**3GPP TSG-SA WG2 Meeting #139E*****S2-2003860r04***

**June 01 - 12, 2020, Elbonia**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.502** | **CR** | **2318** | **rev** | **-** | **Current version:** | **16.4.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network | **x** |

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| ***Title:*** | Alignment CR for DAPS HO | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Qualcomm Incorporated, Ericsson, Nokia, Nokia Shanghai Bell, CATT | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5GS\_ph1, LTE\_feMob-Core, NR\_Mob\_enh-Core | | | | |  | ***Date:*** | | | 2020-05-13 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12) Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | RAN3 agreed to support S1/NG DAPS (Dual Active Protocol Stacks) HO over S1 and NG in R3-202932/S2-2003579. The N2 based HO procedure need to be updated to support DAPS HO.  There is another issue which is not addressed in RAN3’s LS and the attached RAN3 CR. After UE accesses the T-RAN and send the HO confirmation, T-RAN will send the HO Notify with the new *Notify Source NG-RAN node* IE which will further trigger a new N2 HO Success procedure from S-AMF to S-RAN. This procedure requires both RAN and CN can support the DAPS HO but there is no description in RAN’s spec on how to negotiate the DAPS HO capability between RAN and CN. This paper assumes that RAN and CN will exchange the DAPS HO capability during the N2 setup procedure, S-RAN will only initiate the DAPS HO when both S-RAN and S-AMF supports DAPS HO. T-RAN will only send the DAPS HO accept when both T-RAN and T-AMF supports the DAPS HO. | | | | | | | | |
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| ***Summary of change:*** | | - adds new clause 4.9.1.3.3a to support DAPS HO.  New changes beyond RAN’s spec.  - S-RAN requests DAPS HO when DAPS HO is supported by both S-RAN and S-AMF.  - T-RAN sends the DAPS Information IE If the DAPS HO is supported by both the T-RAN and T-AMF. | | | | | | | | |
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| ***Consequences if not approved:*** | | DAPS HO is not supported. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.9.1.3.1; 4.9.1.3.2; 4.9.1.3.3; new clause 4.9.1.3.3a | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

\*\*\* BEGIN CHANGES \*\*\*

##### 4.9.1.3.1 General

Clause 4.9.1.3 includes details regarding the inter NG-RAN node N2 based handover without Xn interface.

The source NG-RAN decides to initiate an N2-based handover to the target NG-RAN. This can be triggered, for example, due to new radio conditions or load balancing, if there is no Xn connectivity to the target NG-RAN, an error indication from the target NG-RAN after an unsuccessful Xn-based handover (i.e. no IP connectivity between T-RAN and S-UPF), or based on dynamic information learnt by the S-RAN.

The availability of a direct forwarding path is determined in the source NG-RAN and indicated to the SMFs. If IP connectivity is available between the source and target NG-RAN and security association(s) is in place between them, a direct forwarding path is available.

If a direct forwarding path is not available, indirect forwarding may be used. The SMFs use the indication from the source NG-RAN to determine whether to apply indirect forwarding.

If both source NG-RAN and source AMF support DAPS the source NG-RAN may decide that some of the DRBs are subject for DAPS handover as defined in TS 38.300 [9]; in this case, , the source NG-RAN provides the DAPS information indicateing the request concerns a DAPS handover for the DRB as part of the Source to Target (NG-RAN)Transparent Container . If the target NG-RAN accepts that the request concerns of DAPS handover and both Target NG-RAN and Target AMF support DAPS, the DAPS handover will be performed and target NG-RAN provides DAPS response information as part of the Target to Source (NG-RAN) Transparent Container .

In the case of handover to a shared network, the source NG-RAN determines a PLMN to be used in the target network as specified by TS 23.501 [2]. The source NG-RAN shall indicate the selected PLMN ID (or PLMN ID and NID, see TS 23.501 [2], clause 5.30) to be used in the target network to the AMF as part of the Tracking Area sent in the HO Required message.

If the AMF generates the N2 downlink signalling during the ongoing handover and receives a rejection to a N2 interface procedure (e.g. DL NAS message transfer; Location reporting control; etc.) from the NG-RAN with an indication that an Inter NG-RAN node handover procedure is in progress, the AMF may reattempt the same N2 interface procedure either when the handover is complete or the handover is deemed to have failed if the AMF is still the serving AMF, when possible. If the Inter NG-RAN node handover changes the serving AMF, the source AMF shall terminate any other ongoing N2 interface procedures except the handover procedure.

In order to minimize the number of procedures rejected by NG-RAN, the AMF should pause non-handover related N2 interface procedures (e.g. DL NAS message transfer, Location Report Control, etc.) while a handover is ongoing (i.e. from the time that a Handover Required has been received until either the Handover procedure has succeeded (Handover Notify) or failed (Handover Failure)) and continue them once the Handover procedure has completed if the AMF is still the serving AMF.

If during the handover procedure the AMF detects that the AMF needs be changed, the AMF shall reject any SMF initiated N2 request received since handover procedure started and shall include an indication that the request has been temporarily rejected due to handover procedure in progress.

