Failure and Error Handling Support

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	cnSGW-C
Applicable Platform(s)	SMI
Feature Default Setting	Enabled - Always-on
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
Added support for the Information Elements (IE): • Failure Cause Code • Cause Source (Bit 1 – CS) • Bearer Context IE error (Bit 2 – BCE)	2021.02.3

Revision Details	Release
First introduced.	2021.01.0

Overview

cnSGW-C supports:

- Attach and Detach failure and error handling.
- Create, Update, Delete Bearer Request and Response failure and error handling.
- Radio Access Bearer or Modify Beare Request failure and error handling.

The different types of failures that can occur during the call processing are as follows, except for Session Setup timer:

- Advance validation failure on request and response.
- Retransmission timeout.
- Transaction service level agreement (SLA).
- Failure reported from peer (UP, PGW, or MME depending on the stage of message process).

For Session Setup timer during attach procedure, following failures can happen:

- Ongoing PDN establishment and Modify Bearer Request from MME isn't received for Initial Attach and multi-PDN.

Attach and Detach Failure and Error Handling

cnSGW-C supports the following:

- Setup timeout functionlaity
- Failure response handling for:
  - Clear Session Request as a part of the Initial Attach and additional PDN setup procedures
  - Delete Beare Request and Delete Session Request processing for the PGW and UPF

Create Session Request Failure Handling

This section covers the Create Session Request procedure failure scenarios.

When failure occurs during Initial Attach procedure, subscriber context isn't created,

When another PDN setup fails, PDN isn't created in subscriber context.

The following table summarizes cnSGW-C behavior during different stages in the call processing for various failure types:

Table 3: cnSGW-C Behavior for Create Session Request Proceudure Failure Scenarios

Scenarios	Sx Signaling (Revert)	S11 Signaling (Revert)	S5 Signaling
• Create Session Request advance validation failure • Sx Session Establishment Response failure from User Plane (UP)	No	Negative - Create Session Response	No
• Create Session Response failure	Yes Delete traffic endpoint for newly created bearers	Negative - Create Session Response	No
• Sx Modify Response process failure	Yes Delete traffic endpoint for newly created bearers	Negative - Create Session Response	Delete Session Request to delete newly created session

Delete Default Bearer Procedure Failure Handling

This section covers the PGW-initiated default bearer deletion procedure failure scenarios.

The following table summarizes cnSGW-C behavior during different stages of call processing for various failure types:

Table 4: cnSGW-C Behavior for Delete Default Bearer Procedure Failure Scenarios

Scenarios	SGW-service Behavior	Signaling	Output
Delete Bearer Request advance validation failure	Send failure/No signaling over Sx/PGW	Negative - S5 Delete Bearer Response	Session/PDN is not deleted
Sx Session Modify failure	Skip failure and continue	Send S11 Delete Bearer Request towards MME S5 Delete Bearer Response (Cause = Accepted) Sx Delete Request (to Delete traffic endpoint) depends upon Sx Session Modify Response	Session/PDN is deleted
S11 Delete Bearer Request failure	Skip failure and continue	Send Delete Bearer Response (Cause = Accepted) to PGW Sx Delete Request (to Delete traffic endpoint)	Session/PDN is deleted

Scenarios	SGW-service Behavior	Signaling	Output
Sx Session Delete Request failure	Skip failure and continue	Send Delete Bearer Response (Cause = Accepted) to PGW	Session/PDN is deleted

Delete Session Procedure Failure Handling

This section covers the MME-initiated Deletion Session procedure failure scenarios.

The following table represents cnSGW-C behavior for the failure scenarios:

Table 5: cnSGW-C Behavior for Delete Session Procedure Failure Scenarios

Scenarios	SGW-service Behavior	Signaling	Output
Delete Session Request advance validation failure	Send failure/No signaling over Sx/MME	Negative - S11 Delete Session Response	Session/PDN is not deleted
Sx Session Modify Request failure	Skip failure and continue	Send Delete Session Request towards PGW Send Delete Session Response (Cause = Accepted) to MME Sx Delete Request (to Delete traffic endpoint) depends upon Sx Session Modify Response	Session/PDN is deleted
S5 Delete Session Request failure	Skip failure and continue	Send Delete Session Response (Cause = Accepted) to MME Sx Delete Request (to Delete traffic endpoint)	Session/PDN is deleted
Sx Session Delete Request failure	Skip failure and continue	Send Delete Session Response (Cause = Accepted) to MME	Session/PDN is deleted

Session Setup Timer during Attach Procedure

This section covers the session setup timer during attach procedure.

