3GPP TSG RAN Meeting #102 RP-233303
Edinburgh, Scotland, December 11-15, 2023
Agenda Item: 9.1.2.3

Views on scope for NR NTN enhancements in Rel-19

Qualcomm Incorporated

Qualcomm

Summary of proposals - NR NTN

- DL coverage enhancement including pre-paging notification
  - In certain scenarios (e.g. phone in pocket or backpack, non-LOS), downlink coverage may be limited.
  - A more robust channel may be used to notify the end user of MT call/data.
  - Other enhancements to accommodate e.g. smaller satellite power can be considered.

- Improved UL capacity (OCC)
  - In coverage limited scenarios, usage of a large number of repetitions limits the uplink capacity.
  - When operating at low coding rate, we can use orthogonal cover codes (OCC) to multiplex multiple UEs in the same RB.
  - Uplink capacity gains of up to ~10x are possible in this scenario.

- HD-RedCap over NTN
  - Due to large TA of NTN, the HD collision rules need to be redefined.
  - Our assumption is that FD-RedCap would work without any change

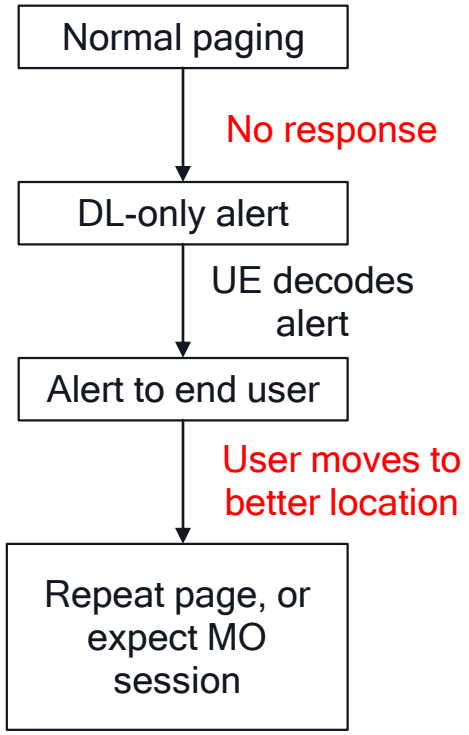
- UE PowS with discontinuous coverage
  - Extension / adaptation of NTN IOT mechanisms for discontinuous coverage.

- Mobility enhancements
  - HO signaling overhead reduction
    - Sequential HO, broadcast/groupcast HO
  - SMTC only update in connected mode

- SA2 alignment:
  - System level / architectural changes (e.g. local switch without feeder link) may need corresponding RAN changes.

