

HSS and PCRF Based P-CSCF Restoration Support

This feature enables support for HSS-based and PCRF-based P-CSCF restoration that helps to minimize the time a UE is unreachable for terminating calls after a P-CSCF failure.

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Feature Description

The P-CSCF restoration procedures were standardized to minimize the time a UE is unreachable for terminating calls after a P-CSCF failure. In compliance with 3GPP standard Release 13, this feature includes the following P-CSCF restoration mechanisms:

- HSS-based P-CSCF Restoration for Trusted/Untrusted WLAN Access (S2a/S2b)
- PCRF-based P-CSCF Restoration for LTE (S5/S8) and Trusted/Untrusted WLAN Access (S2a/S2b)



Important HSS-based P-CSCF Restoration was supported at P-GW for LTE (S5/S8) prior to StarOS release 21.0.

This feature provides support for both basic and extended P-CSCF Restoration procedures.

HSS-based P-CSCF Restoration for WLAN

If the P-CSCF restoration mechanism is supported, gateway indicates the restoration support to AAA server through Feature-List AVP in the Authorization Authentication Request (AAR) message sent over S6b. The Feature-List AVP is part of the Supported-Features grouped AVP. The Bit 0 of the Feature-List AVP is used to indicate P-CSCF Restoration support for WLAN.

During the P-CSCF Restoration, 3GPP AAA server, after having checked that the P-GW supports the HSS-based P-CSCF restoration for WLAN, sends a P-CSCF restoration indication to the P-GW over S6b in a Re-authorization Request (RAR) command. A new Diameter AVP "**RAR-Flags**" is encoded in the RAR message with the Bit 1 set, would indicate to the gateway that the AAA server requests the execution of HSS-based P-CSCF restoration procedures for WLAN.

The existing CLI command **diameter authentication** under AAA Group configuration is extended to encode P-CSCF Restoration feature as part of Supported-Features AVP in the AAR message.

Important Supported-Features will be sent in every AAR message for RAT type WLAN. Feature negotiation is required in every AAR. ReAuth AAR will also do the feature renegotiation.

Emergency PDN HSS based P-CSCF Restoration for S5/S8 will be performed if CLI is configured at P-GW service to support the restoration for emergency PDNs.

PCRF-based P-CSCF Restoration

PCEF supporting P-CSCF restoration mechanism indicates the restoration support in CCR-I message through the Supported-Features AVP. The 24th Bit of the Supported-Feature-List AVP indicates whether this mechanism is supported or not.

The existing CLI command **diameter encode-supported-features** in Policy Control configuration is extended to allow the negotiation of P-CSCF Restoration feature support with PCRF. A new Diameter AVP "**PCSCF-Restoration-Indication**" is introduced to indicate to PCEF that a P-CSCF Restoration is requested. This is achieved by setting AVP value to 0.

Supported-Features AVP is negotiated in CCR-I of all access types (eHRPD, P-GW, GGSN); however, Restoration trigger, if received, is ignored in eHRPD and GGSN.

Limitations

- As per the 3GPP standard specification, if S6b re-authorization request is used for P-CSCF Restoration for WLAN, then for extended P-CSCF Restoration the gateway may send authorization request with only mandatory AVPs. However, in the current implementation, ReAuth used for extended P-CSCF Restoration is a common authorization request of normal ReAuth. It will contain all the AVP of ReAuthorization AAR.
- For P-CSCF Restoration extension mechanism during P-CSCF ReDiscovery with P-CSCF FQDN, local DNS cache will be queried first. If FQDN is already present in local DNS cache, then DNS query will not be sent out to the DNS server and P-GW will immediately get the DNS response.

  Since local DNS cache flush will not be done, operator should configure the cache accordingly.

Licensing

Use of P-CSCF Restoration requires that a valid license key be installed. Contact your local Sales or Support representative for information on how to obtain a license.

How It Works

- Restoration is supported for IPv4/IPv6/IPv4v6 calls.
- With extension, Restoration Support UBR will always go on default bearer.

- P-GW does not compare any of the stored values with the new updated P-CSCF IP addresses; it relies on the DNS provided/discovered values and forwards the P-CSCF IP addresses as is.
- P-CSCF Restoration will be performed for all PDN connections, regardless of APN configuration of IMS/non-IMS.
- Upon receiving P-CSCF Restoration trigger for extended mechanism, P-CSCF address discovery priority is first for P-CSCF FQDN. If FQDN is already present in DNS cache, then as per current implementation of HSS based (S5/S8) P-CSCF Restoration, DNS query will not be sent to the DNS server and P-GW will immediately get the DNS response.

  Since local DNS cache flush will not be done, operator should configure the cache accordingly.
- In case of S6b RAR, P-GW supports configuration for whether to perform ReAuthentication Request and Response (AAR/AAA) with extended restoration support.

