3GPP TSG-WG SA2 Meeting #150E meeting S2-2202003

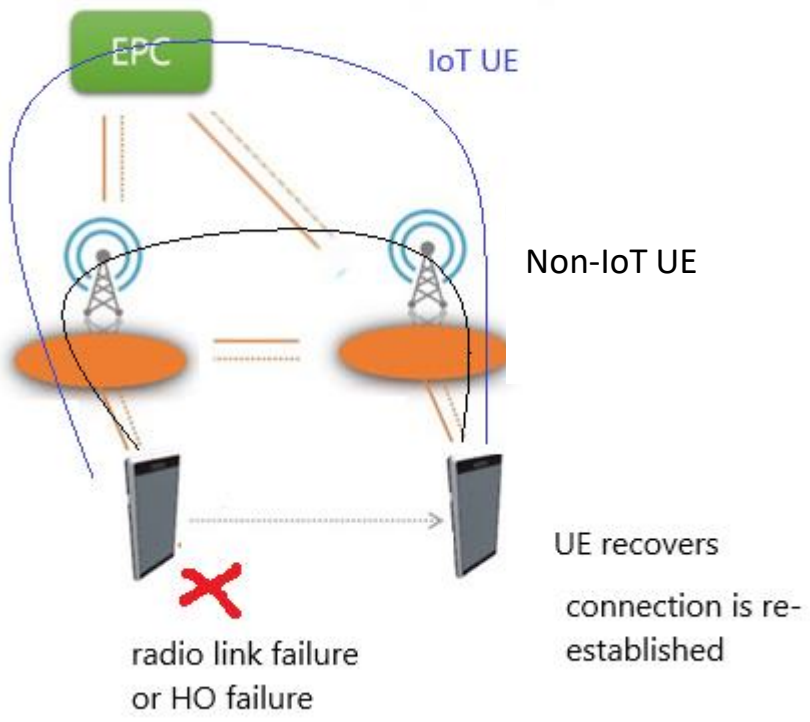
Elbonia, 6-12 April, 2022

TN-NTN NB-IoT mobility for CP-CIoT

Source: Qualcomm

Connection re-establishment for NB-IoT using CP CIoT optimisation

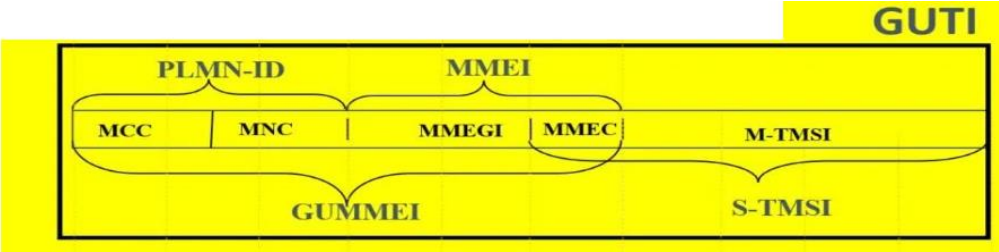
- For non-NB-IoT UE, RRC connection re-establishment is handled in the radio network
  - Core NW is not aware of it (if it succeeds)
- For NB-IoT UE, RRC connection re-establishment is handled in the MME
  - For NB-IoT using CP CIoT optimisation, there is no security in RAN. The security is handled in the core network.
  - eNB invokes the eNB CP Relocation Indication procedure to request MME to authenticate the UE
  - MME invokes the MME CP Relocation Indication procedure towards old eNB to handle the non-delivered NAS data PDUs



RRC Connection re-establishment for NB-IoT using CP CIoT optimisation (cont.)

- Upon recovering from RLF, the CP-CIoT UE sends RRC Connection Re-establishment Request message including the UE identity S-TMSI (TS 36.331):

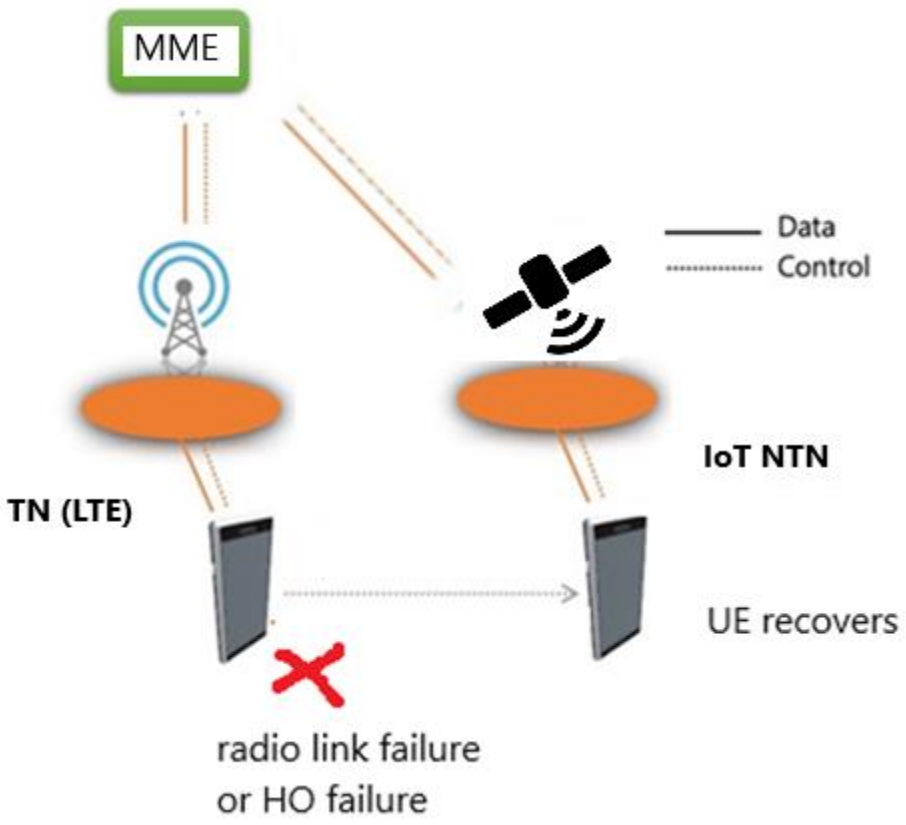
```
ReestabUE-Identity-CP-NB-r14 ::=   SEQUENCE {
 s-TMSI-r14            S-TMSI,
 ul-NAS-MAC-r14        BIT STRING (SIZE (16)),
 ul-NAS-Count-r14      BIT STRING (SIZE (5))
}
```



