

64TRx MIMO and above for Rel-19 NR MIMO evolution



Introduction

- **The maximum number of CSI-RS ports is still limited to 32 which is the same as in Rel-15.**
 - **In Rel-16/17:** many NR MIMO features were specified with a focus on DL performance improvement (e.g., Type II CSI overhead reduction, Multi-TRP operation). However, the maximum number of CSI-RS ports is unchanged.
 - **Rel-18:** UL performance improvements (e.g., 8Tx UL operation targeting CPE/FWA/vehicle/Industrial devices) is one of main topic of Rel-18 MIMO evolution. As a result, expansion of the number of CSI-RS ports beyond 32 port was behind.
- **At the same time, mainstream of mid-band 5G radio market is shifting from 32TRx radio to 64TRx radio.**
 - 64T64R radio provides significant gain over 32TRx radio using increased vertical beamforming flexibility and antenna gain.
 - So, many operators are deploying lots of 64TRx radio equipments in their commercial network now.
- **So, we believe that one of most important aspects of Rel-19 NR MIMO evolution is to maximize performance of 64TRx Massive MIMO radio equipment which is already in live network.**

Discussion

- **Observation 1: 64TRx Massive MIMO radio's beamforming flexibility cannot be fully utilized at cell edge (i.e., when SRS is released) due to the current 32 ports CSI-RS limitation.**
 - 64TRx radio provides significant gain over 32TRx radio if the CSI acquisition based on channel reciprocity is possible.
 - However, there is no performance difference between 32TRx and 64TRx radio if SRS is released due to its inherit Tx power limitation

Figure 1. digital beamforming ports under current 32 Ports CSI-RS limitation

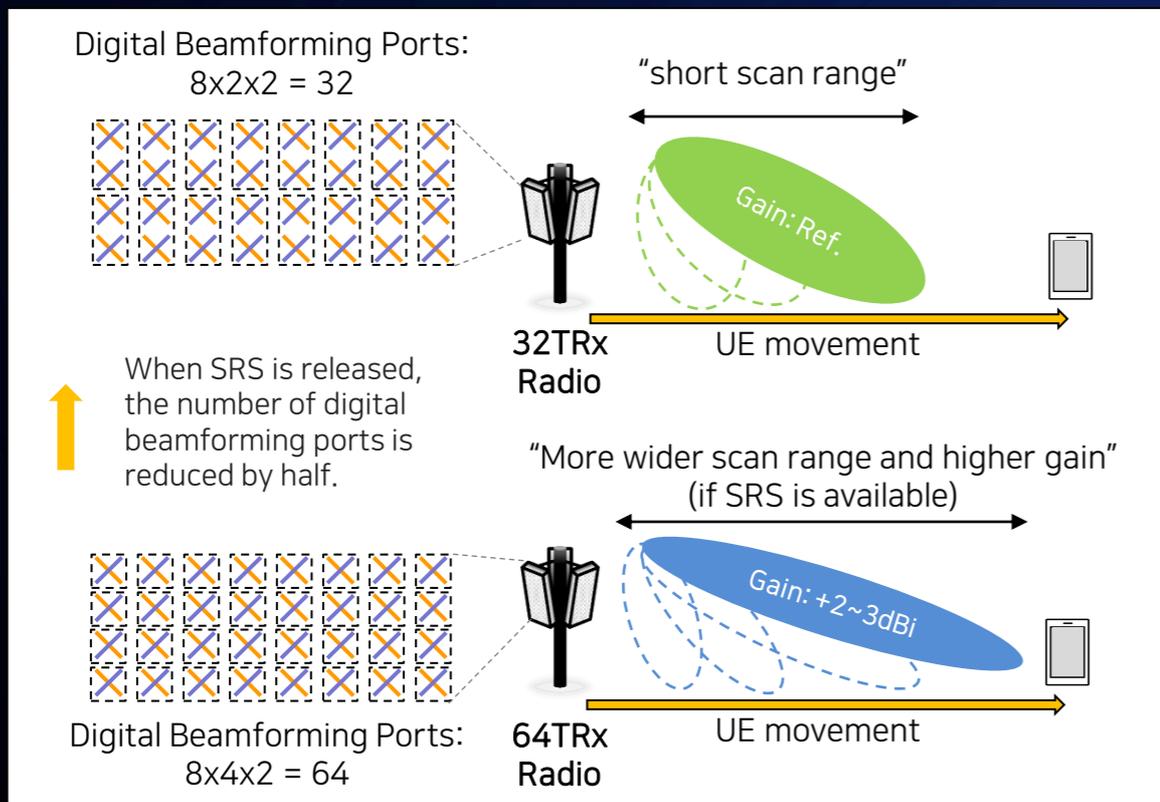
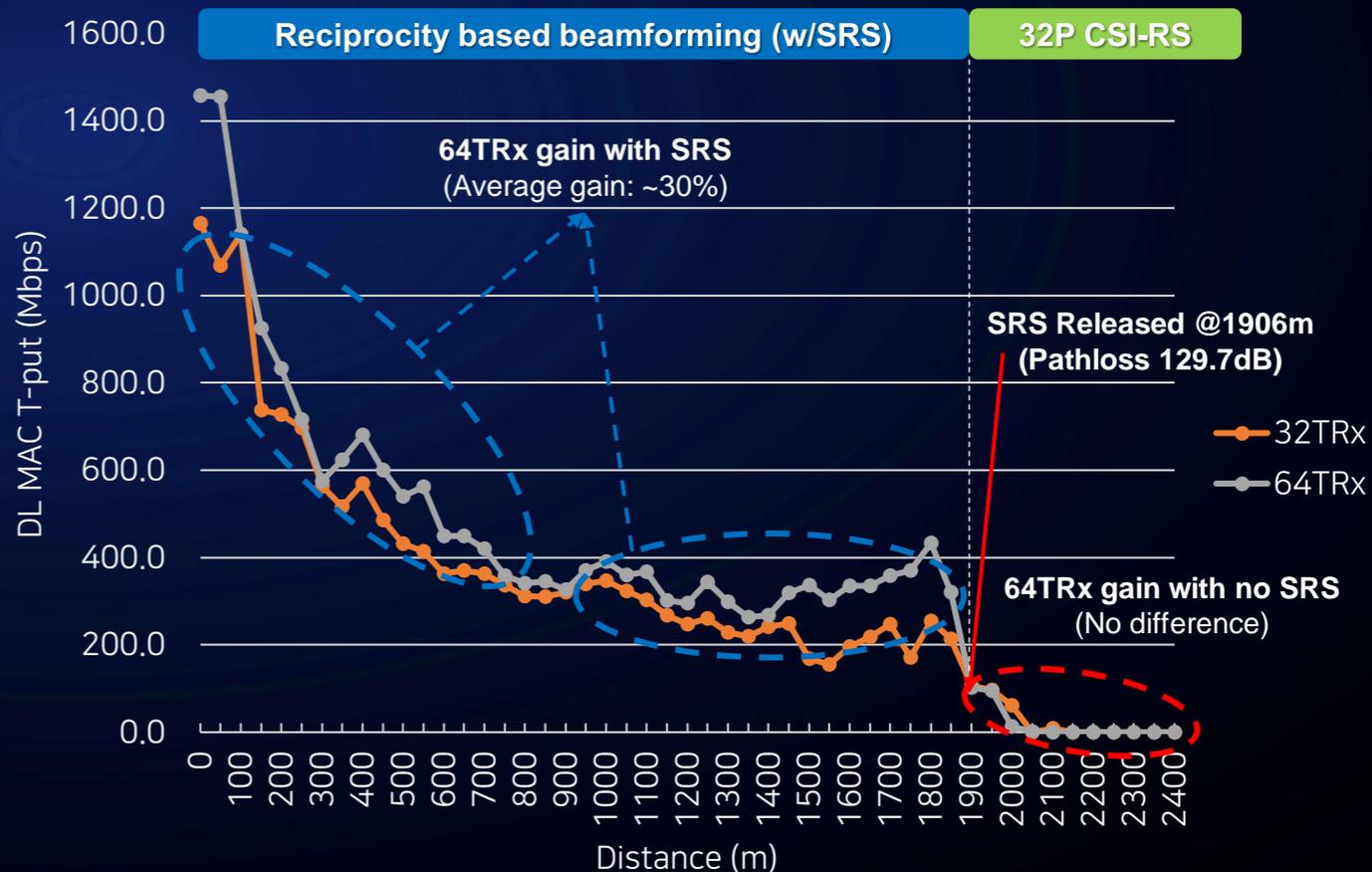


