Handling UE/USIM with Misconfigured Routing Indicator

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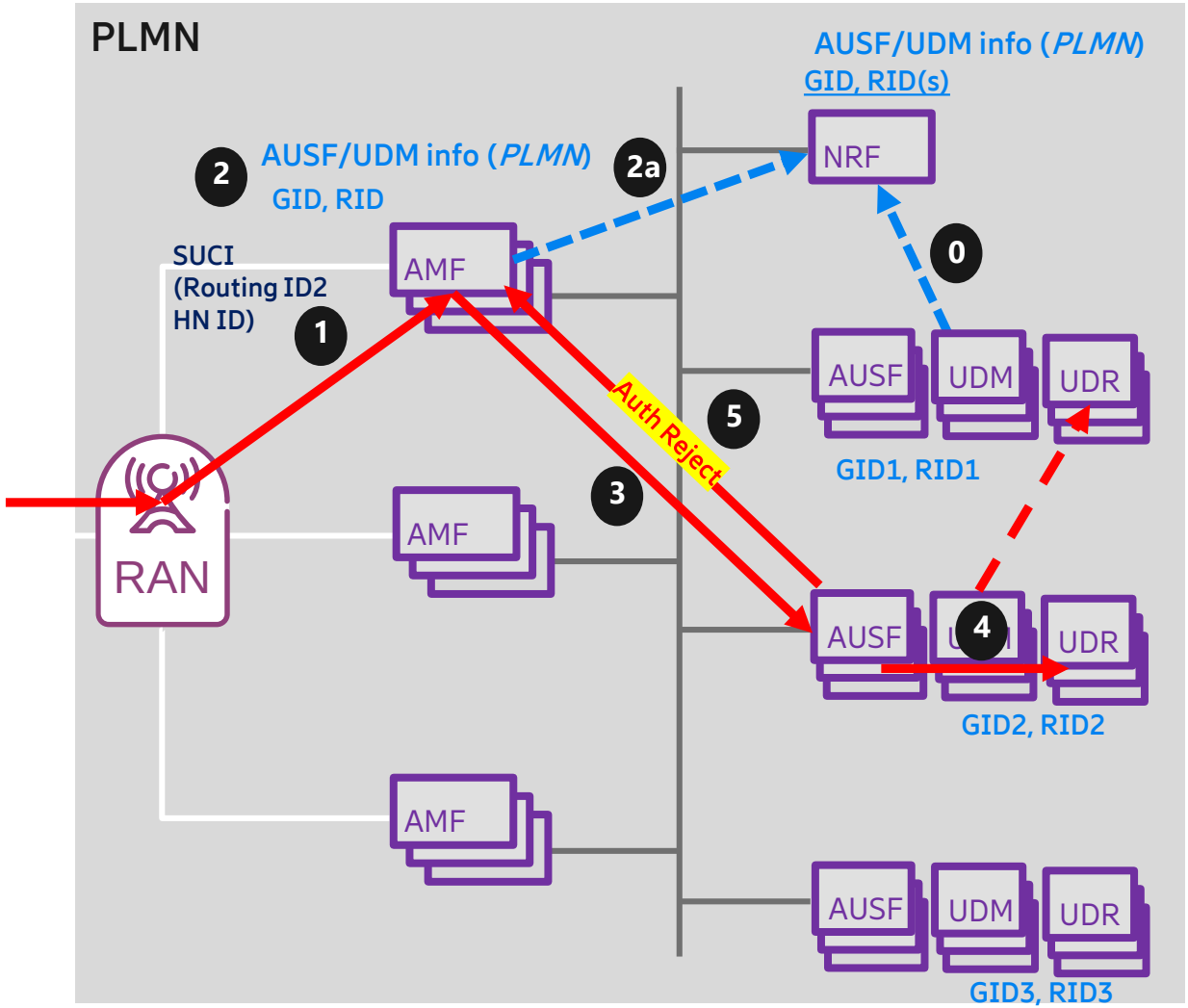
Background and Scope

- 5GC allows deployment scenarios where different sets of AUSF, UDM and/or UDR instances of AUSF, UDM and UDR serve different sets of subscriptions within a PLMN.
- In these deployment scenarios, the USIMs are required to be provisioned with a Routing Indicator (RID) that together with the Home Network Identifier allows to route network signalling to AUSF and UDM instances capable to serve the subscriber.
- The lifecycle Management of the USIMs may however be disconnected from the life cycle Management of the actual subscription within the 5GC.
  - SA2 has been discussing about the need for a mechanism to update the Routing Indicator in the USIM when the USIM for a given subscriber/SUPI is configured with a wrong Routing Indicator.
- Unless the Routing Indicator is updated using legacy Radio Access Technologies, any solution to get the USIM configured properly requires that the UE/USIMs with misconfigured Routing Indicators get connected to the 5GC despite providing a wrong Routing Indicator.
- This discussion paper, analyses this scenario and proposes the principles for a possible mechanism to achieve that these UE/USIMs get connected to the 5GC so they can be updated with a right Routing Indicator later on.

