



3GPP TSG RAN Rel-19 workshop

Taipei, June 15 - 16, 2023

Agenda Item: 5

Source: Apple

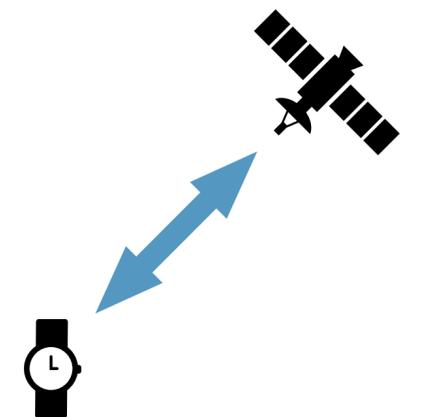
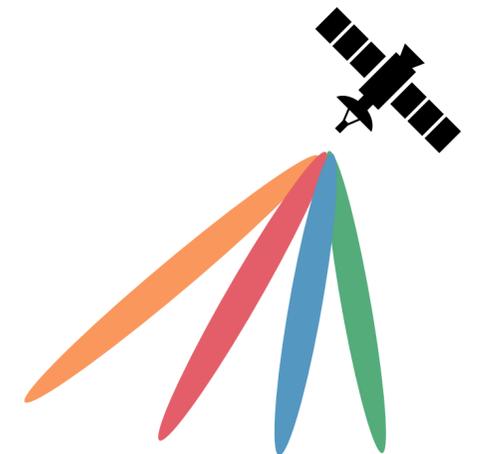
RWS-230279

Views on NTN Enhancements for R19

Apple

Rel-19 NR NTN | NTN Coverage Enhancement

- Coverage is the most important issue for successful NTN commercialization
 - Further enhancement to both DL and UL are needed
- For NTN DL coverage enhancement
 - NTN DL coverage issue can arise from multiple factors
 - Single satellite sectorization
 - Single satellite to support multiple cells by beam forming
 - Mobile terminated (MT) call or messaging may experience lower SNR due to lower user cooperation.
- Further coverage enhancement should also be considered for the following case
 - Support of RedCap (Wearable) of NTN considering the following factors
 - Antenna gain loss due to wearable format fact
 - Reduced number of Rx/Tx
 - Discontinuous coverage of satellites



Rel-19 NR NTN | NTN Coverage Enhancement

- Justification:
 - R1-2208268 (FL's note): margin when satellite TX power reduction is not applied:
 - PDCCH and Msg4 PDSCH, Msg2 PDSCH have the least margin among downlink channels
 - With the adjustment of UE antenna gain from -5 dBi to -5.5 dBi
 - Msg2 PDSCH: 6.7 to 10.3 dB
 - Msg4 PDSCH: 3.3 to 6.2 dB
 - PDCCH: 5.4 to 9.7 dB
 - Satellite total transmission power:
 - Set-1 satellite: 10 dBW/MHz without Tx antenna gain
 - In case of 20 MHz bandwidth, satellite Tx power is upper bounded 23 dBW or 200 Watts.
 - Satellite transmission power per beam
 - Multiple beams per cell is supported in NTN
 - If satellite transmits on more than 4 beams simultaneously, then PDCCH will start having coverage issue
 - More transmission power needs to be allocated to beams with smaller elevation angles



Rel-19 NR NTN | NTN Coverage Enhancement

Number of simultaneous beams	Tx power per beam (dBW)	EIRP density per beam (dBW/MHz)	Tx power reduction amount (dB)	PDCCH coverage gap
1	23	40	0	-6
2	20	37	3	-3
4	17	34	6	0
8	14	31	9	3
16	11	28	12	6
32	8	25	15	9



Rel-19 NR NTN | NTN Coverage Enhancement

- Objectives
 - For Rel-19 NR NTN enhancement, focus the effort on coverage enhancement for both DL and UL, considering all the following factors [RAN1]
 - DL transmission power limitation
 - Coverage loss due to RedCap (Wearable) devices including both
 - Antenna gain loss due to the form factor
 - Reduce number of Rx/Tx
 - For Rel-19 NR NTN enhancement, study RRM relaxation for NTN on RedCap UE, and specify corresponding requirements if necessary, considering all the following factors [RAN4]
 - Power saving in RRM, e.g., cell detection/measurement/monitoring
 - NTN with 1Rx on RedCap UE
 - For Rel-19 NR NTN enhancement, study the higher layer power saving mechanism of the NTN on RedCap UE in the scenario of discontinuous satellite coverage [RAN2]
 - Suspend or minimize the AS function (e.g. no mobility, relax measurement, suspend data activity) when in the discontinuous satellite coverage.



Rel-19 NR NTN | Operation without GNSS

- Justification
 - R17/18 NTN assumes UE has GNSS capability
 - Uplink time and frequency synchronization is based on UE's GNSS location and satellite ephemeris
 - UE may not always receive GNSS signals due to
 - Power saving
 - GNSS measurement gap
 - Infeasible GNSS signal
 - GNSS independent operation is one of the use cases in R19 SA1 study.
- Objectives
 - **Operations for UE without GNSS**
 - Uplink synchronization in RRC idle mode
 - RACH enhancement
 - Uplink synchronization in RRC connected mode
 - Time and frequency synchronization maintenance enhancement
 - Note: other impacts need to be considered together (e.g., DL synchronization, measurement)