  Authentication after RAR for restoration is not mandatory as it increases the authentication signaling flow at AAA Server. In order to maintain backward compatibility with the existing Diameter Relay Agents (DRA)/AAA servers, which expect authentication after RAR, authentication can be configured for RAR with P-CSCF Restoration.
- If the DNS resolution for FQDN fails or P-GW does not have P-CSCF address configured in any other way, P-GW will still send UBR with no P-CSCF address PCO/APCO during restoration.
- If the P-CSCF Restoration is already in progress, then restoration will not be performed again for any second restoration indication received.
- For basic P-CSCF Restoration, call will be cleared with disconnect reason "ue-pcscf-reselect-not-supported (613)".
- P-GW does not expect change in S6b P-CSCF FQDN during ReAuth. In the rare scenario that P-CSCF FQDN is changed in S6b ReAuth, then the new FQDN will be used in next P-CSCF Discovery. If P-CSCF FQDN if changed during ReAuth, then it is not recovered.
- For S6b, every AAR supported-feature will be negotiated. ReAuth AAR will also do the feature renegotiation. It’s expected that S6b AAA server should do the renegotiation in every AAA. This is specifically applicable to LTE-WiFi and vice versa handoff. During LTE attachment, supported-feature will not be sent. During WiFi handoff, however, support for P-CSCF Restoration should be indicated in AAR.
- Supported-feature on Gx for P-CSCF Restoration will apply to GGSN/eHRPD calls as well to support handoff scenarios.
- For S6b RAT type WLAN, AAA group supports configuration to control when AAR is sent with the supported-feature to S6b server. If AAA group disables this functionality, then once the AAA response comes with supported-feature it is considered not negotiated. Thus, negotiation depends on the CLI configuration of supported-feature at the time of handling AAA.
- Supported-feature for P-CSCF Restoration in S6b will only go for RAT type WLAN.
- During IPv6 reporting S6b information update, if information update AAA is pending and RAR for restoration is received, then only the restoration will be handled. In this case, ReAuth will not be performed again for extended restoration, even if configured.
- APCO for Update Bearer Request (UBRequest) for extended P-CSCF Restoration in ePDG will be sent at bearer context level itself. APCO is not at message level for UBRequest.

- If S6b RAR ReAuth is pending and AAA of ReAuth is not yet received when RAR for restoration is received, then only the restoration will be handled. In this case, ReAuth will not be performed again for extended restoration, even if configured.
- For PCRF based P-CSCF Restoration/HSS based (S2a/S2b) P-CSCF Restoration, if UE PDN type and the PCO requested P-CSCF address do not match (for example, PDN type is IPv4 and PCO P-CSCF requested in IPv6, and vice versa), then basic restoration will be performed.
- UE Capability PCO and P-CSCF Restoration for S5/S8:

P-CSCF Reselect Support	P-CSCF Address Requested	MME-triggered Restoration	PCRF-triggered Restoration
✓	✓	Extended Restoration	Extended Restoration
✓	✗	Restoration Ignored	Basic Restoration
✗	✓	Basic Restoration	Basic Restoration
✗	✗	Basic Restoration	Basic Restoration

For S2a only, if MCM mode/WPMSI flag and UE P-CSCF re-selection support and P-CSCF address request is received, then only extended P-CSCF Restoration will be performed. For all other scenarios, if P-CSCF Restoration Indication is received, then basic P-CSCF Restoration is performed.

If both MCM/SCM flag are set, then it's considered SCM.

For S2b only, if UE P-CSCF re-selection support and P-CSCF address request is received during establishment or handoff is received, then only extended P-CSCF Restoration will be performed. For all other scenarios, if P-CSCF Restoration Indication is received, then basic P-CSCF Restoration is performed.

Call Flows

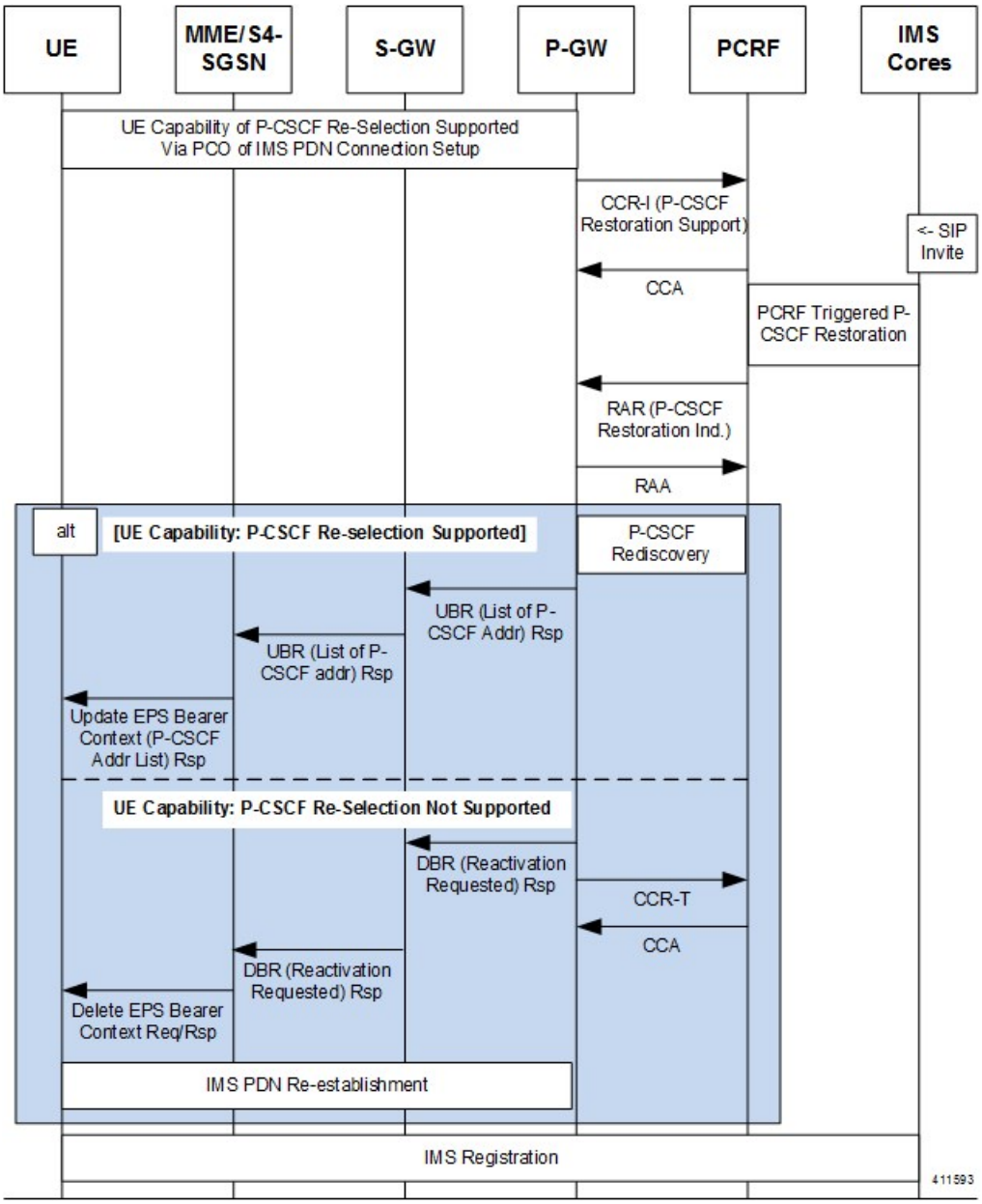
PCRF Based P-CSCF Restoration for LTE (S5/S8)

