



UE-Usage-Type Based P-GW or SMF+PGW-C Selection

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Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	ePDG
Applicable Platform(s)	<ul style="list-style-type: none"> • ASR 5500-DPC2 • VPC-DI
Feature Default	<p>UUT-based P-GW Selection without 5G Interworking: Disabled - License not Required.</p> <p>UUT-based PGW/SMF+PGW-C Selection with 5G Interworking: Disabled - Existing 5G License to be Enabled.</p>
Related Changes in This Release	Not applicable
Related Documentation	<ul style="list-style-type: none"> • <i>Command Line Interface Reference</i> • <i>ePDG Administration Guide</i> • <i>Statistics and Counters Reference</i>

Revision History

Revision Details	Release
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ePDG is enhanced to select PGW/SMF+PGW-C based on the UE-Usage-Type with 5G Interworking.	21.28.6
ePDG is enhanced to select P-GW based on the UE-Usage-Type Without 5G Interworking.	21.28.5

UE-Usage-Type Based P-GW or SMF+PGW-C Selection

Feature Description

The Cisco ePDG supports selection of P-GW based on the allocated **UE-Usage-Type** (UUT) of the subscriber. **UE-Usage-Type** is stored in the HSS (Home Subscriber Server) within the subscription information of the UE. Each UE can have no more than one **UE-Usage-Type**. This functionality of selecting P-GW based on **UE-Usage-Type** is used to latch the subscribers to different cores by assigning an appropriate UE-Usage-Type value.

There is no change in the fallback mechanism, priority, and preference order of selection based on various criteria between AAA provided IP, DNS, and Static as in the existing P-GW selection, and same is applicable to UUT associated P-GWs.

AVP Support

This feature supports the **UE-Usage-Type** AVP with type Unsigned32 in the Diameter EAP Answer (DEA) message. This value indicates the usage characteristics of an UE that enables the selection of a specific Dedicated Core Network (DCN). The allowed value of **UE-Usage-Type** is in the range 0–255.

P-GW Selection based on UE-Usage-Type

The ePDG considers **UE-Usage-Type** AVP from the AAA/CPAR in the Diameter EAP Answer (DEA) message for the selection of P-GW to which the session has to be latched.



Note Subscribers not associated with any **UE-Usage-Type** are treated as per the current implementation. They will not be assigned any default **UE-Usage-Type** value.

To select the P-GW to be latched on based on the UE-Usage-Type:

- Enable the **UE-Usage-Type** feature through the CLI without **5G Interworking** and ensure that **UE-Usage-Type** AVP is received for a subscriber from the AAA server in the DEA (Diameter EAP Answer).

When the feature is enabled and **UE-Usage-Type** AVP is received from the AAA or CPAR in the DEA message, the ePDG uses the S-NAPTR procedure with the **x-s2b-gtp+ue-<uut value>** service parameter in the following scenarios:

- AAA provided FQDN based PGW selection

- APN-FQDN based PGW selection
- Local FQDN based PGW selection

The following process happens:

- ePDG first initiates the SNAPTR query against the AAA provided PGW-ID(FQDN) or Local FQDN or APN-FQDN to the server, to get the PGW IP address.
- The DNS server returns the NAPTR Resource Records (RRs) with “s” flag.
- RRs with service-parameter **x-3gpp-pgw: x-s2b-gtp+ue-<uut value1>** are considered by the ePDG to match one of the uut-value with the received **UE-Usage-Type** value.

Fallback Mechanism for UE-Usage-Type P-GW Selection

From DNS responses, if ePDG selects the P-GW based on the service parameter **x-s2b-gtp+ue-<uut-value1>.<uut-value2>.<uut-value3>**, where one of the UUT value in the Service parameter of the received DNS records matches with the **UE-Usage-Type** value received from AAA for a subscriber, the following selection order applies:

1. If DNS response has records for the given UUT, ePDG selects the P-GW. If none of the selected P-GWs are not reachable, fallback to static P-GW selection works based on local configuration, with the given UUT.
2. If DNS response has no matching UUT records, but has P-GW records without UUT, then ePDG ignores the P-GW list and fallback based on local configuration.
3. If the DNS query fails, or there are no PGW records matching with the given UUT value, or DNS is not reachable then, ePDG fallback to static P-GW selection based on the local configuration. The appropriate DNS-related failures get incremented.

In case of Local Static selection:

- If P-GW with the matching UUT value is configured, that will be considered
- If weight is defined, then, the Weight algorithm similar to the existing P-GW selection is applied to UUT-based selection.
- If no weight is configured, P-GW is selected in a round robin manner.
- If no P-GW with subscriber’s UUT is configured, but configured with P-GWs without UUT, or different UUTs, then ePDG ignores the P-GW lists and P-GW selection fails, a call gets terminated with appropriate disconnect reasons.

Limitations

This feature has the following limitations:

- The P-GW selection based on **UE-Usage-Type** (UUT) support is limited only to GTPv2 based s2b interface. All the three PDN types are supported including the IPv4, IPv6 and IPv4v6.
- ePDG does not send the value of **UE-Usage-Type** to P-GW in the Create Session Request.
- ePDG considers only the UUTs received in DEA message and not in any other diameter messages.

- This feature is not supported for Emergency calls. P-GW selection for emergency calls is as per the current implementation.

Configuring ePDG to Select P-GW based on the UE-Usage-Type

Use the following configuration commands to enable or disable the UE-Usage-Type.

```
configure
  context context_name
    epdg-service service_name
      [ no ] pgw-selection ue-usage-type
    end
```

NOTES:

- **pgw-selection ue-usage-type** : Enables P-GW selection based on the UE-Usage-Type.
- **no pgw-selection ue-usage-type** : Disables P-GW selection based on the UE-Usage-Type.

By default, the P-GW selection based on the **UE-Usage-Type** feature is disabled. If **UE-Usage-Type** is not enabled or not associated with the subscriber, then the Gateway selection is performed as per the existing implementation.

Configuring Local P-GW with a Specific UE-Usage-Type

Use the following configuration command to configure the P-GW with a specific UE-Usage-Type (UUT).



Note A single P-GW can serve multiple UE-Usage-Type and single UE-Usage-Type can be served by multiple P-GW.

```
configure
  apn-profile apn_name
    pgw-address ip_address ue-usage-type value
  end
```

NOTES:

- **pgw-address ip_address ue-usage-type value**: Configures the UE-Usage-Type for the gateway service. The UE-Usage-Type integer value must be 1–255. If the P-GW is configured in either primary or secondary mode, then you cannot configure more than two IPs for the P-GW regardless of the **UE-Usage-Type**.

Monitoring and Troubleshooting

This section provides information to monitor and troubleshoot this feature using show commands.

