Configure 5G Non-Standalone Differential Online Charging

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Introduction

This document describes how to configure Presence Reporting Area (PRA)-based differential charging for 5G Non-Standalone (NSA) deployments.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- PRA
- Mobility Management Entity (MME)
- Serving Gateway (SGW)
- Packet Data Network Gateway (PGW)
- Policy and Charging Rules Function (PCRF)
- Online Charging System (OCS)
- User Equipment (UE) mobility in 5G NSA Option 3x
- Dual Connectivity with New Radio (DCNR)
- Diameter Gx policy and charging procedures

Components Used

The information in this document is based on StarOS 21.28.x.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Deployment Requirements

Item	Requirement
MME PRA mapping	MME can map the S1 user-plane (S1-U) Internet Protocol (IP) transport address of the 5G base station to a PRA identifier.
PGW PRA support	PGW supports the PRA event trigger toward PCRF.
PRA identifier	PCRF is configured with the same PRA identifier used by MME.
PCC rulebase selection	PCRF can choose the required Policy and Charging Control (PCC) rulebase when the reported PRA status changes.

Background Information

Purpose

PRA-based differential charging allows a 5G NSA deployment to apply different online-charging treatment when a subscriber moves between 4G and 5G coverage.

PRA represents an area in the 3GPP packet domain for reporting UE presence for policy-control or charging purposes. In this design, PRA state represents whether a DCNR UE is inside or outside the configured 5G coverage area.

Solution Overview

1. PCRF subscribes to the PRA event trigger.

2. PGW stores the PRA action and forwards the request toward SGW.

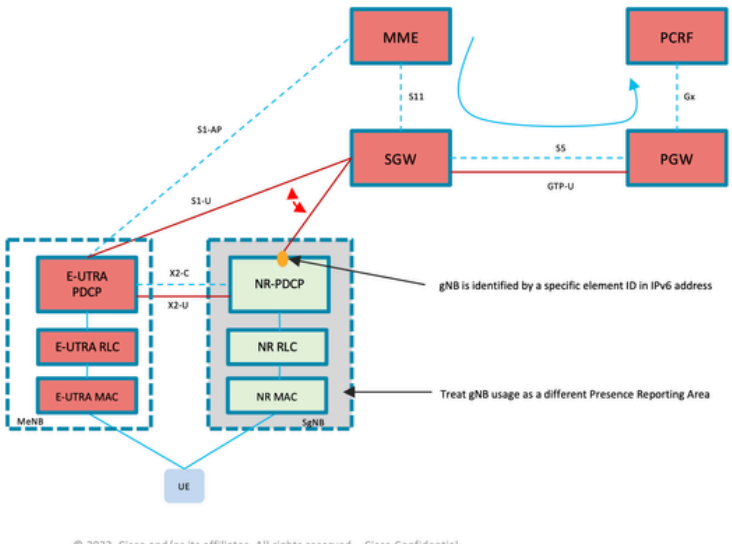
3. MME detects a 4G-to-5G or 5G-to-4G mobility event and maps the 5G base-station S1-U transport address to the configured PRA identifier.

4. MME reports the PRA status to SGW, and SGW forwards it to PGW.

5. PGW reports the PRA information toward PCRF.

6. PCRF changes the applicable PCC rulebase based on the PRA state.

7. The user plane applies the resulting charging and policy changes.



- MME identifies gNB vs. eNB usage.
- MME sends Modify Bearer Request with Presence Reporting Area to SPGW and then PCRF

Element	High Level Changes
MME	Vendor specific solution, needs to be consulted with the MME vendor. Identify UE movement to gNB coverage. Send MBRs to PGW.
PGW	Support Presence Reporting Area reports (standard feature) Inform PCRF
SGW	Support Presence Reporting Area reports (standard feature)
PCRF	Support Presence Reporting Area reports (standard feature) Implement policies based on reports