Upon reception for an SMF initiated N1 and/or N2 request(s) with an indication either from the NG-RAN (via N2 SM Info) or AMF that the request has been temporarily rejected due to handover procedure in progress, the SMF starts a locally configured guard timer. The SMF should hold any signalling messages targeted towards AMF for a given UE during the handover preparation phase unless it detects that the handover execution is completed or handover has failed/cancelled. The SMF may re-attempt, 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.

In the case of home routed roaming scenario, the SMF in the Inter NG-RAN node N2 based handover procedure (Figure 4.9.1.3.2-1 and Figure 4.9.1.3.3-1) interacting with the S-UPF, T-UPF, S-AMF and T-AMF is the V-SMF, and the SMF (Figure 4.9.1.3.3-1) interacting with the UPF (PSA) is the H-SMF.

##### 4.9.1.3.2 Preparation phase



Figure 4.9.1.3.2-1: Inter NG-RAN node N2 based handover, Preparation phase

1. S-RAN to S-AMF: Handover Required (Target ID, Source to Target transparent container, SM N2 info list, PDU Session IDs, intra system handover indication).

Source to Target transparent container includes NG-RAN information created by S-RAN to be used by T-RAN, and is transparent to 5GC. It also contains for each PDU session the corresponding User Plane Security Enforcement information, QoS flows /DRBs information subject to data forwarding. It may also contain DAPS Information if DAPS HO is supported by S-RAN and S-AMF and DAPS HO is requested for one or more DRBs as described in TS 38.300 [9].

All PDU Sessions handled by S-RAN (i.e. all existing PDU Sessions with active UP connections) shall be included in the Handover Required message, indicating which of those PDU Session(s) are requested by S-RAN to handover. The SM N2 info includes Direct Forwarding Path Availability if direct data forwarding is available.

Direct Forwarding Path Availability indicates whether direct forwarding is available from the S-RAN to the T-RAN. This indication from S-RAN can be based on e.g. the presence of IP connectivity and security association(s) between the S-RAN and the T-RAN.

If the source NG RAN and target NG RAN support RACS as defined in TS 23.501 [2], the Source to Target transparent container shall contain the UE's UE Radio Capability ID instead of UE radio access capabilities. In the case of inter-PLMN handover, when the source and target NG-RAN support RACS as defined in TS 23.501 [2] and the source NG-RAN determines based on local configuration that the target PLMN does not support the UE Radio Capability ID assigned by the source PLMN, then the source NG-RAN includes the UE radio access capabilities in the Source to Target transparent container instead of UE Radio Capability ID.

2. T-AMF Selection: When the S-AMF can't serve the UE anymore, the S-AMF selects the T-AMF as described in clause 6.3.5 on "AMF Selection Function" in TS 23.501 [2].

3. [Conditional] S-AMF to T-AMF: Namf\_Communication\_CreateUEContext Request (N2 Information (Target ID, Source to Target transparent container, SM N2 information list, PDU Session IDs), UE context information (SUPI, Service area restriction, Allowed NSSAI for each Access Type if available, Tracing Requirements, LTE M Indication, the list of PDU Session IDs along with the corresponding SMF information and the corresponding S-NSSAI(s), PCF ID(s), DNN, UE Radio Capability ID and UE Radio Capability Information). If the subscription information includes Tracing Requirements, the old AMF provides the target AMF with Tracing Requirements.

In inter PLMN mobility case, UE context information includes HPLMN S-NSSAIs corresponding to the Allowed NSSAI for each Access Type, without Allowed NSSAI of source PLMN. The target AMF may determine the Allowed NSSAI based on the HPLMN S-NSSAIs received in step 3, or else the target AMF queries the NSSF by invoking Nnssf\_NSSelection\_Get service operation with the HPLMN S-NSSAIs and PLMN ID of SUPI. The target AMF may trigger AMF re-allocation when Mobility Registration Update is performed during the Handover execution phase as described in clause 4.2.2.2.3.

The S-AMF initiates Handover resource allocation procedure by invoking the Namf\_Communication\_CreateUEContext service operation towards the T-AMF.

When the S-AMF can still serve the UE, this step and step 12 are not needed.

If Service area restrictions are available in the S-AMF, they may be forwarded to the T-AMF as described in clause 5.3.4.1.2 in TS 23.501 [2].

If both Home and Visited PCF ID(s) are provided by the S-AMF, the T-AMF contacts the (V-) PCF identified by the (V-)PCF ID. If the (V-)PCF identified by the (V-)PCF ID is not used or there are no PCF ID(s) received from the S-AMF, the T-AMF may select the PCF(s) as described in TS 23.501 [2], clause 6.3.7.1 and according to the V-NRF to H-NRF interaction described in clause 4.3.2.2.3.3. The T-AMF informs the S-AMF that the PCF ID is not used, as defined in step 12 and then the S-AMF terminates the AM Policy Association with the PCF identified by the PCF ID.

4. [Conditional] T-AMF to SMF: Nsmf\_PDUSession\_UpdateSMContext (PDU Session ID, Target ID, T-AMF ID, N2 SM Information).

