N2 Persistence control

May 8, 2017

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Agreements from TR 23.799
Snippet from Section 8

The architecture should support mechanisms **to avoid issues caused by the persistence ("stickiness") of UE-specific associations on at least NG2.**

What are the issues to be addressed?
See next slide for reference from TS 23.799!

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Requirements from TR 23.799
Snippet from 5.19.2 Issues to be addressed

5.19.2.1 Avoid UE interaction from NF Load Balancing, Scaling and Migration

When a Network Function is created, deleted, or moved, either within a data centre or between data centres, the IP address used by a remote entity (e.g. NG RAN node, MMF, SMF, UPF, SDM, etc.) to route signalling/data to that NF might (or might not) change.

If the IP address of such a Network Function does change, then it is very important that there is no need for UE interaction. The need to avoid UE interaction is to avoid radio interface signalling load, UE battery consumption and to handle cases where the UE is out of coverage or in Power Save Mode's/eDRX's deep sleep state.

5.19.2.2 Scaling in/out of the AMF, and, handling of long lived NG1/2 connections

Once registered on the (V)PLMN, other key issues have concluded that the UE accesses the network with a temporary ID that is used to route the UE's Initial NAS message to the 'registered' AMF.

In a virtualised environment, this AMF could be instantiated multiple times in one or multiple data centres.

To avoid the need for interaction between the AMF's compute and storage resources at every step of a NAS procedure (and hence to maintain low control plane latency), the Next Generation system should permit complete NAS procedures (c.f. EPC Attach procedure) to be executed on the same instance of the AMF.

To allow for the effective scaling in, and scaling out, when long-lived NG1/2 connections are in use (e.g. for the "RRC-connected-inactive" sub-state) the Next Generation system should permit time-separated NAS procedures from one UE to use different instances of the AMF.

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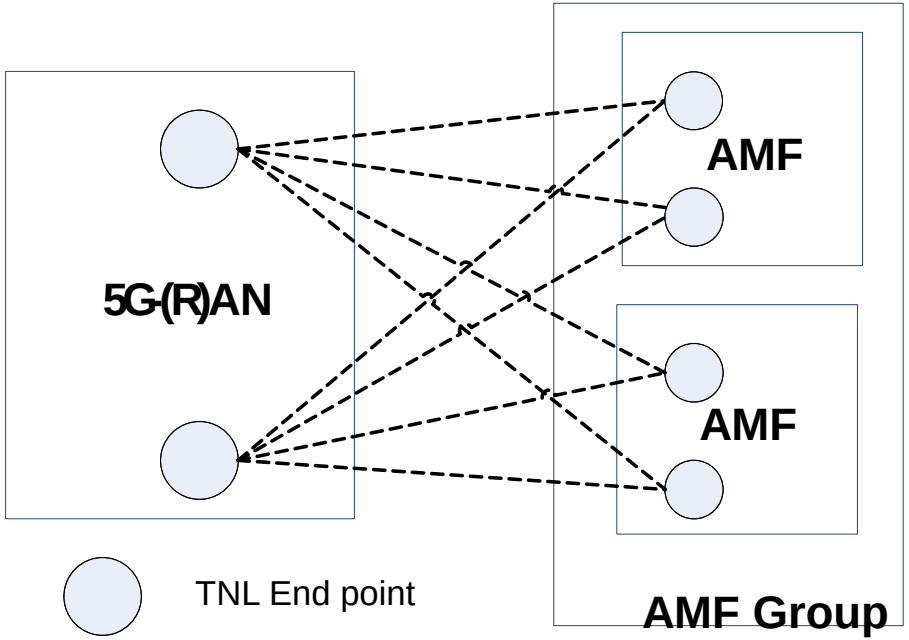
Connectivity between 5G-RAN and AMF

More than one TNL associations between an AMF/xNB pair assumed



---------- TNL association

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Handling UE(s) in Connected mode

Solution options to address N2 persistence control for UE(s) in CONNECTED Mode:

- **Option 1 -** AMF shall be able to release the binding of a specific TNL association between 5G-RAN and AMF. When the next N2 message needs to be sent for a UE for which the N2AP UE TNLA binding has been released, the following behavior applies: the RAN (or the AMF) for uplink (for downlink) N2 messages, respectively, shall re-select a TNL association for the UE. (S2-172812)
- **Option 2 -** AMF shall be able to release its own binding with the 5G-RAN. When subsequent N2 message needs to be sent, RAN or AMF reactivates N2AP association with the new AMF ID.
- **Option 3 -** AMF shall be able to instruct the RAN to switch the N2AP association with another AMF.
- **Option 4 –** AMF change is supported just like AMF relocation. New AMF updates the RAN with AMF ID and N2AP association is updated.