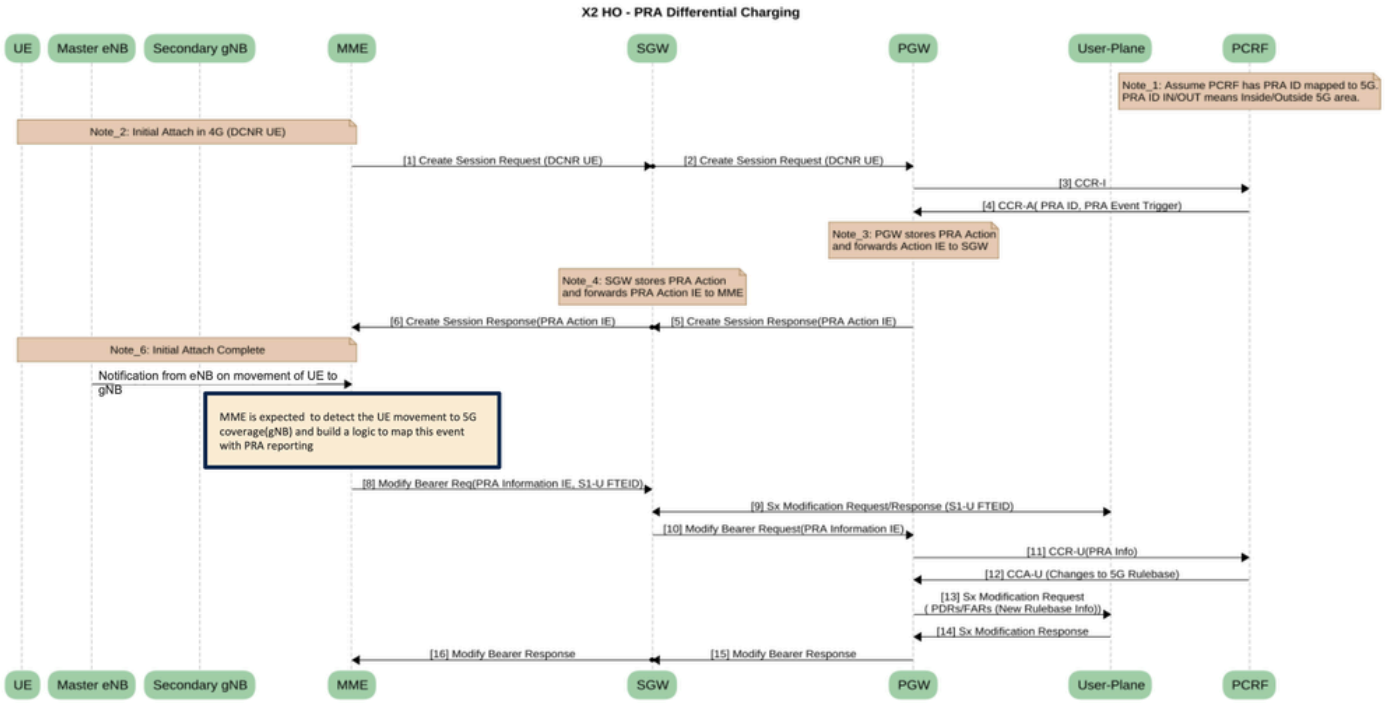
High level setup architecture

PRA Status

UE Location	PRA State	Reported Status	Charging Result
Inside configured 5G coverage	Inside PRA	In area (0)	PCRF chooses the configured 5G charging treatment
Outside configured 5G coverage	Outside PRA	Out of area (1)	PCRF chooses the configured 4G charging treatment