The following table represents cnSGW-C behavior for the session timeout scenarios:

Table 6: cnSGW-C Behavior for Session Timeout Failure Scenarios

Scenarios	Sx Signaling (Revert)	S11 Signaling (Revert)	S5 Signaling	Output
Session setup timeout expired after SGW sends Create Session Response to MME and waits for the Modify Bearer Request from MME.	Sx Delete Request (To delete traffic endpoint for newly created bearers)	Delete Session Request	Delete Bearer Request	Session/PDN is deleted

Create-Update-Delete Bearer Request and Response Failure and Error Handling

This section describes create, update, and deletge bearer request and response failure and error handling scenarios.

Create Bearer Procedure Failure Handling

This section covers the PGW-initiated dedicated bearer creation procedure failure scenarios.

The following table summarizes cnSGW-C behavior during different stages of call processing for various failure types:

Note During processing of create dedicated Bearer Request and Response, if SGW receives Context Not Found from peer (MME/UP) it deletes the PDN without performing any signaling towards the peer which sent this cause.

Table 7: cnSGW-C Behavior for Create Bearer Procedure Failure Scenarios

Scenarios	Sx Signaling (Revert)	S11 Signaling (Revert)	S5 Signaling	Output
• Create Bearer Request advance validation failure • Sx Session Modify Request failure (request sent to UP to allocate tunnel endpoint and GTPU TEIDs).	No	No	Negative - Create Bearer Response to PGW	New Bearer Context is not created.

Scenarios	Sx Signaling (Revert)	S11 Signaling (Revert)	S5 Signaling	Output
Create Bearer Request is sent to MME and SGW is waiting for the Response.	Yes To remove traffic endpoint for newly created bearers.	No	Negative - Create Bearer Response to PGW	New Bearer Context is not created. Optional parameters of Create Bearer Response are ignored.
SGW receives Create Bearer Resposne from MME and sends Sx Modify to UP to connect GTPU tunnel between eNodeB and SGW-U.	Yes To remove traffic endpoint for newly created bearers.	Yes To delete newly created bearers.	Negative - Create Bearer Response to PGW	New Bearer Context is not created. Optional parameters of Create Bearer Response are ignored.
Failure in Revert handling for the Delete Bearer Request or Sx Modify Request.	No	No	Negative - Create Bearer Response	Bearer Context is not created. Optional parameters of Create Bearer Response are ignored.

Delete Dedicated Bearer Procedure Failure Handling

This section covers the PGW-initiated dedicated bearer deletion procedure failure scenarios.

The following table summarizes cnSGW-C behavior during different stages of the call processing for various failure types:

Note During processing of delete dedicated Bearer Request and Response if SGW receives Context Not Found from peer (MME/UP), it deletes the PDN without performing any signaling towards the peer which sent this cause.

Table 8: cnSGW-C Behavior for Delete Dedicated Bearer Procedure Failure Scenarios

Scenarios	SGW-Service Behavior	Signaling	Output
Delete Bearer Request advance validation failure	Send failure/No Signaling over Sx/MME	Negative - Delete Bearer Response to PGW	Dedicated Bearer is not deleted.

Scenarios	SGW-Service Behavior	Signaling	Output
Partial Accepted: Delete Bearer Request received with multiple EBI's, where: • Some EBIs belong to PDN • Some EBIs don't belong to PDN/Invalid EBIs	Continue DBR Procedure and delete all existing bearers for which Delete Bearer Request is received. S11 Delete Bearer Request should carry only existing EBIs information Sx Session Modification Request should carry existing EBIs information (Remove Traffic Endpoint)	S5 Delete Bearer Response (Cause = Partially Accepted)	S5 Delete Bearer Response where message level cause is Partially Accepted and bearer level cause is: • **Some EBIs belong to PDN:** S11 Delete Bearer Response • **Some EBIs does not belong to PDN/Invalid EBIs:** Context Not Found CDL is updated (Remove all existing bearers)
Sx Session Modify to set action as DROP	Skip failure and continue	S5 Delete Bearer Response (Cause = Accepted)	Skip failure and continue with DBR Procedure Call Flow: Yes S5 Delete Bearer Response (Cause = Accepted) CDL is updated
S11 Delete Bearer Request Failure	Skip failure and continue	S5 Delete Bearer Response (Cause) = Accepted	Skip failure and continue with DBR Procedure Call Flow: Yes CDL is updated
Sx Session Modify Request failure (Request to remove traffic endpoint on UP)	Skip failure and continue	S5 Delete Bearer Response (Cause = Accepted)	Skip failure and continue with DBR Procedure Call Flow: Yes CDL is updated

Update Bearer Procedure Failure Handling

This section covers the PGW-initiated update bearer procedure failure scenarios.