Show Commands and Outputs

This section provides information about the show commands and outputs for the PGW selection based on **UE-Usage-Type** feature.

show epdg-service name *service-name*

If the **UE-Usage-Type** feature is enabled the **show epdg-service name *service-name*** CLI command displays the following output with the status:

```
Service name: epdg1
Context: pdif
Bind: Done
Max Sessions : 100000
IP address: 111.111.11.2          UDP Port : 500
Crypto-template: boston
Reporting Action:
  Event Record: Enabled
Service State: Started          Service Id: 6
EGTP service : egtp-epdg-egress-v4
MAG service : n/a
MAG context : n/a
PLMN Id: MCC:242 , MNC:002
Setup Timeout (sec) : 60
dns-pgw context: pdif
dns-pgw selection : weight,topology
fqdn: n/a
pgw-selection agent-info error-handling: terminate
pgw-selection based on UE-Usage-Type: Enabled
Custom SWm-SWu Error Mapping: Disabled
Custom S2b-SWu Error Mapping: Disabled
3GPP SWu Private Notify Error Types: Disabled
Preferred PGW selection mechanism: AAA/DNS
vendor-specific-attr dns-server-req: APCO
vendor-specific-attr pcscf-server-req: Private Extension
Username MAC Address Stripping : Disabled
QCI QOS Mapping Table : epdg_mapping
Username MAC Address Validate : Enabled Failure-handling : Continue
Newcall Policy : None
Duplicate precedence in TFT - Allowed
IP Fragment-Chain Timeout : 5 sec and Max OOO Fragment : 45
EBI :
  Allowed Range 10 to 13
Username MAC Address Delimiter - colon-or-NAI-Label
Subscriber Map : map1
AAA Send Framed-MTU Size : Disabled
Data Buffering : Enabled
PDN-type IPv6 Path-MTU : Enabled
GTPC Overload Control Profile : None
GTPC Load Control Profile: None
LTE Emergency Profile: emergency
Timeout Idle : Disabled
Suppress International Roamer Handover : Disabled
5G Interworking : Disabled
```

show configuration

The output of this command includes the following information:

```
config
cli hidden
tech-support test-commands encrypted password ***
logging disable eventid 36012
```

show epdg-service statistics ue-usage-type

```

license key "\
:
:

epdg-service epdg1
.....
dns-pgw selection topology weight
associate qci-qos-mapping epdg_mapping
associate subscriber-map map1
pgw-selection agent-info error-terminate
pgw-selection ue-usage-type
pgw-selection select pgw 4gonly-ue
pgw-selection select pgw no-5gs-interworking
associate lte-emergency-profile emergency
username check-mac-address failure-handling          continue
reporting-action event-record
max-sessions 100000
bind address 111.111.11.2 crypto-template boston
#exit
    
```

show epdg-service statistics ue-usage-type

The **show epdg-service statistics ue-usage-type** command displays relevant counters for UUT based P-GW selection performed at the context level. This command is available as part of SSD.

Table 1: show epdg-service statistics ue-usage-type Command Output Descriptions

Field	Description
UUT Preferred PGW: The number of times that P-GW based on UE-Usage-Type is preferred.	
DNS Provided PGW	Number of times the P-GW selected from DNS responses for the given UE-Usage-Type.
Locally Configured PGW	Number of times the P-GW selected from local ePDG configuration for the given UE-Usage-Type.
AAA Provided PGW IP	Number of times the P-GW selected from AAA server provided IP attribute.
PGW not available reasons: Provides counters on how many times the UUT based P-GW selection is failed due to P-GW is not locally configured.	
No local PGW with matching UUT	The number of times that P-GW selection failed due to missing configuration.
Total Number of PGW Fallback: Fallback related counters for P-GW provided by AAA, DNS, and local configuration, for the associated UUT. In general, an attempt will be considered as fallback, after failed to connect first P-GW.	
PGW Fallback Attempted	Total number of UE-Usage-Type based P-GW fallback attempted when P-GW must be selected based on UUT.
PGW Fallback Success	Number of times session connected to P-GW, selected through fallback algorithm.
PGW Fallback Failure	Number of times session unable to connect to P-GW, selected through fallback algorithm.
Alternate PGW not found	Number of times where attempts to all P-GW is failed, and there are no alternate P-GW available further to attempt for a session to connect.

Field	Description
Local PGW resolution : Fallback related counters for total number of P-GW based on UE-Usage-Type provided by the local configuration. These counters are incremented when the previous attempt of P-GW is failed and the next fallback attempt of P-GW for the associated UE-Uage-Type is based on the local configuration.	
PGW Fallback Attempted	Total number of local UE-Usage-Type based P-GW fallback attempted when P-GW must be selected based on UUT.
PGW Fallback Success	Number of times session connected to local UE-Usage-Type based P-GW, selected through fallback algorithm.
PGW Fallback Failure	Number of times session unable to connect to local UE-Usage-Type based P-GW, selected through fallback algorithm.
Alternate PGW not found	Number of times where attempts to local UE-Usage-Type based P-GW failed, and there are no alternate P-GW available further to attempt for a session to connect.
DNS-related Failures	
DNS server not reachable	Number of times there are no response from DNS for the associated UE-Usage-Type.
No resource records	Number of times DNS server responded with no resource records for the associated UE-Usage-Type.
No matching PGW service params	Number of times DNS server responded with no P-GW, serving the requested UUT, in the resource records, when P-GW must be selected based on UUT for the session.
DNS PGW list exhausted	Increments when all the P-GW, provided by DNS, serving the given UUT, response is failed to connect.

Similarly, to view all the above mentioned counter details for a specific service in ePDG, use the **show epdg-service statistics name *service-name* ue-usage-type** command.

clear epdg-service statistics ue-usage-type

The **clear epdg-service statistics ue-usage-type** command clears statistics at context level.

clear epdg-service statistics name *service-name* ue-usage-type

The **clear epdg-service statistics name *service-name* ue-usage-type** command clears statistics at service level.

Bulk Statistics

This section provides bulk statistics variables supported for **UE-Usage-Type** in the ePDG schema.

show bulkstats variables epdg

Use the **show bulkstats variables epdg** command to view UE-Usage-Type related variables.

Bulk Statistics Variables	Description
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show bulkstats variables epdg

uut-pgw-preferred	Number of times P-GW preferred based on UE-Usage-Type.
uut-pgw-dns-selected	Number of times the P-GW selected from DNS responses for the given UE-Usage-Type.
uut-pgw-local-selected	Number of times the P-GW selected from local epdg configuration for the given UE-Usage-Type.
uut-pgw-aaa-selected	Number of times the P-GW selected from AAA server provided IP attribute.
PGW not available reasons:	
uut-no-local-pgw-selected	The number of times that P-GW selection failed due to missing configuration.
Total Number of PGW Fallback:	
uut-pgw-fallback-attempted	Total number of UE-Usage-Type based P-GW fallback attempted when P-GW must be selected based on UUT.
uut-pgw-fallback-success	Number of times session connected to P-GW, selected through fallback algorithm.
uut-pgw-fallback-failed	Number of times session unable to connect to P-GW, selected through fallback algorithm.
uut-pgw-fallback-noalt-pgw	Number of times where attempts to all P-GW is failed, and there are no alternate P-GW available further to attempt for a session to connect.
Local PGW resolution:	
uut-local-pgw-fallback-attempted	Total number of local UE-Usage-Type based P-GW fallback attempted when P-GW must be selected based on UUT.
uut-local-pgw-fallback-success	Number of times session connected to local UE-Usage-Type based P-GW, selected through fallback algorithm.
uut-local-pgw-fallback-failed	Number of times session unable to connect to local UE-Usage-Type based P-GW, selected through fallback algorithm.
uut-local-pgw-fallback-noalt-pgw	Number of times where attempts to local UE-Usage-Type based P-GW failed, and there are no alternate P-GW available further to attempt for a session to connect.
DNS Related Failures:	

uut-dns-server-notreachable	Number of times there are no response from DNS for the associated UE-Usage-Type.
uut-dns-no-resourcerecords	Number of times DNS server responded with no resource records for the associated UE-Usage-Type,
uut-dns-no-matching-pgw-service	Number of times DNS server responded with no P-GW, serving the requested UUT, in the resource records, when P-GW must be selected based on UUT for the session.
uut-dns-pgw-list-exhausted	Increments when all the P-GW, provided by DNS, serving the given UUT, response is failed to connect.

P-GW or SMF+PGW-C Selection Based on UE-Usage-Type with 5G Interworking

Feature Description

ePDG supports handling of 4G and 5G Capable User Equipment (UE) for VoWIFI functionality along with **Interworking-5G** subscription data provided by HSS/AAA.

