

Closed Subscriber Group Mobility Event Support on P-GW and GGSN

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Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	• P-GW • GGSN
Applicable Platform(s)	• ASR 5500 • VPC-DI
Feature Default	Disabled - Configuration Required
Related Changes in this Release	Not Applicable
Related Documentation	• *Statistics and Counters Reference* • *P-GW Administration Guide*

Revision History

Revision Details	Release
In this release, support for Closed Subscriber Groups mobility event for P-GW and GGSN is added.	21.23

Feature Description

Closed Subscriber Group (CSG) identifies a group of subscribers who are permitted to access one or more CSG cells of the Public Land Mobile Network (PLMN) as a member of the CSG. A CSG ID is a unique identifier within the scope of PLMN, which identifies a CSG in the PLMN associated with a CSG cell or group of CSG cells. For CSG information change reporting for a subscriber session requested by GGSN, the Serving GPRS Support Node (SGSN) includes the User CSG Information if the MS is located in the CSG cell or the hybrid cell.

When users enter or exit the CSG Cells or Hybrid Cells, if there are no event notifications sent back to the P-GW and Gateway GPRS Support (GGS), the capability to provide different policy and charging characteristic to the users becomes limited. In this StarOS 21.23 and later releases, CSG mobility event support is available in multiple network elements, namely eNodeB, MME, SGW, PGW, PCRF, SGSN, GGSN, HSS, and so on. This CSG mobility event feature provides full support of CSG capability on P-GW and GGSN based on 3GPP standards. This CSG mobility event feature includes capability to:

- Enable and trigger the CSG notification event.
- Apply appropriate policy and charging rules.

Access Control

The CSG Mobility Event feature functions on S5/S8, Gn/Gp, Gx, and Rf interfaces:

S5 and S8 Interfaces

The message types that processes CSG information shows the message initiated from MME and the messages initiated from PGW. S-GW passes the information from and to MME.and to and from P-GW:

- **Create Session Request**: In the Create Session Request (CSR) message, it contains a CSG Change Reporting Support Indication(CCRSI) flag when MME is configured to support CSG information change reporting to the S-GW and P-GW. If the UE is attached through a CSG or hybrid cell, the User CSG information (UCI) IE is included in the CSR. The User CSG Information IE contains the PLMN and CSG ID of the CSG or hybrid cell, the access mode (closed or hybrid), and if the access mode is hybrid, the membership status of the UE in the CSG.
- **Create Session Response**: If CSG information reporting is started or stopped, the P-GW/S-GW sends the CSG Information Reporting Action (CIRA) IE in the Create Session Response . This IE includes three bits that indicate whether the MME should report when the UE enters or leaves a CSG (non-hybrid) cell, a subscribed hybrid cell, or an unsubscribed hybrid cell. If all three bits are set to zero, all CSG information reporting to the S-GW and P-GW is stopped. The MME stores the CSG reporting information as part of the PDN context,.
- **Create Bearer Request**: If CSG reporting from the MME changes, the Create Bearer Request message from the P-GW and S-GW includes a CIRA IE. The MME stores the CSG reporting information as part of the PDN context.
- **Modify Bearer Request**: The CCRSI flag in the Indication IE is set in a Modify Bearer Request when the MME is configured to support CSG information change reporting to the S-GW and P-GW. If the

P-GW and S-GW has requested CSG information reporting and a TAU, Handover, or UE-initiated Service Request is taking place, the MME includes the UCI IE in the Modify Bearer Request message.

- **Update Bearer Request**: If CSG reporting from the MME changes, the Create Bearer Request message from the P-GW and S-GW includes a CIRA IE. The MME stores the CSG reporting information as part of the PDN context.
- **Change Notification Request**: If there is a change to the CSG connection information without a Create Bearer Request or Modify Bearer Request, the MME sends a Change Notification Request to the S-GW P-GW for each PDN where it is requested. The Change Notification Request contains a UCI IE. Since Location Reporting also uses the Change Notification Request message, the MME minimizes the number of Change Notification Request messages sent by bundling the reporting of a location change with a CSG change into the same message whenever possible.
- **Change Notification Response**: If CSG reporting from the MME changes, the Change Notification Response message from the P-GW and S-GW includes a CIRA IE. The MME stores the CSG reporting information as part of the PDN context.

Gn and Gp Interfaces

The message types that processes CSG information shows the message initiated from SGSN and the messages initiated from GGSN:

- **Create PDP Context Request (CPC Request)**: The CPC Request message contains a CSG Change Reporting Support Indication (CCRSI) flag when SGSN is configured to support CSG information change reporting to the GGSN. If the UE is attached through a CSG or hybrid cell, the User CSG information (UCI) IE is included in the CPC. The User CSG Information IE contains the PLMN and CSG ID of the CSG or hybrid cell, the access mode (closed or hybrid), and if the access mode is hybrid, the membership status of the UE in the CSG.

Note Ignores UCI value on GGSN/P-GW when access mode value is reserved (2 or 3).

- **Create PDP Context Response (CPC Response)**: If CSG information reporting is to be started or stopped, the GGSN sends the CSG Information Reporting Action (CIRA) IE in the CPC Response. This IE includes three bits that indicate whether the SGSN should report when the UE enters or leaves a CSG (non-hybrid) cell, a subscribed hybrid cell, or an unsubscribed hybrid cell. If all three bits are set to zero, all CSG information reporting to the GGSN is stopped.
- **Update PDP Context Request (UPC Request)**: The CCRSI flag in the Extended Common Flags IE is set in UPC Request when the SGSN supports CSG Information Change Reporting and if CSG Change Reporting is requested by the GGSN through the CSG Information Reporting Action. If the UE is accessed through CSG cell or Hybrid cell, the SGSN includes the User CSG Information IE.
- .**Network Requested Update PDP Context Request (NRUPC Request)**: If CSG reporting from the SGSN changes, the NRUPC Request message from the GGSN includes a CIRA IE. The SGSN stores the CSG reporting information as part of the PDN context.
- **MS Info Change Notification Request**: The MS Info Change Notification Request contains a UCI IE and CCRSI flag in the Extended Common Flags IE. Since Location Reporting also uses the MS Info Change Notification Request message, the SGSN minimizes the number of MS Info Change Notification

Request messages sent by bundling the reporting of a location change with a CSG change into the same message whenever possible.

- **MS Info Change Notification Response**: If CSG reporting from the SGSN changes Notification Response message from the GGSN includes a CIRA IE . The SGSN stores the CSG reporting information as part of the PDN context.

Gx Interface

During CSG handling related messages over Gx interface the following functions happen:

- **Internet Protocol**: During an Internet Protocol connectivity Access Network (IP-CAN) session, the PCRF determines whether the reports for change of CSG cell or Hybrid cell is required for an IP-CAN session.
- When the UE enters or leaves the CSG or Hybrid cell, Policy and Charging Enforcement Function (PCEF) reports either USER_CSG_INFORMATION_CHANGE, USER_CSG_HYBRID_SUBSCRIBED_INFORMATION_CHANGE, or USER_CSG_HYBRID_UNSUBSCRIBED_INFORMATION_CHANGE event. PCEF also reports the CSG change within the User-CSG-Information AVP.
- If CSG-Information-Reporting AVP is not received in subsequent CCA-U messages, existing CSG-Information-Reporting values are reused.
- CSG-Information-Reporting AVP is used by PCRF to inform PCEF to report the user CSG information change to the Charging Data Function (CDF)/ Offline Charging Server (OFCS) over RF interface. If this AVP is not received during IPCAN session, PCEF does not report the user CSG information change to the CDF/OFCS.

Rf Interface

The ACR messages in the CSG information handling involve:

- User CSG Information (UCI) at PS level (Ps-Information AVP) to send information only during ACR start message. Sends UCI information SDC level (Service-Data-Container AVP) in subsequent messages



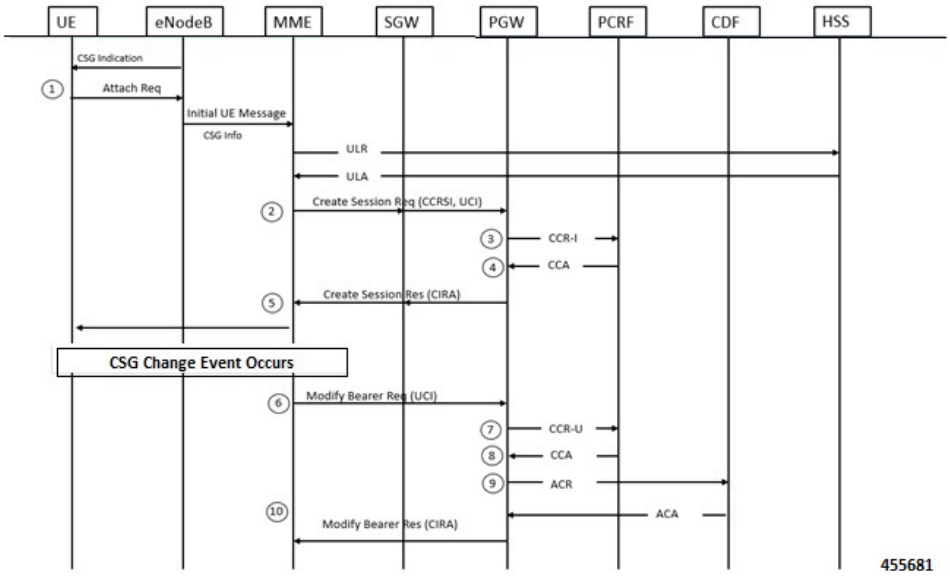
Important Configuration **attribute csg** in the Rf profile enables UCI information at PS level when transmitted in the ACR start message.

- User CSG Information (UCI) change value gets added in the Change-Condition AVP at SDC level every time when change of User CSG Information is received from access side and CSG change reporting to OFCS in CSG Information is enabled in the Reporting AVP from PCRF.
- If CSG Information Reporting is not received during IP-CAN session, P-GW does not send User CSG Information AVP to OFCS over Rf interface.

