S-GW Restoration

This chapter describes restoration of PDN connections after an SGW failure on the MME, in the following sections:

Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	MME
Applicable Platform(s)	ASR 5500
Feature Default	Disabled - Configuration Required
Related Changes in This Release	Not Applicable
Related Documentation	• *Command Line Interface Reference* • *MME Administration Guide* • *Statistics and Counters Reference*

Revision History

Revision Details	Release
First introduced.	21.3

Feature Description

The S-GW Restoration provides continuous delivery (resume delivery) of downlink data towards the UE with minimum service interruption, and minimal signaling in the network.

Path failure, as a result of S-GW restart or S-GW availability/reachability on the S11 interface, is supported for S-GW Restoration.

The following functionalities are supported in this feature:

- Prioritizing PDN Restorations
- Pacing PDN Restorations
- Restoration of PDN connections after S-GW Failure

How It Works

When a S-GW fails, all its Bearer contexts affected by the failure become invalid and may be deleted.

Previously, when MME detects a peer S-GW restart, it deletes all PDN connection table data or MME bearer contexts associated with that peer S-GW node. Also, MME clears any S-GW resource associations with these PDN connections.

Now, if the S-GW Restoration feature is configured at the MME, the PDN connection table data is not deleted, instead the MME restores the PDN connections with an alternative S-GW peer (in case of S-GW failure) or with the same S-GW (in case of S-GW restart) within a configured time. MME starts the “T-Release-PDN” timer during S-GW restart. On expiry of the “T-Release-Timer”, the MME detaches the remaining PDN connections of the affected S-GW.

Note The MME will have the identity of an S-GW currently in use for a PDN connection, available in the MME’s PDN connection table as part of the existing EPC procedures as well as other peer state data.

The S-GW Restoration feature is optional on the MME. This feature can be enabled or disabled at an MME Service level or through the APN Profile configuration. If configured through the APN profile, the configuration values takes precedence over the values configured at an MME Service level (if configured), and are applied for restoration of PDN connections for the given APN.

PDN Restorations are performed in a paced manner. The pacing rate can be configured using the network-overload-protection mme-tx-msg-rate command, under Global Configuration Commands mode. If the pacing rate is not configured, the internal default pacing rate of 100 restorations per session manager, per second is applied.

MME restores sessions per PDN connection basis. Sometimes, it is possible for a UE to have some PDN connections restored and some still detached, based on their configuration.

S-GW Restoration Procedure

Once the S-GW Restoration has begun for a UE, the following restoration procedures are applied:

- If UE has an emergency PDN:
  - The UE is brought to IDLE state.
  - The UE is restored through S-GW relocation. The target S-GW might be the same as the source S-GW during S-GW restart.
- If UE has an IMS PDN:
  - The UE is brought to IDLE state.
  - The UE is restored through S-GW relocation. The target S-GW might be the same as the source S-GW during S-GW restart.
- IF UE has a connected PDN:
  - Handover requests that arrive for a connected PDN are rejected.
  - Connected PDN is moved to IDLE state.
  - The UE is restored through S-GW relocation. The target S-GW might be the same as the source S-GW during S-GW restart.
- If UE is in IDLE state, it is restored through S-GW relocation. The target S-GW might be the same as the source S-GW during S-GW restart.

Impact of Session Recovery on S-GW Restoration

- If S-GW restoration is enabled, and if path failed sessions are in NLP queue and if the sessmgr restarts, then all path failed sessions are en-queued in NLP queue after recovery. S-GW Restoration is initiated for recovered sessions.
- If S-GW restoration is in process for a UE (waiting for CS Response/DNS Response), and if sessmgr restarts, then on completion of sessmgr recovery such an UE is en-queued again in the NLP queue and S-GW restoration will be restarted for such UE's.

Standards Compliance

The S-GW Restoration feature complies with the following standard(s):

- 3GPP TS 23.007 Restoration Procedures v13.3.0

Configuring S-GW Restoration

This section describes the S-GW Restoration configuration at an MME Service level configuration and at an APN Profile level configuration. If configured through the APN profile, the configuration values takes precedence over the values configured at an MME Service level (if configured), and are applied for restoration of PDN connections for the given APN.