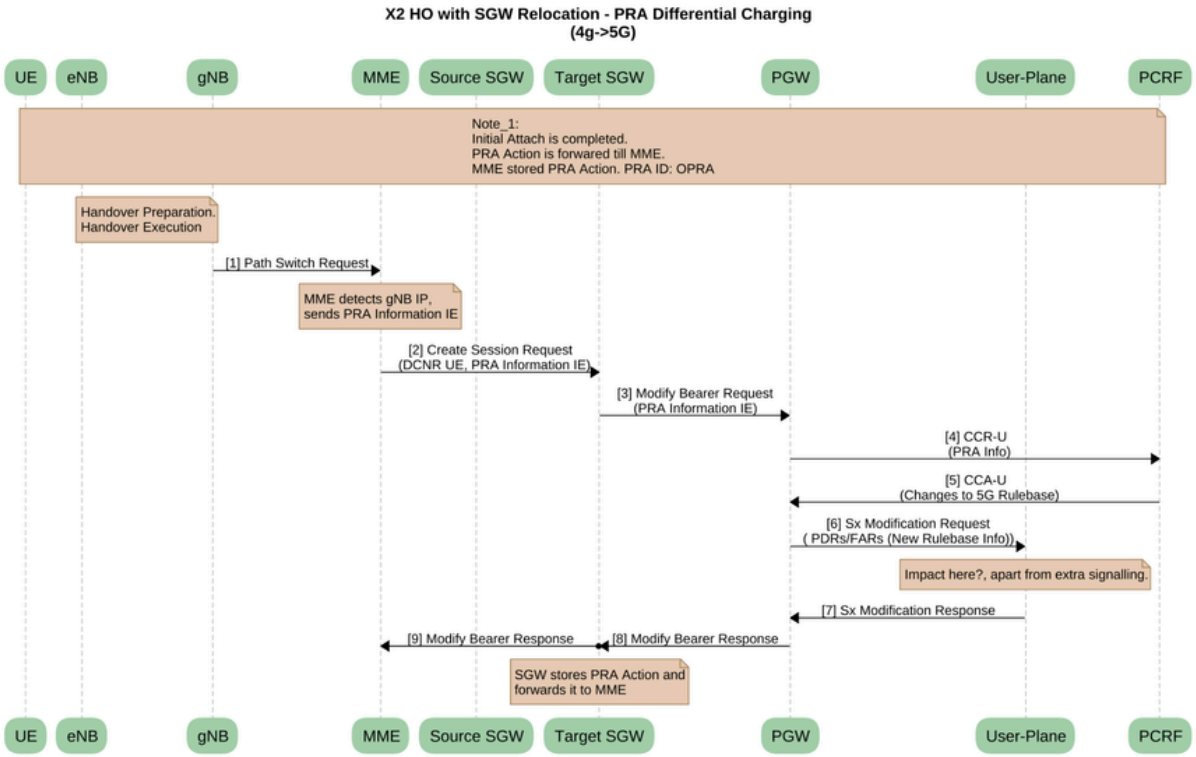
Mobility Flows

X2 Handover



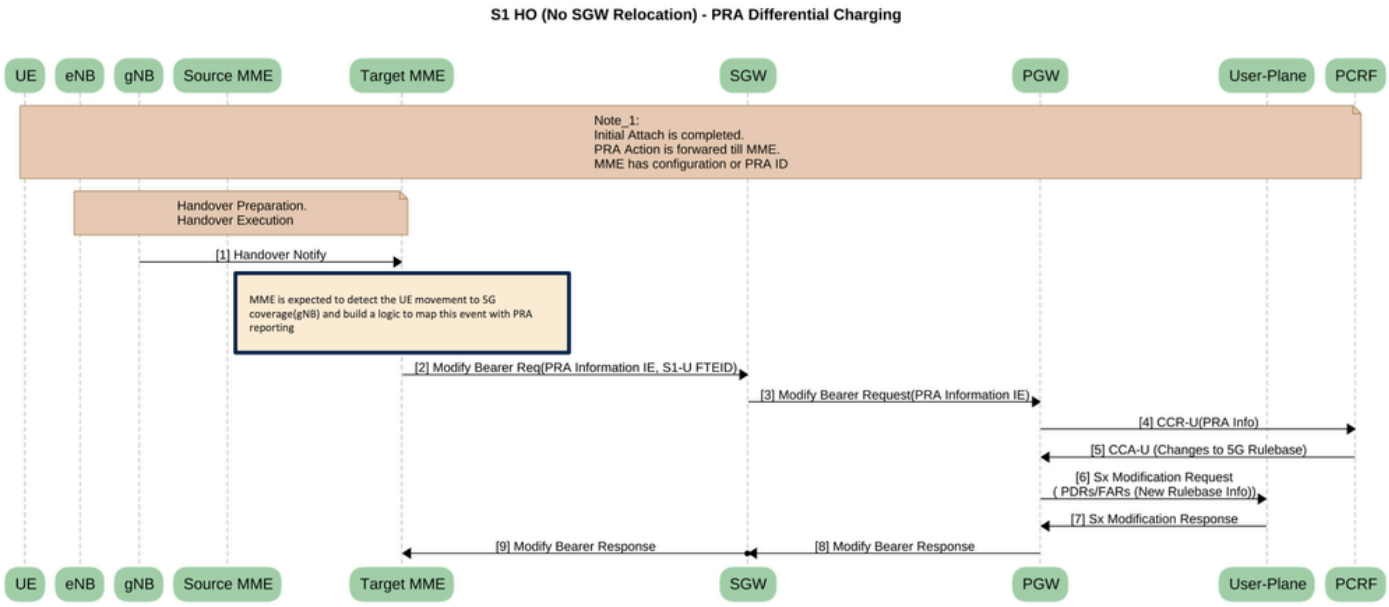
X2-HO – PRA Differential Charging

X2 Handover with SGW Relocation



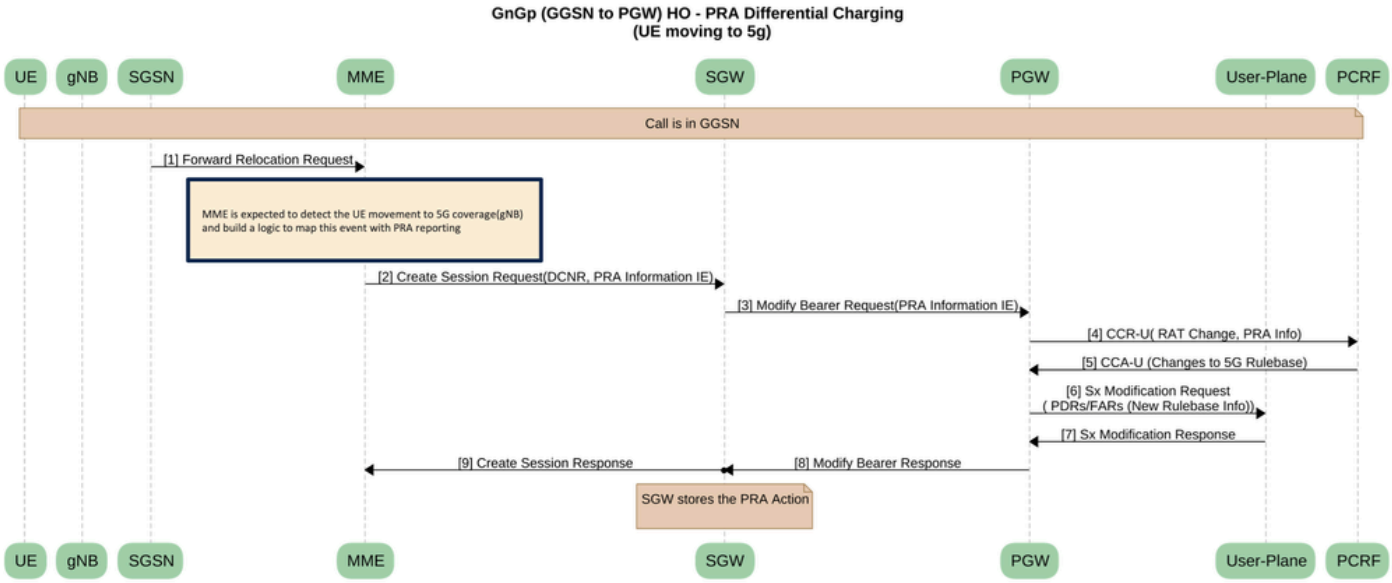
X2 HO with SGW Relocation - PRA Differential Charging (4g✳□g)

S1 Handover without SGW Relocation



S1 HO (No SGW Relocation) - PRA Differential Charging

Gn/Gp Mobility toward PGW



GnGp (GGSN to PGW) HO – PRA Differential Charging (UE Moving to 5g)

Before You Begin

Required Configuration Inputs

Input	Required Value or Object
MME context	Existing MME context name used by the target MME service.
MME service	Existing MME service name that will be associated with the PRA profile.
PRA profile and identifier	PRA profile name and PRA identifier. The identifier must match the value configured on PCRF.
5G coverage prefixes	gNB S1-U IPv4 and/or IPv6 prefixes that identify the configured 5G coverage area.
Gateway context and service	Existing gateway context and IMS authorization service used for policy-control configuration.
Active charging service	Existing active charging service name used for the 5G charging rule.
5G charging objects	Rule definition name, group-of-ruledefs name, priority, charging action, Rating Group, and rulebase name required by the charging design.

PCRF PRA handling	Confirmation that PCRF is configured for the PRA event trigger and can choose the required PCC rulebase for the configured PRA state.

Deployment and Impact Considerations

Item	Requirement or Impact
Deployment type	This solution applies to 5G NSA option 3x deployments.
Customization	This solution is a customization rather than a globally deployed default configuration.
Validation	End-to-end field validation is required before production enablement.
CCR-U signaling	Frequent movement between 4G and 5G increases Credit-Control-Request Update (CCR-U) signaling.
Gx signaling	Additional Gx signaling can increase PCRF processing load.
CUPS signaling	Control and User Plane Separation (CUPS) deployments can generate additional Sx interface session modifications.
Flow transitions	Rulebase changes can cause additional slow-path and fast-path flow transitions.