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Handling UE in CONNECTED mode – Option 1

AMF releases the TNL binding for the UE in connected mode (S2-172812)

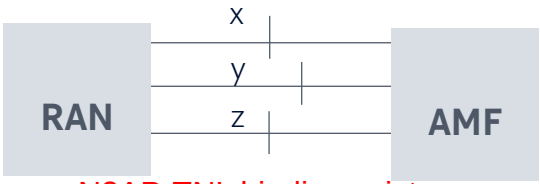
Assumptions:

1) 5G-RAN and AMF support multiple TNL association (per node).

2) N2AP association is an association between xNB and AMF for a certain UE (per UE).

3) N2AP-TNL binding is association of TNL with a certain N2AP association for a certain UE (per UE)

Pre-condition: N2AP-TNL binding for a UE

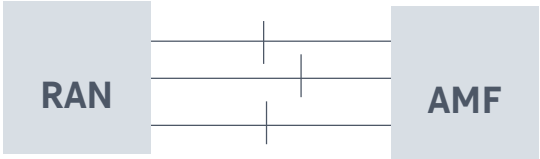


N2AP-TNL binding exists

{UE ID, xNB ID, AMF ID, **TNL x**}

{UE ID, xNB ID, AMF ID, **TNL x**}

Solution: Long connected mode - TNL binding released for N2AP association



{UE ID, xNB ID, AMF ID, ~~**TNL X**~~}

{UE ID, xNB ID, AMF ID, ~~**TNL X**~~}

N2AP association remains

Subsequent MO/MT transaction - TNL binding setup for N2AP association

{UE ID, xNB ID, AMF ID, TNL y}

{UE ID, xNB ID, AMF ID, TNL y}

N2AP TNL binding setup

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Handling UE in CONNECTED mode - Option 2

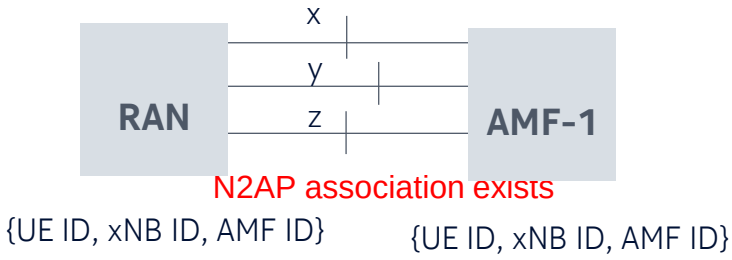
AMF deactivates N2AP association to release its binding for the UE

Assumptions:

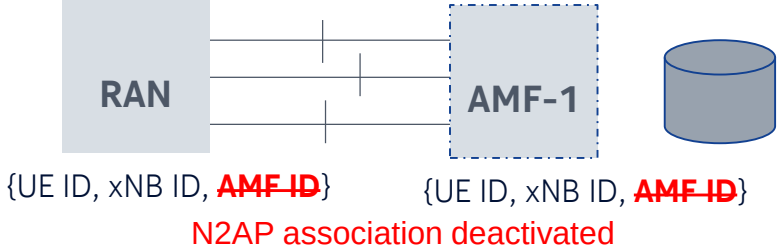
1) 5G-RAN and AMF can support one or more TNL association (per node).

2) N2AP association is an association between xNB and AMF for a certain UE (per UE).

Pre-condition: N2AP association for a UE



Solution: Long connected mode – AMF releases "per UE assoc" Binding to an AMF deactivated from N2AP association.



Subsequent MO/MT transaction - N2AP assoc. reactivated

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Handling UE in CONNECTED mode - Option 3

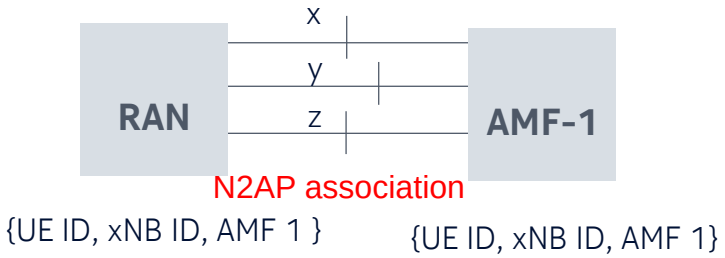
AMF requests RAN to switch N2AP association to another AMF

Assumptions:

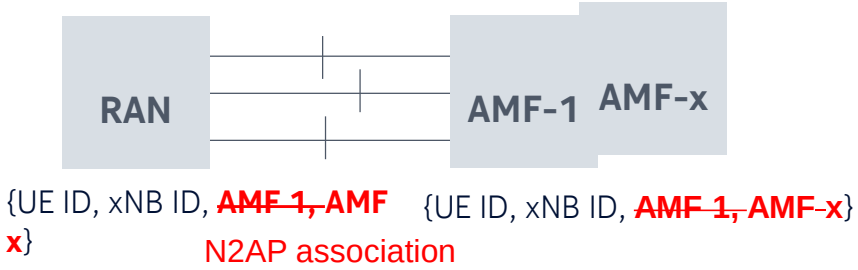
1) 5G-RAN and AMF support one or more TNL association (per node).

2) N2AP association is an association between xNB and AMF for a certain UE (per UE).

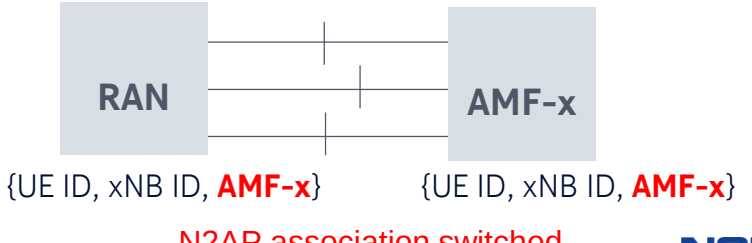
Pre-condition: N2AP association for a UE



Solution: Long connected mode – AMF-1 release "per UE assoc" and requests RAN to switch to AMF x for the UE



Subsequent MO/MT transaction – Updated N2AP assoc. used



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Handling UE in CONNECTED mode - Option 4

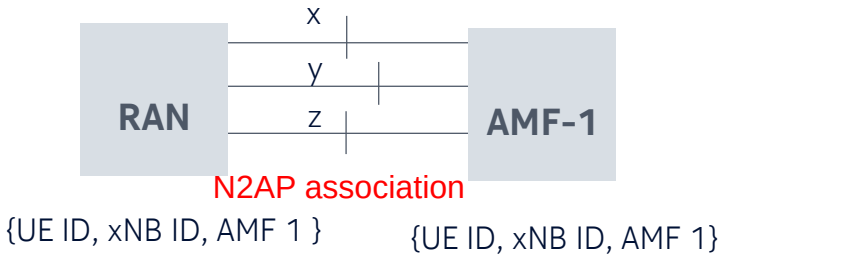
New AMF updates RAN with its ID to switch N2AP association to another AMF

Assumptions:

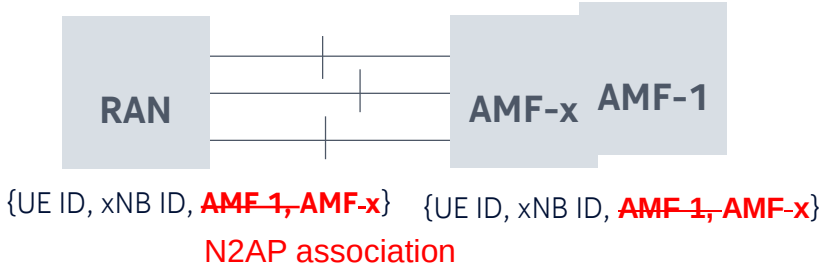
1) 5G-RAN and AMF support one or more TNL association (per node).

2) N2AP association is an association between xNB and AMF for a certain UE (per UE).

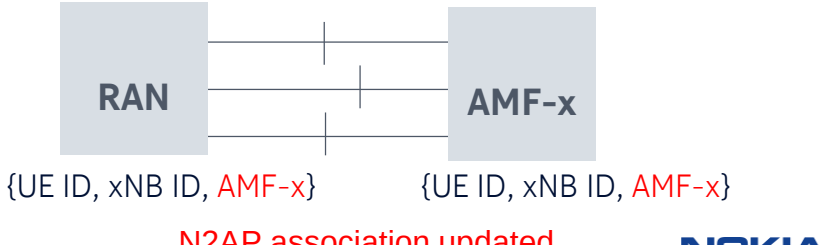
Pre-condition: N2AP association for a UE



Solution: Long connected mode – AMF-1 moves "per UE assoc" to AMF-x; AMF-x updates RAN with the new ID



Subsequent MO/MT transaction – Updated N2AP association used



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Comparison of different options

Requirements	Option 1	Option 2	Option 3	Option 4
Temporary ID reassignment	Yes, during Service request (SR)	If temp ID does not include AMF ID, temporary ID reassignment not necessary	Yes, during SR	Yes, during SR
permit complete NAS procedures (c.f. EPC Attach procedure) to be executed on the same instance of the AMF.	Yes	Yes	Yes	Yes
when long-lived NG1/2 connections are in use (e.g. for the "RRC-connected-inactive" sub-state) the Next Generation system should permit time-separated NAS procedures from one UE to use different instances of the AMF.	No	Yes	Yes	Yes
Characteristics	N2AP-TNL binding released but N2AP association remains.	Allows AMF to store UE context in a DB and release “per UE association” when UE in long connected mode.	AMF request “per UE association” to be moved to another AMF.	AMF moves “per UE association” to another AMF

Way forward proposal

- Benefit with just Option 1 is unclear – unbinds a certain TNL association but what is the benefit?
- Protocol specified should allow support for option 2 and option 3

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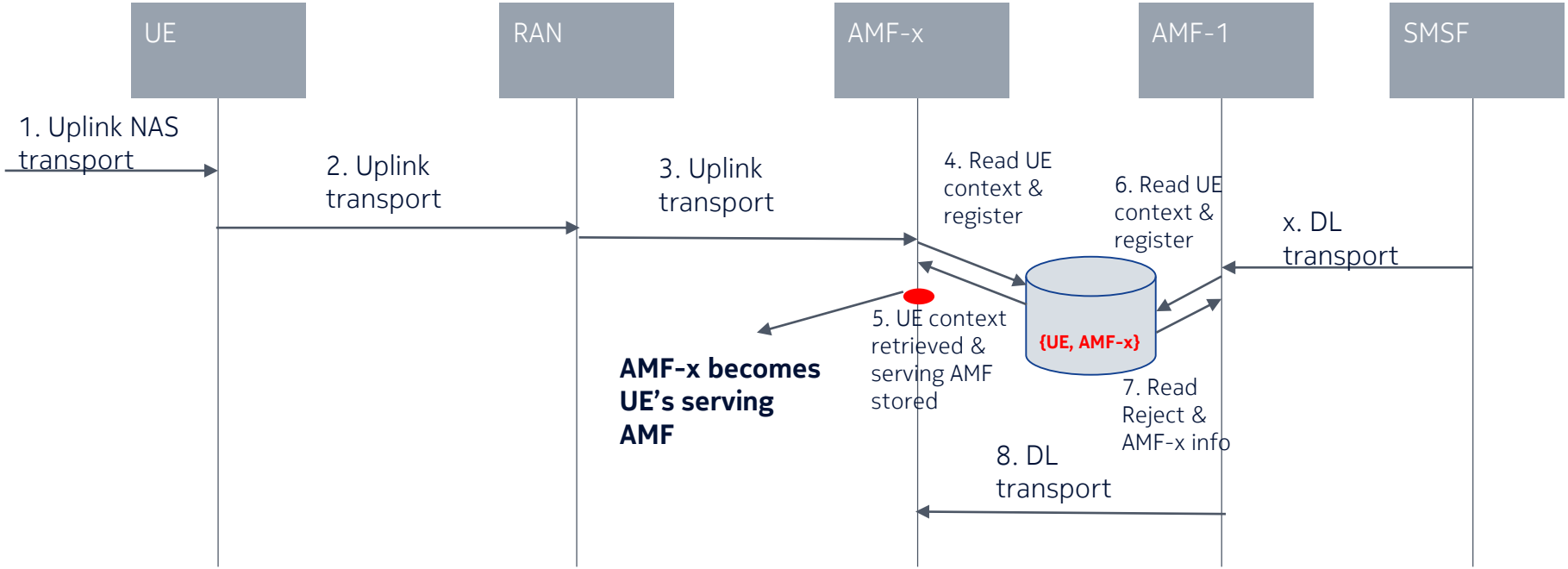
Option 2 – handling MO/MT transactions when they arrive simultaneously or sequentially



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