Pre-paging notification & DL coverage enhancements

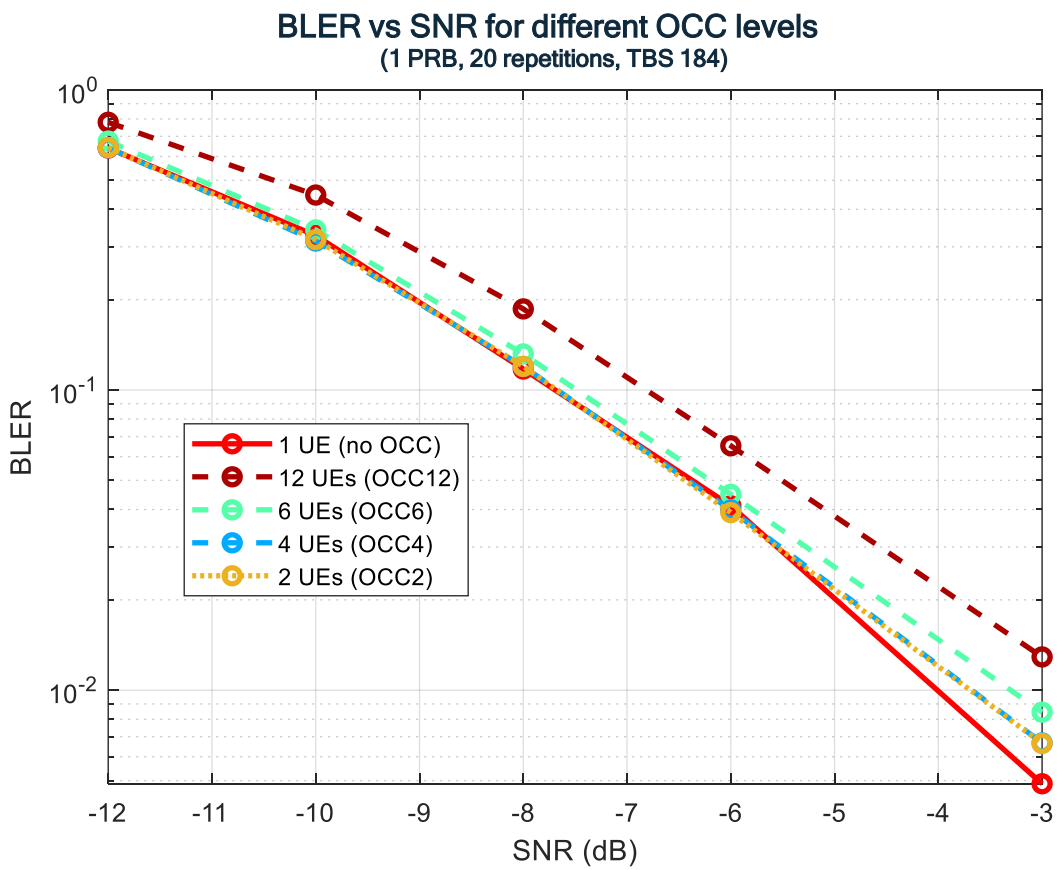
- Pre-paging notification: scenario description
  - Even with Rel-17 coverage enhancements, the link budget, especially the UL link budget has thin margins
  - For MO calls/sessions, the user is expected to move into a preferred location and to attempt to minimize blockage
  - The above doesn't work for MT calls/sessions
  - Paging may not be successful if the smartphone is in a pocket or in backpack
- Proposed enhancement
  - Introduce a 'pre-paging' alert
  - Try to reuse Rel-17 power saving enhancement, if applicable
  - Needs sufficient repetition level
    - Although the paging failure is most likely due to insufficient UL link budget
    - Need to provide close to zero false alarm to avoid annoyance factor
- DL coverage enhancements:
  - On top of the above, some small enhancements may be considered for downlink channels to accommodate e.g. power limit. Target coverage enhancement level should be decided at RAN.
  - If "system level enhancements" are to be specified (e.g. beam hopping), RAN should give a clear scope on the potential set of solutions (e.g. reusing Rel-18 NES techniques as a baseline).



Improved uplink capacity - OCC

- Long repetitions = low spectral efficiency
  - During the Rel-17 study in coverage enhancements, for NTN, it was determined that a large number of repetitions are needed to close the link in uplink.
  - For the same data rate, the same per UE performance can be achieved while drastically increasing the capacity / spectral efficiency of the system by using OCC