For each PDU Session indicated by S-RAN, the AMF invokes the Nsmf\_PDUSession\_UpdateSMContext Request to the associated SMF. However, if the S-NSSAI associated with PDU Session is not available in the T-AMF, the T-AMF does not invoke Nsmf\_PDUSession\_UpdateSMContext for this PDU Session.

PDU Session ID indicates a PDU Session candidate for N2 Handover. Target ID corresponds to Target ID provided by S-RAN in step 1. SM N2 Info includes the Direct Forwarding Path Availability if the direct data forwarding is available between the S-RAN and the T-RAN and has been inserted by the S-RAN.

If the (T-)AMF detects that the UE moves into a non-allowed area based on Service area restrictions, the (T‑)AMF notifies each NF consumer which has subscribed for UE reachability event (e.g. SMFs corresponding to the list of PDU Sessions received in UE Context from (S-)AMF via Namf\_EventExposure\_Notify that the UE is only reachable for regulatory prioritized services.

5. [Conditional] Based on the Target ID, SMF checks if N2 Handover for the indicated PDU Session can be accepted. The SMF checks also the UPF Selection Criteria according to clause 6.3.3 of TS 23.501 [2]. If UE has moved out of the service area of the UPF connecting to NG-RAN, SMF selects a new intermediate UPF. If redundant transmission is performed for one or more QoS Flows of the PDU Session, the SMF selects two new Intermediate UPFs to support the redundant transmission based on two N3 and N9 tunnels between the T-RAN and the UPF (PSA) as described in clause 5.33.2.2 of TS 23.501 [2]. In this case, step 6c and 6d are performed between SMF and each T-UPF.

In the case that the SMF fails to find a suitable I-UPF, the SMF decides to (based on local policies) either:

- trigger re-establishment of PDU Session. After handover procedure, SMF sends N1 message to the UE via the AMF by invoking Namf\_Communication\_N1N2MessageTransfer containing the cause indicating PDU Session re-establishment is required for the UE; or

- keep the PDU Session, but reject the activation request of User Plane connection for the PDU Session and inform the AMF about it; or

- release the PDU Session after handover procedure.

6a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request.

If the SMF selects a new UPF to act as intermediate UPF for the PDU Session, and the different CN Tunnel Info need be used, the SMF sends N4 Session Modification Request message to UPF (PSA). The SMF provides the CN Tunnel Info (on N9) if the CN Tunnel Info is allocated by the SMF, and UL Packet detection rules associate the CN Tunnel Info (on N9) to be installed on the UPF (PSA).

If redundant transmission is performed for one or more QoS Flows of the PDU Session and the different CN Tunnel Info need be used, the SMF provides two CN Tunnel Info (on N9) to the UPF (PSA) if the CN Tunnel Info is allocated by the SMF and indicates to the UPF (PSA) one of the CN Tunnel Info is used as redundancy tunnel of the PDU Session.

6b. [Conditional] UPF (PSA) to SMF: N4 Session Modification Response.

The UPF (PSA) sends an N4 Session Establishment Response message to the SMF. If the UPF (PSA) allocates CN Tunnel Info (on N9) of UPF (PSA), it provides CN Tunnel Info (on N9) to the SMF. If redundant transmission is performed for one or more QoS Flows of the PDU Session, the UPF (PSA) provides two CN Tunnel Info (on N9) of UPF (PSA) to the SMF and indicates the SMF that one CN Tunnel Info is used as redundancy tunnel of the PDU Session as described in in clause 5.33.2.2 of TS 23.501 [2]. The UPF (PSA) associate the CN Tunnel Info (on N9) with UL Packet detection rules provided by the SMF.

6c. [Conditional] SMF to T-UPF (intermediate): N4 Session Establishment Request.

If the SMF selects a new intermediate UPF, i.e. the target UPF (T-UPF), for the PDU Session and if CN Tunnel Info is allocated by the T-UPF, an N4 Session Establishment Request message is sent to the T-UPF, providing Packet detection, enforcement and reporting rules to be installed on the T-UPF. The CN Tunnel Info (on N9) of UPF (PSA) for this PDU Session, which is used to setup N9 tunnel, is also provided to the T-UPF.

6d. T-UPF (intermediate) to SMF: N4 Session Establishment Response.

The T-UPF sends an N4 Session Establishment Response message to the SMF with DL CN Tunnel Info and UL CN Tunnel Info (i.e. N3 tunnel info). The SMF starts a timer to release the resource of S-UPF, which is to be used in step 13a of the Execution Phase.

7. SMF to T-AMF: Nsmf\_PDUSession\_UpdateSMContext Response (PDU Session ID, N2 SM Information, Reason for non-acceptance).

