP address can also be specified as an IPv6 address. To support this, the **ip address** command can be changed to the **ipv6 address** command and the **bind ipv4-address** command can be changed to **bind ipv6-address** command.

  This command also allows for the configuration of a secondary IP address in support of SCTP multi-homing.
- The VLR interface (**vlr** command) also supports IPv6 addressing and SCTP multi-homing.
- When the VLR configuration includes the same pair of peer VLR addresses with different destination port, this results in paging drops. The configuration to support the same IP address and different port is not supported by MME.