With **Interworking-5G** enabled on ePDG, for a seamless handover with NR, customer requests ePDG to select PGW/ SMF+PGW-C based on **UE-Usage-Type** for both initial attach and handover scenarios. ePDG determines the type of gateway PGW/SMF+PGW-C based on the existing **Interworking-5G** decision matrix. For more information on decision matrix, see the [Selecting P-GW or SMF+PGW-C Based on UE-Usage-Type, on page 16](#).

When both **UE-Usage-Type** and **Interworking-5G** features are enabled and if the subscriber is allocated with **UE-Usage-Type** in the subscriber profile stored in HSS, ePDG determines the gateway type as PGW/SMF+PGW-C using the **Interworking-5G** decision matrix.

Based on the selected gateway type and UUT values (if received from AAA), ePDG either applies the appropriate DNS service parameter to select the gateway from the DNS responses received or selects the gateway serving the UUT through local configuration.

Upon enabling **UE-Usage-Type** feature with the **Interworking-5G** feature disabled, the selection of P-GW would be as per current implementation. For more information, refer [P-GW Selection based on UE-Usage-Type, on page 2](#).

License Requirements

Existing **Interworking-5G** license shall be used to enable **Interworking-5G** feature, no separate license would be required for **UE-Usage-Type** Interworking with 5G feature.

For more details, see the *License Requirements* section in the [ePDG Interworking with SMF+P-GW-IWK Support](#) chapter .

How it Works

The gateway selection between PGW/SMF+PGW-C with the help of the AVP **UE-Usage-Type** happens in the following way:

- The CLI commands implemented under epdg-service for both **UE-Usage-Type** and **Interworking-5G** (licensed feature) features should be enabled for UUT **Interworking-5G** functionality.
- The existing CLI to configure SMF+PGW-C with the associated, **UE-Usage-Type** under APN profile shall be enhanced to be supported in ePDG as well. Same SMF+PGW-C IP can be configured to service more than one **UE-Usage-Type**. More than one SMF+PGW-C can be associated with a particular **UE-Usage-Type**. The valid range for **UE-Usage-Type** is 1-255.



Note Range 1-255 is as per current implementation, by MME. As per the standard, the range is 0–255, where the range 0–127 is reserved.

- If the **UE-Usage-Type** feature is not enabled, ePDG will not consider **UE-Usage-Type**, received in DEA, for the selection of PGW/SMF+PGW-C.
- Subscribers not associated with any **UE-Usage-Type**, would be treated as per the existing **Interworking-5G** implementation. Such subscribers with no UUT value from AAA, would not be assigned any default **UE-Usage-Type** value.
- Upon enabling both the features (**Interworking-5G** and **UE-Usage-Type**), ePDG uses the existing decision matrix to decide whether to latch on SMF+PGW-C/PGW. If the **UE-Usage-Type** is received from the AAA, then ePDG shall use this **UE-Usage-Type** and compare it against the **UE-Usage-Type** provided by DNS or local configuration based on the selection mechanism and select PGW or SMF+PGW-C serving the specific **UE-Usage-Type**.
- If the selected gateway is PGW, ePDG does not share either PDU session ID to SMF+PGW-C or S-NSSAI, PLMNID to UE, which remains the same as per the existing implementation.
- If the **UE-Usage-Type** is not received or if both **UE-Usage-Type** and **Interworking-5G** features are not enabled, the subscriber will be treated as per the current implementation.
- If the selected PGW/SMF+PGW-C IP is provided by the AAA server, then ePDG assumes that the provided PGW or SMF+PGW-C serves the **UE-Usage-Type** of the connecting UE and ePDG does not validate the same.
- Based on the decision matrix:
 - If the ePDG decides the selected gateway type as SMF+PGW-C, then DNS records with the service parameter **x-3gpp-pgw:x-s2b-gtp+nc-smf+ue-<value>** shall be filtered.
 - If the ePDG decides the selected gateway type as PGW then DNS records with the service parameter **x-3gpp-pgw:x-s2b-gtp+ue-<value>** shall be filtered.
- If PGW/SMF+PGW-C is selected, e-PDG shall use the S-NAPTR procedure in the following scenarios:
 - AAA provided FQDN-based PGW/ SMF+PGW-C selection.
 - APN-FQDN based PGW/SMF+PGW-C selection.
 - Local FQDN-based PGW/SMF+PGW-C selection.

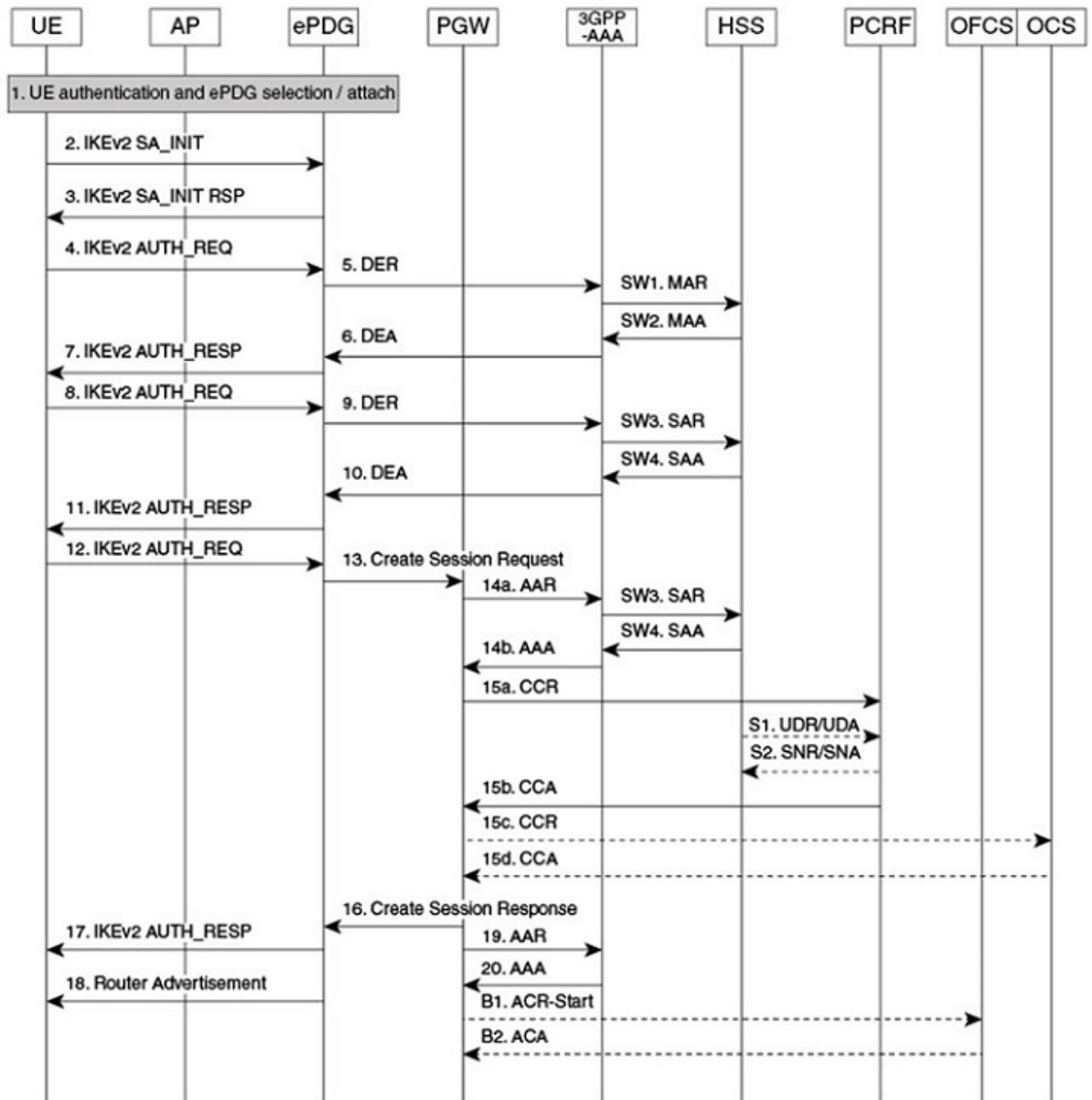
The service parameters used are **x-3gpp-pgw:x-s2b-gtp+ue-<value>** for PGW and **x-3gpp-pgw:x-s2b-gtp+nc-smf+ue-<value>** for SMF+PGW-C.

