Possible observation 3.2.1-updated2

For the study of adaptation of PRACH in spatial domain, following network energy savings gains were reported by sources based on the evaluation framework agreed in RAN1#116bis:

* Two sources showed following NES gain for TDD, CAT1 BS power model, case C1 vs A1-1, zero load [CATT, Ericsson]
  + -4% ~ -45%
* Eight sources showed following NES gain for TDD, CAT1 BS power model, case C1 vs B1/A1-2, zero load [Nokia, vivo, Interdigital, Samsung, ZTE, Ericsson, Qualcomm]
  + 0% ~ 31%
  + Note: Five sources assumed that case B1 has same PRACH resources as case A1-2. Remaining three sources evaluated only A1-2.
  + Note: Three sources showed NES gains 0% ~ 10% only [Nokia, vivo, Interdigital]
* One source showed following NES gain for TDD, CAT1 BS power model, case C1 vs B1, zero load [CMCC]
  + 1.0%~8.8%
  + Note: The evaluation results provide the NES gain of spatial domain PRACH adaptation compared to time domain PRACH adaptation, where spatial domain and time domain PRACH adaptations are based on dynamic switching between PRACH resources according to two PRACH configuration indexes.
* One source showed following NES gain for TDD, CAT1 BS power model, case C1 vs B1, zero load [Xiaomi]
  + -48.41%~0%
  + Note: For B1, it was assumed that periodicity of PRACH resources can be adapted. For C1, it was assumed that periodicity of PRACH resources is not adapted and some ROs within a periodicity can be deactivated.
* For TDD, CAT1 BS power model, for case C1 vs A1-2, zero load
  + One source showed NES gains 4.59%~38.04% [Xiaomi]
* Four sources showed following NES gain for TDD, CAT2 BS power model, case C1 vs B1/A1-2, zero load [ZTE, Nokia, Huawei, Xiaomi]
  + 0% ~ 3.5%
  + Note: Three sources assumed that case B1 has same PRACH resources as case A1-2. One source evaluated only A1-2.
* One source showed following NES gain for TDD, CAT2 BS power model, case C1 vs B1, zero load [CMCC]
  + 0%~0.2%
  + Note: The evaluation results provide the NES gain of spatial domain PRACH adaptation compared to time domain PRACH adaptation, where spatial domain and time domain PRACH adaptations are based on dynamic switching between PRACH resources according to two PRACH configuration indexes
* One source showed following NES gain for TDD, CAT2 BS power model, case C1 vs B1, zero load [Xiaomi]
  + -1.19%~0%
  + Note: For B1, it was assumed that periodicity of PRACH resources can be adapted. For C1, it was assumed that periodicity of PRACH resources is not adapted and some ROs within a periodicity can be deactivated.
* Two sources showed following NES gain for TDD, CAT1 or CAT2 BS power model, case C2 vs B2, zero load [Huawei, Ericsson]
  + Less than 0.2%
* One source showed following NES gain for TDD, CAT1 BS power model, (C1 vs A1-2 with changed PRACH format), PRACH format A, 10ms PRACH periodicity, different loads [Intel]
  + 13.7%/8.7%/4.9%/2.6% for zero/low/light/medium cell load
* One source showed following NES gain for TDD, CAT1 BS power model, (C1 vs B1 with changed PRACH format), PRACH format A, 10ms PRACH periodicity, different loads [Intel]
  + 8.03%/5.1%/3.06%/1.74% for zero/low/light/medium cell load
* One source showed following NES gain for TDD, C1 vs B1/A1-2, different loads [ZTE]
  + 16%/4.78% for light/medium cell load for CAT1 BS power model
  + 0.65%/0.29% for light/medium cell load for CAT2 BS power model
* One source showed following NES gain for TDD, C1 vs B1, different loads [Xiaomi]
  + -18.57%~0%/-2.52%~0% for low /medium cell load for CAT1 BS power model
  + -0.81%~0%/-0.42%~0% for low /medium cell load for CAT2 BS power model
  + Note: For B1, it was assumed that periodicity of PRACH resources can be adapted. For C1, it was assumed that periodicity of PRACH resources is not adapted and some ROs within a periodicity can be deactivated.
* One source showed following NES gain for TDD, C1 vs A1-2, different loads [Xiaomi]
  + 3.67%~19.88%/2.29%~5.22% for low /medium cell load for CAT1 BS power model
  + 0.67%~1.75%/0.39%~0.91% for low /medium cell load for CAT2 BS power model
  + Note: For C1, it was assumed that periodicity of PRACH resources is not adapted and some ROs within a periodicity can be deactivated.
* One source showed NES gain for FDD, C1 vs B1, zero load [CMCC]
  + 1.4%~7% for CAT1 BS power model
  + 0%~0.3% for CAT2 BS power model
  + Note: The evaluation results provide the NES gain of spatial domain PRACH adaptation compared to time domain PRACH adaptation, where spatial domain and time domain PRACH adaptations are based on dynamic switching between PRACH resources according to two PRACH configuration indexes
* One source showed NES gain for FR2, CAT1 BS power model, spatial domain adaptation of PRACH configuration index 75 vs a time domain adaptation of PRACH configuration index 75, zero load [Qualcomm]
  + 4%~7%
* Note 1: About possibility of scenarios with non-uniform distribution of UEs in different beams
  + Several companies indicated (and three companies showed data/analysis) that there can be scenarios with non-uniform distribution of UEs in different beams.
  + Several companies mentioned that for non-uniform UE distribution, it can be addressed by gNB implementation e.g. by adjusting SSB beamwidth, etc. Several companies also mentioned that it is not clear how gNB can predict the distribution of UEs in different beams, especially for Idle/Inactive UEs.
* Note 2: Most sources that showed the NES gains (if any) for adaptation of PRACH in spatial domain compared to A1-2/B1 observed that the gain would be due to reduction in the number of overall ROs in time domain in their evaluations. Most of these companies only accounted for ROs in time domain.
* Note 3: The evaluation results assumed the non-uniform distribution of UE is static during the evaluation time period.