

Title: Xn based mobility across RA
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1 Introduction

Given that NW slice could be deployed in only part of the whole network, it is likely that target node cannot support the same NW slice(s) the UE is in question at the source node. Considering the slice availability, the handover procedure involves a NGC has been captured in TS 38.300. This paper focus on the Xn based handover procedure by taking the slice availability into account.

2 Discussion

Regarding the granularity of slice availability, it is assumed in SA2 that “*the slice configuration does not change within the UE’s registration area.*” Following the temporary assumption made by SA2, when the UE is moving to the boundary of registration areas that support different slices, the effect of slice availability for handover needs to be considered. If one or more related slices of the ongoing sessions cannot be supported by the target gNB, Rel-15 shall support release the PDU sessions of non-supported slices [1]. For the CN involved handover case which has been captured in TS38.300, the target AMF is responsible for removing slices that are not supported by target gNB, and slice removal is included in the handover preparation signalling.

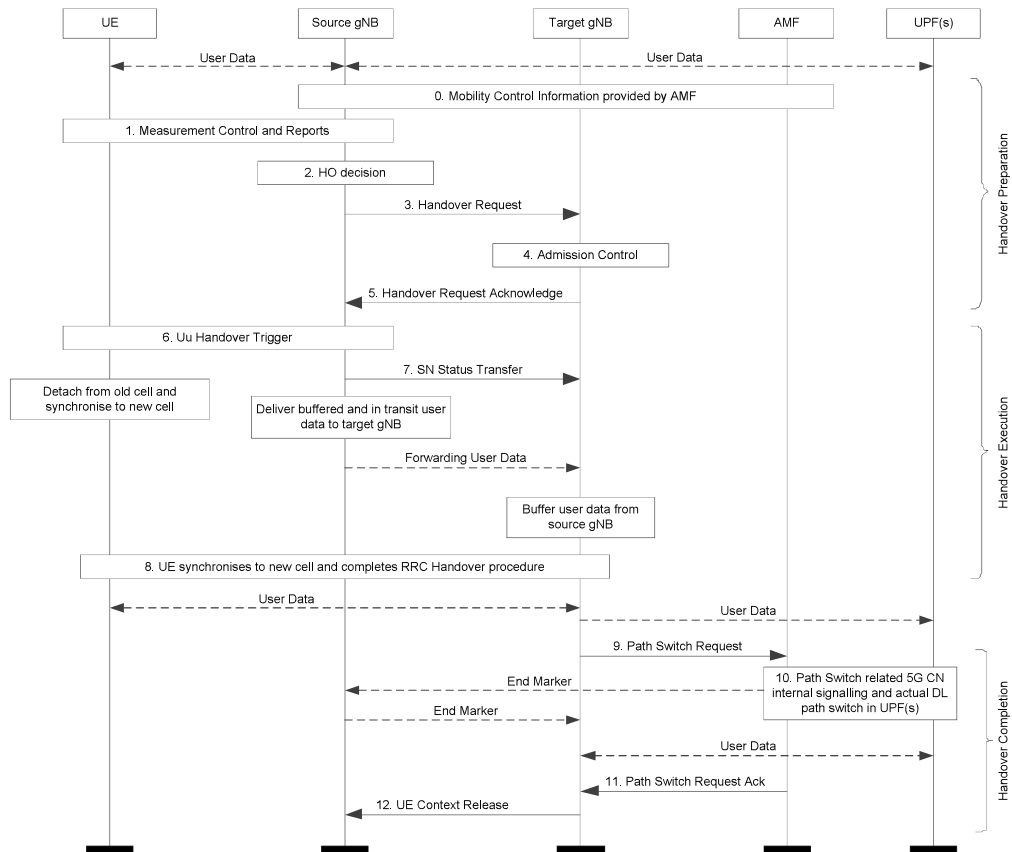


Figure 1 Xn based handover

Consider the Xn based handover as in figure 1 which has been captured in the TS38.300, we will discuss whether the Xn based handover can be used for mobility across Registration Area (RA), regardless of slice availability.

To make the discussion clearly, we first discuss how it works in a case that the source gNB and the target gNB are in the *same RA*:

1. For the Handover Request message, it includes (all) PDU sessions with active UP connections handled by the source gNB, to indicate the target gNB which PDU session should handover to the target.
2. For the Admission Control, the target gNB may admit all/part of PDU sessions included in the Handover Request message. It is undoubted that the target gNB may reject some PDU sessions, e.g., due to resource limitation.
3. For the Handover Request ACK message, it includes the admitted PDU session list and not admitted PDU session list, to indicate which PDU session can handover to the target. Handover Request ACK message also includes the *RRC Context* IE, which will send to UE via the source gNB transparently (i.e., via Handover Command message). In the *RRC Context* IE, the target gNB presents how to configure the RBs for UE, and if some PDU sessions are rejected, the target gNB will put the DRBs associated to the rejected PDU sessions in the *DRB-ToReleaseList* (which is included in the *RRC Context* IE), and thus UE is notified which PDU sessions are not admitted in the target gNB.
4. For the Path Switch message, the target gNB informs a list of PDU sessions to be switched to the AMF. About how to inform the AMF which PDU sessions are rejected in the target gNB, there are two options: option one is the target gNB also sends a list of non-admitted PDU sessions in the Path Switch message; option two is the AMF considers the non-included PDU sessions as implicitly rejected by the target gNB. As the AMF stores all the PDU sessions successfully established before (i.e., both active and deactivate PDU sessions), for option two, the AMF shall ask SMF(s) release or deactivate the non-included PDU sessions (It was FFS in SA2 that “*whether to release or deactivate the PDU session(s) if all of their QoS flows are not accepted by the Target RAN.*”), including the deactivate PDU sessions before (i.e., deactivated before the handover procedure).

Regarding to mobility *across RA* and the target gNB cannot supports all the UE’s slices, the Xn based handover can also be adopt, as:

1. As the target gNB cannot support all the slices, the PDU sessions with active UP connections handled by the source gNB can be divided to two part: one part is the PDU sessions which associated slice(s) is supported by the target gNB, another part is the PDU sessions which associated slice(s) is *not* supported by the target gNB. One option is only including the latter part of PDU sessions, however, for this option, the source gNB always check the slice availability before handover. Another option is including all parts of PDU sessions in the Handover Request message. In this option, check the slice availability is not mandatory, but the source gNB may also check the slice availability for selecting the suitable target gNBs (in step 2 as in figure 1), e.g., the source gNB will not request handover UE to a gNB cannot support any slice.
2. For the Admission Control, the target gNB will check whether the slices of requested PDU sessions are supported, and the target gNB will reject the PDU sessions associated non-supported slice. However, this does not mean that the gNB release the rejected PDU sessions, but just means the target gNB will not establish the AS resources associated to the rejected PDU sessions. Even the Handover Request message only contains PDU sessions of supported slice(s), the target gNB still needs to check the slice availability to make sure that it can support the corresponding slice of each PDU sessions.
3. For the Handover Request ACK message, the target gNB informs non-admitted PDU sessions (e.g., including due to slice availability) list to the source gNB. The non-admitted PDU session is also indicated in the *RRC Context IE* through *DRB-ToReleaseList*, and thus UE can be informed.
4. The target gNB informs AMF the admitted/non-admitted PDU sessions by path switch procedure. Then, the NGC can release the non-admitted PDU sessions (including non-admitted PDU sessions due to slice availability).
5. After receiving the Handover Command message including *RRC Context IE*, UE releases the DRB associated to the non-admitted PDU sessions and informs the NAS level.

About how to release the PDU sessions, it has been agreed in SA2 as “*when a Network Slice instance used for a one or multiple PDU Sessions is no longer available, the 5GC initiates a network-triggered PDU session release procedure with an appropriate cause value for the impacted PDU session(s)*”, and “*the PDU session(s) may be also implicitly released*”. Thus, the PDU session(s) can be implicitly released (i.e., without PDU session release procedure). That is, the target gNB determines to reject the PDU session(s), and informs AMF and UE by path switch and Handover Command (e.g., via *RRC Context IE*), respectively. Then, the AMF and UE release the PDU session in the NAS level automatically. On the other hand, the RA update procedure will be performed after handover procedure due to across RA, which can be used to align the slices supported/PDU session status between UE and network, and RA update procedure can also be used for releasing PDU sessions.

For NGC based handover, it is the SMF which responsible for session management, and after receiving the Handover Required message from the source gNB, the AMF should send the PDU Handover Request to SMF(s) which checks the indicated PDU session can be accepted. Only AMF receives the PDU Handover Response messages from all the SMF(s) or the pre-configured maximum wait time is expired, the AMF can continue with the NG involved handover procedure. Such procedure may bring delay, and lead to handover failure. However, as the Xn based handover is proceeded between the source gNB and the target gNB directly, compared with CN involved handover, Xn based handover can provide lower signalling cost and better latency performance. Moreover, if Xn based handover is not allowed for active mode mobility across different registration areas, then the source gNB always check whether the target gNB can support all the slices corresponding to the ongoing PDU sessions, which is much complicated.

Proposal 1: Xn based handover shall be supported for active mode mobility across different Registration Areas (i.e., regardless of slice availability).

Proposal 2: Source gNB may check the slice availability for handover decision.

Proposal 3: Target gNB shall check the slice availability of each PDU session for admission control.

3 Conclusions

This contribution discusses the Xn based handover procedure across different Registration Areas. In the above discussions, we have the following proposals

Proposal 1: Xn based handover shall be supported for active mode mobility across different Registration Areas (i.e., regardless of slice availability).

Proposal 2: Source gNB may check the slice availability for handover decision.

Proposal 3: Target gNB shall check the slice availability of each PDU session for admission control.

4 References

[1] S2-174019 Response LS on slice re-mapping during connected mode mobility

5 Text Proposal

Beginning of Text Proposal to TS 38.300

17.3.4.5 Mobility

To make mobility slice-aware in case of Network Slicing, S-NSSAI is introduced as part of the PDU session information that is transferred during mobility signalling. This enables slice-aware admission and congestion control.

Examples for the case of active mode mobility across different Registration Areas, ~~is~~ are shown in Figure 17.3.4.5-1 for the case of 5GC involved handover and in Figure 17.3.4.5-x for the case of Xn based handover.

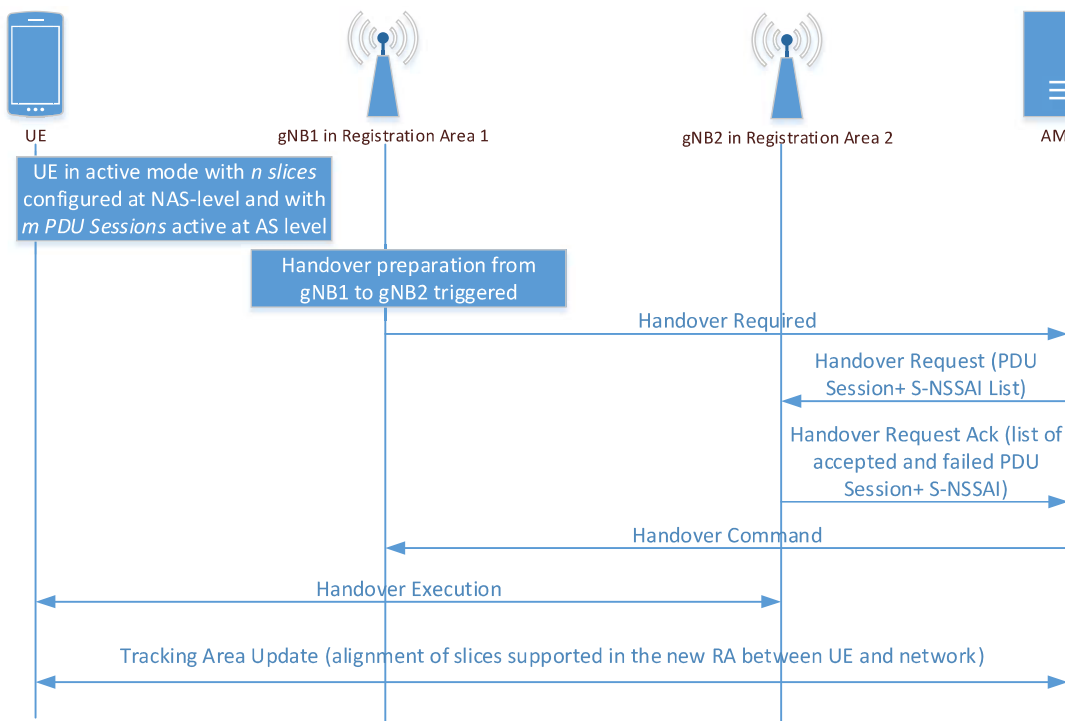


Figure 17.3.4.5-1: Active mode CN involved mobility across different Registration Areas

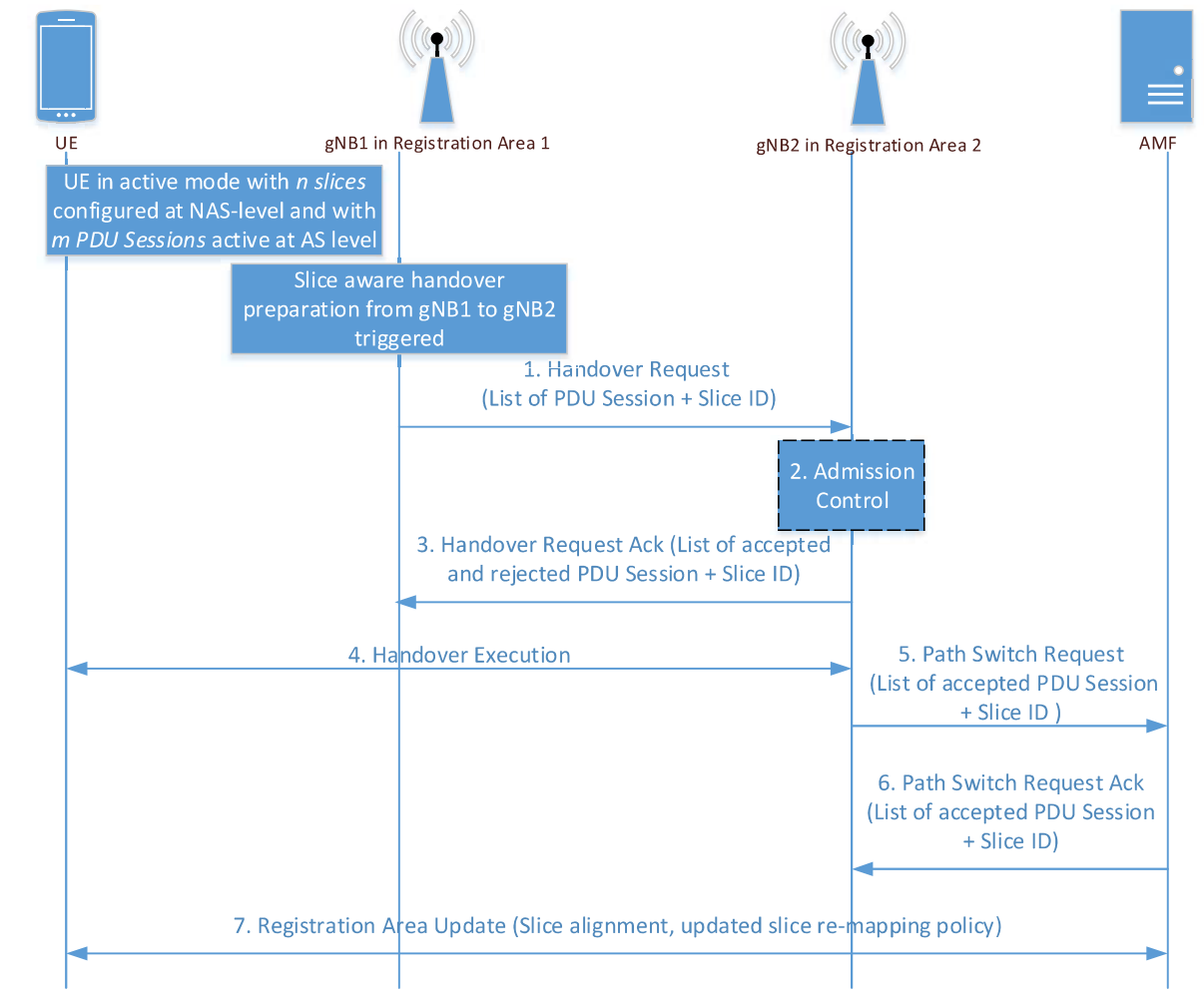


Figure 17.3.4.5-x: Active mode Xn based mobility across different Registration Areas

End of Text Proposal to TS 38.300