- ePDG will first initiate the S-NAPTR query against AAA provided FQDN or Local FQDN or APN-FQDN to DNS server to get the PGW/SMF+PGW-C IP address. DNS server shall return NAPTR Resource Records (RRs), which should be fed to a filter where only RRs having one of the UUT value matching the UUT associated with the subscriber, shall be considered by ePDG. When there are more than one matching PGWs/ SMF+PGW-Cs, priority and weight will be applied to choose the PGW/ SMF+PGW-C as per the existing implementation. The service parameters used are **x-3gpp-pgw: x-s2b-gtp+ue-<value1>.<value2>...** for PGW and **x-3gpp-pgw: x-s2b-gtp+nc-smf+ue-<value1>.<value2>...** for SMF+PGW-Cs.
- If the DNS query fails or there is no matching DNS record for the given UUT or DNS provided PGW/SMF+PGW-C is not reachable or DNS provided the SMF+PGW-C list is exhausted, ePDG shall fallback to locally configured SMF+PGW-C with matching UUT from AAA, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons. ePDG will not select DNS records without **UE-Usage-Type** in the service parameter, when the **UE-Usage-Type** feature is enabled.
- For static PGW/SMF+PGW-C selection with **UE-Usage-Type**, if PGW/SMF+PGW-C is not configured with the matching UUT or configured PGWs or SMF+PGW-Cs without UUT or different UUTs, ePDG ignores the other locally configured PGWs/SMF+PGW-Cs. The ePDG shall fallback to other PGW selection mechanism like DNS or AAA provided IP, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons.
- In local configuration, under APN-profile, if the PGW/SMF+PGW-C is configured in primary/secondary mode, you cannot define more than two IPs (Prim/Sec) for the PGW/SMF+PGW-C. The **UE-Usage-Type** configured along with primary and secondary mode shall be the same or unique and you cannot configure multiple sets of **UE-Usage-Type** in primary/secondary mode under the same APN profile.

Call Flows

Following call flow discusses the process and call flow of SMF+PGW-C gateway selection when both **UE-Usage-Type** and **Interworking-5G** are enabled.

Figure 1: Call Flow of P-GW/SMF Gateway Selection



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Table 2: Call Flow Description

Step	Description
1.	The UE sends the IKE_SA_INIT message.

Step	Description
2.	The ePDG responds with the IKE_SA_INIT_RSP message.
3.	<p>The UE sends the user identity (in the IDI payload) and the APN information (in the IDr payload) in the first message of the IKE_AUTH phase, and begins negotiation of child security associations. The UE omits the AUTH parameter to indicate to the ePDG that it wants to use EAP over IKEv2. The user identity is compliant with the Network Access Identifier (NAI) format as specified in <i>3GPP TS 23.003</i>. The UE sends the configuration payload (CFG_REQUEST) within the IKE_AUTH request message to obtain an IPv4 home IP Address and/or a Home Agent Address. When the MAC ULI feature is enabled, the root NAI used is of the form "0<IMSI>AP_MAC_ADDR:nai.epc.mnc<MNC>.mcc<MCC>.3gppnetwork.org".</p> <p>5GC NAS capable UE indicates its support of 5GC NAS in IKEv2. The UE allocates a PDU Session ID and also includes the N1_MODE_CAPABILITY Notify payload.</p>
4.	During the IKEv2 tunnel establishment procedure, the 5GC NAS capable UE shall indicate its support of 5GC NAS in IKEv2. The UE allocates a PDU Session ID and includes this in IKEv2 to the ePDG.
5.	UEs mobility restriction parameters related to 5GS or indication of support for interworking with 5GS for this APN or both are obtained by ePDG as part of the reply from the HSS via 3GPP AAA Server. These parameters and the 5G NAS support indicator from the UE, may be used by ePDG to determine if PGW/SMF+PGW-C should be selected.
6.	The ePDG responds with its identity, a certificate, and sends the AUTH parameter to protect the previous message sent to the UE (in the IKE_SA_INIT Exchange). It completes the negotiation of the child security associations if any. The EAP message received from the 3GPP AAA server (EAP-Request/AKA-Challenge) is included to start the EAP procedure over IKEv2.
7.	The UE checks the authentication parameters and responds to the authentication challenge. The only payload (apart from the header) in the IKEv2 message is the EAP message.
8.	The ePDG forwards the EAP-Response/AKA-Challenge message to the 3GPP AAA server.
8a.	The AAA server checks if the authentication response is correct.
9.	ePDG shall select PGW/SMF+PGW-C based on the existing decision matrix. If UE-Usage-Type is enabled and associated with the subscriber profile, that is, ePDG receives UE-Usage-Type value from AAA in DEA (Diameter EAP Answer), this parameter shall be used by ePDG and compare it with the UE-Usage-Type received from DNS server or local configuration.

Step	Description
10.	The Primary Session Key (PSK) is used by the ePDG to generate the AUTH parameters to authenticate the IKE_SA_INIT phase messages, as specified for IKEv2 in <i>RFC 4306</i> . These two first messages were not authenticated before as there was no key material available. According to <i>RFC 4306 [3]</i> , the shared secret generated in an EAP Exchange (PSK), when used over IKEv2, is used to generate the AUTH parameters.
11.	The EAP Success or Failure message is forwarded to the UE over IKEv2.
12.	The UE takes its own copy of the PSK as input to generate the AUTH parameter to authenticate the first IKE_SA_INIT message. The AUTH parameter is sent to the ePDG.
13.	<p>If the UE supports 5G NAS and the PDN connection is not restricted to interworking with 5GS by user subscription, then ePDG shall send the 5GS Interworking Indication and the PDU Session ID to SMF+PGW-C and it does not carry any additional elements to indicate the UE-Usage-Type of the subscriber.</p> <p>If the SMF+PGW-C supports more than one S-NSSAI and the APN is valid for more than one S-NSSAI, the SMF+PGW-C selects one S-NSSAI.</p> <p>If the UE does not support 5GC NAS but has 5GS subscription, and a SMF+PGW-C is selected and interaction with UDM, PCF and UPF is required, the SMF+PGW-C assigns PDU Session ID. The SMF+PGW-C shall not provide any 5GS related parameters to the UE.</p>
14.	<p>The P-GW allocates the requested IP address to the session and responds back to the ePDG with a Create Session Response (Cause, P-GW S2b Address C-plane, PAA, APN-AMBR, [Recovery], Bearer Contexts Created, [Additional Protocol Configuration Options (APCO)], Private IE (P-CSCF)) message.</p> <p>If SMF+PGW-C receives PDU Session ID, it adds S-NSSAI in the APCO field of Create Session Response.</p>
15.	The ePDG calculates the AUTH parameter which authenticates the second IKE_SA_INIT message.
16.	<p>The SMF+PGW-C assigns a S-NSSAI to be associated with the PDN connection. The SMF+PGW-C sends the S-NSSAI to ePDG together with a PLMN ID that the S-NSSAI relates to.</p> <p>If the UE does not support 5GC NAS but has 5GS subscription, and a SMF+PGW-C is selected and interaction with UDM, PCF and UPF is required, the SMF+PGW-C assigns PDU Session ID. The SMF+PGW-C shall not provide any 5GS related parameters to the UE.</p>
17.	The IKEv2 Authentication Response message, the ePDG sends S-NSSAI and PLMN ID to the UE, if the same is received from SMF+PGW-C.

