3GPP TSG RAN #101
Bangalore, India, September 11 - 15, 2023
RP-232091
Agenda Item: 9.3.2.7
Document for: Discussion

Discussion on Rel-18 NR NTN

NTT DOCOMO, INC.

Background

WID description (RP-231484)

4.1.1 Coverage enhancement

The Rel-18 NTN objectives are focused on the applicability of the “solutions developed by general NR coverage enhancement” (NR_cov_enh) to NTN, and identifying potential issues and enhancements if necessary, considering the NTN characteristics including large propagation delay and satellite movement. Only NTN-specific characteristics are to be included in this coverage enhancement work, otherwise it should be part of another WI (e.g., UL enhancement of coverage).

The following reference scenario is considered for the definition of uplink coverage enhancements for NTN: parameter set-1 for LEO-1200 satellite operating at Line of Sight (LOS) and commercial smartphones with -5.5 dBi antenna gain and 3 dB polarisation loss (per antenna port).

Note: It is understood that the enhancements defined for LEO can also apply to GEO and MEO scenarios as appropriate. No additional work is expected for MEO/GEO.

The targeted services are VoIP using AMR 4.75 kbps and data transmission services with Low data rate of 3 kbps.

The detailed objectives are for NTN:

- To specify PUCCH enhancements for Msg4 HARQ-ACK (e.g. repetition) [RAN1, RAN4]
- To specify if necessary, enhancements to the Rel-17 procedures for DMRS bundling for PUSCH taking into account NTN-specifics (e.g. time-frequency pre-compensation) [RAN1]

Background

Conclusion in RAN#100

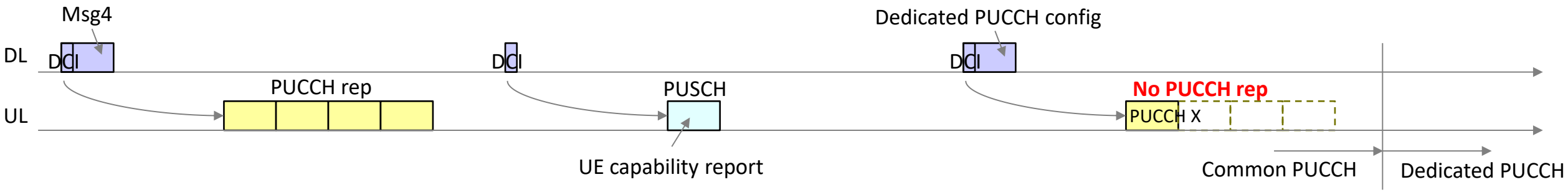
RP-231482 **Way forward on WI NR_NTN_enh** ***THALES***

conclusion: proposals 1/2/3/4/5(opt.1) are endorsed

- Proposal 5: Select one among the 2 options here after
  - Opt1: The discussion on the followings is postponed to RAN#101 however without further discussion in RAN1#114
    - whether to support repetitions for PUCCH transmission when dedicated PUCCH resource configuration is not provided
    - Regarding the PUCCH transmission behavior after the transmission of HARQ ACK of PDSCH with UE contention resolution identity until the decoding of RRC message containing dedicated PUCCH resource configuration, whether to support SIB indication for the choice between "no PUCCH repetition" or "same as the PUCCH transmission of HARQ ACK of PDSCH with UE contention resolution identity"

Discussion

- <u>Coverage issue of PUCCH by using common PUCCH resource</u>
  - So far, RAN1 agreements/working assumptions/conclusions were made for PUCCH transmissions for Msg4 HARQ-ACK. However, it is observed that **coverage issue is remaining in PUCCH transmissions** as illustrated below
    - » There is no restriction to convey dedicated PUCCH configuration on Msg4 PDSCH, but gNB has not received at that timing any PUCCH-related capabilities except for repetition of Msg4 HARQ-ACK. gNB cannot configure appropriate dedicated PUCCH config before the capabilities, and hence it will be typical to provide dedicated PUCCH config after Msg4 PDSCH
    - » If PUCCH repetition is not applicable to the subsequent PUCCH transmissions (let's call PUCCH X), it is clear that handheld UEs face coverage issue of the PUCCH transmission
    - » The fact in RAN1 study phase to identify which channel should be enhanced is that coverage performance of PUCCH X was not explicitly evaluated; companies may have understood that coverage performance of 'PUCCH for Msg4 HARQ-ACK' intends for 'PUCCH X' as well, but it was not clarified explicitly



Discussion

- Coverage issue of PUCCH by using common PUCCH resource
  - This issue was discussed in the two RAN plenary meetings and in the two RAN1 meetings, but no consensus was reached. One note is that an agreement was made in RAN1, where technical part is decided but whether spec supports the feature has not been concluded

> **Agreement**
> If PUCCH repetition discussed in R18 NR NTN coverage enhancement is supported for PUCCH transmission when dedicated PUCCH resource configuration is not provided:
> - The agreements and working assumptions for PUCCH for Msg4 HARQ-ACK are applied to any PUCCH transmission by using common PUCCH resource
> - The same repetition factor is applied for PUCCH for Msg4 HARQ-ACK and subsequent PUCCH transmissions by using common PUCCH resource
> - Note: It is not precluded for gNB to provide dedicated PUCCH config via Msg4 PDSCH.

  - Based on further offline discussion, the following three alternatives can be identified
    - » Alt 1: Apply repetition for PUCCH X
    - » Alt 2: Apply repetition for PUCCH X only when enabling repetition of PUCCH X is provided via SIB
    - » Alt 3: Dynamically indicate per UE/TX which repetition factor is applied for PUCCH X
  - Most companies have the same view on this issue, i.e., support Alt 1, while one company believes that 1) Msg4 PDSCH can include temporal dedicated PUCCH config or 2) gNB should not be forced to use the same repetition factor for PUCCH X due to variation of channel condition and thus support Alt 2.
  - However, the 1st rationale, where PUCCH X is not used, should not block Alt 1 and the 2nd rationale seems to be aligned with Alt 3 rather than Alt 2. Note that Alt 3 has been already precluded in the above RAN1 agreement.

Proposal: For coverage enhancement, 'PUCCH enhancements for Msg4 HARQ-ACK' in R18 NR NTN is applied to 'PUCCH transmission when dedicated PUCCH resource configuration is not provided'

- ***Note: Additional work in RAN1 for PUCCH after TX of Msg4 HARQ-ACK is not expected***

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