The following table summarizes cnSGW-C behavior during different stages in call processing for various failure types:

Table 9: cnSGW-C Behavior for Update Bearer Procedure Failure Scenarios

Scenarios	S5/Sx Signaling	Output
Update Bearer Request advance validation failure	Negative - Update Bearer Response	No change in Bearer/PDN context.

Scenarios	S5/Sx Signaling	Output
Update Bearer Request with non-existing EBIs	Update Bearer Response with message level cause as REQ_PARTIALLY_ACCEPTED. Bearer level cause for non-existing EBIs as Context Not Found. (Normal handling for existing EBIs)	Update Bearer Response with message level cause as REQ_PARTIALLY_ACCEPTED. Bearer level cause for non-existing EBIs as CONTEXT_NOT_FOUND. Normal handling for existing EBIs. CDL is updated for existing EBIs only.
Update Bearer Request is sent to MME and waiting for the response	Negative - Update Bearer Response	Negative - Update Bearer Response CDL is not updated.
S11 Update Bearer Response (Message level Cause == CONTEXT_NOT_FOUND) and S5 Update Bearer Req/Rsp had default bearer in the bearer context list	Sx Delete Req/Rsp Negative - Update Bearer Response	Negative - Update Bearer Response CDL is not updated. Statistics/Transactional Logs PDN Key Release + PDN deallocation If this is the last PDN, then resource manager is released, all subscriber keys are released and subscriber deallocation is done.
S11 Update Bearer Response (Message level Cause == CONTEXT_NOT_FOUND) and S5 Update Bearer Req/Rsp didn't have default bearer in the bearer context list	Sx Modify Req/Rsp Negative - Update Bearer Response	CDL is not updated.
S11 Update Bearer Response (Message level Cause == REQ_PARTIALLY_ACCEPTED, Bearer Context Cause == Any failure for dedicated bearer)	Sx Modify Req/Rsp Update Bearer Response with message level cause as REQ_PARTIALLY_ACCEPTED	Update Bearer Response with message level cause as REQ_PARTIALLY_ACCEPTED CDL is updated for successful bearers.

Scenarios	S5/Sx Signaling	Output
S11 Update Bearer Response (Message level Cause == REQ_PARTIALLY_ACCEPTED, Bearer Context Cause == CONTEXT_NOT_FOUND for default bearer)	Sx Delete Req/Rsp Negative - Update Bearer Response	Negative - Update Bearer Response CDL is not updated. PDN Key Release and PDN deallocation If this is the last PDN, then resource manager is released, all subscriber keys are released and subscriber deallocation is done.
If Sx modify is triggered after Update Bearer Response: • Sx Session Modify Request (IPC/Retransmission Timeout/Internal Failure and so on) • Sx Session Modify Response (Cause != ACCEPTED except CONTEXT_NOT_FOUND)	Ignore failure and continue	Ignore failure and continue
If Sx Modify is triggered after Update Bearer Response: • Sx Session Modify Response (Cause == CONTEXT_NOT_FOUND)	[1]	[2]
If Sx Delete is triggered after Update Bearer Response: • Sx Session Delete Request (IPC/Retransmission Timeout/Internal Failure and so on) • Sx Session Delete Response (Cause != ACCEPTED) • Resource manager release (Internal Error)	Ignore failure and continue	Ignore failure and continue

[1] As part of Update Bearer Procedure handling, SGW-service triggers new transaction for PDN deletion:

- Sx Failure Cause received as part of Sx Session Modification Response
  - Context Not Found

SGW Behavior (New Transaction):

- SGW triggers S11 Delete Bearer Request and S5 Delete Session Request to delete that PDN
- No Sx Signaling

SGW Behavior (Update Bearer Transaction): SGW sends S5 Update Bearer Response with Cause as No Resource Available, as part of Update Bearer Procedure Transaction. Also, SGW doesn't initiate any signaling towards UP as soon as it receives Sx Session Modification Response with cause as Context Not Found.

2 As part of Update Bearer Procedure handling, SGW-SVC additionally triggers new transaction for PDN deletion:

- Sx Failure Cause received as part of Sx Session Modification Response
  - Context Not Found

SGW Behavior (New Transaction):

- SGW triggers S11 Delete Bearer Request and S5 Delete Session Request to delete that PDN
- No Sx Signaling

SGW Behavior (Update Bearer Transaction): SGW sends S5 Update Bearer Response with Cause as No Resource Available, as part of Update Bearer Procedure Transaction. Also, SGW doesn't initiate any signaling towards UP as soon as it receives Sx Session Modification Response with cause as Context Not Found.

Radio Access Bearer/Modify Bearer Request Failure and Error Handling

This section covers the Radio Access Bearers (RAB), Modify Bearer Request and Response (MBR) from PGW and User Plane (UP) failure scenarios.

The following table summarizes cnSGW-C behavior during different stages of call processing for various failure types:

Table 10: cnSGW-C Behavior for Radio access Bearer and Modify Bearer Response Procedure Failure Scenarios

Message Type	Failure Interface	Failure Response Recevied	Failure Response to be sent	Handling
MBR initial attach	Sx	CONTEXT_NOT_FOUND	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Cleanup PDN with DSR towards PGW and DBR towards MME
		Other Failure Response	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Cleanup PDN with DSR towards PGW and DBR towards MME. Sx_Modification_Req/ Sx_Session_Delete to cleanup resource on UP
	Timeout	Timeout on PFCP	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Cleanup PDN with DSR towards PGW and DBR towards MME. Sx_Modification_Req/ Sx_Session_Delete to cleanup resource on UP
MBR Service Request	Sx	CONTEXT_NOT_FOUND	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Cleanup PDN with DSR towards PGW and DBR towards MME
		Other Failure Responses	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Do not update anything in PDN, Ignore S5 Signaling
		Timeout	EGTP_CAUSE_ NO_RESOURCES_ AVAILABLE	Do not update anything in PDN, Ignore S5 Signaling
	S5	EGTP_CAUSE_ CONTEXT_NOT_ FOUND	EGTP_CAUSE_ CONTEXT_NOT_ FOUND	Sx_Session_Delete send to UP MBRsp failure to MME (No DBR/DSR)
		Other Failure Responses	Failure Response received from PGW	Do not update PDN/DB
	Timeout	Timeout from PGW	EGTP_CAUSE_ PEER_NOT_ RESPONDING	Do not update PDN/DB

Message Type	Failure Interface	Failure Response Recevied	Failure Response to be sent	Handling
RAB	Sx	CONTEXT_ NOT_FOUND (Single PDN call)	EGTP_CAUSE_ REQ_ACCEPTED	Cleanup PDN with DSR towards PGW and DBR towards MME
		CONTEXT_ NOT_FOUND (Multi PDN call and context not found for one PDN)	Send RAB Resp (EGTP_CAUSE_ REQ_ACCEPTED)	Cleanup the PDN for which context not found received with DSR towards PGW and DBR towards MME Move other PDN/UE to IDLE
		Other Failure Response	EGTP_CAUSE_ REQ_ACCEPTED	Move PDN/UE to IDLE
		Timeout	EGTP_CAUSE_ REQ_ACCEPTED	Move PDN/UE to IDLE

Support for Failure Cause Code, Cause Source, and Bearer Context Error

This section describes the support for the Information Elements (IE) – Failure cause code, Cause Source (CS), and Bearer Context Error (BCE).

For more information on the technical specifications for the IEs, see *3GPP TS 29.274*.

Failure Cause Code

cnSGW-Csupports handling any failure cause code received from SMF on S5 interface.

Cause Source

Bit 1 – CS (Cause Source) value ‘0’ indicates that the error is originated by the node sending the message.

Bit 1 – CS (Cause Source) value ‘1’ indicates that the error is originated by the remote node (MME/SGSN to a PGW, or PGW to an MME/SGN).

Bearer Context Error

The default value of Bit 2-BCE (Bearer Context IE Error) is ‘0’. If the BCE Bit is 1, it indicates that the corresponding rejection clause is due to the error in the Bearer Context IE. This bit is discarded if the cause value is one of Acceptance cause value.