The PCRF-based P-CSCF Restoration makes use of the path through an alternative P-CSCF and PCRF to inform the P-GW regarding P-CSCF Restoration.

There are two mechanisms to handle the P-CSCF Restoration support:

1. **Basic Restoration Support**: UE does not support the P-CSCF Re-selection. P-GW informs UE to release the PDN connection. P-GW initiates bearer deactivation procedure for the default bearer with cause "reactivation requested".
2. **Extended Restoration Support**: P-GW sends the UBR with PCO having list of alternate P-CSCF addresses after the P-CSCF rediscovery. The optional extension avoids the PDN deactivation and re-activation and is based on the P-GW identifying whether or not the UE supports "Update PDP context/bearer at P-CSCF failure". The UE indicates this capability to the P-GW at the activation of the PDN connection in a PCO parameter.

Figure 1: PCRF Based P-CSCF Restoration - EPC



P-CSCF Restoration for WLAN (S2a/S2b)

This section describes solutions to support P-CSCF Restoration for UEs with WLAN access.

There are two mechanisms to handle the P-CSCF Restoration support:

1. **Basic Restoration Support**: The basic mechanism for the HSS-based solution and for the PCRF-based solution relies on the release of the PDN connection, followed by its re-establishment to trigger a new IMS registration by the UE.

2. **Extended Restoration Support**: The extension mechanism for trusted WLAN and untrusted WLAN access avoids the release of the PDN connection and triggers a new IMS registration by the UE over the existing PDN connection.

   The extension mechanism for trusted WLAN is supported only for multi-connection mode (MCM).

In the basic P-CSCF Restoration for TWAN access or untrusted WLAN access, the P-GW sets the cause "Reactivation requested" when tearing down the PDN connection.

If the re-authorization request is used for the purpose of the P-CSCF Restoration for WLAN, only the P-CSCF Restoration Request bit shall be set in the RAR Flags.

If the P-CSCF Restoration Request bit in the RAR Flags is set in ReAuthorization request (S6b):

- When P-GW triggers the extended P-CSCF restoration mechanism, the P-GW may send the authorization request.
- When P-GW triggers the basic P-CSCF restoration mechanism, the P-GW shall send a Session Termination Request to the 3GPP AAA Server.

For Trusted WLAN Access

- The TWAN shall advertise the support of the WLCP PDN connection modification request procedure over S2a at establishment (or handover) of the PDN connection. This allows the P-GW to use the P-CSCF Restoration extension on this TWAN.
- UE capability (UE support of the P-CSCF Restoration extension for the TWAN access) to the P-GW at the establishment (or handover) of the PDN connection over the WLAN is transferred via PCO IE.
- Upon receipt of a P-CSCF Restoration Indication, the P-GW may invoke this P-CSCF Restoration extension procedure if:
  - The UE is accessing the EPC via a TWAN in the multi-connection mode
  - The UE indicated support of this extension for the TWAN access via PCO, and
  - If the TWAN indicated support of the WLCP PDN connection modification procedure.
  - If UE requested P-CSCF address at establishment or handover.

  Otherwise, the basic restoration procedure is executed.
- For a trusted WLAN with the single connection mode or the transparent single connection mode, only the basic P-CSCF Restoration mechanism may apply.
- In the P-CSCF Restoration extension procedure for TWAN access, the P-GW shall send the updated list of the addresses of available P-CSCFs toward the UE via the TWAN using the PCO IE.