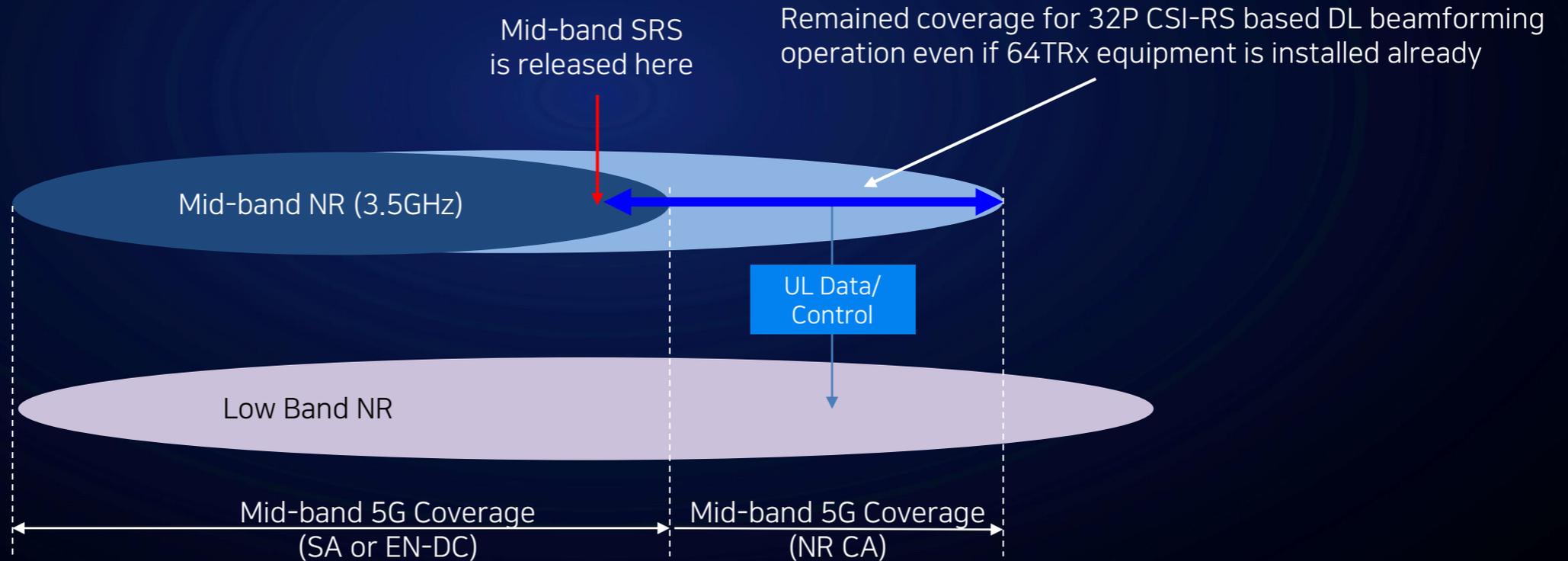
Figure 2. DL performance comparison of 32/64 TRx radio (Tx Power: 50.2/52dBm)



Discussion

- **Observation 2:** Considering low/mid-band NR CA scenario, there is quite large mid-band 5G DL coverage for 32P CSI-RS based DL beamforming operation even if new 64TRx equipments are installed for mid-band.

Figure 3. 32 Port CSI-RS based operation coverage for low-band & mid-band NR CA scenario



Discussion

- **Observation 3:** Even at cell center, 64T64R Massive MIMO radio's beamforming flexibility cannot be fully utilized for large number UEs in a cell under current maximum 32 Ports CSI-RS limitation.

