

# Review CPE Allocated IP Changing on each Radio Bearer Re-Establishment

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## Introduction

This document describes the unexpected allocated IP change when Customer Premises Equipment (CPE) tries to re-establish the radio bearer.

## Prerequisites

## Requirements

Cisco recommends that you have knowledge of these topics:

- Long-Term Evolution (LTE)
- General Packet Radio Service (GPRS)
- Terrestrial Radio Access Network (E-UTRAN)

## Components Used

This document is not restricted to specific software and hardware versions.

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.

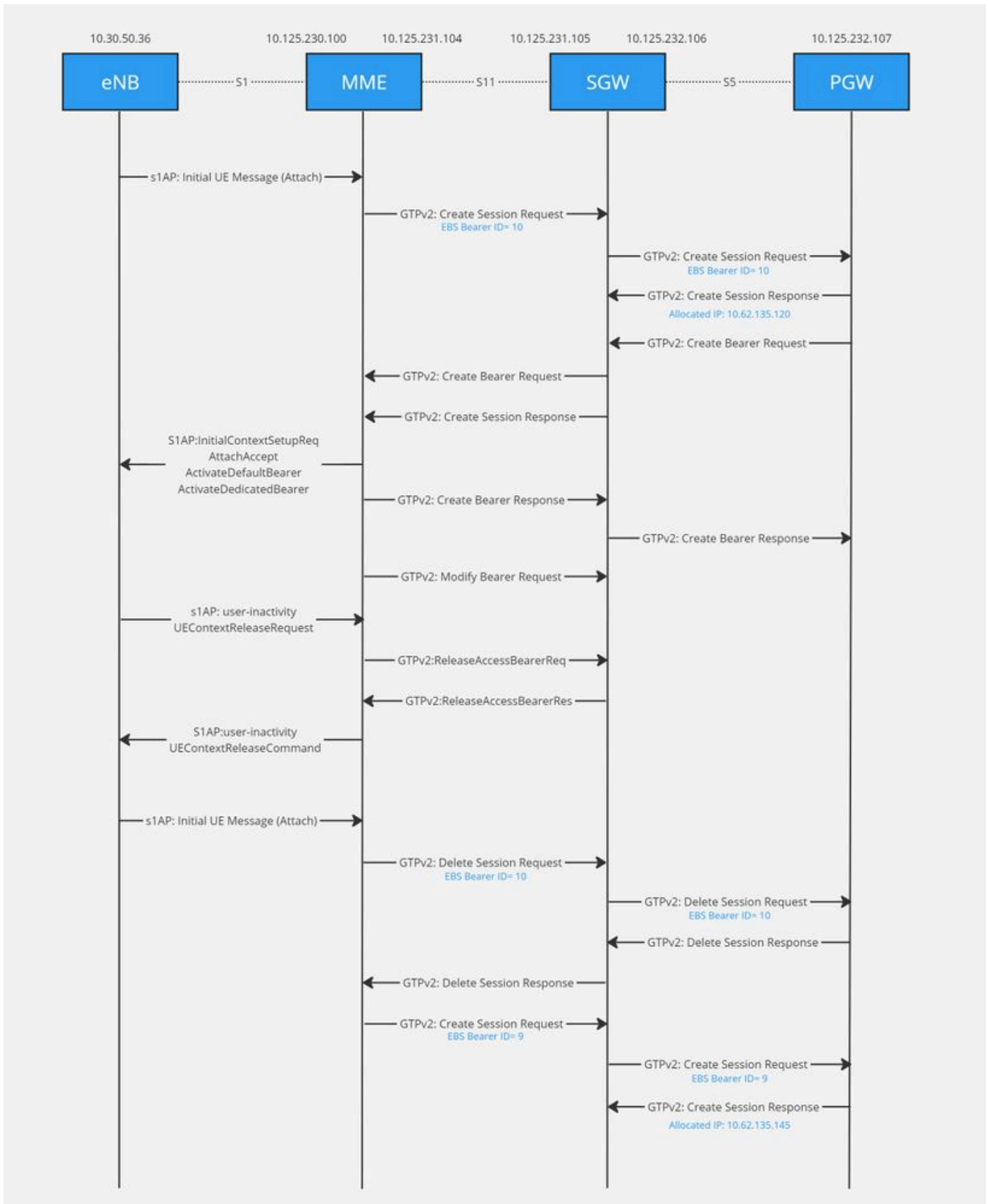
## Background Information

In this case, CPE are modems deployed for providing fixed LTE (Home Broadband) services. However, the information and scenario described in this article can also apply to mobile phones.