Figure 2: PCRF Based P-CSCF Restoration for Trusted WLAN Access

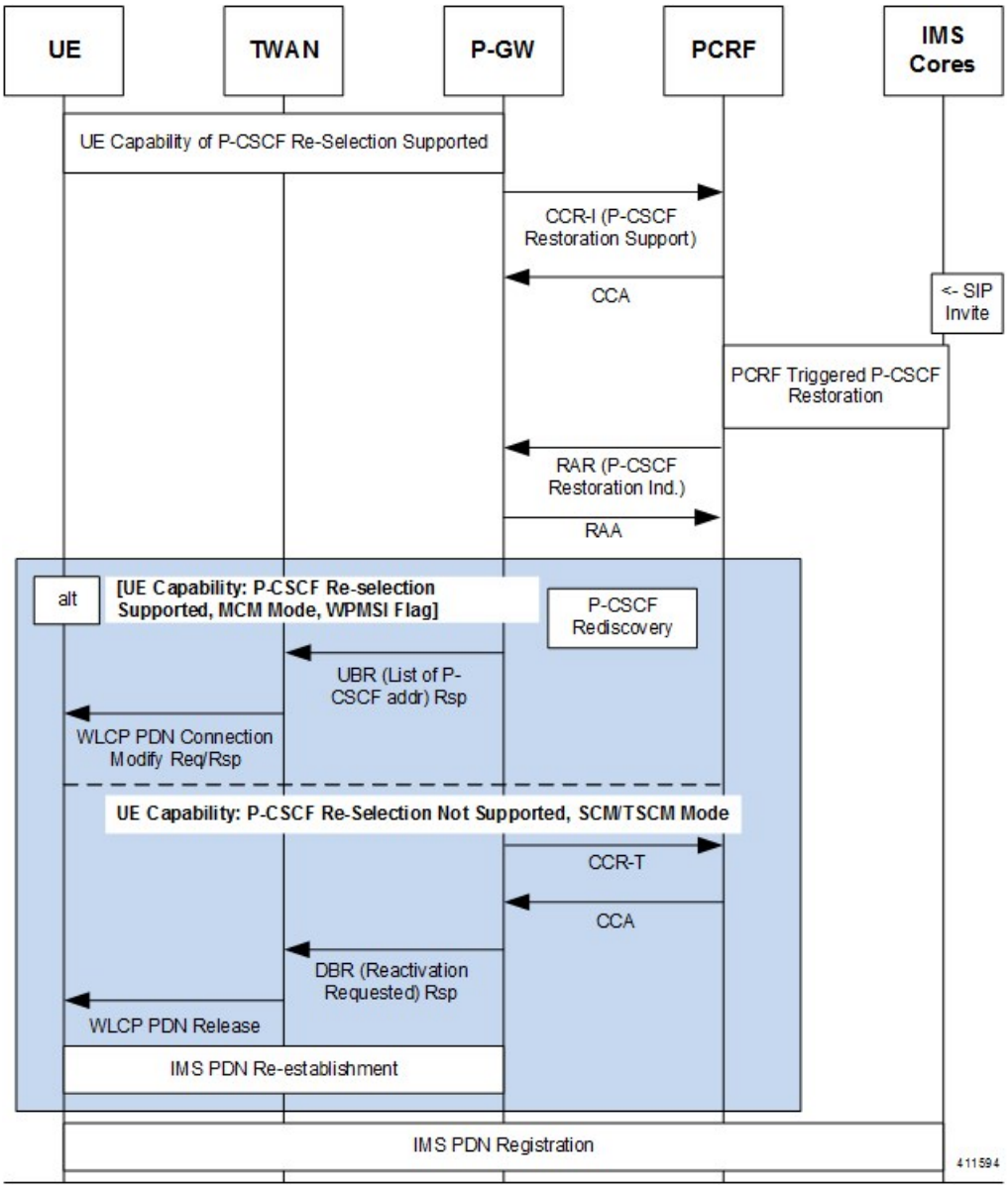
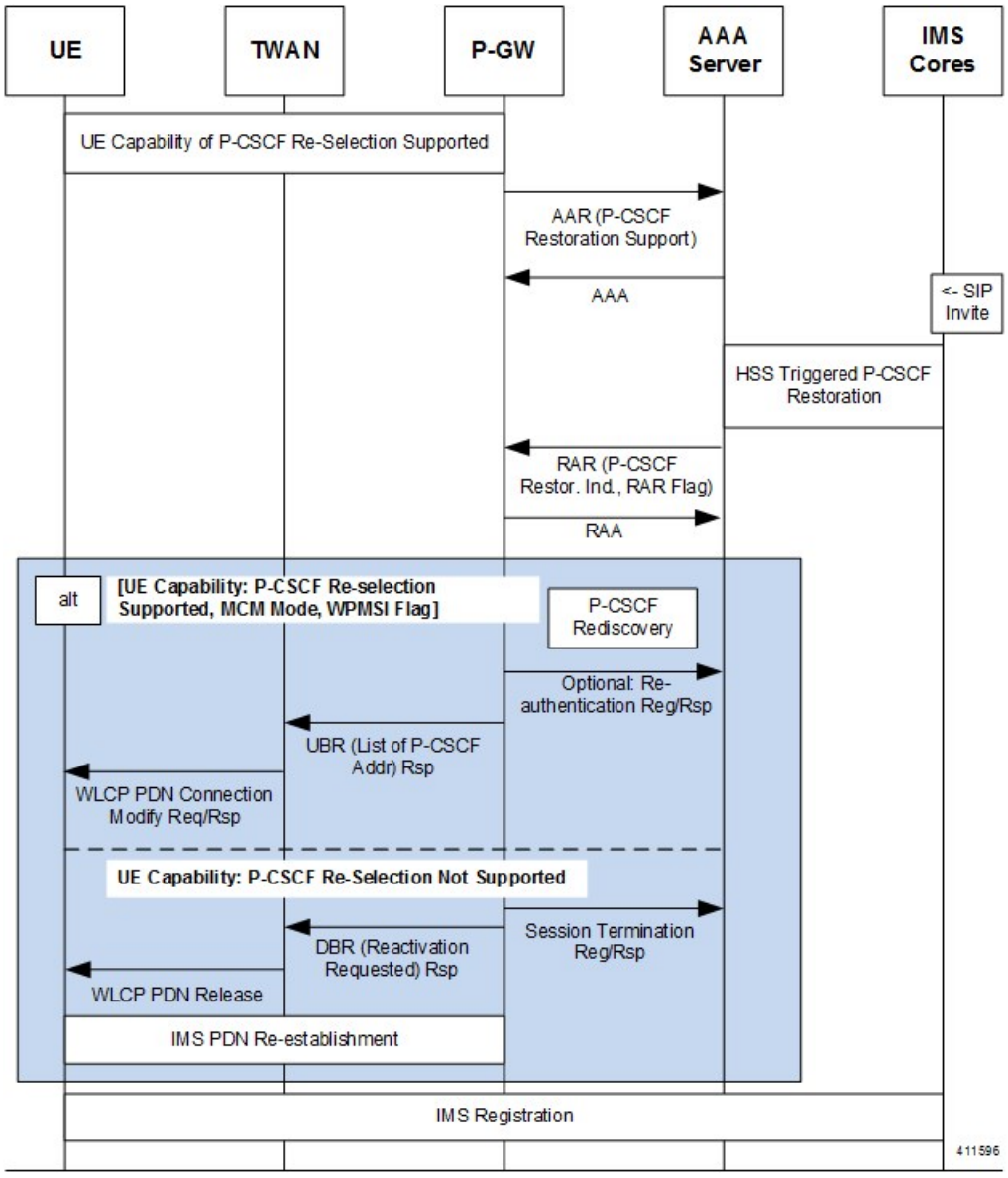