Handling of UE/USIMs with Misconfigured Routing Indicator



0) AUSF/UDM instances register in NRF.
   - Using e.g. GID, RID(s).

1) AMF receives an initial Registration request for a UE
   - UE presents a SUCI with a wrong RID meaning that at 5GC CN side SUPI is related to AUSF/UDM instances of a different RID value.
   - For example, UE presents "RID2" or "default" RID but it is defined in AUSF/UDM managing RID1 instead.

2-3) AMF selects and interacts with an AUSF instance corresponding to RID provided by UE (e.g. RID2).
   2a) NRF interaction may take place (e.g. based on RID).

4) AUSF selects a UDM based on RID2 but selected UDM can't either decrypt the SUCI or find the SUPI in the UDR managing SUPIs of the UDM GID2.

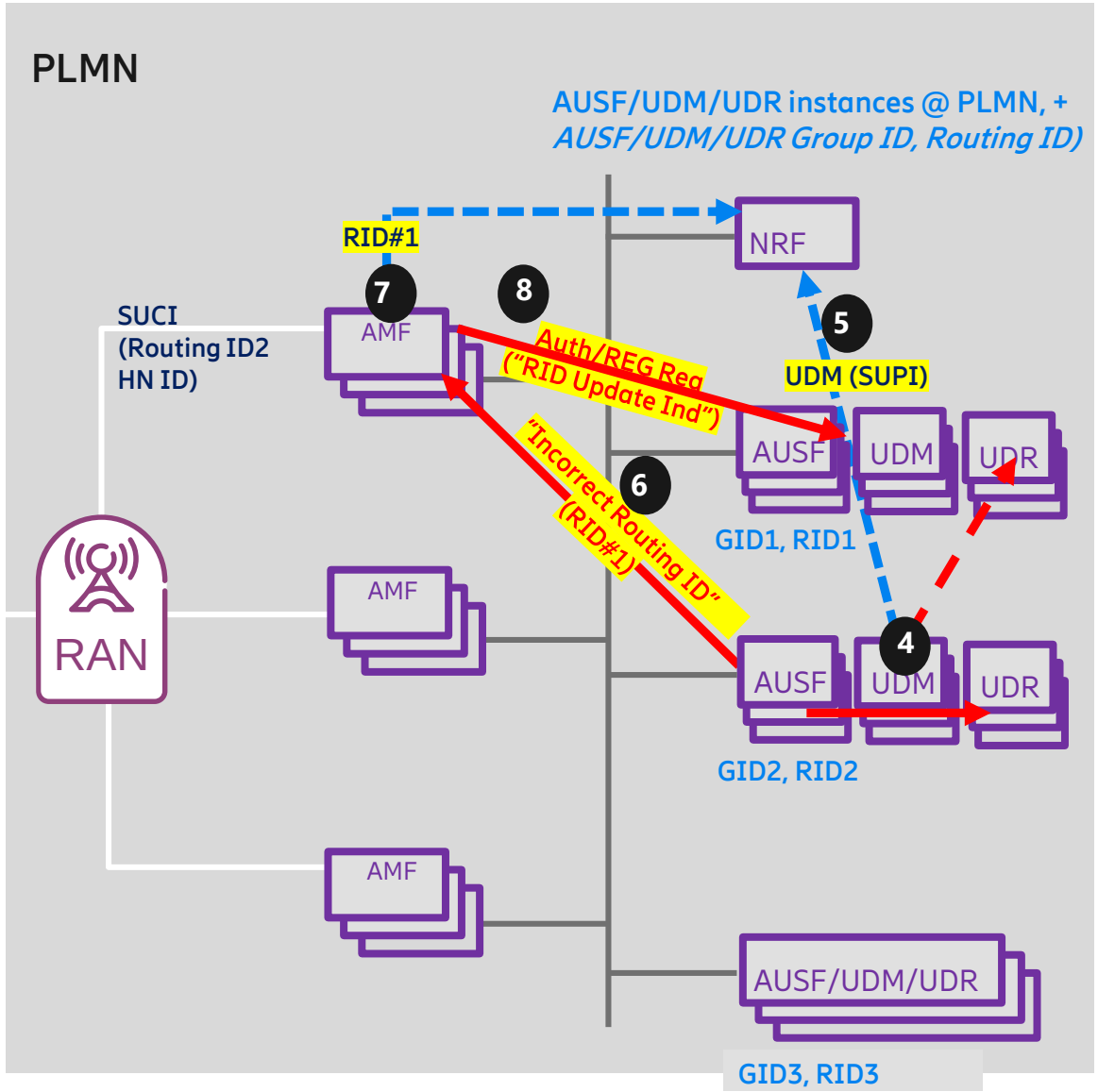
5) UDM will reject the Authentication Request.
   - A solution to ensure these misconfigured UE/USIMs can get connected is required.

