3GPP TSG RAN Rel-19
Edinburgh, Scotland, December 11-15, 2023

RP-233288

Agenda Item: 9.1.1.5
Source: Xiaomi
Document for: Discussion

Views on Rel-19 network energy saving

Xiaomi

Background and overall progress in Rel-18 Network Energy Saving

- In Rel-18 NES SI, time/frequency/spatial/power domain techniques are extensively simulated and evaluated.

Time domain

- A-1: Adapting transmission/reception of common channels/signals
- A-2: Adaptation of UE specific signals and channels
- A-3: UE wake up signal (WUS) for gNB
- A-4: Adaptation of DTX/DRX
- A-5: Adaptation of SSB/SIB1

Frequency domain

- B-1: Multi-carrier energy savings enhancements
- B-2: Adaptation of bandwidth part of UE(s) within a carrier
- B-3: Adaptation of bandwidth of UE(s) within a BWP

Spatial domain

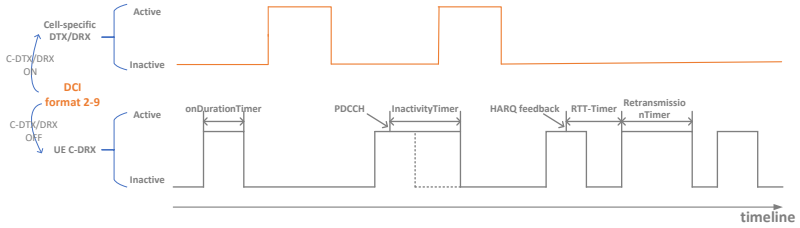
- C-1: Adaptation of spatial elements
- C-2: Adaptation of TRPs in mTRP operation

Power domain

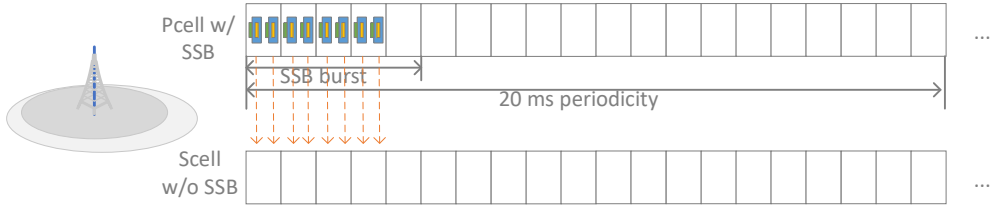
- D-1: Adaptation of transmission power of signals and channels
- D-2: Over the air digital pre-distortion
- D-3: Tone reservation
- D-4: PA power bias adaptation
- D-5: UE post-distortion

- In Rel-18 NES WI, 3GPP focus and specify the following techniques due to limited TU. **100% completion**.

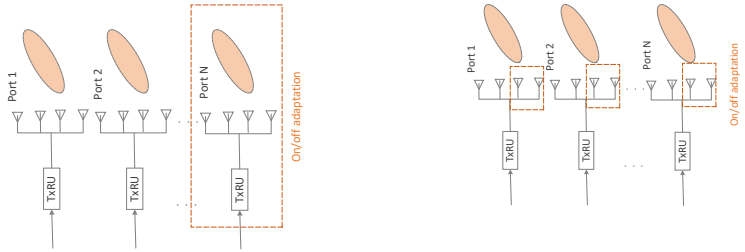
- Enhancement on Cell-specific DTX/DRX mechanism(A-4)



- SSB-less SCell operation for inter-band CA for FR1 and co-located cells(B-1)



- Techniques in spatial domain(C-1)



- Techniques in power domain(D-1) - Power offset adaptation between CSI-RS and PDSCH