Figure 3: HSS Based P-CSCF Restoration for Trusted WLAN Access



Important Supported feature on S6b is sent in every ReAuth for RAT type WLAN.

For Un-Trusted WLAN Access

An ePDG which supports the P-CSCF Restoration extension for untrusted WLAN shall forward the UE capability (UE support of the P-CSCF restoration extension) in the APCO information element to the P-GW over the S2b interface at the PDN connection establishment (or handover) over S2b.

In the P-CSCF Restoration extension procedure for untrusted WLAN access, the P-GW shall send the updated list of the addresses of available P-CSCFs toward the UE via the ePDG using the APCO IE.

Figure 4: PCRF Based P-CSCF Restoration for Un-Trusted WLAN Access

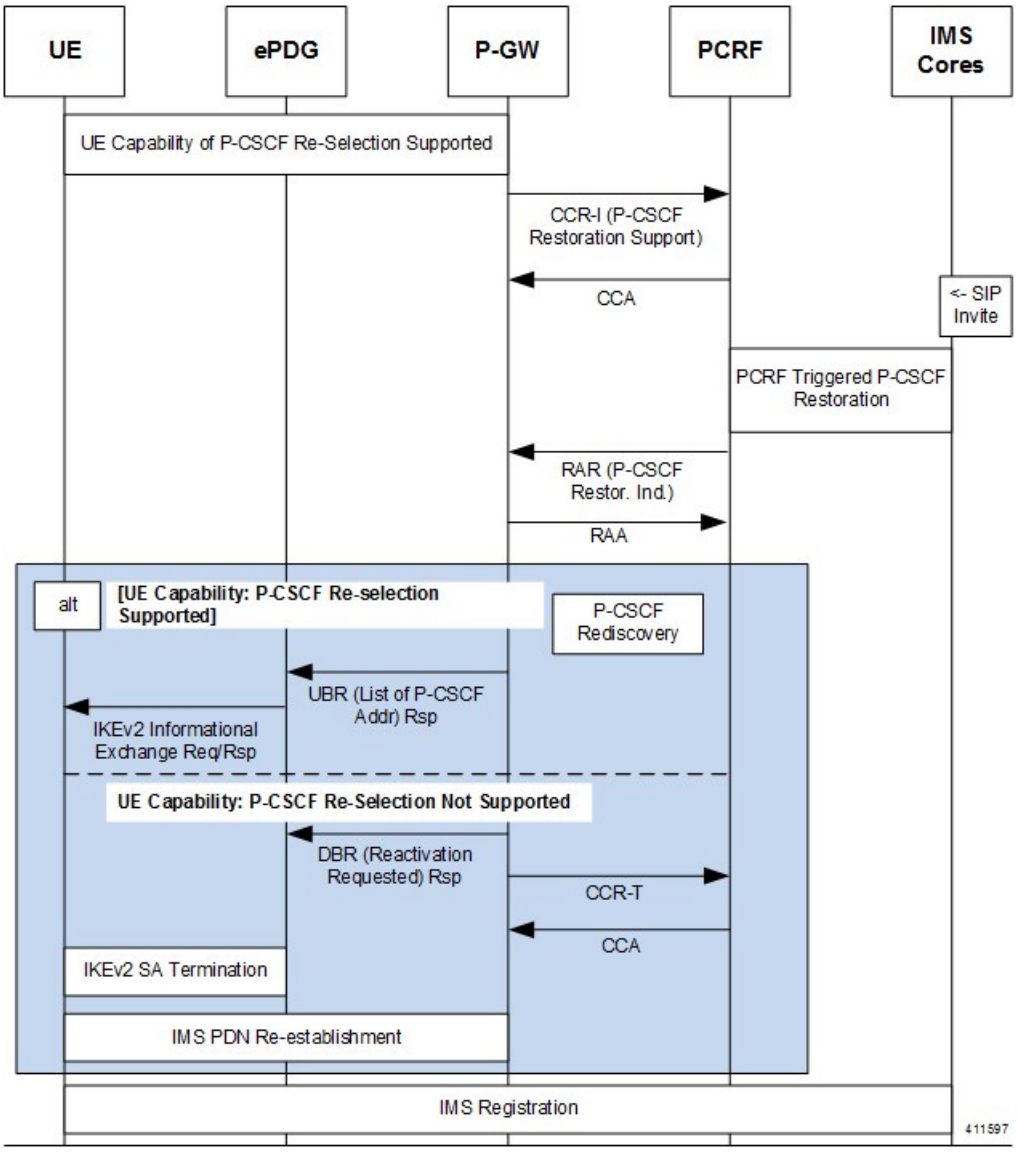
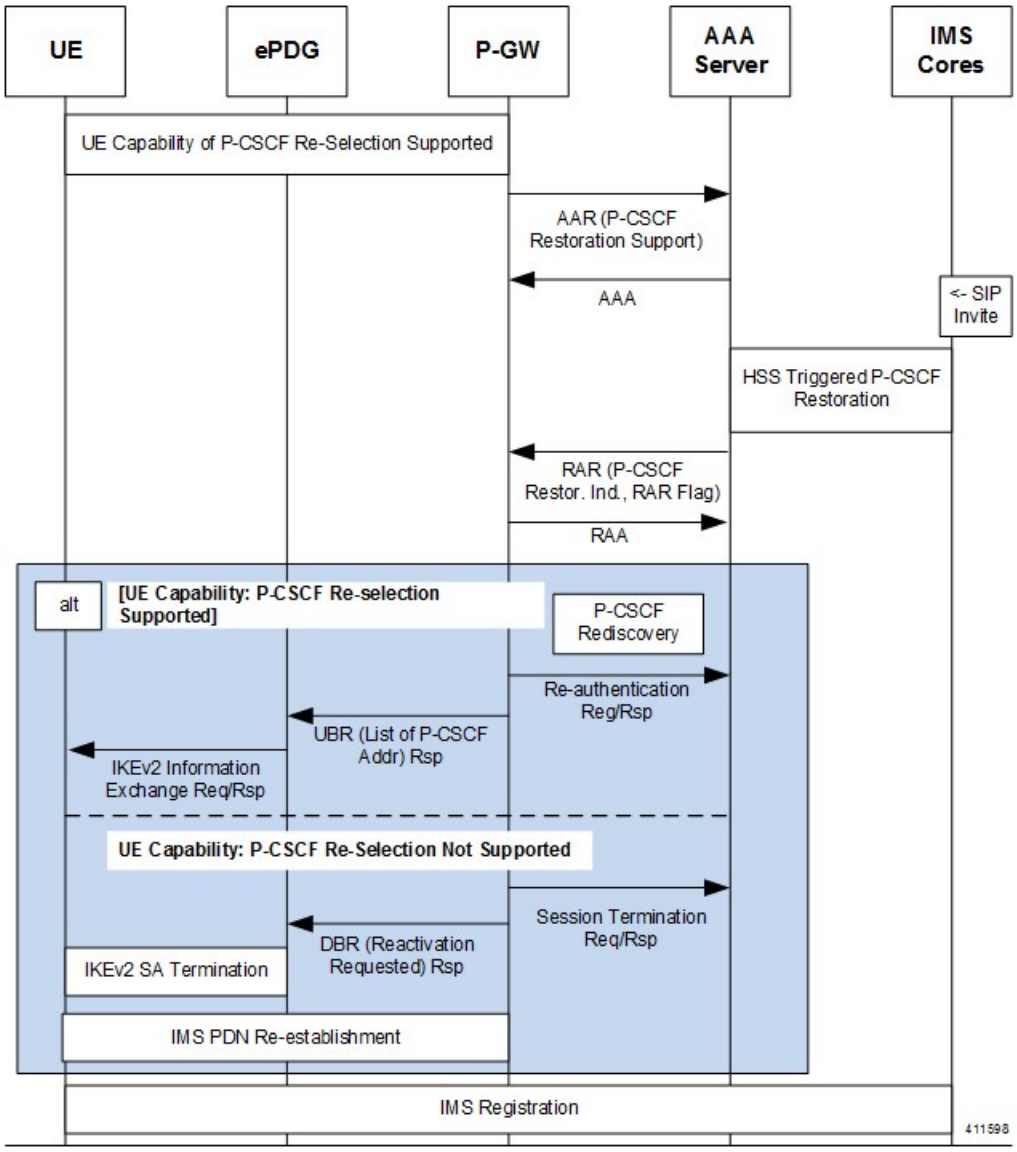


Figure 5: HSS Based P-CSCF Restoration for Un-Trusted WLAN Access



Standards Compliance

- Release 13 3GPP TS 23.380: IMS Restoration Procedures
- Release 13 3GPP TS 24.008: Mobile radio interface Layer 3 specification; Core network protocols
- Release 13 3GPP TS 29.212: Policy and Charging Control (PCC); Reference points
- Release 13 3GPP TS 29.273: 3GPP EPS AAA Interfaces
- Release 13 3GPP TS 29.274: 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3

Configuring the HSS/PCRF-based P-CSCF Restoration

The following section provides the configuration commands to enable support for HSS-based and PCRF-based P-CSCF Restoration feature.

Enabling P-CSCF Restoration Indication on S6b AAA Interface