Limitations

Some of the known limitations of this feature are as follows:

- This feature is not applicable to emergency calls.

- ePDG will not send the value of **UE-Usage-Type** to PGW/SMF+PGW-C in CreateSessionRequest.
- ePDG would provide support for AVP's (**UE-Usage-Type** /Interworking5GS-Indicator/Core-Network-Restrictions) received only in DEA message and not in any other diameter messages.
- The scope of this feature is limited to GTPv2 based S2b/S2b-C interface only.

Use Cases

If both **UE-Usage-Type** and **Interworking-5G** features are enabled and **UE-Usage-Type** is associated for the subscriber, ePDG would either compare it with the locally configured **UE-Usage-Type** or with the **UE-Usage-Type** value received from DNS service parameter based on the local configuration.

Feature Enabled/ Disabled	UUT Received from AAA	Core-Network-Restriction	Interworking-5GS-Indicator	N1 Mode	DNS Selection	Static Selection
UUT & IWK5G	No	5GC Allowed	Subscribed/Not Subscribed	0 or 1	ePDG selects SMF+PGW-C with service parameter x-3gpp-pgw: x-s2b-gtp+nc-smf, without +ue<value> .	ePDG selects SMF+PGW-C address configured without UUT.
UUT & IWK5G	Received from AAA and matches with DNS/local config: e.g.:130.	5GC Allowed	Subscribed/Not Subscribed	0 or 1	ePDG selects SMF+PGW-C with service parameter x-3gpp-pgw: x-s2b-gtp+nc-smf+ue-130 .	ePDG selects SMF+PGW-C address configured with UUT 130.
UUT & IWK5G	Received from AAA and matches with DNS/local config: e.g.:130.	5GC Not Allowed	Subscribed/Not Subscribed	0 or 1	ePDG selects PGW with service parameter x-3gpp-pgw: x-s2b-gtp+ue-130 .	ePDG selects PGW address configured with UUT 130.

Feature Enabled/ Disabled	UUT Received from AAA	Core-Network-Restriction	Interworking-5GS-Indicator	N1 Mode	DNS Selection	Static Selection
UUT & IWK5G	Received from AAA and does not match with DNS/Local config e.g.: 150.	5GC Allowed	Subscribed/Not Subscribed	0 or 1	If the local fallback is applicable, based on local configuration or PDN-GW-Allocation-Type received from AAA, ePDG falls back to local selection of SMF+PGW-C based on UUT 150 if configured, else the call would be dropped.	Call would be dropped, only if no other fallback mechanism is applicable.
UUT or IWK5G disabled or both disabled	UUT associated e.g.: 130	Restricted/Not Restricted	Subscribed/Not Subscribed	0 or 1	ePDG selects PGW/ SMF+PGW-C as per current implementation.	ePDG selects PGW/ SMF+PGW-C as per current implementation.

Selecting P-GW or SMF+PGW-C Based on UE-Usage-Type

- If ePDG decides to choose SMF+PGW-C based on the decision matrix, then ePDG shall use the below service parameters in case if the selection mechanism is DNS.

Service Parameters: x-3gpp-pgw:x-s2b-gtp+nc-smf+ue-<ue usage type>

Or

Service Parameters: x-3gpp-pgw:x-s2b-gtp+ue-<ue usage type>+nc-smf

Or

Service Parameters: x-3gpp-pgw:x-s2b-gtp+ue-<ue usage type1>.<ue usage type2>..+nc-smf

- If ePDG decides to choose PGW based on the decision matrix, then ePDG shall use the below service parameters in case if the selection mechanism is DNS.

Service Parameters: x-3gpp-pgw:x-s2b-gtp+ue-<ue usage type>

Or

Service Parameters: x-3gpp-pgw:x-s2b-gtp+ue-<ue usage type1>.<ue usage type2>

Figure 2: P-GW or SMF+PGW-C Based on a UE-Usage-Type Decision Matrix Table

Scenario	UE 5GC NAS Capability	Core-Network-Restrictions	Interworking-5GS APN-Configuration	ePDG Policy	Service tag for selection of DNS records by ePDG	SGSNWKI	5GCNRS	5GCNRI	PGW or SMF
							Rel-15: N/A Rel-16 Values below		
	From UE	From HSS					+On S2b/S2b-c		
1-2	Yes or No	Not Included	Not Included	No	x-s2b-gtp+ue-<uut>	0	1	0	PGW
3	No	Not Included	SUBSCRIBED	Operator Policy (NOTE1) (NOTE3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	1	SMF (Default) PGW
4	Yes	Not Included	SUBSCRIBED	Operator Policy (NOTE3)	x-s2b-gtp+nc-smf+ue-<uut>	1	1	1	SMF PGW
5	No	Not Included	NOT SUBSCRIBED	Operator Policy (NOTE 1) (NOTE 2) (NOTE 3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	0	SMF (Default) PGW
6	Yes	Not Included	NOT SUBSCRIBED	Operator Policy (NOTE 2) (NOTE 3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	0	SMF (Default) PGW
7-12	Yes or No	5GC not allowed	SUBSCRIBED or NOT SUBSCRIBED or Not Included	No	x-s2b-gtp+ue-<uut>	0	1	0	PGW
13	No	5GC allowed	SUBSCRIBED	Operator Policy (NOTE1) (NOTE 3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	1	SMF (Default) PGW
14	Yes	5GC allowed	SUBSCRIBED	Operator Policy (NOTE3)	x-s2b-gtp+nc-smf+ue-<uut>	1	1	1	SMF PGW
15-16	No	5GC allowed	NOT SUBSCRIBED or Not Included	Operator Policy (NOTE 1) (NOTE 2) (NOTE 3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	0	SMF (Default) PGW
17-18	Yes	5GC allowed	NOT SUBSCRIBED or Not Included	Operator Policy (NOTE 2) (NOTE 3)	x-s2b-gtp+nc-smf+ue-<uut> (default) x-s2b-gtp+ue-<uut>	0	1	0	SMF (Default) PGW

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• **NOTE 1:**

Default Behavior: SMF+PGW-C supports Rel-16 functionality to support 4G-only UEs, that is, the SMF+PGW-C shall generate PDU Session ID for 4G-only UEs.

Custom Behavior: To handle the case where SMF+PGW-C is Rel-15 and cannot support 4G only UEs.

• **NOTE 2:**

Default Behavior: When Interworking-5GS APN-Configuration is set to not allowed, the APN configuration is in UDR, but handover to 5G SA is not allowed.

Custom Behavior: When Interworking-5GS APN-Configuration is set to not allowed, the APN configuration is in SPR and not in UDR, hence P-GW needs to be selected.

• **NOTE 3:** Whenever SMF+PGW-C IP or FQDN is not preferably upgraded in the DNS server or in the local ePDG config, in such a case if the CLI (**smf-not-configured**) is configured, then ePDG ignores the SMF+PGW-C selection and always choose P-GW in all the scenario.