## Problem

Each time CPE tries to re-establish the radio bearer, the MME sends a Create Session Request with a different EPS Bearer ID (EBI) than the previously established. This is causing the CPE IP assigned by PGW to be changing.

# Analysis Performed



Call Flow Analyzed

1. Focusing on the UEContextReleaseRequest, once the signaling connection between the MME and the eNodeB for a particular CPE is released, the MME deletes any eNodeB-related information (eNodeB

Address in use for S1-MME, MME UE S1 AP ID and eNB UE S1AP ID). However, retains the rest of the CPE MME context; including the S-GW S1-U configuration information (address and TEIDs).

Frame 74	2022-05-31 08:48:14.866	10.30.50.36	10.125.230.100	S1AP
Frame 75	2022-05-31 08:48:14.866	10.125.231.104	10.125.231.105	GTPv2
Frame 77	2022-05-31 08:48:14.866	10.125.231.105	10.125.231.104	GTPv2
Frame 79	2022-05-31 08:48:14.867	10.125.230.100	10.30.50.36	S1AP

At this point, based on 3GPP TS 23.401, 5.3.5 S1 release procedure:

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All non-GBR EPS bearers established for the UE are preserved in the MME and in the Serving GW

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If the cause of the S1 release is because of User Inactivity, Inter-RAT Redirection, the MME shall

Both statements mean that the CPE still has a PDN connection established and it is registered in the network (Default bearer is still present in MME, SGW and PGW; only radio resources were released). Since the CPE is still registered at a network, but its S1 connection was released due to inactivity, the CPE has no radio resources available. That means that the CPE is in EMM-REGISTERED, but ECM-IDLE state.

2. Based on 3GPP TS 23.401, when CPE in EMM-REGISTERED and ECM-IDLE states has new traffic to send but no radio resources available, it must be sending a Service Request procedure. By sending the Service Request message, S1 connectivity is reestablished but EBI and IP assigned by PGW are not modified.

3GPP TS 23.401 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio  
ECM-IDLE

[...]

In the EMM-REGISTERED and ECM-IDLE state, the UE shall:

- answer to paging from the MME by performing a service request procedure.

[...]

- perform the service request procedure in order to establish the radio bearers when uplink user data is