Use the following configuration commands for encoding Supported-Features AVP in the AAR message to AAA server via S6b interface.

```
configure
   context context_name
      aaa group group_name
         diameter authentication encode-supported-features
pcscf-restoration-indication
         end
```

Notes:

- **encode-supported-features**: Encodes Supported-Features AVPs.
- **pcscf-restoration-indication**: Enables the P-CSCF Restoration Indication feature.
- **default encode-supported-features**: Configures the default setting, that is not to send the Supported-Features AVP in AAR message.
- **no encode-supported-features**: Disables the CLI command to not send the Supported-Features AVP.
- **pcscf-restoration-indication** : Keyword is license dependent. For more information, contact your Cisco account representative.

Enabling P-CSCF Restoration Indication on Gx Interface

Use the following configuration for P-CSCF Restoration supported feature.

```
configure
   context context_name
      ims-auth-service service_name
         policy-control
            diameter encode-supported-features pcscf-restoration-ind
            end
```

Notes:

- **pcscf-restoration-ind**: Enables the P-CSCF Restoration Indication feature. This keyword is license dependent. For more information, contact your Cisco account representative. By default, this feature is disabled.
- **default encode-supported-features**: The default configuration, which is removing/resetting the supported features.
- **no encode-supported-features**: Removes the previously configured supported features.