Handling of Misconfigured UE/USIMs with wrong RID
Solution Principles

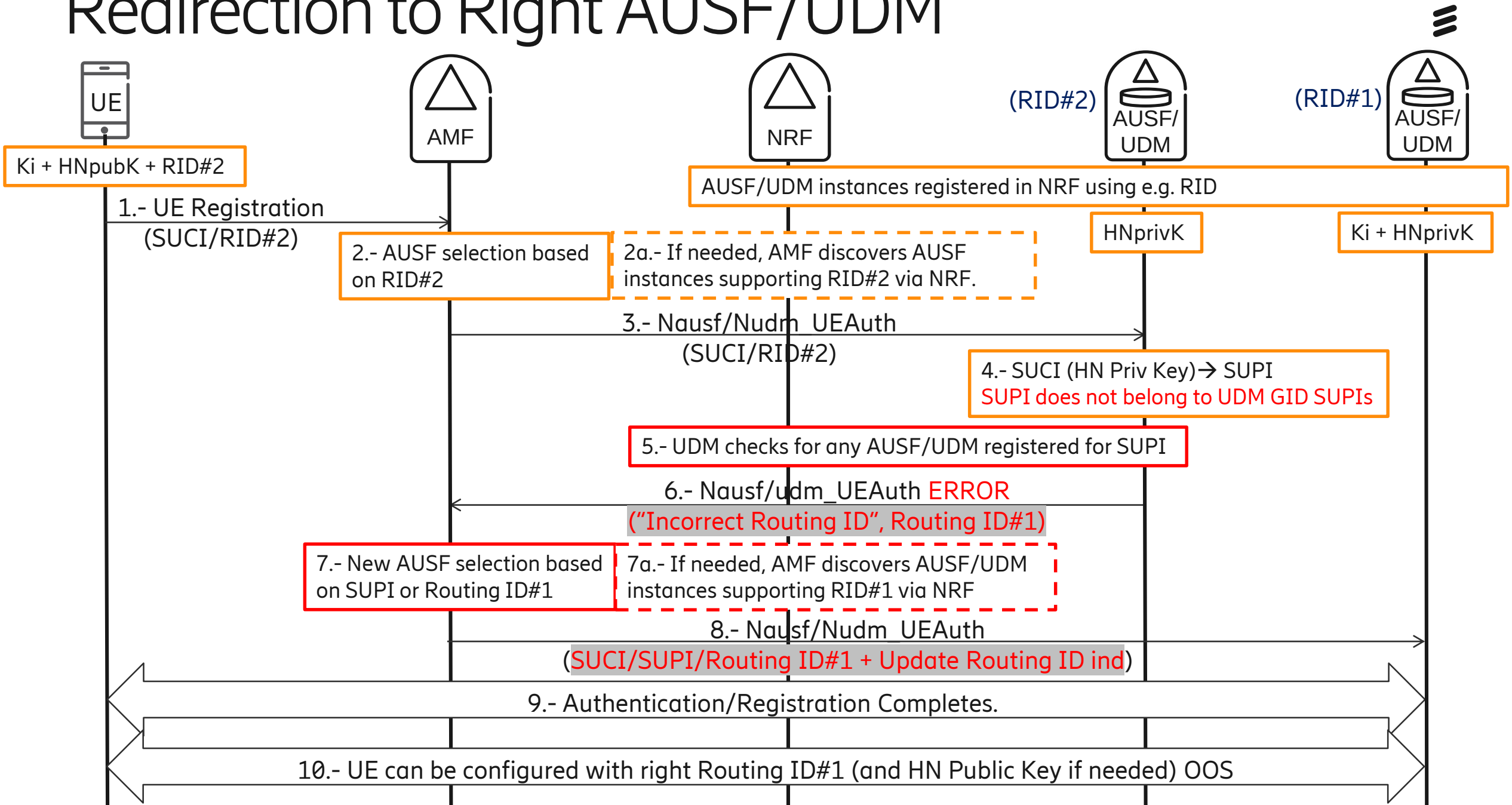
- Assumption is that any UDM instance within PLMN can decrypt any SUCI regardless UDM GID SUPI belongs to.
  - Resolution of this Use Case if this assumption is not in place becomes quite complex and requires much more impacts.
- UDM detects SUPI does not belong to the set of SUPIs managed within UDM GID … but before rejecting the Auth Request, UDM checks if SUPI can be managed by other UDM within the PLMN.
  - E.g. by interacting with NRF based on SUPI.
- If SUPI can be managed in a different UDM, UE shall be authenticated/registered using correct AUSF/UDM.
  - Would not be correct to authenticate/register UE via AUSF/UDM not managing the SUPI even if these could use the UDR storing SUPI profiles as e.g. Kausf would be kept in a wrong AUSF instance.
- UDM instructs AMF to redirect UE authentication/Registration to AUSF/UDM instances supporting that SUPI.
  - UDM Rejects Authentication Request with Redirection Indication to right AUSF/UDM instances.
  - Propose UDM provides right Routing Indicator for SUPI to AMF to redirect UE Auth/Reg to right AUSF/UDM instances.
    UDM resolves SUPI's Routing Indicator based on results of discovery procedures with NRF based on SUPI.
  - Group ID could be used but requires UDM to provide AUSF GID + UDM GID to AMF … and AMF provide UDM GID to AUSF
  - Mind SUPI can not be provided to AMF as the UE has not been properly authenticated yet.
- AMF authenticates and registers UE in 5GC with AUSF/UDM supporting the RID associated with the SUPI.
  - AMF may provide Indication to right UDM for the need to update Routing Indicator for that SUPI/UE.
  - After Auth/REG, UE/USIM can be properly configured with right RID (Out of Scope of this Analysis).

Handling of Misconfigured UE/USIMs with wrong RID
AMF Redirection to right AUSF/UDM Group

4) UDM detects possible UE/USIM misconfiguration.
5) Before rejecting the Authentication Request, UDM finds out whether SUPI is managed by another UDM within PLMN e.g. by interacting with NRF based on SUPI.
   - NRF provides RID associated with SUPI (i.e. NRF keeps a mapping of SUPI with its Routing Indicator, e.g. RID#1).
6) UDM Rejects Authentication Request with new Error Code e.g. "Incorrect Routing ID" including right RID for the SUPI.
7) AMF makes a new AUSF/UDM selection based on provided Routing Indicator. AMF may query NRF.
8) AMF authenticates UE and registers in 5GC with AUSF/UDM supporting the RID associated with the SUPI within the 5GC.
   - After Auth/REG, UE/USIM can be properly configured with right Routing ID (Out of Scope of this Analysis).



Redirection to Right AUSF/UDM

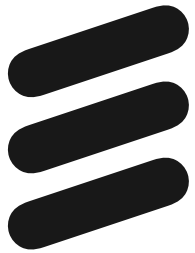


Handling of Misconfigured UE/USIMs with wrong RID
Standardization Gaps

- UDM discovery of UDM instances based on SUPI.
  - No procedure/protocol impact just allow UDM to use Nnrf service to discover other UDM instances.
- NRF to discovery results based on SUPI to include Routing Indicator of the given SUPI.
- New error code (e.g. “Incorrect Routing Indicator” + Right “Routing Indicator”) in Nausf/Nudm_UEAuthentication responses.
- AMF re-selection of AUSF based on info within unsucc Nausf response and redirection of Authentication/Registration Requests to selected AUSF/UDM instances of right Routing Indicator of SUCI/SUPI.
- New indication in Nudm_SDM_Get to trigger in UDM the update of the UE’s Routing Indicator.

Handling of Misconfigured UE/USIMs with wrong RID
Proposal

- It is proposed to agree on the principles for the solution to enable connectivity for UE/USIMs presenting a wrong Routing Indicator for the SUPI they represent according to the proposal in this Discussion Paper.
  - i.e. Based on the redirection of the UE Auth/Reg procedures to the right AUSF/UDM instances managing the SUPI.

- It is also proposed that SA2 discusses and agrees on how the solution for this scenario should be captured in 3GPP specifications.
  - Should this be considered as an error situation, then it should fall under CT4 responsibility to specify corresponding procedures. LS should be sent to CT4.
  - Should this be considered under the remit of SA2, then corresponding CRs could be provided to next SA2 meeting.

- In either case, it is proposed to consider the topic under Rel-15 scope.