Note The service parameters from DNS are updated considering that **UE-Usage-Type** is enabled and received from AAA. If **UE-Usage-Type** is either not enabled or not received from AAA, then the service parameters would remain the same as the existing implementation, that is, **x-s2b-gtp** in case of PGW and **x-s2b-gtp+nc-smf** in case of SMF+PGW-C.

In case of dynamic selection mechanism, ePDG would first initiate the S-NAPTR query against AAA provided FQDN or Local FQDN or APN-FQDN to DNS server, to get the PGW/SMF+PGW-C IP address based on **UE-Usage-Type**. DNS server shall return NAPTR RRs (Resource Records) and these RRs shall be fed to a filter where only RRs with the service-parameter **x-3gpp-pgw: x-s2b-gtp+ue-<value>** or **x-3gpp-pgw: x-s2b-gtp+nc-smf+ue-<value>** shall be considered by ePDG. The PGW or SMF+PGW-C IP provided by the DNS server shall be considered only when the ue-usage-type matches with the **UE-Usage-Type** AVP received from AAA/CPAR in the DEA message.

In case of local/static SMF+PGW-C selection mechanism, the **UE-Usage-Type** configured under apn-profile should match with the **UE-Usage-Type** AVP from AAA/CPAR in DEA message.

Below are the sample configurations:

```
pgw-address 1.1.1.1 ue-usage-type 130 smf-combined
pgw-address 1.1.1.1 ue-usage-type 130
```

Fallback Mechanism for SMF+PGW-C Selection with UE-Usage-Type

With both **Interworking-5G** and **UE-Usage-Type** features enabled, based on the decision matrix if the selected gateway is SMF+PGW-C, ePDG uses the existing fallback mechanisms, priority, and preference order of selection and the same is applicable to UUT associated SMF+PGW-Cs as well. The existing fallback selection order is as follows:

1. **error-terminate** configured (pgw-selection agent-info error-terminate)
 - a. PDN-GW-Allocation-Type from AAA: Dynamic
 - Enabled **pgw-selection prefer aaa-pgw-id**
AAA->DNS->Local
 - Enabled **pgw-selection local-configuration-preferred** and **pgw-selection prefer aaa-pgw-id**
AAA->Local->DNS
 - Enabled **pgw-selection local-configuration-preferred**
Local->DNS
 - Disabled both **pgw-selection local-configuration-preferred** and **pgw-selection prefer aaa-pgw-id**
DNS->Local
 - b. PDN-GW-Allocation-Type from AAA: Static or Absent
 - Enabled **pgw-selection prefer aaa-pgw-id**
AAA->DNS->Local
 - Enabled **pgw-selection local-configuration-preferred** and **pgw-selection prefer aaa-pgw-id**

AAA->Local->DNS

- Enabled **pgw-selection local-configuration-preferred**

Local->AAA

- Disabled both **pgw-selection local-configuration-preferred** and **pgw-selection prefer aaa-pgw-id**

AAA->Local

2. **error-terminate** unconfigured (**no pgw-selection agent-info error-terminate**): If **error-terminate** is unconfigured, all the aforementioned cases, 1.a. and 1.b., remain the same except the below mentioned cases:

- a. PDN-GW-Allocation-Type from AAA: Static or Absent

- Enabled **pgw-selection local-configuration-preferred**

Local->AAA->DNS

- Disabled both **pgw-selection local-configuration-preferred** and **pgw-selection prefer aaa-pgw-id**

AAA->Local->DNS

DNS Selection

From the DNS responses, ePDG selects SMF+PGW-C with UUT based on the service parameter received from DNS server, i.e., the records with the service parameter **x-s2b-gtp+nc-smf+ue-*<value1>*. *<value2>*. *<value3>*.....**, where one of the UUT value in the service parameter from the received DNS records should match with the **UE-Usage-Type** value received from AAA for the subscriber. That specific SMF+PGW-C IP with UUT given by DNS shall be selected.

- If DNS response has records for the given UUT with SMF+PGW-C capability, which matches with the UUT received from AAA, the corresponding SMF+PGW-C will be selected. If the selected SMF+PGW-Cs IPs are not reachable, the ePDG shall fallback to the alternate SMF+PGW-C address with matching UUT from the DNS records if available. Else, it shall fallback to the locally configured SMF+PGW-C with matching UUT from AAA based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons.
- If the DNS response has no matching UUT records, but has PGW records with matching UUT or both PGW and SMF+PGW-C records without UUT, in this case, ePDG shall ignore the PGW and SMF+PGW-C records and falls back to locally configured SMF+PGW-C with matching UUT from AAA, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons and the corresponding DNS-related failure statistics would be updated.
- If the DNS query fails or no records received from DNS or DNS is not reachable, ePDG shall fallback to locally configured SMF+PGW-C with matching UUT from AAA, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons and the corresponding DNS-related failure statistics would be updated.

Local Static Selection

If SMF+PGW-Cs configured with UUT matches with the UUT received from AAA, then the selection of GW IP shall be considered based on:

- If Weight is Defined: Existing Weight algorithms for PGW selection would be applied for UUT based SMF+PGW-C selection as well.
- If No Weights Configured: UUT based SMF+PGW-C shall be selected in a round-robin method.
- If SMF+PGW-C is not configured with the matching UUT from AAA or configured SMF+PGW-Cs without UUT or different UUTs: ePDG ignores the other locally configured SMF+PGW-C. ePDG shall fallback to other PGW selection mechanism like DNS or AAA provided IP, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons.
- If the selected SMF+PGW-Cs with UUT is not reachable, then ePDG shall fallback to alternate locally configured SMF+PGW-C IP with matching UUT if available, else ePDG shall fallback to other PGW selection mechanism like DNS or AAA provided IP, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons.
- If no local entries defined: ePDG shall fallback to other PGW selection mechanism like DNS or AAA provided IP, based on the fallback selection order if applicable, else the call would be dropped with appropriate disconnect reasons.
- In both primary and secondary mode configuration under local apn-profile, if the SMF+PGW-C configured with UUT does not matches with the UUT received from AAA, or there is no SMF+PGW-C or SMF+PGW-C configured without UUT, then ePDG shall fallback to the AAA provided IP if available, when the PDN-GW-Allocation-Type received from AAA is static, else the call would be dropped with appropriate disconnect reasons.

**Note**

- All the above mentioned behaviour under DNS selection and local static selection are applicable for PGW selection based on UUT as well.
- In a handover scenario, ePDG shall consider AAA provided PGW ID (IP address/FQDN) for PGW/SMF+PGW-C selection as per the existing implementation.

Configuring ePDG to Select SMF Based on UE-Usage-Type

Configuring ePDG to select SMF+PGW-C based on **UE-Usage-Type** involves enabling **Interworking-5G** and **UE-Usage-Type** features.

To enable **Interworking-5G**, see the topic [Configuring ePDG to Enable 5G Interworking](#).

To enable **UE-Usage-Type**, see the topic [Configuring ePDG to Select P-GW Based on UE-Usage-Type](#).

Configuration for Local SMF+PGW-C Serving Specific UE-Usage-Type

Use the following configuration command to configure the SMF+PGW-C selection with a specific **UE-Usage-Type**:

```
configure
  apn-profile apn_name
    pgw-address ip_address ue-usage-type value smf-combined
  end
```

NOTES:

- **smf-combined**—Specifies if the PGW and SMF+PGW-C are combined.

Monitoring and Troubleshooting

This section provides information to monitor and troubleshoot this feature using show commands.