Enabling P-CSCF Restoration for Emergency PDNs

Use the following configuration to enable P-CSCF Restoration for Emergency PDNs.

```
configure
   context context_name
      pgw-service service_name
         pcscf-restoration { hss-solution | custom-hss-solution }
         pcscf-restoration emergency-pdn
         end
```

Notes:

- **{ hss-solution | custom-hss-solution }** : Enables standards-based or private extension-based HSS solution for P-CSCF Restoration. This keyword must be configured on a separate command line from **emergency-pdn**.
- **emergency-pdn**: Enables P-CSCF Restoration for Emergency PDNs.

  This keyword is license dependent. For more information, contact your Cisco account representative. By default, this feature is disabled.
- **default pcscf-restoration**: P-CSCF Restoration is disabled for Emergency PDNs and Private Extn mechanism will be used for P-CSCF Restoration.
- **no pcscf-restoration emergency-pdn**: Disables P-CSCF restoration for Emergency PDNs.

Enabling Re-Auth After S6b Triggered P-CSCF Restoration of WLAN

Use the following configuration to enable Re-Auth after S6b triggered P-CSCF Restoration of WLAN.

```
configure
   context context_name
      pgw-service service_name
         pcscf-restoration s6b-reauth
         end
```

Notes:

- **s6b-reauth**: Enables Re-Auth after S6b triggered P-CSCF Restoration of WLAN. Only applicable for S2a and S2b. By default, Re-Auth will be performed for P-CSCF restoration extension on S6b.

  This keyword is license dependent. For more information, contact your Cisco account representative. By default, this feature is disabled.
- **default pcscf-restoration**: Re-Auth will be performed for P-CSCF restoration extension on S6b.
- **no pcscf-restoration s6b-reauth**: Disables Re-Auth after P-CSCF restoration extension on S6b.

Verifying the HSS/PCRF-based P-CSCF Restoration

show aaa group all

This show command displays **pcscf-restoration-ind** as part of Supported-Features if this feature is configured under AAA group.

```
show aaa group all
 Group name:    default
 Context:   local

 Diameter config:
  Authentication:
....
Supported-Features:   pcscf-restoration-ind
....
```

show ims-authorization sessions full all

This command generates a display that indicates the negotiation status of this feature.

The following sample display is only a portion of the output which shows **pcscf-restoration-ind** among the Negotiated Supported Features.

```
show ims-authorization sessions full all

 CallId: 00004e22            Service Name:  imsa-Gx
   IMSI: 123456789012341
   ....
 Negotiated Supported Features:
   3gpp-r8
   pcscf-restoration-ind
 ....
```

show pgw-service name <pgw_service>

This command generates a display that indicates the configuration status of this feature.

The following sample display is only a portion of the output.

P-GW service output is enhanced to clearly specify HSS-based solution of **MME-Triggered**; this avoids confusion with the HSS-based S6b Triggered solution. In addition, it displays whether **P-CSCF Restoration supported for Emergency PDNs** and/or **Re-Auth After s6b Triggered P-CSCF Restoration** is enabled.

```
show pgw-service name <pgw_service>

    Service name : pgw_service
    Restoration solution : HSS-based MME-Triggered (Rel12)
    P-CSCF Restoration supported for Emergency PDNs : Yes/No
    Re-Auth After s6b Triggered P-CSCF Restoration : Enabled / Disabled
 ....
```

Monitoring and Troubleshooting the HSS/PCRF-based P-CSCF Restoration

This section provides information regarding show commands and/or their outputs in support of this feature.

The following operations can be performed for troubleshooting any failure related to this feature:

- Verify if the feature is enabled using **show ims-authorization sessions full all** and **show aaa group all** CLI commands. If not enabled, configure the required CLI commands both under Policy Control and AAA group configuration and check if it works.
- Execute **monitor protocol** command and check if the support for P-CSCF Restoration feature is negotiated in CCR-I and AAR messages. If not, enable the respective CLI commands for this feature to work.
- If the failure is still observed, obtain the following information and contact Cisco account representative for further analysis:
  - Monitor protocol log with options 74 (EGTPC) and 75 (App Specific Diameter –Gx/S6b) turned on
  - Logs with sessmgr, imsa, and diameter-auth enabled
  - Output of **show session disconnect reason** CLI command and the relevant statistics at service level

Output of Show Commands

show aaa group all

The **Supported Features** field in this show command output displays whether or not the P-CSCF Restoration feature is configured as part of the Supported-Features AVP.

This supported feature is displayed only when the feature license is configured.

show ims-authorization sessions full all

The **Negotiated Supported Features** field in this show command output displays whether or not the P-CSCF Restoration feature is negotiated with PCRF.

This supported feature is displayed only when the feature license is configured.

show license information

If the license to enable the P-CSCF Restoration feature is configured, then the **show license information** command displays the associated license information.

show pgw-service name <pgw_service>

P-GW service output is enhanced to clearly specify HSS-based solution of **MME-Triggered**; this avoids confusion with the HSS-based S6b Triggered solution. In addition, it displays whether **P-CSCF Restoration supported for Emergency PDNs** and/or **Re-Auth After s6b Triggered P-CSCF Restoration** is enabled.

```
show pgw-service name <pgw_service>

    Service name : pgw_service
    Restoration solution : HSS-based MME-Triggered (Rel12)
    P-CSCF Restoration supported for Emergency PDNs : Yes/No
    Re-Auth After s6b Triggered P-CSCF Restoration : Enabled / Disabled
 ....
```

show pgw-service statistics all

This command provides statistics on the number of P-CSCF Restorations.

The MME received P-CSCF Restoration count has moved from " **P-CSCF Restoration Indications received:**" to "**MME triggered Restoration**". Now, " **P-CSCF Restoration Indications received:**" shows total number of P-CSCF Restoration indications received (HSS Triggered and PCRF Triggered). Bulkstat counter "**sessstat-pcscf-recovery-count**" will continue to display the MME received P-CSCF Restoration only.

The total number of triggers received on any interface (MME/PCRF/S6b) = Basic + Extended + Ignored (ignored for reasons such as restoration already in progress, license not present, validation check fails, or call not connected).

```
PDNs Released By Reason:
  Network initiated release:           0    MME initiated release:             0
    Admin disconnect:                  0    S4 SGSN initiated release:         0
    GTP-U error ind:                   0
    SGW path failure:                  0
    Local fallback timeout:            0
    UE P-CSCF Reselect not supported:  0
…

 S2bGTP-to-eHRPD handover:               eHRPD-to-S2bGTP handover:
        Attempted:                       0      Attempted:                      0
        Succeeded:                       0      Succeeded:                      0
        Failed:                          0      Failed                          0
 …
```

```
     P-CSCF Restoration Indications received:              <total_count
at service level>
      HSS Triggered Restoration:
        MME Triggered Restoration:                      <>
            Basic Restoration Performed:                <>
            Extension Restoration Performed:            <>
        S6b Triggered Restoration:                      <>
            Basic Restoration Performed:                <>
            Extension Restoration Performed:            <>
      PCRF Triggered Restoration:                       <>
          Basic Restoration Performed:                  <>
          Extension Restoration Performed:              <>

     Data Statistics Per Interface:
…
```

show srp checkpoint statistics active verbose

This command provides the following P-CSCF Restoration micro checkpoint information:

```
.
.
    Total pgw ubr_mbr micro-chkpnt sent:              0
    Total pcscf update micro-chkpnt sent:                  0
```

show srp checkpoint statistics standby verbose

This command provides the following P-CSCF Restoration micro checkpoint information:

```
.
.
```

```
 PGW ubr_mbr session microchkpt rcvd:          0

PCSCF info update microchkpt rcvd:              0
```

Monitoring Logs

This section provides information on how to monitor the logs that are generated relating to the HSS/PCRF-based P-CSCF Restoration feature.

Gx Diameter Protocol Logs

Under **Supported-Features**, the P-CSCF Restoration **Feature-List** is available in CCR-I/CCA-I section. The output generated will appear similar to the following:

```
<<<<OUTBOUND  13:52:06:117 Eventid:92820(5)
....
 [V] [M] Supported-Features:
   [M] Vendor-Id: 10415
   [V] Feature-List-ID: 1
   [V] Feature-List: 16777217
....
INBOUND>>>>>  13:52:06:118 Eventid:92821(5)
....
 [V] [M] Supported-Features:
   [M] Vendor-Id: 10415
   [V] Feature-List-ID: 1
    [V] Feature-List: 16777216
....
```

The **PCSCF-Restoration-Indication** AVP is available in RAR. The output generated will appear similar to the following:

```
INBOUND>>>>>  13:52:26:119 Eventid:92821(5)
....
[M] Re-Auth-Request-Type: AUTHORIZE_ONLY (0)
[V] PCSCF-Restoration-Indication: 0
....
```

S6b Diameter Protocol Logs

The **Supported-Features** field is available in AAR/AAA section. The log output generated will appear similar to the following:

```
<<<<OUTBOUND  15:37:23:561 Eventid:92870(5)
....
 [V] [M] Supported-Features:
   [M] Vendor-Id: 10415
   [V] Feature-List-ID: 1
   [V] Feature-List: 1
....
INBOUND>>>>>  15:37:23:562 Eventid:92871(5)
....
 [V] [M] Supported-Features:
   [M] Vendor-Id: 10415
   [V] Feature-List-ID: 1
   [V] Feature-List: 1
....
```

The **RAR-Flags** field is available in RAR section. The log output generated will appear similar to the following:

```
INBOUND>>>>>  15:37:43:562 Eventid:92871(5)
....
[M] Re-Auth-Request-Type: AUTHORIZE_ONLY (0)
[V] RAR-Flags: 2
....
```

Bulk Statistics

P-GW Schema

The following counters are specific to **pcscf-recovery**:

- sessstat-pcscf-recovery-count
- sessstat-pcscf-recovery-basic-count
- sessstat-pcscf-recovery-extension-count
- sessstat-s6b-pcscf-recovery-count
- sessstat-s6b-pcscf-recovery-basic-count
- sessstat-s6b-pcscf-recovery-extension-count
- sessstat-pcrf-pcscf-recovery-count
- sessstat-pcrf-pcscf-recovery-basic-count
- sessstat-pcrf-pcscf-recovery-extension-count

SAEGW Schema

The following counters are specific to **pcscf-recovery**:

- pgw-sessstat-pcscf-recovery-count
- pgw-sessstat-pcscf-recovery-basic-count
- pgw-sessstat-pcscf-recovery-extension-count
- pgw-sessstat-s6b-pcscf-recovery-count
- pgw-sessstat-s6b-pcscf-recovery-basic-count
- pgw-sessstat-s6b-pcscf-recovery-extension-count
- pgw-sessstat-pcrf-pcscf-recovery-count
- pgw-sessstat-pcrf-pcscf-recovery-basic-count
- pgw-sessstat-pcrf-pcscf-recovery-extension-count