How it Works

The following diagram shows the messaging between the EPC elements in a Closed Subscriber Group implementation.

Figure 1: Closed Subscriber Groups Message Call Flow



The following steps describes the workflow:

1. The eNodeB broadcasts the CSG Information to UEs. When an Attach Request event happens, the eNodeB sends its own CSG-related Information in Initial UE message to the MME. The MME sends an Update Location Request (ULR) to the HSS to get subscriber's profile. The HSS responds with an update Location Answer including subscription-data which includes CSG-subscription-data.
2. The MME proceeds with the call according to the user profile from the HSS. The MME sets the CSG membership Indication and passes it to the S-GW including Access Mode and CSG-ID. The S-GW transparently passes the information to the P-GW.
3. The P-GW requests policy and charging rule from the PCRF.
4. The PCRF sends Event-Trigger:=USER_CSG_INFORMATION_CHANGE, USER_CSG_HYBRID_SUBSCRIBED_INFORMATION_CHANGE and USER_CSG_HYBRID_UNSUBSCRIBED_INFORMATION_CHANGE and CSG-Information-Reporting AVP based on the user subscription profile.
5. The P-GW sets CSG-Information-Reporting-Action in Create Session Response when the P-GW receives Event-Trigger:=USER_CSG_INFO_CHG.
6. The MME sends CSG-Membership-Status to eNodeB. This is only occurs when the Access mode is set to Hybrid.
7. The eNodeB/MME reports the event when a CSG change event happens. The MME updates CSG change event using a Change Notification Request or Modify Bearer Request.

8. The P-GW reports CSG change event using Event-Reporting-Indication AVP to the PCRF.
9. The PCRF updates the policy and charging rule with Charging-Rule-Base-Name or install new Charging-Rule-Base-Name.
10. The P-GW reports charging record to CDF over Rf interface and includes User-CSG-Information AVP, if PCRF reports CSG-Information-Reporting AVP with CHANGE_CSG_CELL flags.
11. If the policy and charging rule changes cause bearer modification or creation, the P-GW sends a CSG Information Reporting Action IE as part of the Modify Bearer Response, a Change Notification Response, or it can initiate a change through an Update Bearer Request.

Behavior Matrix

Following Message types and the CSG AVP are available in the Gx and Rf interfaces.

Table 1: Message Type behaviour (E-UTRAN/UTRAN)

Message Type	User-CSG-Information AVP (Gx)	User-CSG-Information AVP (Rx)
Create-Session-Request/ Create PDP Context Request	CCR - I	ACR-Start
Modify-Bearer-Request/Update PDP Context Request	CCR-U	ACR-Interim
Change -Notification -Request/MS Info Change Notification Request	CCR-U	ACR-Interim
Delete-Session-Request/ Delete PDP Context Request	-	ACR-Stop
Delete-bearer-Request	-	ACR-Interim/Stop

Note Only 3G and E-UTRAN RAT Type is supported for CSG -information on Gx and Rf Interface.

Handoff Expected Behavior: If there are UE handover from E-UTRAN or 3G to other RAT types (for example. WI-FI) , then the User-CSG-Information AVP will not be sent on Gx and Rf interface.

Monitoring and Troubleshooting

This section provides information regarding show command outputs available for the Closed Subscriber Groups mobility event feature.

Show Commands and Outputs

show subscribers pgw-only full all

The output of **show subscribers pgw-only full all** command has been enhanced to include the following output fields in support of the Closed Subscriber Groups Mobility Event feature on P-GW and GGSN.

Similarly, the output of **show subscribers ggsn-only full all** and **show subscribers saegw-only full** CLI commands has been enhanced to include the following output fields:

Field	Description
UCI	
MCC	Displays a Mobile Country Code (MCC) for User CSG Information.
MNC	Displays a Mobile Network Code (MNC) for the User CSG Information.
CSG-ID	Displays the Closed Subscriber Group identifier.
Access Mode	Displays a matching access mode.
LCSG	Displays Leave Closed Subscribers Group (LCSG) value. The default value is 0.
CMI	Displays CSG Membeship Information (CMI). The CMI displayed is either Member or Non-Member of hybrid cell.

show ims-authorization sessions full all

The output of this command has been enhanced to include the following output fields in support of the Closed Subscriber Groups Mobility Event feature on P-GW and GGSN.

Field	Description
Auth Decision:	
Event Triggers:	
User-CSG-Information-Change	Displays total number of User CSG Information change request event triggers.
User- CSG -Hybrid-Subscribed -Information -Change	Displays total number of User CSG Hybrid Subscribed Information.change request event triggers.
User-CSG-Hybrid- Unsubscribed -Information -Change	Displays total number of User CSG Hybrid Unsubscribed Information.change request event triggers..

show ims-authorization service statistics

The output of this command displays the the CSG feature statistics.

Field	Description
Re-Authorization Triggers	
User CSG Info Chg	Displays total number of User CSG Information.change counters.
User CSG Hybrid Sub Info Chg	Displays total number of User CSG Hybrid Subscribed Information change counters.
User CSG Hybrid Unsub Info Chg	Displays total number of User CSG Hybrid Unsubscribed Information change counters.