RP-212353

3GPP TSG RAN #93e
Electronic Meeting, Sep 13 - Sep 17, 2021

R18 FR2 Specific L2/L3 Enhancements

Apple Inc.

Additions to RAN Plenary R-18 WS Topic #3

- With this presentation, we intend to bring up for discussion and propose additional L2/L3 based enhancements that are specific to FR2 to be included as part of the mobility enhancements topic #3.

- Topic #3 : Mobility enhancements, with the following example areas:
  - Layer 1/layer 2 based inter cell mobility
  - DAPS (Dual Active Protocol Stack)/CHO (Conditional HandOver) related improvements
  - FR2 (frequency range 2)-specific enhancements

FR2 Aspects | Potential Areas of improvement

- Many potential areas of improvements…
  - Frequent sudden loss of beam strength
    - Due to blockage
    - Due to MPE
      - For eg: Loss of signals in the uplink while the downlink is good.
    - Due to orientation of the UE (antenna panel displacement etc)
  - Latency in beam locking
    - P1/P2/P3 steps needed for beam locking
      - (P1 - DL Rx beam sweep, P2 - DL beam refinement, P3 - UL beam refinement)
  - Gaps in Tx/Rx, leading to inefficiencies
    - Gaps for switching (between beams for eg, PDCCH/PDSCH and SSB)
    - Gaps for UL Tx swithcing
    - Gaps for UL calibration etc.

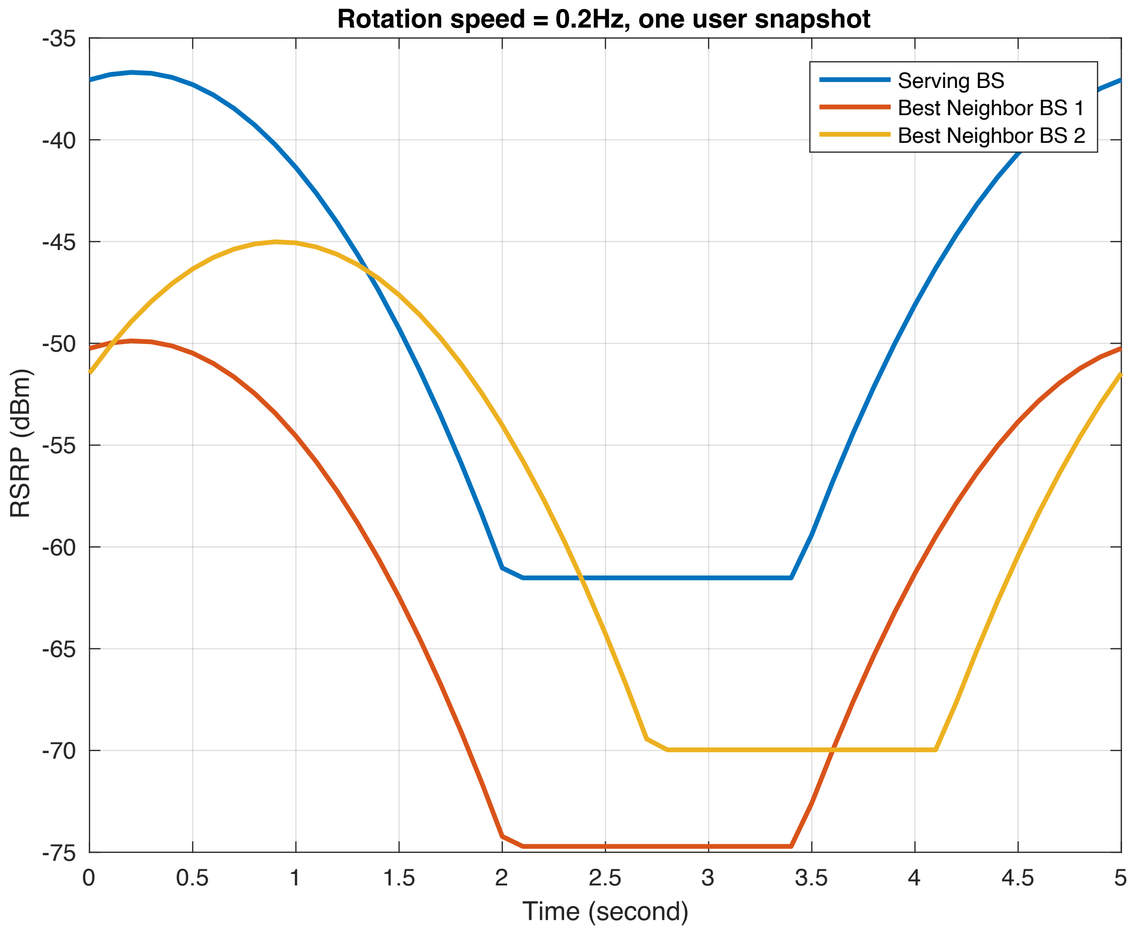
- Addressable aspects for Rel-18 timeframe
  - sudden loss of beam strength (either in static case or during mobility)

FR2 Aspects | Beam Loss - Main Areas of improvement

- Observed in field trials
  - Frequent sudden loss of beam strength
  - UL going bad while the DL remains ok (for eg., from MPE or due to UL/DL imbalance)

- In-house simulations[1] have also shown a large degradation in received power due to UE rotation (of around 20dB).

- Critical to address such issues at least in Rel-18, as this problem can exacerbate in applications where latency is critical (for eg., in XR applications)



[1] R2-1904984 - On NR Mobility in FR2. Apple Inc.

FR2 Aspects | Solution Approach

- Approach on addressing this for Rel-18
  - To inform the NW about the UE impairments in advance if possible, if these impairments effect the L2/L3 procedures.
  - To inform the NW about UE's view of the beams wherever L2/L3 gets impacted.
    - Allow the NW to take actions based on accurate information about the UE/channel conditions.

- L2 level communications/feedback would be a better choice
  - The changes are relatively long term (i.e., likely 500ms to seconds)
  - A level of feedback from L1 HARQ on the communication.
  - Does not entail the processing delay associated with RRC.

- Additional UE procedural change for mobility based on the above
  - Procedural/functional changes at the UE for any L3 procedures like filtering, event triggering, UL related DL pathloss calculations etc..

- There is discussion in RAN1 on L1/L2 based signalling for some of the aspects we raised, but
  - The discussion might not have a conclusion in Rel-17 due to availability of time, in which case, need to be handled in Rel-18.
  - L2/L3 procedures can be viewed as complimentary to the current Rel-17 discussions

FR2 Aspects | Proposal

- **Proposal**: To evaluate and design potential L2/L3 enhancements to address the FR2/FR2.x link/beam impairments
  - Specifically, to evaluate L2 and L3 procedures that can conduct mobility procedures that follow more accurately the channel conditions [RAN2, RAN1, RAN4]

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