- MME authenticates the UE based on the security parameters included in the message (ul-NAS-MAC and ul-NAS-Count)
- There is an indication in the SIB indicating whether RRC conn. Re-establishment using S-TMSI is allowed or not.
- The procedure is documented in TS 23.401 clause 5.3.4B.5 and related RAN and SA3 specs
- RRC connection re-establishment is not supported upon RAT change

IoT TN and IoT NTN RATs

- In Rel-17, 3GPP specified IoT NTN RAT, which is satellite access network for IoT devices
- According to TS 23.401 cl. 4.13.2 NB-IoT TN and NTN cells need to be deployed in different TAs in order to perform RAT type identification in the CN
- It is possible for NB-IoT TN and NB-IoT NTN RAT to still be served by the same MME
- In this case, there seems to be no reason to not allow RRC connection re-establishment for CP CIoT UE upon RAT change (NB-IoT TN-to-NB-IoT NTN or vice versa)



RAN-based vs. NAS-based solution for RRC re-establishment upon NB-IoT TN <-> NB-IoT NTN mobility

- For the RAN-based solution, CP CIoT UE needs to know if the RRC connection re-establishment upon NB-IoT TN <-> NB-IoT NTN mobility is supported
  - Otherwise, the procedure may fail, degrading user experience
- A new SIB indication would possibly be needed to indicate support for RRC connection re-establishment upon NB-IoT TN <-> NB-IoT NTN mobility
  - The existing SIB indication cannot always be re-used because RRC connection re-establishment may be supported for NB-IoT TN <-> NB-IoT TN mobility (e.g. same MME) but not for NB-IoT TN <-> NB-IoT NTN mobility (e.g. if deployed for example in different MME)
- UE always initiates TAU procedure upon NB-IoT TN <-> NB-IoT NTN mobility (mandatory upon RAT change)
- NAS-based solution comes with no RAN impact and no NAS signaling impact (see next slide)

NAS-based Solution

1. Upon radio link recovery in NB-IoT NTN, UE establishes a new RRC connection
2. UE initiates TAU procedure (mandatory upon RAT change) and uses a new value “e.g. access change” for the EPS update type IE in the Tracking Area Update Request message
3. Based on the new EPS update type value in the Tracking Area Update Request message and s-TMSI extracted from GUTI, MME invokes the MME Control Plane Relocation Indication procedure to
   - inform the old eNB that the UE's connection is to be relocated to a new eNB and
   - retrieve the non-delivered NAS data PDUs from the old eNB
4. MME initiates mobility Tracking Area Update procedure

NAS-based solution (continued)

- There are two unused code points in the EPS update type IE in the TAU REQUEST msg

EPS update type value (octet 1, bit 1 to 3)

Bits

3	2	1	
0	0	0	TA updating
0	0	1	combined TA/LA updating
0	1	0	combined TA/LA updating with IMSI attach
0	1	1	periodic updating
1	0	0	unused; shall be interpreted as "TA updating", if received by the network.
1	0	1	unused; shall be interpreted as "TA updating", if received by the network.

All other values are reserved.

  - Rel-16 MME will process the new value “access change” as “TA updating”
  - No backward compatibility issues
- The header of the Tracking Area Update Request message contains the security parameters for the MME to authenticate the message and the UE
- If there is an MME change, the new MME supporting the new “access change” EPS update type value can either:
  - Reject the TAU request with appropriate cause value; or
  - Accept the TAU request as if it were sent with update type “TA updating”

Conclusion

- Inter-RAT mobility between NB-IoT TN and NB-IoT NTN using CP CIoT is currently not supported
- “Reusing” the RAN-based solution creates new RAN impacts
- NAS-based solution has no RAN impacts and no NAS signaling impacts
- NAS-based solution is a simpler way to handle the mobility between IoT TN and IoT NTN
- It proposed for SA2#150 to endorse the NAS based solution (see CR: S2-2202004) and send LS to RAN2, RAN3, CT1, SA3 to ask for feedback (see LS: S2-2202005)