If N2 handover for the PDU Session is accepted, the SMF includes in the Nsmf\_PDUSession\_UpdateSMContext response the N2 SM Information containing the N3 UP address and the UL CN Tunnel ID of the UPF and the QoS parameters indicating that the N2 SM Information is for the Target NG-RAN. If redundant transmission is performed for one or more QoS Flows of the PDU Session, two UL CN Tunnel Info are included in the N2 SM Information. If the N2 SM information received at step 4 does not include the Direct Forwarding Path Availability and the SMF knows that there is no indirect data forwarding connectivity between source and target, the N2 SM Information includes a Data forwarding not possible indication. If the Target NG-RAN supports Alternative QoS Profiles (see TS 23.501 [2]), the SMF sends them to the Target NG-RAN on a per QoS Flow basis, if available.

If N2 handover for the PDU Session is not accepted as described in step 5, the SMF does not include an N2 SM Information regarding the PDU Session to avoid establishment of radio resources at the target NG-RAN. Instead of that, the SMF provides a reason for non-acceptance. If the SMF has received notification from (T-)AMF that the UE is only reachable for regulatory prioritized services, the SMF does not include any N2 SM info regarding the PDU Session for non-regulatory prioritized services to avoid establishment of radio resources at the target NG-RAN. If the SMF receives notification from (T-)AMF that UE is only reachable for regulatory prioritized service after this step via Namf\_EventExposure\_Notify, the SMF deactivates the PDU Session after handover procedure finish if the PDU Session is not for regulatory prioritized services.

8. AMF supervises the Nsmf\_PDUSession\_UpdateSMContext Response messages from the involved SMFs. The lowest value of the Max delay indications for the PDU Sessions that are candidates for handover gives the maximum time AMF may wait for Nsmf\_PDUSession\_UpdateSMContext Response messages before continuing with the N2 Handover procedure. At expiry of the maximum wait time or when all Nsmf\_PDUSession\_UpdateSMContext Response messages are received, AMF continues with the N2 Handover procedure (Handover Request message in step 9).

NOTE: The delay value for each PDU Session is locally configured in the AMF and implementation specific.

9. T-AMF to T-RAN: Handover Request (Source to Target transparent container, N2 MM Information, N2 SM Information list, Tracing Requirements, UE Radio Capability ID). If the subscription information includes Tracing Requirements, the target AMF provides the target RAN with Tracing Requirements in the Handover Request.

T-AMF determines T-RAN based on Target ID. T-AMF may allocate a 5G-GUTI valid for the UE in the AMF and target TAI.

Source to Target transparent containeris forwarded as received from S-RAN. N2 MM Information includes e.g. security information and Mobility Restriction List if available in the T-AMF.

N2 SM Information list includes N2 SM Information received from SMFs for the T-RAN in the Nsmf\_PDUSession\_UpdateSMContext Response messages received within allowed max delay supervised by the T-AMF mentioned in step 8.

Mobility Restriction List is sent in N2 MM Information if available in the Target AMF.

If the UE Radio Capability ID is included in the Handover Request message, when there is no corresponding UE radio capabilities set for UE Radio Capability ID at T-RAN, T-RAN shall request the T-AMF to provide the UE radio capabilities set corresponding to UE Radio Capability ID to the T-RAN.

10. T-RAN to T-AMF: Handover Request Acknowledge (Target to Source transparent container, List of PDU Sessions to Hand-over with N2 SM information, List of PDU Sessions that failed to be established with the failure cause given in the N2 SM information element).

Target to Source transparent containerincludes a UE container with an access stratum part and a NAS part. The UE container is sent transparently via T-AMF, S-AMF and S-RAN to the UE. If DAPS HO is supported by the T-RAN and T-AMF and the DAPS Information for one or more DRBs had been received in the Source to Target Transparent Container, the T-RAN includes the DAPS Response information in the Target to Source Transparent Container as described in TS 38.300 [9].

T-RAN creates List Of PDU Sessions failed to be setup and reason for failure (e.g. T-RAN decision, S-NSSAI is not available, unable to fullfill User Plane Security Enforcement) based on T-RAN determination. The information is provided to the S-RAN.

The N2 SM information in the List Of PDU Sessions to Hand-over, contains per each PDU Session ID T-RAN N3 addressing information i.e. N3 UP address and Tunnel ID of T-RAN for the PDU Session.

If redundant transmission is performed for one or more QoS Flows of the PDU Session, the T-RAN provides two AN Tunnel Info for the PDU Session in the N2 SM information. The T-RAN indicates to the SMF one of the AN Tunnel Info is used as the redundancy tunnel of the PDU session as described in clause 5.33.2.2 of TS 23.501 [2]. If only one AN Tunnel Info is provided by the Target NG-RAN for the PDU session, the SMF may release these QoS Flows by triggering PDU Session Modification procedure as specified in clause 4.3.3 after the handover procedure.

The N2 SM information may also include:

- an Indication whether UP integrity protection is performed or not on the PDU Session.

- if the PDU Session has at least one QoS Flow subject for data forwarding, N3 UP address and Tunnel ID of T-RAN for receiving forwarded data. The T-RAN provides data forwarding addresses for each data forwarding tunnel which it decided to setup.

- For each QoS Flow accepted with an Alternative QoS Profile (see TS 23.501 [2]), the Target NG-RAN shall include a reference to the fulfilled Alternative QoS Profile.