Overall view on Rel-19 Network Energy Saving package

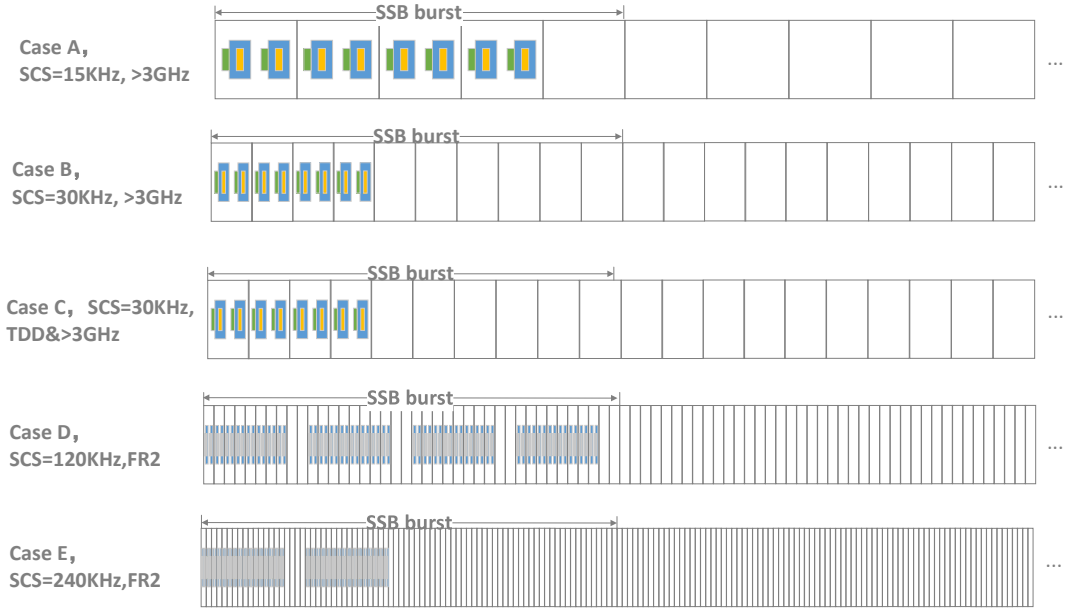
- In RP-232745, around 2TU is possibly assigned to Rel-19 Network Energy Saving.
- As summarized in RP-232745, only the following two objectives are stable although further refinement and clarification are needed.
  - On-demand SSB transmission on SCell for connected UE
  - On-demand SIB1 transmission for idle/inactive UE

Observation 1: The scope can be either jumbo or relative small on basis of the above two objectives, according to the commonality of understanding among companies.

Observation 2: Considering the limited TU, it is important to focus on the stable objectives. One additional objective can be pursued on best-effort manner only if the group achieves a settlement on both on-demand SSB and on-demand SIB1.

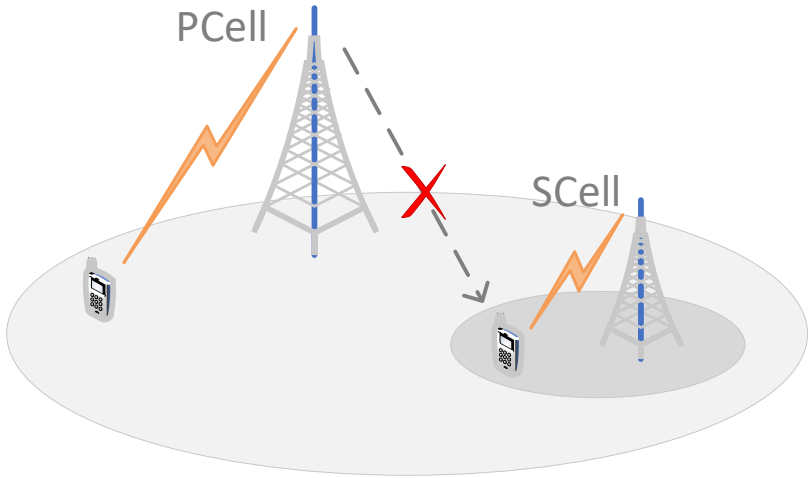
On-demand SSB on SCell for CONNECTED UE

- SSB overhead in time domain within 20 ms periodicity is **5.7%-11.42%** depending on deployment.



- During Rel-18 NES SI, simulation results show on-demand SSB can achieve BS energy savings by 22.0% or 43.4% at low load compared to a baseline of 20ms SSB/SIB1 periodicity, for without or with gNB DTX configuration respectively.

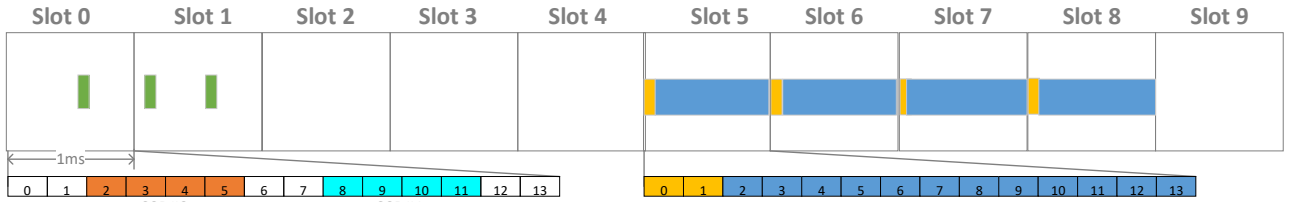
- For non-collocated CA, especially for inter-band CA, it is difficult or even impossible for a UE to obtain synchronization from another cell.



- In order to extend the territory of NES techniques and further reduce operator's OPEX, specify procedures and signalling method(s) to support on-demand SSB SCell operation for UEs in CONNECTED mode in Rel-19 is promising.

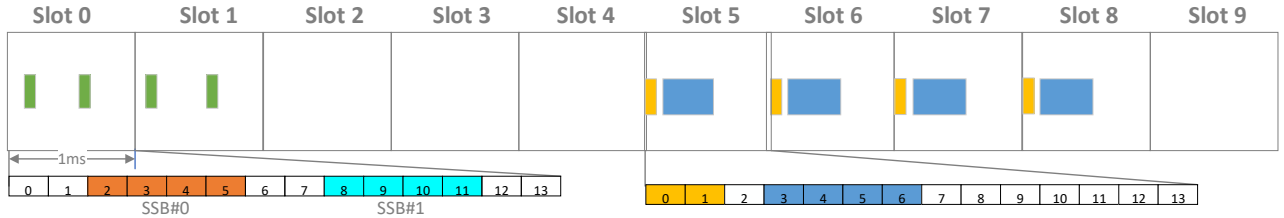
On-demand SIB1 for IDLE/INACTIVE UE

- SIB1 overhead in time domain within 20 ms periodicity is **4.28%-17.14%** depending on SSB&SIB1 multiplexing pattern and configuration. If SSB is also take into consideration, SSB+SIB1 overhead is **7.14%-38.56%.**



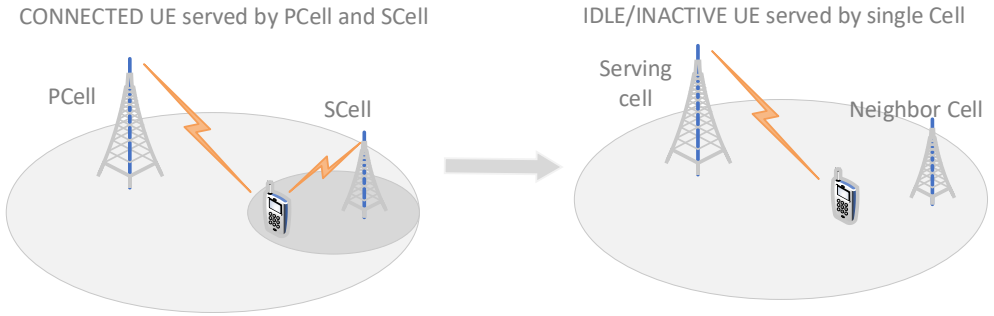
Example-1: Frame 0, FR1, SSB Pattern A, SSB&CORESET#0 multiplexing pattern 1, {SSB, CORESET#0}SCS=15KHz, Parameters for CORESET#0: Table 13-1 (index 0)
Parameters for SearchSpace#0: Table 13-11 (index 4)
Parameters for SIB1: Table 5.1.2.1.1-2 (Type A index 1 DMRS Position 2)

SSB CORESET#0 SIB1



Example-2: Frame 0, FR1, SSB Pattern A, SSB&CORESET#0 multiplexing pattern 1, {SSB, CORESET#0}SCS=15KHz, Parameters for CORESET#0: Table 13-1 (index 0)
Parameters for SearchSpace#0: Table 13-11 (index 4)
Parameters for SIB1: Table 5.1.2.1.1-2 (Type A index 5 DMRS Position 3)

- During Rel-18 NES SI, simulation results shows on-demand SIB can achieve BS energy savings up to 38.8% for 8 beams case for a same SIB1 transmission rate range at empty load with baseline of 20ms SSB/SIB1 periodicity. Additionally, SIB-less can achieve up to 98.4% energy saving gain, which can be considered as the upper bound of on-demand SIB1 technique.



- In order to extend the territory of NES techniques and further reduce operator's OPEX, specify procedures and signalling method(s) to support on-demand SIB1 operation for UE in IDLE/INACTIVE mode in Rel-19 is promising.

Candidate objectives for Rel-19 Network Energy Saving

Accordingly, we propose the following candidate objectives for Rel-19 Networking Energy Saving:

Objective 1: Specify procedures and signalling method(s) to support on-demand SSB SCell operation for UEs in connected mode configured with CA. [RAN1/2/3/4]

- Specify triggering method (e.g., UE uplink wake-up-signal using an existing signal/channel, cell on/off indication via backhaul, SCell activation/deactivation signaling, etc.)
- Note1: on-demand SSB transmission is used by UE for SCell time/frequency synchronization, L1/L3 measurements and SCell activation, and is supported for FR1 and FR2.

Objective 2: Specify procedures and signalling method(s) to support on-demand SIB1 for UEs in idle/inactive mode. [RAN1/2/3]

- Specify triggering method by uplink wake-up-signal using an existing signal/channel.

Objective 3: Specify the corresponding RRM core requirements. [RAN4]

Thanks!