vivo

3GPP TSG RAN Rel-18 workshop RWS-210171

Electronic Meeting, June 28 – July 2, 2021

Support of lower UE power class for Uu and SL in Rel-18

Source: vivo

Document for: Discussion & Decision

Agenda Item: 4.3

Background

- UE power class in LTE
  - Power class 3 (23dBm), Power class 2(26dBm) supported for general use cases
  - Power class 1 (31dBm) supported for some limited use cases
  - In addition to power class 3, LTE eMTC and NB-IOT supports power class 5 (20dBm) and power class 6 (14dBm)
  - LTE SL-V2X supports power class 3 only
- UE power class in NR
  - Similar as LTE, NR supports power class 1, power class 2, power class 3 for Uu
  - NR also supports power class 3 for SL-V2X
  - However, power class 5 and power class 6 is missing in NR
- NR Redcap
  - Redcap support UE BW down to 20MHz in Rel-17

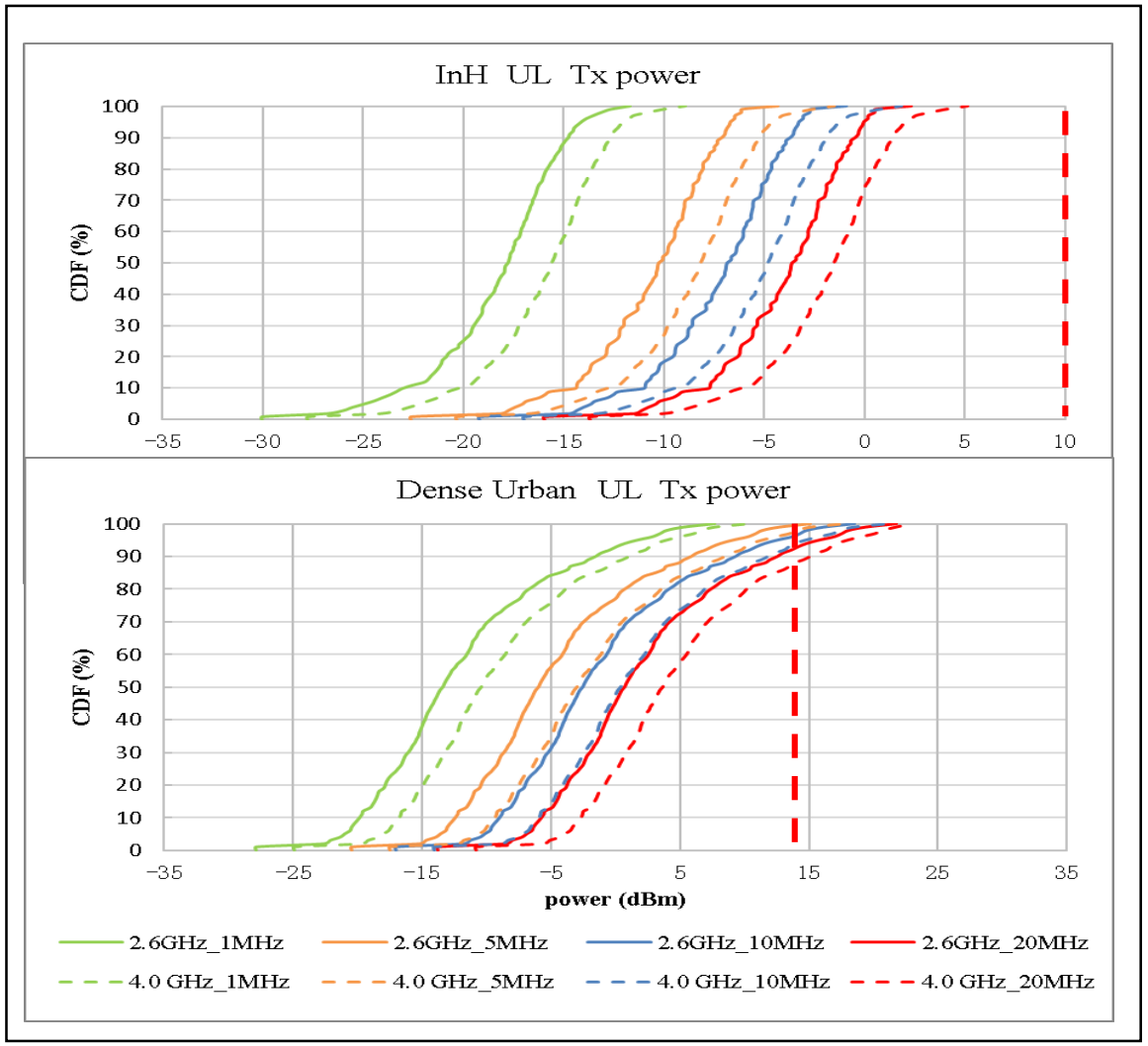
PA efficiency

SET_POUT	N78						B41					
	4.2V			APT			4.2V			APT		
	P_DC (mW)	CALC_GAIN	CALC_PAE	P_DC (mW)	CALC_GAIN	CALC_PAE	P_DC (mW)	CALC_GAIN	CALC_PAE	P_DC (mW)	CALC_GAIN	CALC_PAE
0	2673.65	28.37	0.04	188.02	23.71	0.53	2500.29	29.77	0.04	67.42	15.16	1.48
1	2759.09	28.40	0.05	187.12	23.69	0.67	2585.83	29.76	0.05	67.46	15.27	1.87
2	2726.63	28.40	0.06	191.74	23.33	0.83	2497.58	29.76	0.06	70.27	15.40	2.26
3	2707.14	28.39	0.07	184.32	23.67	1.08	2579.28	29.75	0.08	73.30	15.53	2.72
4	2682.96	28.38	0.09	186.50	23.58	1.35	2497.85	29.74	0.10	133.17	22.72	1.89
5	2660.94	28.38	0.12	186.97	23.53	1.69	2579.64	29.74	0.12	137.31	22.80	2.30
6	2739.27	28.42	0.15	188.31	23.46	2.11	2539.60	29.80	0.16	139.99	22.81	2.84
7	2703.60	28.43	0.19	189.72	23.39	2.64	2526.21	29.81	0.20	144.69	22.79	3.46
8	2656.93	28.46	0.24	191.71	23.30	3.29	2608.50	29.81	0.24	147.81	22.84	4.27
9	2751.45	28.47	0.29	190.54	23.07	4.17	2504.68	29.84	0.32	152.77	22.88	5.20
10	2727.13	28.47	0.37	185.63	22.73	5.39	2561.32	29.88	0.39	162.92	22.91	6.14
11	2697.57	28.48	0.47	191.68	22.32	6.57	2512.72	29.82	0.50	171.59	22.91	7.34
12	2736.01	28.37	0.58	187.96	21.28	8.43	2658.30	29.72	0.60	181.06	22.72	8.75
13	2715.69	28.37	0.73	758.32	26.66	2.63	2582.16	29.71	0.77	195.97	22.65	10.18
14	2703.74	28.35	0.93	760.49	26.61	3.30	2641.42	29.76	0.95	782.55	29.74	3.21
15	2682.39	28.35	1.18	768.14	26.53	4.12	2579.59	29.73	1.23	758.39	29.76	4.17
16	2751.31	28.41	1.45	993.01	27.45	4.01	2637.29	29.80	1.51	796.78	29.74	5.00
17	2707.97	28.45	1.85	1001.77	27.38	5.00	2632.75	29.83	1.90	1201.88	30.23	4.17
18	2705.55	28.42	2.33	1283.83	27.90	4.91	2629.49	29.88	2.40	1212.98	30.25	5.20
19	2780.00	28.49	2.86	1270.63	27.92	6.25	2714.94	29.92	2.93	1235.65	30.24	6.43
20	2723.12	28.56	3.67	1261.62	27.93	7.93	2829.67	29.96	3.53	1270.70	30.21	7.87
21	2789.83	28.65	4.51	1495.50	28.24	8.42	2841.21	30.04	4.43	2204.84	30.32	5.71
22	2869.40	28.73	5.52	1489.07	28.26	10.64	2876.02	30.11	5.51	2245.26	30.36	7.06
23	2826.35	28.81	7.06	2210.34	28.76	9.03	3034.57	30.13	6.58	2345.92	30.32	8.51
24	2888.24	28.74	8.70	2281.76	28.65	11.01	3162.94	30.00	7.94	2472.92	30.16	10.16
25	3043.21	28.80	10.39	2303.53	28.66	13.73	3312.55	30.00	9.55	3312.55	30.00	9.55
26	3089.46	28.88	12.89	2695.60	28.82	14.77	3507.55	29.97	11.35	3507.55	29.97	11.35
27	3254.55	28.94	15.40	2759.97	28.83	18.16	3676.45	29.91	13.63	3676.45	29.91	13.63
28	3346.26	28.96	18.86	3346.26	28.96	18.86	4000.57	29.82	15.77	4000.57	29.82	15.77
29	3521.70	28.91	22.56	3521.70	28.91	22.56	4307.99	29.56	18.44	4307.99	29.56	18.44

Figure 1. Power efficiency (marked red when less than 5%), N78 and N41
Two PA implementation choices: 1) Constant 4.2V P_DC; 2) APT (adaptive power tracking)

- Currently, NR devices are mandated to support 23dBm power class
  - GaAs based external PA is used to support 23dBm
  - However,
    - Indoor devices normally transmits at low power level, e.g. 0~15dBm, in such range the PAE (PA efficiency) is very low (less than 5%)
    - GaAs based PA also increases the device cost

UE Tx power distribution



- Observation from SLS based on 3GPP model
  - For InH scenario,
    - 10dBm Tx power level is sufficient for 100% UEs
  - For dense urban scenario,
    - 14dbm Tx power is sufficient for 90%+ UEs with 20MHz Tx BW
    - 14dBm Tx power is sufficient for 100% UEs with 5MHz Tx BW or lower
- For short range communication based on sidelink (i.e. non-V2X), e.g. wearables, 23dBm is not needed
- With lower UE power class (e.g. 14dBm, 20dBm), CMOS PA is feasible instead of GaAs
  - Reduced device cost
  - Improved PAE in low Tx power range, compared with 23dBm capable devices by GaAs PA
  - Applicable for UE types with shorter communication range

Proposal

- Support lower UE power class(s) for Uu and sidelink in Rel-18
  - Both power class 5 (20dBm) and power class 6 (14dBm) can be considered

THANK YOU.
谢谢。