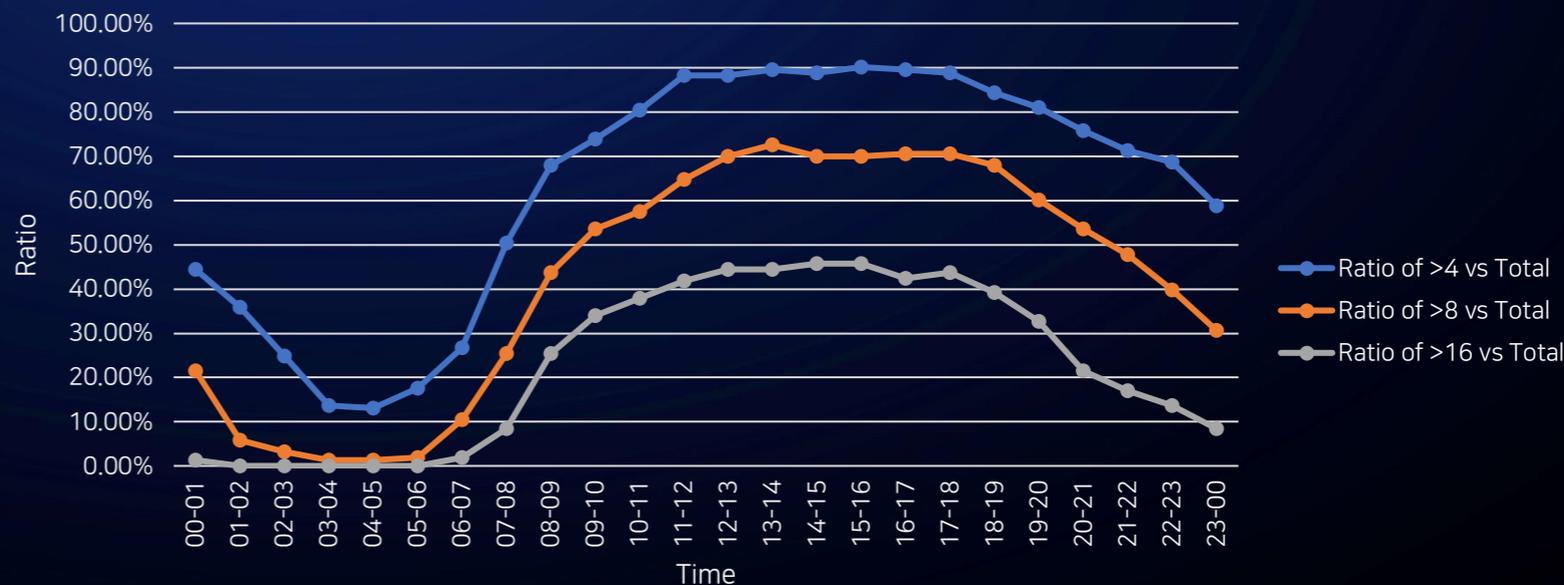
- Practically, the number of 10ms TAS based beamforming UEs in a cell is limited by 8 ~ 16 for 'DDDSU' TDD Pattern with 10:2:2 special slot format (globally wide-used)

Table 1: Maximum 10ms TAS UEs in a cell (4:1 TDD Pattern, 1T4R UE)

UE Capability	Periodicity	Band	Comb (comb offset)	Cyclic shift	Maximum 10ms TAS UEs in a cell
1T4R	sl20	272RB (full-band)	n4 (0,1,2,3)	0/6	8 UE
1T4R	sl20	272RB (full-band)	n4 (0,1,2,3)	0/3/6/9	16 UE

- Based on SK telecom's commercial network statistics in typical urban outdoor area (total 153 Cells, 23/3/2~3), >40% of cells has more than 16 active users during normal daytime already.

Figure 4. The ratio of cells with >4/6/16 5G active UEs in typical urban outdoor area of SK telecom



Conclusion

- Based on the previous observations, we strongly suggest as following;
- **Proposal:** Extending CSI-RS resource to 64/96/128 ports and defining related Type I codebook (e.g., $N_2 > 2$ when $N_1 = 8$) should be specified in Rel-19 NR MIMO evolution.

Thank You.