11a. AMF to SMF: Nsmf\_PDUSession\_UpdateSMContext Request (PDU Session ID, N2 SM response received from T-RAN in step 10).

For each N2 SM response received from the T-RAN (N2 SM information included in Handover Request Acknowledge), AMF sends the received N2 SM response to the SMF indicated by the respective PDU Session ID.

If no new T-UPF is selected, SMF stores the N3 tunnel info of T-RAN from the N2 SM response if N2 handover is accepted by T-RAN.

The SMF/UPF allocates the N3 UP address and Tunnel IDs for indirect data forwarding corresponding to the data fowarding tunnel endpoints established by T-RAN.

If a PDU Session is indicated as a rejected PDU Session by the Target NG-RAN with an indication that the PDU session was rejected because User Plane Security Enforcement is not supported in the Target NG-RAN and the User Plane Enforcement Policy indicates "Required" as described in clause 5.10.3 of TS 23.501 [2], the SMF triggers the release of this PDU Session. In all other cases of PDU Session rejection, the SMF can decide whether to release the PDU Session (possibly triggering the re-establishment of the PDU Session as described in step 5) or to deactivate the UP connection of this PDU Session.

If some of the QoS Flows of a PDU Session are not accepted by the Target NG-RAN, the SMF shall initiate the PDU Session Modification procedure to remove the non-accepted QoS Flows from the PDU Session(s) after the handover procedure is completed.

11b. [Conditional] SMF to T-UPF: N4 Session Modification Request (T-RAN SM N3 forwarding Information list, indication to allocate DL forwarding tunnel(s) for indirect forwarding)

If the SMF selected a T-UPF in step 6a, the SMF updates the T-UPF by providing the T-RAN SM N3 forwarding information list by sending a N4 Session Modification Request to the T-UPF.

If indirect forwarding applies based on indication from the S-RAN and the UPF is re-allocated and if the SMF decides to setup the indirect forwarding tunnel on the same T-UPF, the SMF also requests in the N4 Session Modification Request message to the T-UPF, to allocate DL forwarding tunnel(s) for indirect forwarding.

Indirect forwarding may be performed via a UPF which is different from the T-UPF, in which case the SMF selects a T-UPF for indirect forwarding.

11c. [Conditional] T-UPF to SMF: N4 Session Modification Response (T-UPF SM N3 forwarding Information list).

The T-UPF allocates Tunnel Info and returns an N4 Session Modification Response message to the SMF.

The T-UPF SM N3 forwarding info list includes T-UPF N3 address, T-UPF N3 Tunnel identifiers for forwarding data

11d. [Conditional] SMF to S-UPF: N4 Session Modification Request (T-RAN SM N3 forwarding Information list or T-UPF SM N3 forwarding Information list, indication to allocate DL forwarding tunnel(s) for indirect forwarding).

If the UPF is re-allocated, this message includes the T-UPF SM N3 forwarding info list. If the UPF is not re-allocated, this message includes the T-RAN SM N3 forwarding info list.

If indirect forwarding applies based on indication from NG-RAN and UPF allocates tunnel identities, the SMF indicates in the N4 Session Modification Request message to the S-UPF to allocate DL forwarding tunnel(s) for indirect forwarding.

Indirect forwarding may be performed via a UPF which is different from the S-UPF.

11e. [Conditional] S-UPF to SMF: N4 Session Modification Response (S-UPF SM N3 forwarding Information list).

The S-UPF allocates Tunnel Info and returns an N4 Session establishment Response message to the SMF.

The S-UPF SM N3 forwarding Information list includes S-UPF N3 address, S-UPF N3 Tunnel identifiers for DL data forwarding.

11f. SMF to T-AMF: Nsmf\_PDUSession\_UpdateSMContext Response (N2 SM Information).

The SMF sends an Nsmf\_PDUSession\_UpdateSMContext Response message per PDU Session to T-AMF.

The SMF creates an N2 SM information containing the DL forwarding Tunnel Info to be sent to the S-RAN by the AMF. The SMF includes this information in the Nsmf\_PDUSession\_UpdateSMContext response. The DL forwarding Tunnel Info can be one of the following information:

- If direct forwarding applies, then the SMF includes the T-RAN N3 forwarding information the SMF received in step 11a.

- If the indirect forwarding tunnel is setup in step 11b or 11d, then the SMF includes the T-UPF or S-UPF DL forwarding information containing the N3 UP address and the DL Tunnel ID of the UPF.

12. [Conditional] T-AMF to S-AMF: Namf\_Communication\_CreateUEContext Response (N2 information necessary for S-AMF to send Handover Command to S-RAN including Target to Source transparent container, PDU Sessions failed to be setup list, N2 SM information (N3 DL forwarding Information, PCF ID)).

AMF supervises the Nsmf\_PDUSession\_UpdateSMContext Response message from the involved SMFs. At expiry of the maximum wait time or when all Nsmf\_PDUSession\_UpdateSMContext Response messages are received, T-AMF sends the Namf\_Communication\_CreateUEContext Response to the S-AMF.