⚠ **Caution**: Validate signaling volume, PGW/SGW capacity, PCRF capacity, and charging behavior in a representative test environment before broad production enablement.

Configure PRA-Based Differential Charging

Step 1. Configure the PRA Profile on MME

1. Enter Long-Term Evolution (LTE) policy configuration mode.

2. Create the PRA profile and assign the PRA identifier that matches the PCRF configuration.

3. Add the S1-U Internet Protocol version 4 (IPv4) or Internet Protocol version 6 (IPv6) prefixes that identify the 5G coverage area.

```
configure
  lte-policy
    pra-profile <pra_profile_name> <pra_id>
      gnb-s1u ipv6-prefix <ipv6_prefix_1>
      gnb-s1u ipv6-prefix <ipv6_prefix_2>
      gnb-s1u ipv6-prefix <ipv6_prefix_3>
    exit
end
```



Note: A PRA profile can contain up to 50 IPv4 subnets and 50 IPv6 subnets.

Step 2. Associate the PRA Profile with the MME Service

Associate the configured PRA profile with the target MME service.

```
configure
  context <mme_context_name>
    mme-service <mme_service_name>
      associate pra-profile <pra_profile_name> <pra_id>
end
```



Note: Association or disassociation of the PRA profile does not restart the MME service.

Step 3. Enable PRA Reporting on the Gateway

Enable PRA information reporting in the gateway policy-control configuration.

```
configure
  context <context_name>
    ims-auth-service <service_name>
      policy-control
        diameter encode-supported-features cno-uli
end
```

The **cno-uli** feature token enables PRA information reporting. The **diameter encode-supported-features** command controls encoding and transmission of the Supported-Features Attribute-Value Pair (AVP).

Step 4. Configure the 5G Charging Rule

Create a separate Rating Group (RG) and charging rule for 5G usage. Use deployment-specific rule names and priorities.

```
configure
  active-charging service <active_charging_service_name>
    group-of-ruledefs <5g_group_name>
      group-of-ruledefs-application gx-alias
      add-ruledef priority <priority> ruledef <5g_ruledef_name>
    exit
    ruledef <5g_ruledef_name>
      ip any-match = TRUE
    exit
    rulebase <rulebase_name>
      action priority <priority> static-and-dynamic ruledef <5g_ruledef_name> charging-action <5g_charg
    exit
end
```

Configure the 5G charging action with the RG required by the charging design. Use separate Rating Groups for 5G and 4G usage when required by the charging design.

Verify the Configuration

Step 1. Verify the PRA State from MME

Mobility Event	Presence Reporting Check	Expected Status
UE moves into 5G coverage	Inside presence reporting is True.	In area (0)
UE moves into 4G coverage	Inside presence reporting is False.	Out of area (1)

Step 2. Verify Gateway PRA Reporting

Confirm that gateway signaling contains the expected PRA information and that policy signaling toward PCRF reflects the configured PRA trigger.

Source	Destination	protocol	EPS	Action	Inside Pres	AMBR	Charging-Rule-Base-Name	Rating-Group	Info
Gx	Gv	DIAMETER							cmd=Credit-Control Request(272) flags=RP-- appl=3GPP Gx
Gw	Gw	DIAMETER					test_VOLUME_PLAN		cmd=Credit-Control Answer(272) flags=P-- appl=3GPP Gx(
PGN-OUT	SGN-IN	GTPv2	5	Start Reporting change		300000			Create Session Response
PGN-OUT	SGN-IN	GTPv2	5	Start Reporting change		300000			Create Session Response
SGN-S11	MME-S11	GTPv2	5	Start Reporting change		300000			Create Session Response
MME-S11	SME-S11	GTPv2	5						Modify Bearer Request
SGN-S11	MME-S11	GTPv2	5						Modify Bearer Request
Gx	Gy	DIAMETER					testpaidgprs.com		
Gx	Gy	DIAMETER						483	cmd=Credit-Control Request(272) flags=RP-- appl=Dlamete
Gy	Gw	DIAMETER						483	cmd=Credit-Control Answer(272) flags=P-- appl=Dlameter
PGN-S11	SGN-S11	GTPv2	5		True				Modify Bearer Requests
SGN-IN	PGN-OUT	GTPv2			True				Modify Bearer Requests
SGN-IN	PME-OUT	GTPv2			True				Modify Bearer Requests
Gx	Gy	DIAMETER							cmd=Credit-Control Request(272) flags=RP-- appl=3GPP Gx
PGN-OUT	SGN-IN	GTPv2					test_VOLUME_PLAN, test_VOLUME_PLAN_SG		cmd=Credit-Control Answer(272) flags=P-- appl=3GPP Gx(
PGN-OUT	SGN-IN	GTPv2	5			2000000			Update Bearer Requests
PGN-OUT	SGN-IN	GTPv2							Update Bearer Requests
PGN-S11	PME-S11	GTPv2	5						Modify Bearer Requests
PGN-OUT	SGN-IN	GTPv2	5			2000000			Update Bearer Requests
SGN-S11	MME-S11	GTPv2	5			2000000			Updife Bearer Requests
Gy	Gy	DIAMETER					Postpaidgprs.com	623	cmd=Credit-Control Request(272) flags=RP-- appl=Dlamete
MME-S11	SGN-S11	GTPv2	5						Modify Bearer Requests
SGN-IN	PGN-OUT	GTPv2	5						Modify Bearer Requests
SGN-IN	PGN-OUT	GTPv2	5						Updify Bearer Requests
Gy	Gx	DIAMETER						623	cmd=Credit-Control Request(77) flagss=P-- appl=Diameter
MME-S11	SGN-S11	GTPv2	5		False				Modify Bearer Requests
SGN-IN	PGN-OUT	GTPv2	5		False				Modify Bearer Requests
SGN-IN	PGN-OUT	GTPv2	5		False				Updify Bearer Requests
Gy	Gx	DIAMETER							cmd=Credit-Control Request(272) flags=RP-- appl=3GPP Gx
Gy	Gx	DIAMETER					test_VOLUME_PLAN_SG, test_VOLUME_PLAN		cmd=Credit-Control Answer(272) flagss=P-- appl=3GPP Gx(

Step 3. Verify the Initial Credit-Control Exchange

Verify the applicable Credit-Control-Request Initial (CCR-I) and Credit-Control-Answer Initial (CCA-I) messages.

```
Supported-Features: 0000010a4000000c000028af000002758000001000028af000000010000027680000010…
    AVP: Vendor-Id(266) l=12 f=-M- val=10415
    AVP: Feature-List-ID(629) l=16 f=V-- vnd=TGPP val=1
    AVP: Feature-List(630) l=16 f=V-- vnd=TGPP val=8388609
        AVP Code: 630 Feature-List
        AVP Flags: 0x80, Vendor-Specific: Set
        AVP Length: 16
        AVP Vendor Id: 3GPP (10415)
        GX Feature-List Flags: 0x00800001
            0... .... .... .... .... .... .... .... = CondPolicyInfo: Not supported
            .0.. .... .... .... .... .... .... .... = NetLoc-Untrusted-WLAN: Not supported
            ..0. .... .... .... .... .... .... .... = TSC: Not supported
            ...0 .... .... .... .... .... .... .... = NBIFOM: Not supported
            .... 0... .... .... .... .... .... .... = ExUsage: Not supported
            .... .0.. .... .... .... .... .... .... = ResShare: Not supported
            .... ..0. .... .... .... .... .... .... = Mission Critical QCIs: Not supported
            .... ...0 .... .... .... .... .... .... = P-CSCF Restoration Enhancement: Not supported
            .... .... 1... .... .... .... .... .... = Presence Reporting Area Information reporting: Supported
```

CCR-I

```
AVP: Presence-Reporting-Area-Information(2822) l=44 f=V-- vnd=TGPP
    AVP Code: 2822 Presence-Reporting-Area-Information
    AVP Flags: 0x80, Vendor-Specific: Set
    AVP Length: 44
    AVP Vendor Id: 3GPP (10415)
    Presence-Reporting-Area-Information: 00000b05800000f000028af800000000000b05800000f000028af80000000
        AVP: Presence-Reporting-Area-Identifier(2821) l=15 f=V-- vnd=TGPP val=800000
        AVP: Presence-Reporting-Area-Identifier(2821) l=15 f=V-- vnd=TGPP val=800000
            AVP Code: 2821 Presence-Reporting-Area-Identifier
            AVP Flags: 0x80, Vendor-Specific: Set
            AVP Length: 15
            AVP Vendor Id: 3GPP (10415)
            Presence-Reporting-Area-Identifier: 800000
            Padding: 00
AVP: Event-Trigger(1006) l=16 f=VM- vnd=TGPP val=CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AREA_REPORT (48)
    AVP Code: 1006 Event-Trigger
    AVP Flags: 0xc0, Vendor-Specific: Set, Mandatory: Set
    AVP Length: 16
    AVP Vendor Id: 3GPP (10415)
    Event-Trigger: CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AREA_REPORT (48)
```

Step 4. Verify Differential Charging

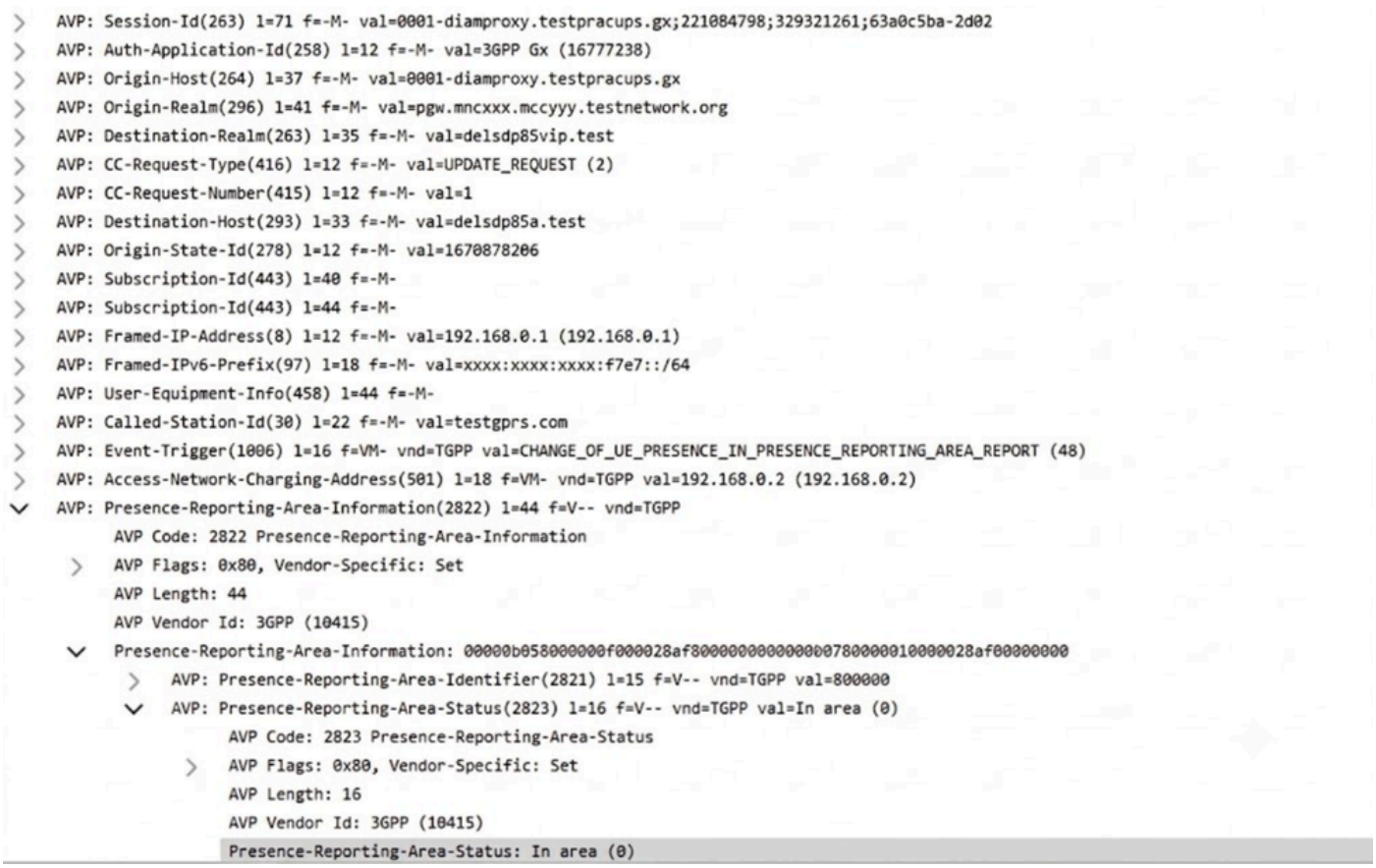
1. Move the test UE into the configured 5G coverage area.

