LTE AND BEYOND

LTE, 4G, EPC, MME, PGW, SGW, Interfaces and beyond tech-blog by Bart Barton

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MAR 16, 2012

X2-based handover with SGW relocation

Last time article was about handover based on X2 interface but without SGW change, that is why it's time to deal with X2 based handover with SGW relocation.

All of this information you can find by reading 3GPP TS 23.401.
Today as usually we will start with a high level of abstract picture. Please see below.

As you can see **Fig. 1.** is almost the same as it was in X2 based handover, where the green arrow was demonstrating the case we talked about last time (if interested you can read about it here) where was no need to change SGW. Today we are interested in case illustrated by blue (azure? blueish?) arrow. Where handover is done bye X2 interface with SGW relocation.
Lines that are green, between UE and eNB, showing changed path on the end of handover operation without SGW change. Blue lines between UE, eNB, MME and new SGW are showing new path after changing old SGW to new.
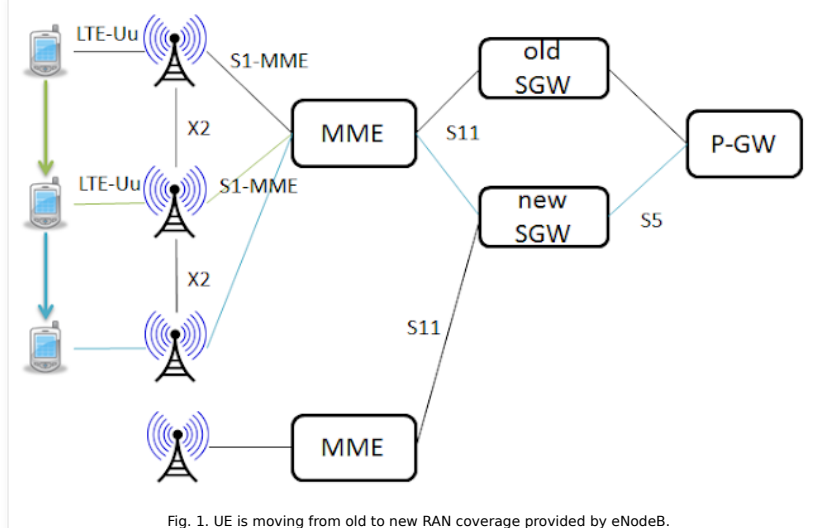

Fig. 1. UE is moving from old to new RAN coverage provided by eNodeB.

Before we will jump into detailed description of handover few general information about X2 interface based handover.

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General X2-based HO description

These procedures are used to hand over a UE from a source eNodeB to a target eNodeB using the X2 interface. In these procedures the MME stays unchanged. Two procedures are defined depending on whether the Serving GW is unchanged or is relocated. In addition to the X2 interface between the source and target eNodeB, the procedures rely on the presence of S1-MME interface between the MME and the source eNodeB as well as between the MME and the target eNodeB.
If the serving PLMN changes during X2-based handover, e.g. you crossed your country boarder, the source eNodeB shall indicate to the target eNodeB (in the Handover Restriction List) the PLMN selected to be the new Serving PLMN.
When the UE receives the handover command it will remove any EPS bearers for which it did not receive the corresponding EPS radio bearers in the target cell. As part of handover execution, downlink and optionally also uplink packets are forwarded from the source eNodeB to the target eNodeB. When the UE has arrived to the target eNodeB, downlink data forwarded from the source eNodeB can be sent to it. Uplink data from the UE can be delivered via the (source) SGW to the PGW or optionally forwarded from the source eNodeB to the target eNodeB. Only the handover completion phase is affected by a potential change of the SGW, the handover preparation and execution phases are identical.
If the MME receives a rejection to a NAS procedure (e.g. dedicated bearer establishment/modification/release; location reporting control; NAS message transfer; etc.) from the eNodeB with an indication that an X2 handover is in progress, the MME shall reattempt the same NAS procedure either when the handover is complete or the handover is deemed to have failed, except in the case of SGW relocation. The failure is known by expiry of the timer guarding the NAS procedure.
If during the handover procedure the MME detects that the Serving GW needs be relocated (this type of HO I will describe later), the MME shall reject any PGW initiated EPS bearer(s) request received since handover procedure started and shall include an indication that the request has been temporarily rejected due to handover procedure in progress. The rejection is forwarded by the SGW to the PGW, with the same indication.
Upon receipt of a rejection for an EPS bearer(s) PDN GW initiated procedure with an indication that the request has been temporarily rejected due to handover procedure in progress, the PGW shall start a locally configured guard timer. The PGW shall re-attempt the procedure, up to a pre-configured number of times, when either it detects that the handover is completed or has failed using message reception or at expiry of the guard timer.
If the MME receives a rejection to a UE Context Modification Request message with a CS Fallback indicator from the eNodeB with an indication that an X2 handover is in progress, the MME shall resend a UE Context Modification Request message with CS Fallback indicator to the target eNodeB when the handover is complete or to the source eNB when the handover is deemed to have failed.

X2-based handover with Serving GW relocation

This procedure is used to handover a UE from a source eNodeB to a target eNodeB using X2 when the MME is unchanged and the MME decides that the Serving GW is to be relocated. Being honest, now when I'm preparing this article, only reason I can think of using this handover type is preparation of old SGW to software upgrade. The presence of IP connectivity between the source Serving GW and the source eNodeB, between the source Serving GW and the target eNodeB, and between the target Serving GW and target eNodeB is assumed. (If there is no IP connectivity between target eNodeB and source Serving GW, it is assumed that the S1-based handover procedure shall be used instead.)

BLOG ARCHIVE

Fig. 2. X2-based handover with Serving GW relocation.
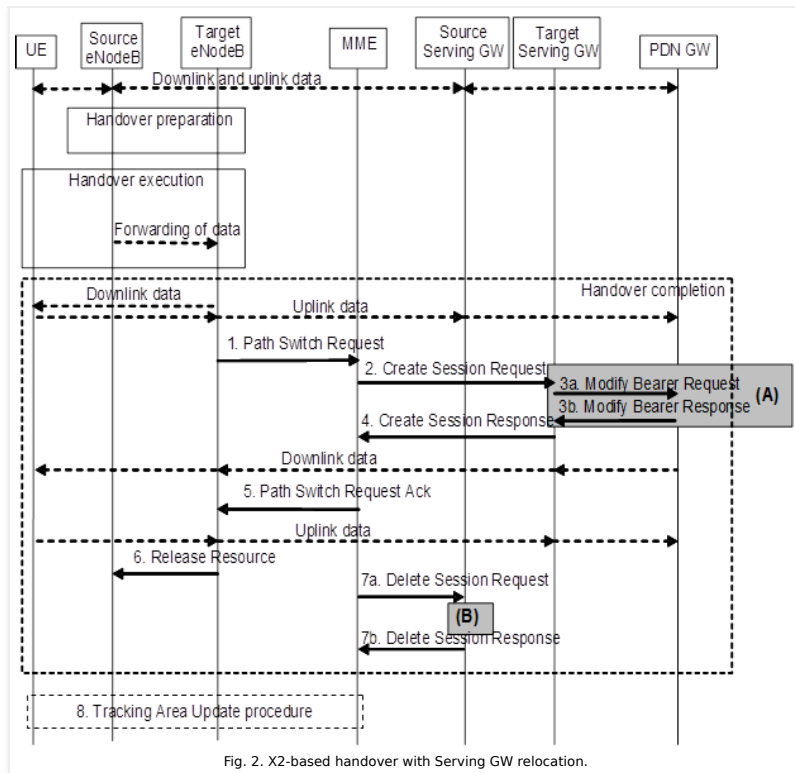
Step 1. The target eNodeB sends a Path Switch Request message to MME to inform that the UE has changed cell, including the ECGI of the target cell and the list of EPS bearers to be switched. The MME determines that the Serving GW is relocated and selects a new Serving GW.

NOTE: The MME knows the SGW Service Area with a TA granularity.

Step 2. The MME sends a Create Session Request (bearer context(s) with PDN GW addresses and TEIDs (for GTP-based S5/S8) or GRE keys (for PMIP-based S5/S8) at the PDN GW(s) for uplink traffic, eNodeB address(es) and TEIDs for downlink user plane for the accepted EPS bearers, the Protocol Type over S5/S8, UE Time Zone) message per PDN connection to the target SGW for each PDN connection where the default bearer has been accepted by the target eNodeB. The target Serving GW allocates the SGW addresses and TEIDs for the uplink traffic on S1-U interface (one TEID per bearer). The Protocol Type over S5/S8 is provided to SGW which protocol should be used over S5/S8 interface. If the PGW requested UE's location info, the MME also includes the User Location Information IE in this message.

The MME uses the list of EPS bearers to be switched, received in **step 1**, to determine whether any dedicated EPS bearers in the UE context have not been accepted by the target eNodeB. The MME releases the non-accepted dedicated bearers by triggering the bearer release procedure via target SGW. If the SGW receives a DL packet for a non-accepted bearer, the SGW drops the DL packet and does not send a Downlink Data Notification to the MME.

If the default bearer of a PDN connection has not been accepted by the target eNodeB and there are multiple PDN connections active, the MME shall consider all bearers of that PDN connection as failed and release that PDN connection by triggering the MME requested PDN disconnection procedure via source SGW.

If none of the default EPS bearers have been accepted by the target eNodeB, the MME shall act as specified in **step 5**.

Step 3. The target Serving GW assigns addresses and TEIDs (one per bearer) for downlink traffic from the PDN GW. The Serving GW allocates DL TEIDs on S5/S8 even for non-accepted bearers. It sends a Modify Bearer Request (Serving GW addresses for user plane and TEID(s)) message per PDN connection to the PDN GW(s). The SGW also includes User Location Information IE and/or UE Time Zone IE if it is present in step 2. The PDN GW updates its context field and returns a Modify Bearer Response (Charging Id, MSISDN, etc.) message to the Serving GW. The MSISDN is included if the PDN GW has it stored in its UE context. The PDN GW starts sending downlink packets to the target GW using the newly received address and TEIDs. These downlink packets will use the new downlink path via the target Serving GW to the target eNodeB. The Serving GW shall allocate TEIDs for the failed bearers and inform to the MME.

Step 4. The target Serving GW sends a Create Session Response (Serving GW addresses and uplink TEID(s) for user plane) message back to the target MME. The MME starts a timer, to be used in **step 7**.

Step 5. The MME confirms the Path Switch Request message with the Path Switch Request Ack (Serving GW addresses and uplink TEID(s) for user plane) message. If the UE AMBR is changed, e.g. all the EPS bearers which are associated to the same APN are rejected in the target eNodeB, the MME shall provide the updated value of UE AMBR to the target eNodeB in the Path Switch Request Ack message. The target eNodeB starts using the new Serving GW address(es) and TEID(s) for forwarding subsequent uplink packets.

If some EPS bearers have not been switched successfully in the core network, the MME shall indicate in the Path Switch Request Ack message which bearers failed to be established and for dedicated bearers initiate the bearer release procedure to release the core network resources of

the failed dedicated EPS bearers. The target eNodeB shall delete the corresponding bearer contexts when it is informed that bearers have not been established in the core network.

If none of the default EPS bearers have been switched successfully in the core network or if they have not been accepted by the target eNodeB, the MME shall send a Path Switch Request Failure message to the target eNodeB. The MME performs explicit detach of the UE as described in the MME initiated detach procedure.

Step 6. By sending Release Resource the target eNodeB informs success of the handover to source eNodeB and triggers the release of resources.

Step 7. When the timer has expired after **step 4**, the source MME releases the bearer(s) in the source Serving GW by sending a Delete Session Request message (Cause). Cause indicates to the Source Serving GW that the Source Serving GW shall not initiate a delete procedure towards the PDN GW. The Source Serving GW acknowledges with Delete Session Response messages. If ISR has been activated before this procedure, the cause also indicates to the Source SGW that the Source SGW shall delete the bearer resources on the other old CN node by sending Delete Bearer Request message(s) to that CN node.

Step 8. The UE initiates a Tracking Area Update procedure when there is such need

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Source(s):
3GPP TS 23.401
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Posted by Unknown at 4:37 PM

Labels: Handover

Location: Budapest, Hungary

1 comment:

Anonymous May 15, 2012 at 10:53 AM

Dear Sir
Could you explain more what you mean in your sentence?

"Being honest, now when I'm preparing this article, only reason I can think of using this handover type is preparation of old SGW to software upgrade."
Thank you in advance

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