The PDU Sessions failed to be setup list includes the List Of PDU Sessions failed to be setup received from target RAN in step 10 and the Non-accepted PDU session List generated by the T-AMF.

Non-accepted PDU Session List includes following PDU Session(s) with proper cause value:

- Non-accepted PDU Session(s) by the SMF(s);

- Non-accepted PDU Session(s) by the AMF due to no response from the SMF within maximum wait time; and

- Non-accepted PDU Session(s) by the AMF due to non-available S-NSSAI in the T-AMF, which is decided at step 4.

The Target to Source transport container is received from the T-RAN. The N2 SM Information is received from the SMF in step 11f.

##### 4.9.1.3.3 Execution phase



Figure 4.9.1.3.3-1: inter NG-RAN node N2 based handover, execution phase

NOTE 1: Registration of serving AMF with the UDM is not shown in the figure for brevity.

1. S-AMF to S-RAN: Handover Command (Target to Source transparent container, List Of PDU Sessions to be handed-over with N2 SM information containing information received from T-RAN during the handover preparation phase, List Of PDU Sessions failed to be setup).

Target to Source transparent containeris forwarded as received from S-AMF. If DAPS Response information for one or more DRBs is received by S-RAN and indicates that DAPS HO is accepted, the execution phase for DAPS HO procedure as described in clause 4.9.1.3.3a is performed.

The SM forwarding info list includes T-RAN SM N3 forwarding info list for direct forwarding or S-UPF SM N3 forwarding info list for indirect data forwarding

S-RAN uses the PDU Sessions failed to be setup list and the indicated reason for failure to decide whether to proceed with the N2 Handover procedure.

If the S-RAN supports and receives a reference to an Alternative QoS Profile for an accepted QoS Flow, it shall take it into account for deciding whether or not to proceed with the N2 Handover procedure (see TS 23.501 [2]).

2. S-RAN to UE: Handover Command (UE container).

UE container is a UE part of the Target to Source transparent container which is sent transparently from T-RAN via AMF to S-RAN and is provided to the UE by the S-RAN.

2a0. If the PLMN has configured secondary RAT usage reporting and the source NG-RAN has Secondary RAT usage data to report, the source NG-RAN node may provide RAN usage data report message (N2 SM Information (Secondary RAT usage data), Handover Flag) as in clause 4.21 to the AMF. The Handover Flag indicates to the AMF that it should buffer the N2 SM Information containing the usage data report before forwarding it.

NOTE 2: This step is not shown in this figure but the secondary RAT usage data reporting procedure is shown in figure 4.21-1 in clause 4.21.

2a. - 2c. The S-RAN sends the Uplink RAN Status Transfer message to the S-AMF, as specified in TS 36.300 [46] and TS 38.300 [9]. The S-RAN may omit sending this message if none of the radio bearers of the UE shall be treated with PDCP status preservation.

If there is an AMF relocation, the S-AMF sends this information to the T-AMF via the Namf\_Communication\_N1N2MessageTransfer service operation and the T-AMF acknowledges. The S-AMF or, if the AMF is relocated, the T-AMF, sends the information to the T-RAN via the Downlink RAN Status Transfer message, as specified in TS 36.300 [46] and TS 38.300 [9].

3. Uplink packets are sent from T-RAN to T-UPF and UPF (PSA). Downlink packets are sent from UPF (PSA) to S-RAN via S-UPF. The S-RAN should start forwarding of downlink data from the S-RAN towards the T-RAN for QoS Flows or DRBs subject to data forwarding. This may be either direct (step 3a) or indirect forwarding (step 3b).

4. UE to T-RAN: Handover Confirm*.*

After the UE has successfully synchronized to the target cell, it sends a Handover Confirm message to the T-RAN. Handover is by this message considered as successful by the UE.

5. T-RAN to T-AMF: Handover Notify*.*

Handover is by this message considered as successful in T-RAN.

For each QoS Flow accepted with an Alternative QoS Profile (see TS 23.501 [2]), the Target-RAN shall send to the SMF a reference to the fulfilled Alternative QoS Profile.

6a. [Conditional] T-AMF to S-AMF: Namf\_Communication\_N2InfoNotify.

The T-AMF notifies to the S-AMF about the N2 handover notify received from the T-RAN by invoking the Namf\_Communication\_N2InfoNotify.

A timer in S-AMF is started to supervise when resources in S-RAN shall be release.

6b. [Conditional] S-AMF to T-AMF: Namf\_Communication\_N2InfoNotify ACK (N2 SM Information (Secondary RAT usage data)).

The S-AMF acknowledges by sending the Namf\_Communication\_N2InfoNotify ACK to the T-AMF. The N2 SM Information here is the one buffered at step 2a0 when applicable.

During inter PLMN mobility, if the S-AMF has I-NEF routing configured, then the S-AMF should send Ninef\_EventExposure\_Unsubscribe message to delete the routing configuration in the old I-NEF. If the T-AMF determines that I-NEF is needed, then it can set up a new routing configuration in the new I-NEF as specified in clause 4.15.3.2.3a.