2. Confirm that the PRA state changes to In area (0).

3. Confirm that PCRF applies the configured 5G PCC rulebase and charging treatment.

4. Move the UE back to 4G coverage.
5. Confirm that the PRA state changes to Out of area (1).

6. Confirm that PCRF restores the configured 4G PCC rulebase and charging treatment.





Source	Destinati	APN-Agg	CC-Requ	Prese	RAT	QoS-	Info	Charging-Rule-Ba	Event-Trigger
GW-GX	DRA-GX	2147484000	INITIAL_RE..		EUTRAN	QCI_9	cmd=Credit-Control Request(..		
DRA->PCRF	PCRF	2147484000	INITIAL_RE..		EUTRAN	QCI_9	cmd=Credit-Control Request(..		
PCRF	DRA->PCRF	300000000	INITIAL_RE..			QCI_9	cmd=Credit-Control Answer(2..		QOS_CHANGE,RAT_CHANGE,PLMN_CHANGE,DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT
DRA-GX	GW-GX	300000000	INITIAL_RE..			QCI_9	cmd=Credit-Control Answer(2..	TEST_NPR1	TEST_NPR1 DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT,CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AR.
GW-GX	DRA-GX		UPDATE_REQ..	In area			cmd=Credit-Control Request(..	TEST_NPR1	TEST_NPR1
DRA->PCRF	PCRF		UPDATE_REQ..		GAN		cmd=Credit-Control Request(..		
PCRF	DRA->PCRF	2000000000	UPDATE_REQ..			QCI_6	cmd=Credit-Control Answer(2..	BHARTI_NPR1,BHARTI_NPR1_5G	QOS_CHANGE,RAT_CHANGE,PLMN_CHANGE,DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT
DRA-GX	GW-GX	2000000000	UPDATE_REQ..			QCI_6	cmd=Credit-Control Answer(2..	BHARTI_NPR1,BHARTI_NPR1_5G	TEST_NPR1,TEST_NPR1_5G DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT,CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AR.
GW-GX	DRA-GX		UPDATE_REQ..	Out of..			cmd=Credit-Control Request(..		TEST_NPR1,TEST_NPR1_5G
DRA->PCRF	PCRF		UPDATE_REQ..		EUTRAN		cmd=Credit-Control Request(..		
PCRF	DRA->PCRF	300000000	UPDATE_REQ..			QCI_9	cmd=Credit-Control Answer(2..	BHARTI_NPR1_5G,BHARTI_NPR1	TEST_NPR1_5G,TEST_NPR1 DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT
DRA-GX	GW-GX	300000000	UPDATE_REQ..			QCI_6	cmd=Credit-Control Answer(2..	BHARTI_NPR1_5G,BHARTI_NPR1	TEST_NPR1_5G,TEST_NPR1 DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT,CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AR.
GW-GX	DRA-GX		UPDATE_REQ..	In area			cmd=Credit-Control Request(..		TEST_NPR1,TEST_NPR1
DRA->PCRF	PCRF		UPDATE_REQ..		GAN		cmd=Credit-Control Request(..		
PCRF	DRA->PCRF	2000000000	UPDATE_REQ..			QCI_6	cmd=Credit-Control Answer(2..	BHARTI_NPR1,BHARTI_NPR1_5G	TEST_NPR1,TEST_NPR1_5G DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT
DRA-GX	GW-GX	2000000000	UPDATE_REQ..			QCI_6	cmd=Credit-Control Answer(2..	BHARTI_NPR1,BHARTI_NPR1_5G	TEST_NPR1,TEST_NPR1_5G DEFAULT_EPS_BEARER_QOS_CHANGE,REVALIDATION_TIMEOUT,CHANGE_OF_UE_PRESENCE_IN_PRESENCE_REPORTING_AR.

Expected Behavior

Event	Expected Result
UE enters configured 5G coverage	MME reports PRA In area (0); PGW forwards PRA information to PCRF; PCRF selects the 5G charging policy
UE leaves configured 5G coverage	MME reports PRA Out of area (1); PGW forwards PRA information to PCRF; PCRF chooses the 4G charging policy
UE repeatedly moves between 4G and 5G	Additional CCR-U and policy-control signaling is generated as the PRA state changes