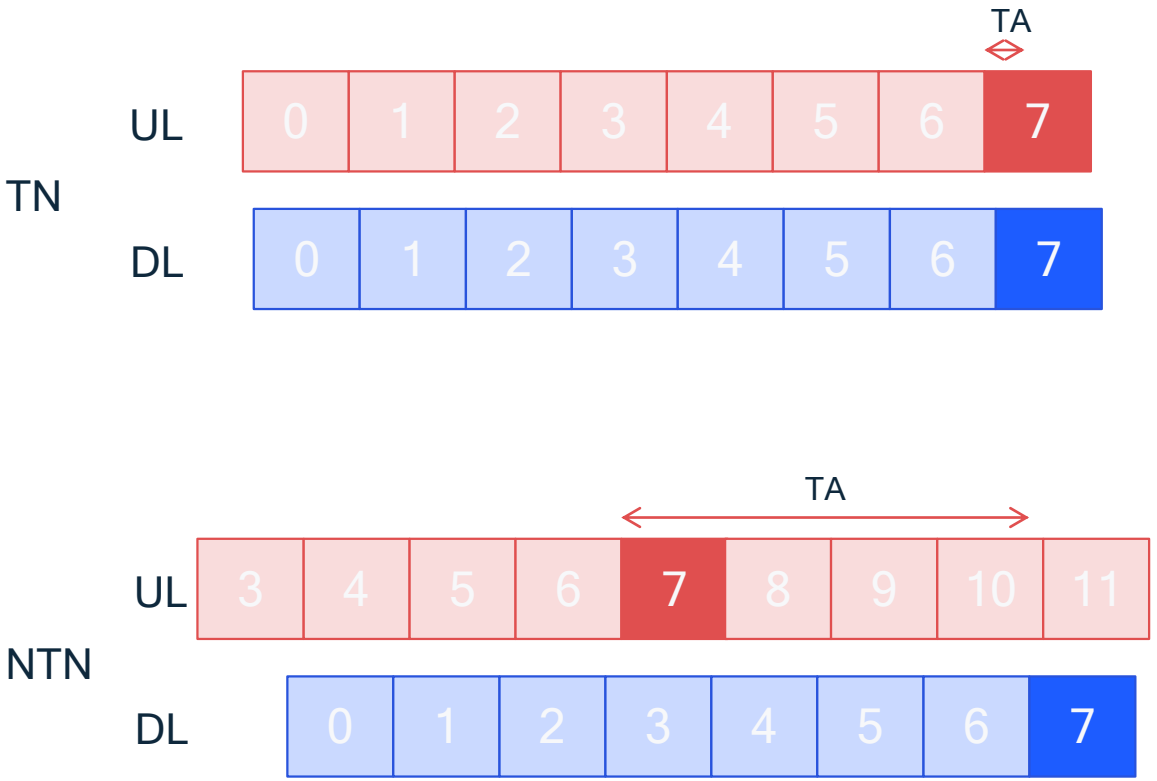
- Proposal: orthogonal spreading
  - Allows for multiplexing multiple UEs in a single PRB.
  - No performance impact at low code rates, no loss with OCC of up to 6 UEs.
  - Sub-PRB /comb can be seen as a particular case of spreading.
  - Limit the work to OCC across symbols and within one OFDM symbol (intra-OFDM symbol OCC allows to implement e.g. a comb structure)



Support of HD-FDD NTN Redcap UEs

- From RAN1 specifications, it is already possible to deploy Redcap UEs in non-terrestrial networks.