Show Commands and Output

The following two show commands provide information about the **Interworking-5G** with **UE-Usage-Type** for configured services or specific to a service.

show epdg-service statistics interworking-5g ue-usage-type

The show command **show epdg-service statistics interworking-5g ue-usage-type** displays the EPDG statistics for **Interworking-5G** with **UE-Usage-Type** for all the configured services.

```
[pdif]asr5500# show epdg-service statistics interworking-5g ue-usage-type
```

Following fields are available in the output of the **show epdg-service statistics interworking-5g ue-usage-type** in support of this feature:

Table 3: show epdg-service statistics interworking-5g ue-usage-type Command Output Descriptions

Field	Description
UUT SMF+PGW-C Preferred: Total number of SMF+PGW-C preferred based on UE-Usage-Type during 5G ePDG sessions for the case where 5GSIWK flag is not set.	
DNS provided SMF+PGW-C	Total number of DNS provided SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
Locally configured SMF+PGW-C	Total number of locally configured SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
AAA provided SMF+PGW-C IP	Total number of AAA provided SMF+PGW-C selected during 5G ePDG sessions.
UUT SMF+PGW-C Only: Total number of SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions for the case where 5GSIWK flag is set and PDUSessionID will be forwarded to SMF+PGW-C.	
DNS provided SMF+PGW-C	Total number of DNS provided SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
Locally configured SMF+PGW-C	Total number of locally configured SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
AAA provided SMF+PGW-C IP	Total number of AAA provided SMF+PGW-C selected for 5G ePDG sessions.
UUT PGW Only: Total number of PGW selected based on UE-Usage-Type during 5G ePDG sessions	
DNS provided PGW	Total number of DNS provided PGW selected based on UE-Usage-Type during 5G ePDG sessions.

show epdg-service statistics interworking-5g ue-usage-type

Field	Description
Locally configured PGW	Total number of locally configured PGW selected based on UE-Usage-Type during 5G ePDG sessions
AAA provided PGW IP	Total number of AAA provided PGW selected during 5G ePDG sessions.
PGW/SMF+PGW-C Not Available Reasons: Provide counters on how many times UE-Usage-Type based PGW/SMF+PGW-C selection is failed due to no matching UE-Usage-Type with locally configured PGW/SMF+PGW-C.	
No PGW configured locally with matching UUT	Total number of gateway selection failures due to no matching UE-Usage-Type with locally configured PGW during 5G ePDG sessions.
No SMF+PGW-C configured locally with matching UUT	Total number of gateway selection failure due to no matching UE-Usage-Type with locally configured SMF+PGW-C during 5G ePDG sessions.
Total Number of SMF+PGW-C Fallback: Fallback related counters (Attempted/Success/Failure) for total number of SMF+PGW-C provided by AAA, DNS, and local configuration for the associated UE-Usage-Type . In general, an attempt for next SMF+PGW-C, if the previously selected SMF+PGW-C for the associated UE-Usage-Type is failed, then it will be considered as fallback. This implies that when a create session request sent for the selected SMF+PGW-C is failed due to some reason, ePDG shall attempt fallback and sends create session request to the next available SMF+PGW-C for the associated UE-Usage-Type .	
SMF+PGW-C Fallback Attempted	Total number of UE-Usage-Type based SMF+PGW-C fallbacks attempted during 5G ePDG sessions.
SMF+PGW-C Fallback Success	Total number of UE-Usage-Type based SMF+PGW-C fallbacks succeeded during 5G ePDG sessions.
SMF+PGW-C Fallback Failure	Total number of UE-Usage-Type based SMF+PGW-C fallbacks failed during epdg 5G sessions.
Alternate SMF+PGW-C not found	Total number of alternate UE-Usage-Type based SMF+PGW-Cs not available in either AAA or DNS, when the call is dropped for a 5G ePDG session.
Local SMF+PGW-C Resolution: Fallback related counters for total number of SMF+PGW-C based on UE-Usage-Type provided by local configuration.	
SMF+PGW-C Fallback Attempted	Total number of local UE-Usage-Type based SMF+PGW-C fallbacks attempted during 5G ePDG sessions.
SMF+PGW-C Fallback Success	Total number of local UE-Usage-Type based SMF+PGW-C fallbacks succeeded during 5G ePDG sessions.
SMF+PGW-C Fallback Failure	Total number of local UE-Usage-Type based SMF+PGW-C fallbacks failed during 5G ePDG sessions.
Alternate SMF+PGW-C not found	Total number of alternate local UE-Usage-Type based SMF+PGW-C not available to further fallback for a 5G session to get connected.

Field	Description
Total Number of PGW Fallbacks: Fallbacks related counters (Attempted/Success/Failure) for total number of PGW provided by AAA, DNS, and local configuration for the associated UE-Usage-Type . An attempt for the next PGW since the previously selected PGW for the associated UE-Usage-Type is failed, will be considered as fallback.	
PGW Fallback Attempted	Total number of UE-Usage-Type based PGW fallbacks attempted during 5G ePDG sessions.
PGW Fallback Success	Total number of UE-Usage-Type based PGW fallbacks succeeded during 5G ePDG sessions.
PGW Fallback Failure	Total number of UE-Usage-Type based PGW fallbacks failed during epdg 5G sessions.
Alternate PGW not found	Total number of alternate UE-Usage-Type based PGWs not available in either AAA or DNS, when the call is dropped for a 5G ePDG session.
Local PGW Resolution: Fallback related counters for total number of PGW based on UE-Usage-Type provided by local configuration.	
PGW Fallback Attempted	Total number of local UE-Usage-Type based PGW fallbacks attempted during 5G ePDG sessions.
PGW Fallback Success	Total number of local UE-Usage-Type based PGW fallbacks succeeded during 5G ePDG sessions.
PGW Fallback Failure	Total number of local UE-Usage-Type based PGW fallbacks failed during 5G ePDG sessions.
Alternate PGW not found	Total number of alternate local UE-Usage-Type based PGWs not available to further fallback for a 5G session to get connected.
DNS Related Failures	
DNS server not reachable	Total number of failures due to DNS server not reachable during 5G ePDG sessions for the associated UE-Usage-Type .
No resource records	Total number of failures due to no DNS resource records during 5G ePDG sessions for the associated UE-Usage-Type .
No matching UUT PGW service params	Total number of PGW received without matching the UE-Usage-Type during 5G ePDG sessions.
No matching UUT SMF+PGW-C service params	Total number of SMF+PGW-C received without matching the UE-Usage-Type during 5G ePDG sessions.
DNS PGW list exhausted	Total number of UE-Usage-Type based PGW list provided in DNS response, has failed to connect and exhausted during 5G ePDG sessions.
DNS SMF+PGW-C list exhausted	Total number of UE-Usage-Type based SMF+PGW-C list provided in DNS response, has failed to connect and exhausted during 5G ePDG sessions.

```
show epdg-service statistics name service-name interworking-5g ue-usage-type
```

show epdg-service statistics name service-name interworking-5g ue-usage-type

The show command **show epdg-service statistics name service-name interworking-5g ue-usage-type** displays the all the counters from previous section with **UE-Usage-Type** for that specific service.

```
[epdg]asr5500# show epdg-service statistics name epdg1 interworking-5g ue-usage-type
```

The output fields of this command are same as the output fields of the **show epdg-service statistics interworking-5g ue-usage-type**. The difference between the two CLIs is that **show epdg-service statistics name service-name service-name interworking-5g ue-usage-type** displays these statistics for a specific service, while **show epdg-service statistics interworking-5g ue-usage-type** displays the statistics at context level.

Error Scenario: Following are the possible error scenarios in this configuration:

Table 4: show epdg-service statistics name service-name interworking-5g ue-usage-type Error Scenarios and Outputs

Error Scenario	Output
If the service name is not valid	Service-Name: No such service
If no statistics are available at epdg level	No statistics available for Interworking-5G with UE-Usage-Type
If UE-Usage-Type is not enabled under a specific service	UE-Usage-Type feature is not enabled for this service
If Interworking-5G is not enabled under a specific service	Interworking-5G feature is not enabled for this service
If both UE-Usage-Type and Interworking-5G is not enabled under a specific service	Both Interworking-5G and UE-Usage-Type feature are not enabled for this service

5G Session Statistics

The total number of 5G session statistics for both **Interworking-5G** and **Interworking-5G** with **UE-Usage-Type** would be updated under the below existing 5G counters. The 5G Attempts/Setup/Failures counter must be referred for interworking of 5G with **UE-Usage-Type** as well.

Example:

```
[pdif]asr5500# show epdg-service statistics interworking-5g
```

The ePDG **Interworking-5G** statistics for all services are as follows:

5G Sessions:

- Attempts
- Setup
- Failures

Clear Statistics

The following clear commands will take care of clearing the statistics at context and service levels:

- **clear epdg-service statistics interworking-5g ue-usage-type:** Clears ePDG statistics related to **Interworking-5G** with **UE-Usage-Type**.
- **clear epdg-service statistics name <service name> interworking-5g ue-usage-type:** Clears ePDG statistics related to **Interworking-5G** with **UE-Usage-Type** for a particular service.

Executing the below command also clears the counters specific to **UE-Usage-Type**:

- **clear epdg-service statistics interworking-5g**
- **clear epdg-service statistics name svcl interworking-5g**

Error Scenarios: Following are the possible error scenarios for the above configurations:

Error Scenario	Output
If no statistics are available at ePDG level.	No ePDG Interworking-5G with UE-Usage-Type statistics is available to clear.
If a service is not valid.	Service-Name: No such service.
If UE-Usage-Type is not enabled for a specific service.	UE-Usage-Type feature is not enabled for this service.
If Interworking-5G is not enabled under a specific service.	Interworking-5G feature is not enabled for this service.
If both UE-Usage-Type and Interworking-5G is not enabled under a specific service.	Both Interworking-5G and UE-Usage-Type feature are not enabled for this service.

Bulk Statistics

Following new counters are provided under the existing **epdg-interworking-5g** schema:

Bulk Statistics Variables	Description
uut-iwk5g-smf-preferred	Total number of SMF+PGW-C preferred based on UE-Usage-Type during 5G ePDG sessions for the case where 5GSIWK flag is not set.
uut-iwk5g-smf-preferred-dns	Total number of DNS provided SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-smf-preferred-local	Total number of locally configured SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-smf-preferred-aaa	Total number of AAA provided SMF+PGW-C selected during 5G ePDG sessions.
uut-iwk5g-smf-only	Total number of SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions for the case where 5GSIWK flag is set and PDUSESSIONID will be forwarded to SMF+PGW-C.
uut-iwk5g-smf-only-dns	Total number of DNS provided SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.

Bulk Statistics Variables	Description
uut-iwk5g-smf-only-local	Total number of locally configured SMF+PGW-C selected based on UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-smf-only-aaa	Total number of AAA provided SMF+PGW-C selected for 5G ePDG sessions.
uut-iwk5g-pgw-only	Total number of PGW selected based on UE-Usage-Type during 5G ePDG sessions
uut-iwk5g-pgw-only-dns	Total number of DNS provided PGW selected based on UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-pgw-only-local	Total number of locally configured PGW selected based on UE-Usage-Type during 5G ePDG sessions
uut-iwk5g-pgw-only-aaa	Total number of AAA provided PGW selected during 5G ePDG sessions.
PGW/SMF+PGW-C Not Available Reasons:	
uut-iwk5g-no-local-pgw	Total number of gateway selection failure due to no matching UE-Usage-Type with locally configured PGW during 5G ePDG sessions.
uut-iwk5g-no-local-smf	Total number of gateway selection failure due to no matching UE-Usage-Type with locally configured SMF+PGW-C during 5G ePDG sessions.
Total Number of SMF+PGW-C Fallback:	
uut-iwk5g-smf-fallback-attempted	Total number of UE-Usage-Type based SMF+PGW-C fallback attempted during 5G ePDG sessions.
uut-iwk5g-smf-fallback-success	Total number of UE-Usage-Type based SMF+PGW-C fallback succeeded during 5G ePDG sessions.
uut-iwk5g-smf-fallback-failed	Total number of UE-Usage-Type based SMF+PGW-C fallback failed during epdg 5G sessions.
uut-iwk5g-smf-fallback-noalt-smf	Total number of alternate UE-Usage-Type based SMF+PGW-C not available in either AAA or DNS, when the call is dropped for a 5G ePDG session.
Local SMF+PGW-C Resolution:	
uut-iwk5g-local-smf-fallback-attempted	Total number of local UE-Usage-Type based SMF+PGW-C fallback attempted during 5G ePDG sessions.
uut-iwk5g-local-smf-fallback-success	Total number of local UE-Usage-Type based SMF+PGW-C fallback succeeded during 5G ePDG sessions.
uut-iwk5g-local-smf-fallback-failed	Total number of local UE-Usage-Type based SMF+PGW-C fallback failed during 5G ePDG sessions.
uut-iwk5g-local-smf-fallback-noalt-smf	Total number of alternate local UE-Usage-Type based SMF+PGW-C not available to further fallback for a 5G session to get connected.

Bulk Statistics Variables	Description
Total Number of PGW Fallback:	
uut-iwk5g-pgw-fallback-attempted	Total number of UE-Usage-Type based PGW fallback attempted during 5G ePDG sessions.
uut-iwk5g-pgw-fallback-success	Total number of UE-Usage-Type based PGW fallback succeeded during 5G ePDG sessions.
uut-iwk5g-pgw-fallback-failed	Total number of UE-Usage-Type based PGW fallback failed during epdg 5G sessions.
uut-iwk5g-pgw-fallback-noalt-pgw	Total number of alternate UE-Usage-Type based PGW not available in either AAA or DNS, when the call is dropped for a 5G ePDG session.
Local PGW Resolution:	
uut-iwk5g-local-pgw-fallback-attempted	Total number of local UE-Usage-Type based PGW fallback attempted during 5G ePDG sessions.
uut-iwk5g-local-pgw-fallback-success	Total number of local UE-Usage-Type based PGW fallback succeeded during 5G ePDG sessions.
uut-iwk5g-local-pgw-fallback-failed	Total number of local UE-Usage-Type based PGW fallback failed during 5G ePDG sessions.
uut-iwk5g-local-pgw-fallback-noalt-pgw	Total number of alternate local UE-Usage-Type based PGW not available to further fallback for a 5G session to get connected.
DNS Related Failures:	
uut-iwk5g-dns-server-notreachable	Total number of failures due to DNS server not reachable during 5G ePDG sessions for the associated UE-Usage-Type .
uut-iwk5g-dns-no-resourcerecords	Total number of failures due to no DNS resource records during 5G ePDG sessions for the associated UE-Usage-Type .
uut-iwk5g-dns-no-matching-pgw-service	Total number of PGW received without matching the UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-dns-no-matching-smf-service	Total number of SMF+PGW-C received without matching the UE-Usage-Type during 5G ePDG sessions.
uut-iwk5g-dns-pgw-list-exhausted	Total number of UE-Usage-Type based PGW list provided in DNS response, has failed to connect and exhausted during 5G ePDG sessions.
uut-iwk5g-dns-smf-list-exhausted	Total number of UE-Usage-Type based SMF+PGW-C list provided in DNS response, has failed to connect and exhausted during 5G ePDG sessions.

