HSS-based P-CSCF Restoration

The home subscriber server-based (HSS) Proxy Call Session Control Function (P-CSCF) Restoration is an optional mechanism during a P-CSCF failure. It applies only when the UE is using 3GPP access technologies.

This section describes MME support for HSS-Initiated P-CSCF Restoration.

Feature Description

P-CSCF Restoration aids in successful establishment of MT VoLTE calls when the serving P-CSCF has failed or unreachable.

The HSS-based P-CSCF Restoration mechanism is executed when a terminating request cannot be serviced due to a P-CSCF failure. The execution is possible if there are no other registration flows available for the terminating UE using an available P-CSCF.

The HSS-based P-CSCF restoration consists of a basic mechanism that makes usage of a path through HSS and MME/SGSN to request the release of the IMS PDN connection to the corresponding UE and an optional extension that avoids the IMS PDN deactivation and re-activation.

The HSS-based P-CSCF Restoration complies with the following standard: 3gpp TS 23.380 section 5.4 HSS-based P-CSCF Restoration

The HSS-based P-CSCF Restoration feature is license controlled. Contact your Cisco Account or Support representative for information on how to obtain a license.

How It Works

The HSS-based P-CSCF restoration feature consists of restoring P-CSCF for the corresponding UE IMS PDN connections in one of the following ways:

- **Basic mechanism** -- This makes usage of a path through HSS and MME to request the release of the IMS PDN connection to the corresponding UE.
- **Optional extension** -- This avoids the IMS PDN deactivation and re-activation. The HSS-based P-CSCF basic mechanism is optionally extended by reusing part of the "Update bearer at P-CSCF failure"

mechanism. This extension is based on the possibility for the P-GW to know whether or not the UE supports the "P-CSCF address assignment through PCO." mechanism.

Architecture

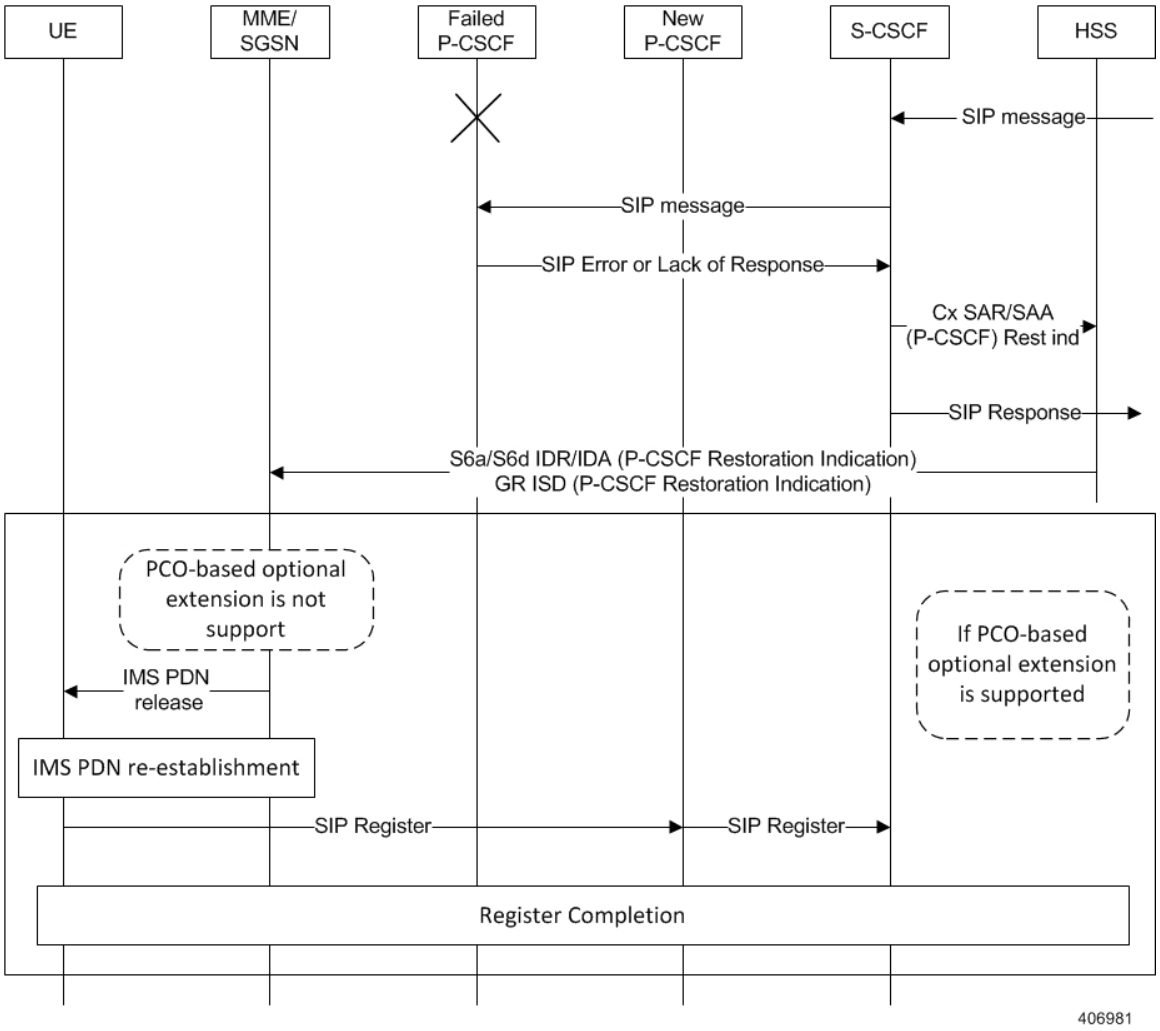
MME provides the following support for HSS-based P-CSCF restoration:

- Advertise support for P-CSCF Restoration on S6a interface towards HSS when configured.
- P-CSCF restoration for IMS PDN's upon receiving s6a IDR message with P-CSCF restoration in IDR flags.
- Identifying IMS PDN based on APN type specified.
- Configuration to select P-CSCF restoration type - PDN Deactivation or PDN Modification.
- Performs PDN Disconnect for IMS PDN deactivation with cause code "reactivation requested" if P-CSCF Restoration type is set to PDN Deactivation.
- "Modify bearer request on S11 interface towards SGW with PCRI indication if P-CSCF Restoration type is set to PDN Modification.
- Detaches UE with cause "reattach required" in case all the UE PDN's need to be deactivated as part of P-CSCF restoration.
- Pages the UE if IDR with P-CSCF restoration is received, while UE is in idle mode.
- Implicitly detach or disconnect the IMS PDN if Paging UE fails and the P-CSCF restoration type is set to PDN deactivation.
- Generate statistics for the number of IMS PDN's Deactivated & Modified for P-CSCF restoration.

Flows

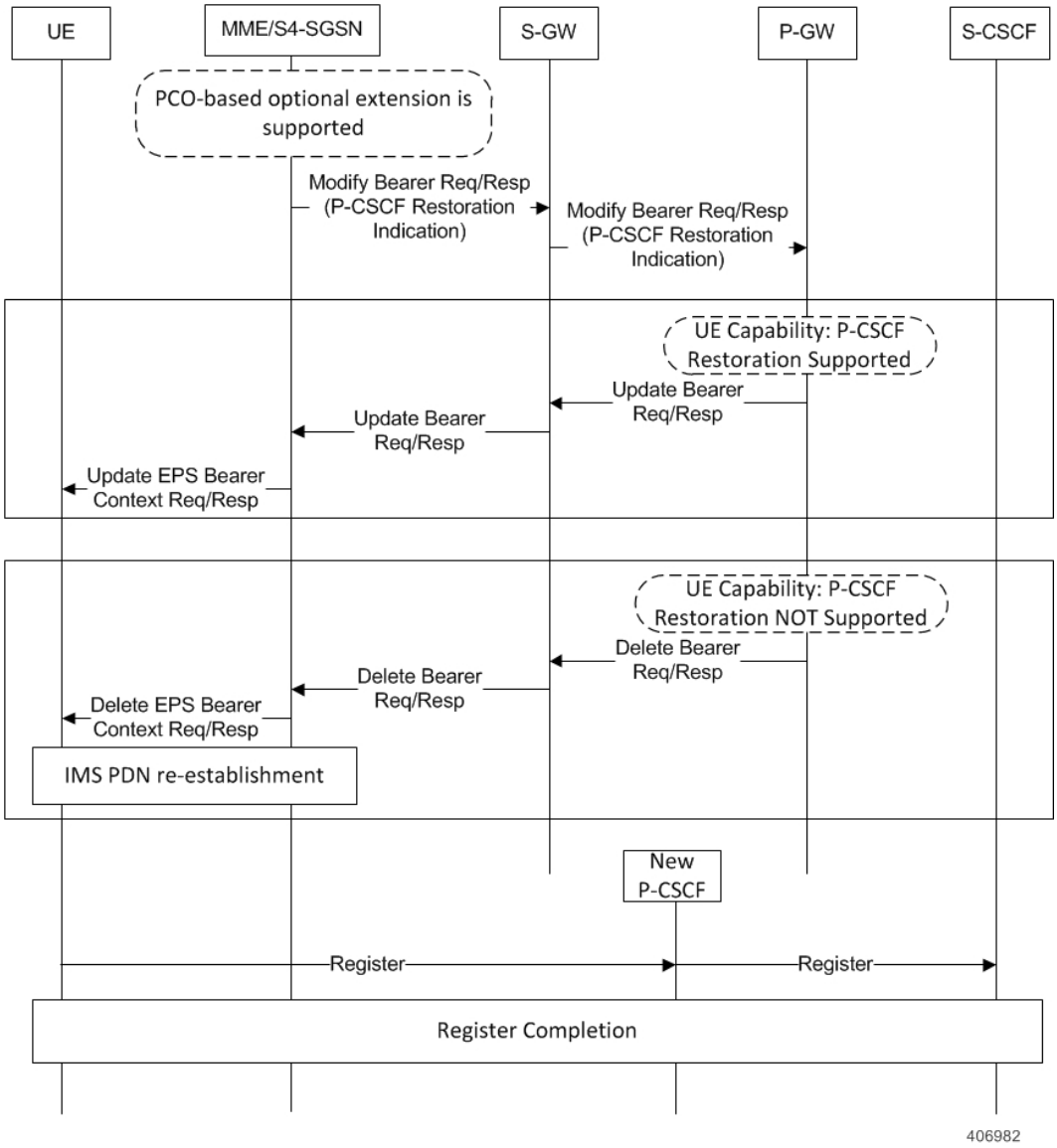
This section provides the MME's call flows for HSS-based P-CSCF Restoration.

Figure 1: Call flow for HSS-based P-CSCF Restoration



On receiving the P-CSCF Restoration indication from the HSS, the MME/SGSN from the received IMSI identifies the UE and finds the corresponding IMS APN. The support of this feature by the serving SGW/PGW is determined based on the local configuration at the MME. If the optional extension is not supported by the SGW/PGW, the MME releases the identified PDN connection towards the UE by executing PDN disconnection/detach procedure with NAS cause code "reactivation requested/ reattach required". Additionally, the MME/SGSN release the same PDN connection towards the SGW/PGW by sending Delete Session message. As a result of the release of the IMS PDN connection, the UE activates the IMS PDN connection to select an available P-CSCF and to perform a new initial IMS registration.

Figure 2: Call flow for HSS-based P-CSCF Restoration, continued...



The HSS-based P-CSCF basic mechanism is optionally extended by reusing part of the "Update PDP context/bearer at P-CSCF failure" mechanism. This in order to avoid the need to deactivate and reactivate the IMS PDN connection. PCO-based optional extension is based on the possibility for the P-GW/GGSN to know whether or not the UE supports the "Update PDP context/bearer at P-CSCF failure" mechanism.

The MME sends Modify Bearer to the P-GW for the associated PDN connection with a P-CSCF Restoration indication. The MME provides this indication to the P-GW through the S-GW. When Modify Bearer Request is received by the S-GW with the P-CSCF Restoration indication, this message is forwarded to PGW. PGW sends Update Bearer Request to the MME along with a list of available P-CSCF addresses within PCO IE to update the destination UE.

MME sends an Update EPS Bearer Context Request or Modify PDP Context Request to the UE, including the PCO with the list of available P-CSCF addresses otherwise, upon reception of Delete Bearer Request the MME sends Delete EPS Bearer Context Request to the UE with NAS cause code "reactivation requested".

When the PDN connection is released, the UE re-activates the IMS PDN connection and selects an available P-CSCF. If the UE has received Modify EPS Bearer Context Request, the UE as per PCO based P-CSCF Restoration procedures, selects an available P-CSCF from the list for IMS registration. The UE performs a new initial IMS registration.

Configuring HSS-based P-CSCF Restoration

Configuring P-CSCF Restoration and Restoration Method

Setting Up P-CSCF Restoration

The **pcscf-restoration** is a newly added command to enable HSS-based P-CSCF Restoration.

The following CLI configuration enables/disables support for HSS-initiated P-CSCF restoration in the Call Control Profile configuration mode.

```
configure
  call-control-profile  profile_name
    [ remove ] pcscf-restoration
    end
```

Notes:

- The **pcscf-restoration** command in the above configuration enables HSS-based P-CSCF restoration. When enabled, MME supports P-CSCF Restoration on the S6a interface towards HSS for IMS PDN.
- The **remove** prefix added to the command disables HSS-based P-CSCF Restoration in the MME.
- By default, the above configuration is disabled.
- To select the method for P-CSCF Restoration, use the **pcscf-restoration** keyword in **apn-type ims** command under APN Profile configuration mode.

Setting Restoration Method

The **apn-type ims** command identifies APN as IMS APN, and indicate whether the PGW supports optional extension or MME initiates PDN deactivation for HSS initiated P-CSCF restoration.