6c. [Conditional] S-AMF to SMF: Nsmf\_PDUSession\_ReleaseSMContext Request (SM Context ID, N2 SM Information (Secondary RAT Usage Data)).

If the PDU Session(s) is not accepted by the T-AMF (e.g. S-NSSAI associated with the PDU Session is not available in the T-AMF), S-AMF triggers PDU Session Release procedure as specified in clause 4.3.4.2 after the S-AMF is notified for the reception of N2 Handover Notify in step 6a.

7. T-AMF to SMF: Nsmf\_PDUSession\_UpdateSMContext Request (Handover Complete indication for PDU Session ID, UE presence in LADN service area, N2 SM Information (Secondary RAT usage data)). The N2 SM Information here is the one received at step 6b when applicable.

Handover Complete indication is sent per each PDU Session to the corresponding SMF to indicate the success of the N2 Handover.

When an Nsmf\_PDUSession\_UpdateSMContext Response message arrived too late during the handover preparation phase (see step 8 of clause 4.9.1.3.2), or the PDU Session with SMF involvement is not accepted by T-RAN, Nsmf\_PDUSession\_UpdateSMContext Request (SM Context ID, Operation Type) is sent to the corresponding SMF allowing the SMF to deallocate a possibly allocated N3 UP address and Tunnel ID of the selected UPF. A PDU Session handled by that SMF is considered deactivated and handover attempt is terminated for that PDU Session.

In the case that the AMF determines that the PDU Session is related to a LADN then the AMF provides the "UE presence in LADN service area". If the AMF does not provide the "UE presence in LADN service area" indication and the SMF determines that the DNN corresponds to a LADN, then the SMF considers that the UE is OUT of the LADN service area.

The SMF takes actions for the LADN PDU Session as defined in TS 23.501 [2] clause 5.6.5 based on the "UE presence in LADN service area" indication.

For each QoS Flow for which the SMF has received a reference to the fulfilled Alternative QoS Profile, the SMF notifies the PCF and the UE as described in TS 23.501 [2].

8a. [Conditional] SMF to T-UPF (intermediate): N4 Session Modification Request.

If new T-UPF is inserted or an existing intermediate S-UPF is re-allocated, the SMF shall send N4 Session Modification Request indicating DL AN Tunnel Info of T-RAN to the T-UPF.

8b. [Conditional] T-UPF to SMF: N4 Session Modification Response.

The T-UPF acknowledges by sending N4 Session Modification Response message to SMF.

9a. [Conditional] SMF to S-UPF (intermediate): N4 Session Modification Request.

If UPF is not re-allocated, the SMF shall send N4 Session Modification Request indicating DL AN Tunnel Info of T-RAN to the S-UPF.

9b. [Conditional] S-UPF to SMF: N4 Session Modification Response.

The S-UPF acknowledges by sending N4 Session Modification Response message to SMF.

10a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request.

For non-roaming or local breakout roaming scenario, the SMF sends N4 Session Modification Request message to PDU Session Anchor UPF, UPF (PSA), providing N3 AN Tunnel Info of T-RAN or the DL CN Tunnel Info of T-UPF if a new T-UPF is inserted or an existing intermediate S-UPF is re-allocated. If redundant transmission is performed for one or more QoS Flows of the PDU Session, two N3 AN Tunnel Info of T-RAN or two DL CN Tunnel Info of two T-UPFs are provided and the SMF indicates to the UPF (PSA) one of the AN/CN Tunnel Info is used as redundancy tunnel of the PDU Session. If the existing intermediate S-UPF terminating to N9 toward the H-UPF (PDU Session Anchor) is re-allocated for the home routed roaming scenario, the V-SMF invokes an Nsmf\_PDUSession\_Update Request (End Marker Indication) service operation toward the H-SMF. The End Marker Indication is used to indicate that End Marker(s) is to be sent.

In the case of the S-UPF acts as a UL CL or BP, the SMF indicates only one of the PDU Session Anchors to send the "end marker" packets. To ensure the "end marker" is the last user plane packet on the old path, the SMF should modify the path on other PDU Session Anchors before it indicates the PDU Session Anchor to send the "end marker" packets.

If T-UPF is not inserted or an existing intermediate S-UPF is not re-allocated, step 10a and step 10b are skipped.

10b. [Conditional] UPF (PSA) to SMF: N4 Session Modification Response.

The UPF (PSA) sends N4 Session Modification Response message to SMF. In order to assist the reordering function in the T-RAN, the UPF (PSA) sends one or more "end marker" packets for each N3 tunnel on the old path immediately after switching the path, the source NG-RAN shall forward the "end marker" packets to the target NG-RAN. At this point, UPF (PSA) starts sending downlink packets to the T-RAN, via T-UPF if a new T-UPF is inserted or an existing intermediate S-UPF is re-allocated. In the case of home routed roaming scenario, the H-SMF responds with the Nsmf\_PDUSession\_Update Response service operation to V-SMF once the H-UPF (PDU Session Anchor) is updated with the UL Tunnel Info of the T-UPF.