### 5.3.4.1 UE triggered Service Request

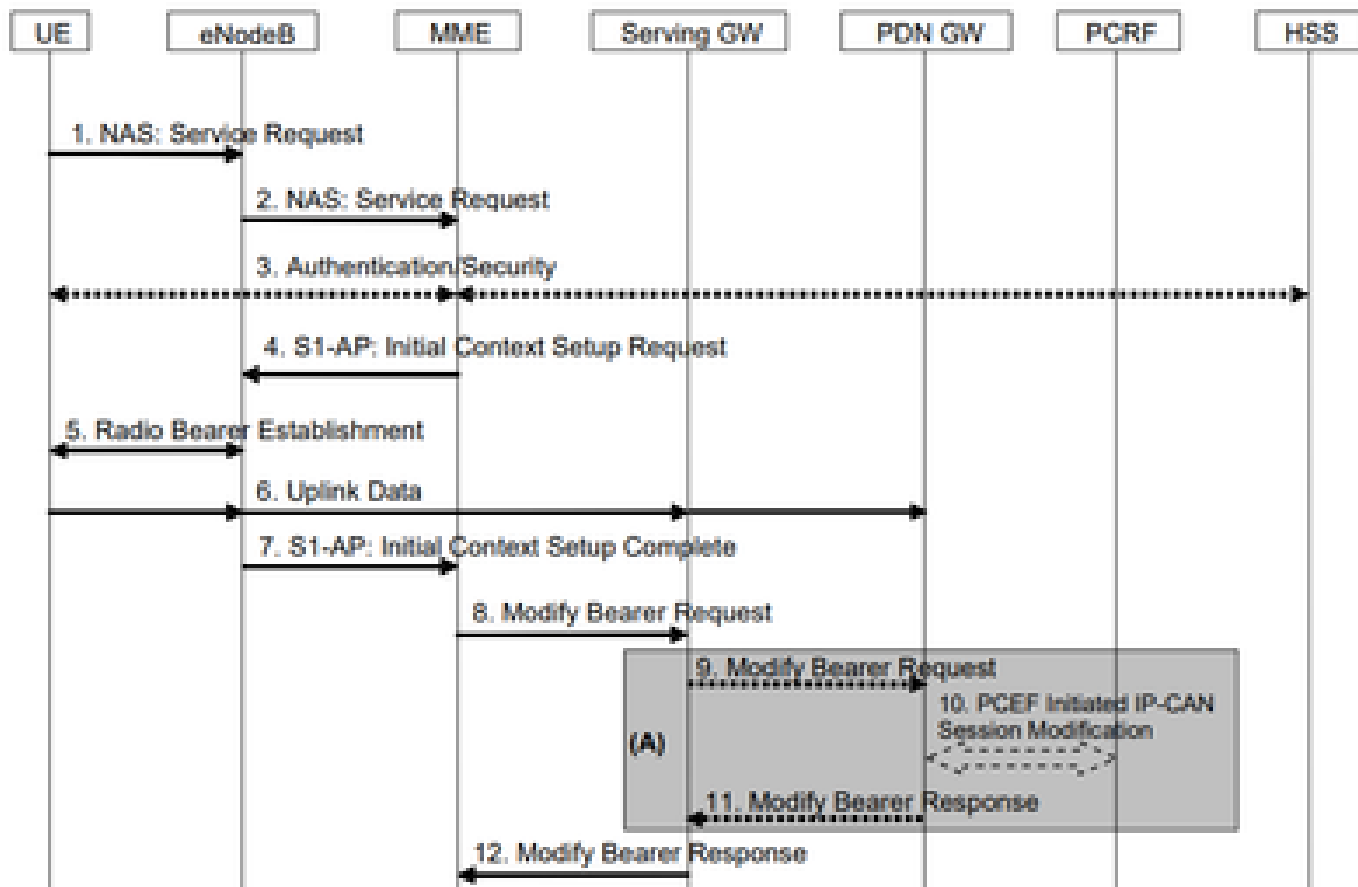


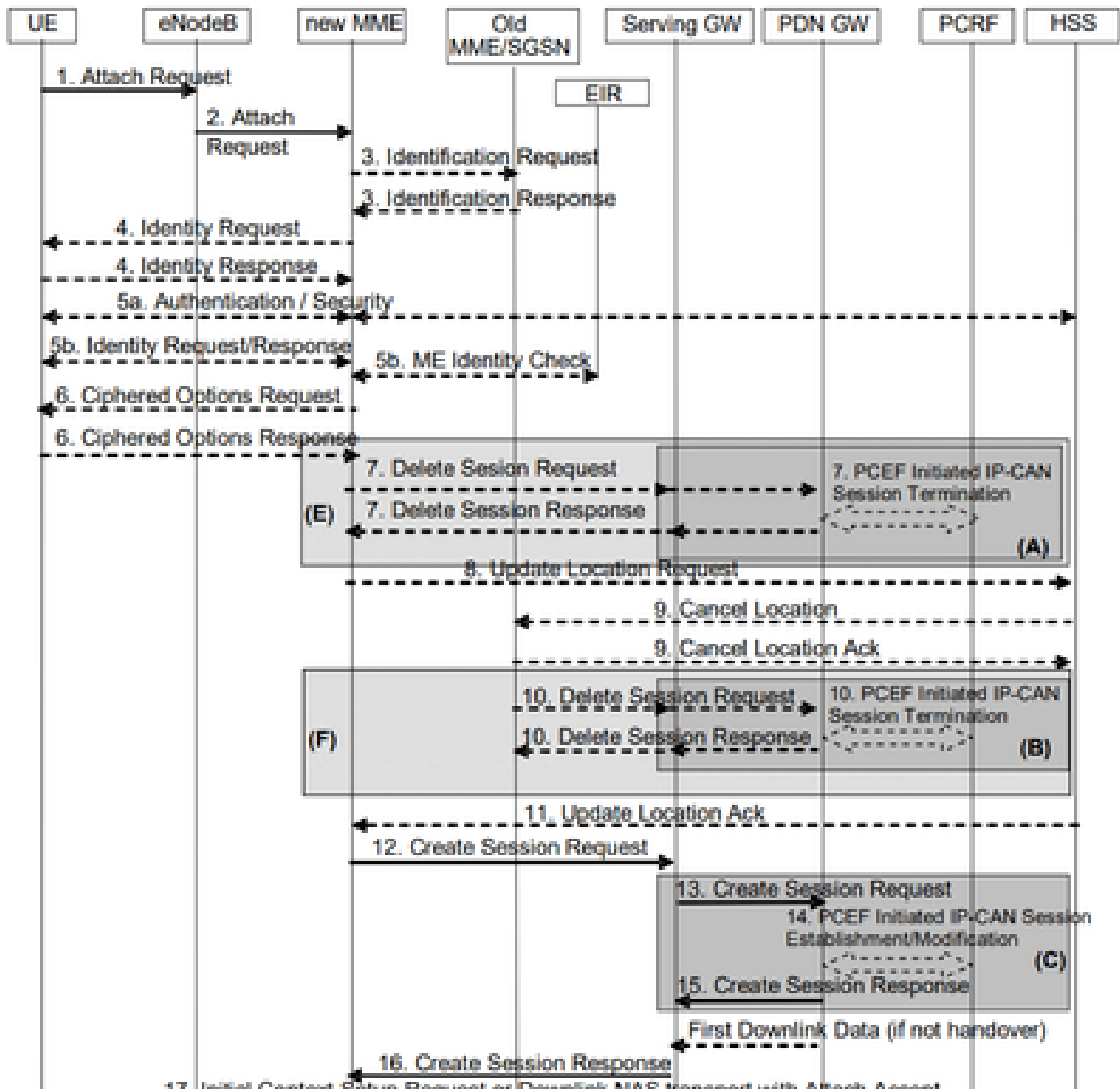
Figure 5.3.4.1-1: UE triggered Service Request procedure