The T-Release-PDN timer is configured as part of the S-GW Restoration procedure. The MME restores as many PDN connections as it can through an alternative S-GW (in case of S-GW failure) or with the sameS-GW (in case of S-GW Restart), within the configured T-Release-PDN time. On expiry of the timer, MME detaches the remaining PDN connections of the affected S-GW.

PDN Restorations are performed in a paced manner. The pacing rate can be configured using the **network-overload-protection mme-tx-msg-rate** command, under *Global Configuration Commands* mode. If the pacing rate is not configured, the internal default pacing rate of 100 restorations per session manager, per second is applied.

MME restores sessions per PDN connection basis. Sometimes, it is possible for a UE to have some PDN connections restored and some still detached, based on their configuration.

S-GW Restoration at an MME Service Level

This section describes the S-GW Restoration configuration at an MME Service level.

The following CLI configuration enables the S-GW Restoration feature:

```
configure
   context context_name
      mme-service service_name
         sgw-restoration session hold-timeout TReleasePDN_Timer
         no sgw-restoration
         end
```

Verifying the Configuration

The S-GW Restoration configuration can be verified using the following show commands:

show configuration

On executing the above command the following output is displayed for this feature:

```
mme-service mmesvc
   s1-mme sctp port 25
   mme-id group-id 32777 mme-code 2
   ...
   ...
   ...
    sgw-restoration session-hold-timeout 10
```

show mme-service name mmesvc

On executing the above command the following output is displayed for this feature:

```
Service name                          : mmesvc
Context                               : MME
Status                                : STARTED
...
...
...
SGW Restoration                       : Enabled
Session Hold (T-PDN Release) time     : 10
```

Notes:

- The **no** keyword disables the S-GW Restoration feature.

- The **sgw-restoration** keyword enables S-GW restoration on the MME.
- The **session** keyword specifies the session to be restored.
- The **hold-timeout** keyword specifies the maximum time available to restore the sessions at S-GW, that is, the number of PDN connections to be restored through the S-GW.
- The *TReleasePDN_timer* specifies the time for S-GW Restoration. The timer value ranges from 1 to 3600. The value is an integer measured in seconds.

S-GW Restoration at an APN Profile Level

This section describes the S-GW Restoration configuration at an MME Service level.

The following CLI configuration enables the S-GW Restoration feature:

```
configure
  apn-profile profile_name
    sgw-restoration session hold-timeout TReleasePDN_timer
    [ no | remove ] sgw-restoration
    end
```

Note Note: If S-GW Restoration is enabled at an MME Service level and at an APN Profile level, the hold-timeout value of the APN Profile configuration will take precedence over that of the MME Service level.

Verifying the Configuration

The S-GW Restoration configuration at an APN Profile level can be verified using the following show commands:

show apn-profile full name apn1

On executing the above command the following output is displayed for this feature:

```
APN Profile Name                    :apn1
Resolution Priority                 : dns-fallback
...
...
...
SGW Restoration                     : Enabled
Session Hold (T-PDN Release) time   : 10
```

Notes:

- The **remove** keyword removes the S-GW Restoration configuration from the APN Profile Configuration. In this case, the hold-timeout value configured at the MME Service level is used for restoration.
- The **no** keyword disables the S-GW Restoration feature at the APN-Profile configuration level.
- The **sgw-restoration** keyword enables S-GW restoration on the MME.
- The **session** keyword specifies the session to be restored.
- The **hold-timeout** keyword specifies the maximum time available to restore the sessions at S-GW, that is, the number of PDN connections to be restored through the S-GW.

- The *TReleasePDN_timer* specifies the time for S-GW Restoration. The timer value ranges from 1 to 3600. The value is an integer measured in seconds.