The **pcscf-restoration { pco-update | pdn-deactivate }** keywords select the method for P-CSCF restoration. The P-CSCF restoration method is configured under the APN Profile configuration mode.

```
configure
  apn-profile  profile_name
    apn-type ims [  pcscf-restoration { pco-update | pdn-deactivate } ]

    end
```

Notes:

- The **apn-type ims** command for MME identifies the type of APN. If an IMS APN is present, the Modify Bearer Request will be delayed during Inbound SRNS relocation.
- The **pcscf-restoration** keyword identifies P-CSCF restoration for IMS PDN. This keyword is functional only if the feature license is installed.
- The **pco-update** keyword selects P-CSCF restoration method as PDN Modification through PCO update.
- The **pdn-deactivate** keyword selects P-CSCF restoration method as PDN Deactivation.

- To enable HSS-based P-CSCF Restoration, use the **pcscf-restoration** command under the Call Control Profile mode.

Important If only "apn-type ims" is configured then default P-CSCF restoration method "pdn-deactivate" is enabled.

Verifying the HSS-based P-CSCF Restoration Configuration

Verify the configuration of HSS-based P-CSCF Restoration by entering the following commands:

```
show call-control-profile full all
```

The command above outputs a display similar to the following:

```
Call Control Profile Name  =  cp1
SAMOG Web-Authorization Mutiple Device Support  :  NO
Super Charger  :  Disabled
P-CSCF Restoration  :  Enabled
Sending Radio Access Technology (RAT) IE  :  Enabled
```

The P-CSCF Restoration field indicates if P-CSCF Restoration is enabled or disabled.

show apn-profile full all

The command above generates a display similar to the following:

```
APN Profile Name :  ap1
CI-QOS mapping table  :  Not Configured
APN Type  :  IMS
PCSCF Restoration Type  :  PCO Update
Dedicated bearers
GBR  :  Not Configured
Non-GBR  :  Not Configured
```

The P-CSCF Restoration Type parameter is displayed if the APN type is set to IMS. This parameter indicates if the P-CSCF Restoration method is PCO Update or PDN Deactivate for the current APN profile.

Monitoring and Troubleshooting the HSS-based P-CSCF Restoration

The following sections describe commands available to monitor HSS-based P-CSCF Restoration on the MME.

HSS-based P-CSCF Restoration Show Command(s) and/or Outputs

This section provides information regarding show commands and their outputs in support of HSS-based P-CSCF Restoration

show mme-service statistics

The following fields are displayed on executing this command for this feature:

```
Bearer Statistics:
All Bearers:  0      Connected Bearers: 0
Idle Bearers:  0
```

```
HSS P-CSCF Restoration:
PDN Deactivation: 0   PDN Modification:  3
```

The PDN Deactivation counter indicates the number of IMS PDN deactivations attempted due to HSS-based P-CSCF Restoration

Troubleshooting HSS-based P-CSCF Restoration

To troubleshoot the HSS-based P-CSCF Restoration feature, use the following instructions:

- Ensure call control profile has PCSCF restoration configured.
- Ensure APN profile has APN type configuration and APN profile is associated for the concerned APN NI.
- Check if HSS supports PCSCF restoration and also if it has advertised its support in the S6a messages.
- Ensure if all PGWs serving the APN supports PCSCF restoration through PCO update. If yes then PCSCF restoration method PDN Modification (PCO-update) should be configured. Otherwise PCSCF restoration method PDN deactivate should be configured by default.
- Check the statistics using the following show commands:
  - **show mme-service statistics esm-only**: Displays the counters illustrated below:

    ```
    HSS P-CSCF Restoration:
    PDN Deactivation:  0   PDN Modification: 3
    ```

  - **show session disconnect-reasons verbose**: Displays the counter illustrated below:

    ```
    mme-pcscf-rest-detach(616)  0           0.00000
    ```

  - **show mme-service statistics**: Displays the counters illustrated below:

    ```
    Paging Initiation for SIGNALING DETACH Events:
    Attempted:  0    Success: 0
    Failures:  0
    Success at Last n eNB: 0   Success at Last TAI: 0
    Success at TAI List:              0

    Paging Initiation for SIGNALING Idr Events:
    Attempted: 0    Success: 0
    Failures: 0
    Success at Last n eNB 0    Success at Last TAI: 0
    Success at TAI List: 0
    HSS Initiated PDN Disconnections:
    Attempted: 2    Success: 2
    Failures: 0
    Disconnect Statistics:
    UE detached:  0    PGW detached: 0
    HSS detached: 1    MME detached: 0
    Implicit detach: 0    Local abort:  0
    Authentication failure: 0  Sub parameter failure: 0
    Foreign PLMN rejected: 0    APN not sup PLMN-RAT:  0
    Other reasons: 0
    ```

HSS-based P-CSCF Restoration Bulk Statistics

The following statistics are included in the MME Schema in support of the HSS-based P-CSCF Restoration:

- pcscf-restoration-pdn-deactivations
- pcscf-restoration-pdn-modifications

For descriptions of these variables, see *MME Schema Statistics* in the *Statistics and Counters Reference*.