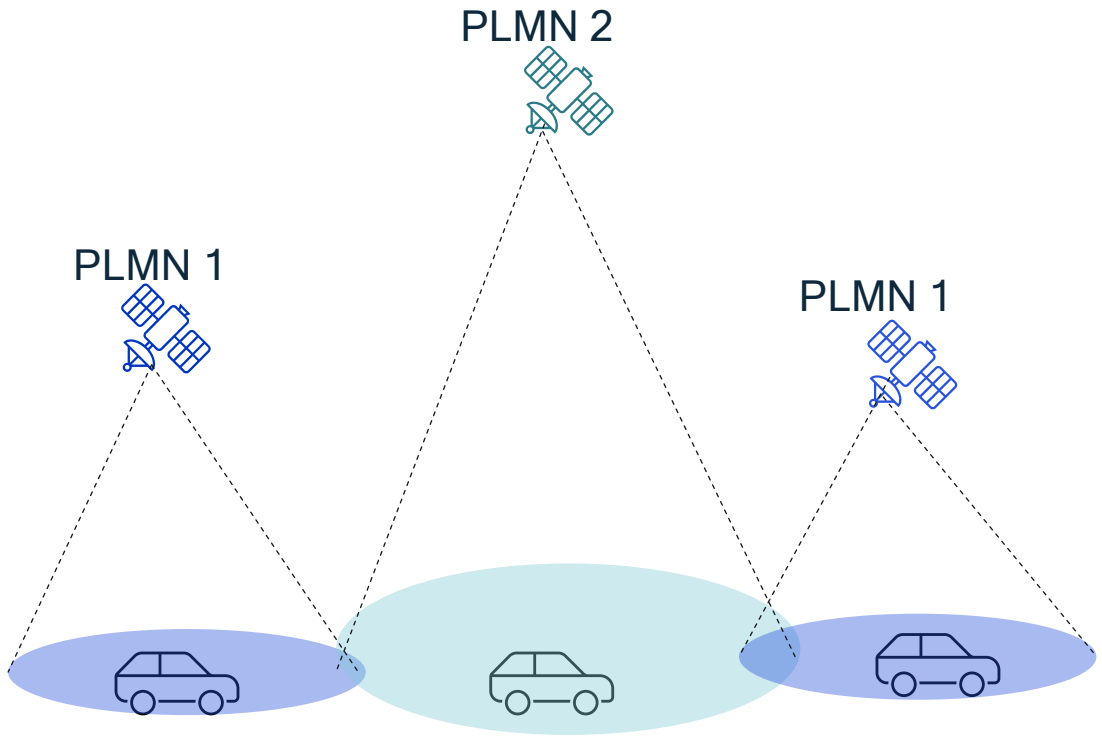
- One gap in the specifications is the handling of half-duplex UEs:
  - Due to large and open loop TA in NTN, the uplink slots may collide with multiple DL slots, even for initial access.
  - The rules for HD collision may need to be redefined considering gNB may not be aware of UE adjusted TA, similar to what was done for eMTC / NB-IoT NTN.



Discontinuous coverage for NR NTN

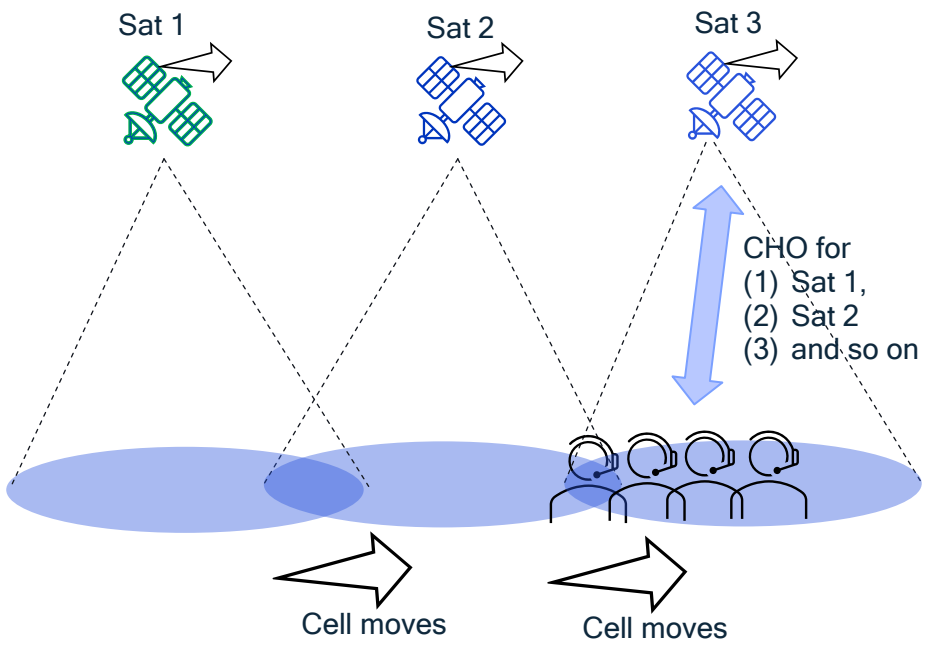
- Coverage information via SIB/RRC
  - Discontinuous coverage solution adopted in IoT NTN can be baseline.
  - Neighbor satellite service start time information can be supported by SIB or RRC signaling.
  - This can be per PLMN, e.g., HPLMN vs EPLMN.
  - This can be based on user's type, mobility prediction or subscription.
  - When a UE is in discontinuous coverage from a PLMN, it could try to access other PLMNs for quicker coverage/service based on subscription/charging policy.