Extracted from 3GPP TS 23.401

In this case, when CPE needs to establish radio bearers again, it sends an Attach Request instead of a Service Request message:

Frame 74	2022-05-31 08:48:14.866	10.30.50.36	10.125.230.100	S1AP
Frame 75	2022-05-31 08:48:14.866	10.125.231.104	10.125.231.105	GTPv2
Frame 77	2022-05-31 08:48:14.866	10.125.231.105	10.125.231.104	GTPv2
Frame 79	2022-05-31 08:48:14.867	10.125.230.100	10.30.50.36	S1AP
Frame 80	2022-05-31 08:48:21.813	10.30.50.36	10.125.230.100	S1AP/NAS-EPS

3. Consider the 3GPP TS 23.401 where E-UTRAN Initial Attach is described:



Extracted from 3GPP TS 23.401

### E-UTRAN Initial Attach

[...]

7. If there are active bearer contexts in the new MME for this particular UE (i.e. the UE re-attaches to the new MME), the new MME initiates the session termination process. The GWs acknowledge with Delete Session Response (Cause) message. If a PCRF is deployed, the PDN GW emp

Since MME receives an unexpected Attach Request from eNB, it deletes the default bearer that was previously established (during UEContextReleaseRequest in frame 74, only radio resources were released, PDN connection was still established after this point) by sending Delete Session Request messages to the SGW and PGW involved. The GWs acknowledge with a Delete Session Response message:

Frame 89	2022-05-31 08:48:22.108	10.125.232.106	10.125.232.107	GTPv2
Frame 91	2022-05-31 08:48:22.109	10.125.232.107	10.125.232.106	GTPv2
Frame 93	2022-05-31 08:48:22.110	10.125.231.105	10.125.231.104	GTPv2

4. Based on E-UTRAN Initial Attach procedure, after the Delete Session Request/Response have been processed, MME sends a Create Session Request to SGW allocating a new EBI and PGW assigns a different IP to the CPE for this new EBI :

Frame 87	2022-05-31 08:48:22.108	10.125.231.104	10.125.231.105	GTPv2
Frame 89	2022-05-31 08:48:22.108	10.125.232.106	10.125.232.107	GTPv2
Frame 91	2022-05-31 08:48:22.109	10.125.232.107	10.125.232.106	GTPv2
Frame 93	2022-05-31 08:48:22.110	10.125.231.105	10.125.231.104	GTPv2
Frame 95	2022-05-31 08:48:22.112	10.125.231.104	10.125.231.105	GTPv2
Frame 97	2022-05-31 08:48:22.114	10.125.232.106	10.125.232.107	GTPv2
Frame 100	2022-05-31 13:48:22.121	10.125.232.107	10.125.232.106	GTPv2

## Solution

CPE is not behaving as per the 3GPP standards. Since eNB initiates the S1 release procedure due to user inactivity, when CPE tries to re-establish the radio bearers, it must send a Service Request message. However, CPE sends an Attach Request instead.

The default bearer is established when the UE connects to a PDN, and that remains established throughout the lifetime of the PDN connection to provide the UE with always-on connectivity to that PDN. As CPE sends a new attach request, MME comply with 3GPP TS 23.401 specification terminating PDN connection by sending Delete Session Request; therefore, the default bearer with EBI=10 is deleted. When MME sends a new Create Session Request, the new default bearer can be allocated with a different EBI and IP (for example, EBI=9 and IP 10.62.135.145) than the previously assigned.