Monitoring and Troubleshooting

This section describes how to monitor and troubleshoot the S-GW Restoration feature

S-GW Restoration Show Command(s) and /or Outputs

This section provides information on show commands and their corresponding outputs for the S-GW Restoration feature.

show mme-service name *service_name*

Executing the above command, displays the following field(s) for this feature:

- SGW Restoration

show apn-profile full name *profile_name*

Executing the above command, displays the following fields for this feature:

- SGW Restoration
- Session Hold (T-PDN Release) time

show mme-service statistics

Executing the above command, displays the following fields for this feature:

- SGW Restoration
  - Attempted
  - Down
  - Restart
- UE PDN Restored
  - Emergency
  - IMS
  - Normal
- UE PDN Failed
  - Emergency
  - IMS
  - Normal

show mme-service statistics verbose

Executing the above command, displays the following fields for this feature:

- SGW Restoration Failure
  - Invalid UE SGW context
  - No EPS Bearer Active
  - SGW Selection Failure
  - SGW Reloc Proc Failed
  - Create Session Failure
  - Abort

Bulk Statistics

The following bulk statistics are added in the MME schema for the S-GW Restoration feature:

Variables	Description
sgw-restoration-attempted	Proprietary counter provides the total number of attempted SGW Restorations at MME. Increments when SGW restoration is attempted at MME due to s11 path failure.
sgw-restoration-peer-restart	Proprietary counter provides the total number of attempted SGW Restoration at MME due to Peer SGW restart. Increments when SGW restoration is attempted at MME due to s11 path failure and because of peer SGW restart.
sgw-restoration-peer-down	Proprietary counter provides the total number of attempted SGW Restoration at MME due to Peer SGW going down. Increments when SGW restoration is attempted at MME due to s11 path failure because peer SGW has gone down
sgw-restoration-pdn-restored	Proprietary counter provides the total number of successful PDNs restored during SGW restoration. Increments when SGW restoration is successfully attempted for PDNs at MME
sgw-restoration-emergency-pdn-restored	Proprietary counter provides the total number of successful emergency PDNs restored during SGW restoration. Increments when SGW restoration is successfully attempted for emergency PDNs at MME
sgw-restoration-ims-pdn-restored	Proprietary counter provides the total number of successful IMS PDNs restored during SGW restoration. Increments when SGW restoration is successfully attempted for IMS PDNs at MME
sgw-restoration-normal-pdn-restored	Proprietary counter provides the total number of successful normal PDNs restored during SGW restoration. Increments when SGW restoration is successfully attempted for Normal PDNs at MME

Variables	Description
sgw-restoration-pdn-failed	Proprietary counter provides the total number of PDNs failed to be restored during SGW restoration. Increments when SGW restoration has failed for PDNs at MME
sgw-restoration-emergency-pdn-failed	Proprietary counter provides the total number of emergency PDNS failed to be restore during SGW restoration. Increments when SGW restoration has failed for Emergency PDNs at MME
sgw-restoration-ims-pdn-failed	Proprietary counter provides the total number of IMS PDNS failed to be restored during SGW restoration. Increments when SGW restoration has failed for IMS PDNs at MME
sgw-restoration-normal-pdn-failed	Proprietary counter provides the total number of normal PDNs failed to be restored during SGW restoration. Increments when SGW restoration has failed for Normal PDNs at MME
sgw-rest-proc-fail-total	Indicates the total number of SGW restoration procedures failed. Increments when a SGW Restoration procedure fails.
sgw-rest-proc-fail-invalid-ue-sgw-ctxt	The total number of SGW restoration procedures failed due to invalid UE SGW context. Increments when a SGW restoration procedure fails due to an invalid UE SGW context.
sgw-rest-proc-fail-no-eps-bearer-active	The total number of SGW restoration procedures failed due to inactive EPS bearers. Increments when sgw restoration procedure fails on account of inactive EPS bearers.
gw-rest-proc-fail-sgw-selection-failure	The total number of SGW restoration procedures failed due to SGW selection failure. Increments when SGW restoration procedure fails due to SGW selection failure.
sgw-rest-proc-fail-sgw-reloc-proc-failed	The total number of SGW restoration procedures failed due to failure of SGW relocation procedure. Increments when SGW restoration procedure fails due to SGW relocation procedure failure.
sgw-rest-proc-fail-create-sess-failure	The total number of SGW restoration procedures failed due to create session failure. Increments when SGW restoration procedure fails due to create session failure.
sgw-rest-proc-fail-abort	The total number of SGW restoration procedures aborted due to failure. Increments when SGW restoration procedure is aborted due to failure.