- Proposed enhancement
  - Support delivery of discontinuous coverage information to UE via SIB and RRC messages and specify its use.



Mobility enhancements

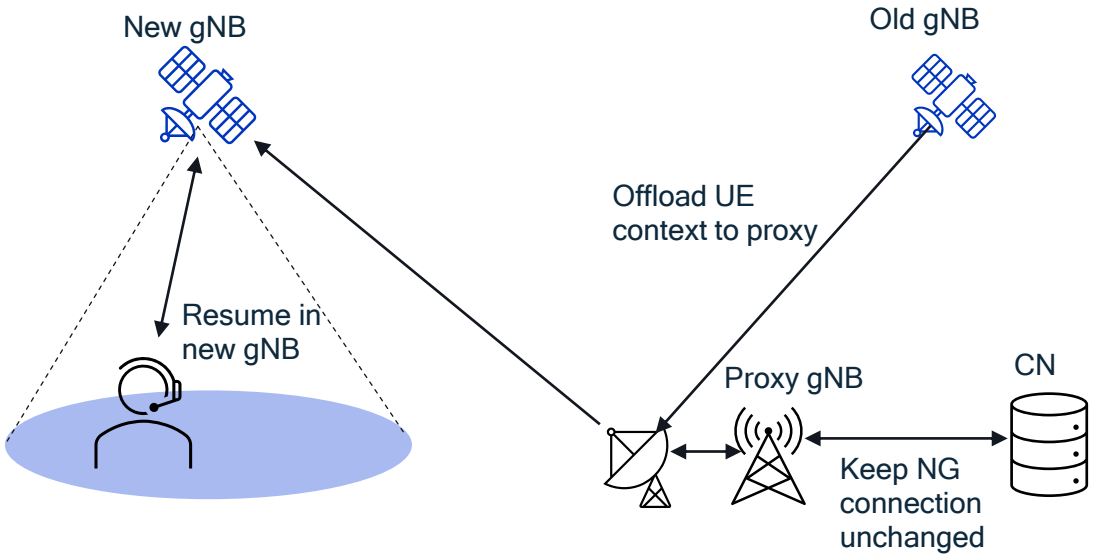
- “SMTC only” update in connected mode
  - SMTC update is provided via measurement object reconfiguration. This requires UE to remove the measurement reporting entry from the *VarMeasReportList*.
  - Network cannot just provide the update of SMTC offset only.
    - In case of satellite switch with PCI unchanged, network needs to update SMTC as soon as possible after UE synchronizes to new satellite.
- HO signaling overhead reduction
  - Sequential CHO
  - broadcast/groupcast handover
- TN to NTN mobility
  - Inter-RAT satellite information, e.g., E-UTRA TN providing NR NTN satellite information



Sequential CHO

Alignment with SA2 - regenerative payload

- New features potentially introduced by SA2 need the corresponding work in RAN2/RAN3 (lead WG should be SA2).
- Regenerative payload architecture
  - On-board gNB can reduce round trip delay.
  - Due to movement of gNB, some further enhancements for RRC_CONNECTED and RRC_INACTIVE state can be considered.
    - For example, pre-configured target gNB, gNB context relocation/proxy gNB on ground to avoid frequent NG-AP setup with core network.
  - Study any optimization for initial access procedure
    - For example, to wait core network response in RA-SDT
  - Specification impact should be reduced as much as possible (e.g. limited to stage 2).



Qualcomm

Thank you

Follow us on:

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog