3GPP TSG RAN Rel-19 workshop
Taipei, 15th - 16th, June 2023
Source: SK telecom
Agenda item: 6

RWS-230343

High-Power UE (HPUE) for Rel-19 NR NTN

SK telecom

Introduction

- **In Rel-18, antenna gain of handheld UE was changed from 0 dBi to -5.5 dBi by assuming more realistic UE devices.**
  - Handheld UE with -5.5 dBi antenna gain may experience UL link budget deficiency issue especially for bad weather.
  - At least in emergency scenarios, it is needed to consider increasing power of the handheld devices for successful communication with satellites in Rel-19.

- **In Rel-18, targeted services are VoNR AMR 4.75 kbps and data transmission services with low data rate of 3 kbps.**
  - With the evolution of satellite hardware, satellites will be able to provide high data rate services on smartphones.
  - So, from Rel-19, we should start discussing HPUE to secure sufficient data rate and UL link budget.

- **Therefore, it is necessary to discuss the increase of handheld device power for Rel-19 NR NTN.**

Discussion

- **Observation 1: With modified antenna gain of -5.5 dBi, handheld UE device may suffer from link budget deficiency.**
  - Link budgets calculated below are under clear sky assumption. If we assume bad weather, this issue could become more severe.
  - Increasing PUSCH repetition level to greater than 20 could solve this issue, however this will cause an increase in latency.

Table 1: Link budget calculation with -5.5 dBi antenna gain based on [R1-2205826]

Satellite parameters	LEO 1200 with Set 2 parameters (TR 38.811)					
UE transmit power [dBm]	23					
UE antenna gain [dBi]	-5.5					
Frequency [GHz]	2.00					
TX: EIRP [dBm]	17.5					
RX: G/T [dB/T]	-4,90					
Free space path loss [dB]	164.48					
Atmospheric loss [dB]	0.07					
Shadow fading margin [dB]	3					
Scintillation Loss [dB]	2.2					
Polarization loss [dB]	3					
Additional losses [dB]	0					
Type	**PUSCH Msg3**	**PUSCH VoNR**	**PUCCH**	**PRACH format 2**	**PRACH format B4**	**PRACH format 0**
Bandwidth [MHz]	0.36	0.72	0.18	1.048	2.16	1.048
Achievable CNR [dB]	**-17.11**	**-20.12**	**-14.1**	**-21.75**	**-24.89**	**-21.75**
Minimum required SNR [dB]	**-14.6**	**-14.2**		**-18.5**	**-14.2**	**-13.3**
SNR Gap [dB]	-2.51	-5.92		-3.25	-10.69	-8.45

Discussion

- **Observation 2: The default power class for handheld UE in Rel-18 NR NTN is Power Class 3, which has a maximum output power of 23 dBm.**

Table 2: UE Power Class for NR NTN [TR38.101-5]

NR satellite band	Class 3 (dBm)	Tolerance (dB)
n256	23	±2
n255	23	±2

- **Observation 3: For certain NR bands, NR UE devices are permitted to transmit with power levels exceeding +26dBm.**
  - The NTN system can adopt power classes already defined in the NR core specifications, such as PC1.5 (+29dBm) and PC1 (+31dBm).

- **Thus, to fully exploit the potential of next generation satellite links, higher power classes should be considered for the NTN UEs.**

Conclusion

- **Based on the previous observations, we strongly suggest as following;**

- **Proposal 1: High-power UE should be discussed as a solution for NR NTN coverage enhancement.**
- **Proposal 2: High-power UE should be discussed to support high data rate services and secure sufficient UL link budget for the NR NTN FR1 bands.**

Thank You.