When there are multiple UPFs(PSA), step 10a and step 10b are performed for each UPFs(PSA).

11. SMF to T-AMF: Nsmf\_PDUSession\_UpdateSMContext Response (PDU Session ID).

SMF confirms reception of Handover Complete.

If indirect data forwarding applies, the SMF starts an indirect data forwarding timer, to be used to release the resource of indirect data forwarding tunnel.

12. The UE initiates Mobility Registration Update procedure as described in clause 4.2.2.2.2.

The target AMF knows that it is a Handover procedure and therefore the target AMF performs only a subset of the Registration procedure, specifically the steps 4, 5, and 10 in the Registration procedure for the context transfer between source AMF and target AMF are skipped.

13a. [Conditional] SMF to S-UPF (intermediate): N4 Session Release Request.

If there is a source intermediate UPF, the SMF initiates resource release, after timer in step 6 or indirect data forwarding timer expires, by sending an N4 Session Release Request (Release Cause) to source UPF. This message is also used to release the indirect data forwarding resource in S-UPF.

13b. S-UPF to SMF: N4 Session Release Response.

The S-UPF acknowledges with an N4 Session Release Response message to confirm the release of resources.

In the case of indirect data forwarding, the resource of indirect data forwarding is also released.

14a. AMF to S-RAN: UE Context Release Command ().

After the timer in step 6a expires, the AMF sends UE Context Release Command.

14b. S-RAN to AMF: UE Context Release Complete ().

The source NG-RAN releases its resources related to the UE and responds with a UE Context Release Complete () message.

15a. [Conditional] SMF to T-UPF: N4 Session Modification Request.

If indirect forwarding applies and UPF is re-allocated, after timer of indirect data forwarding expires, the SMF sends N4 Session Modification Request to T-UPF to release the indirect data forwarding resource.

15b. [Conditional] T-UPF to SMF: N4 Session Modification Response.

The T-UPF acknowledges with an N4 Session Modification Response message to confirm the release of indirect data forwarding resources.

If the AMF is subscribed to Mobility Event by other NFs, the AMF notifies the event to the corresponding NFs by invoking the Namf\_EventExposure\_Notify service operation as described in clause 4.15.4.2.

Upon reception of the Namf\_EventExposure\_Notify with an indication that UE is reachable only for regulatory prioritized service, the SMF deactivates the PDU Session if the service of the PDU Session is not regulatory prioritized. For home routed roaming case, the V-SMF triggers the deactivation of the PDU Session, in addition, the H-SMF refrains from sending downlink signalling if the signalling is not related to regulatory prioritized service upon receiving the notification.

##### 4.9.1.3.3a Execution phase for DAPS HO

This procedure applies only if at the end of the Preparation phase it has been determined that at least one DRB of the UE is subject to a DAPS related Hand-Over.



Figure 4.9.1.3.3a-1: inter NG-RAN node N2 based DAPS handover, execution phase

1 to 2. Same as step 1 to step 2 in clause 4.9.1.3.3 with the following difference.

DAPS Response information received in the Target to Source Transparent Container indicates the DAPS HO is accepted for one or more DRBs.

2a to 2c. The S-RAN sends the Uplink RAN Early Status Transfer message to the S-AMF as specified in TS 38.413 [10]. For the DRBs not subjecti to DAPS, steps 2a to 2c in clause 4.9.1.3.3 may be performed.

If there is an AMF change, the S-AMF sends this information to the T-AMF via the Namf\_Communication\_N1N2MessageTransfer service operation and the T-AMF acknowledges. The S-AMF or, if the AMF is relocated, the T-AMF, sends the information to the T-RAN via the Downlink RAN Early Status Transfer message, as specified in TS 38.413 [10].

3. Same as step 3 in clause 4.9.1.3.3.

4. Same as step 4 in clause 4.9.1.3.3.

5. T-RAN to T-AMF: same as step 5 in clause 4.9.1.3.3 with the difference that Handover Notify includes a Notify Source NG-RAN node which is used to notify the S-RAN that the UE has successfully accessed the T-RAN*.*

6a. [Conditional] T-AMF to S-AMF: Namf\_Communication\_N2InfoNotify.

The T-AMF notifies to the S-AMF as step 6a in clause 4.9.1.3.3 with the difference that Notify Source NG-RAN node information is included.

6b. [Conditional] S-AMF to T-AMF: Namf\_Communication\_N2InfoNotify ACK.

The S-AMF acknowledges by sending the Namf\_Communication\_N2InfoNotify ACK to the T-AMF as step 6b in clause 4.9.1.3.3.

7. S-AMF to S-RAN: Handover Success.

The S-AMF informs the S-RAN node that the UE has successfully accessed the T-RAN as described in TS 38.413 [10], S-RAN stops the UL data transfer for the UE.

8a to 8c. The S-RAN initiates step 8a. Step 8a to 8c are the same as step 2a to 2c in clause 4.9.1.3.3 for the DRB(s) subject to DAPS.

9. Step 6c to step 15 in clause 4.9.1.3.3 are performed.

\*\*\* END CHANGES \*\*\*