

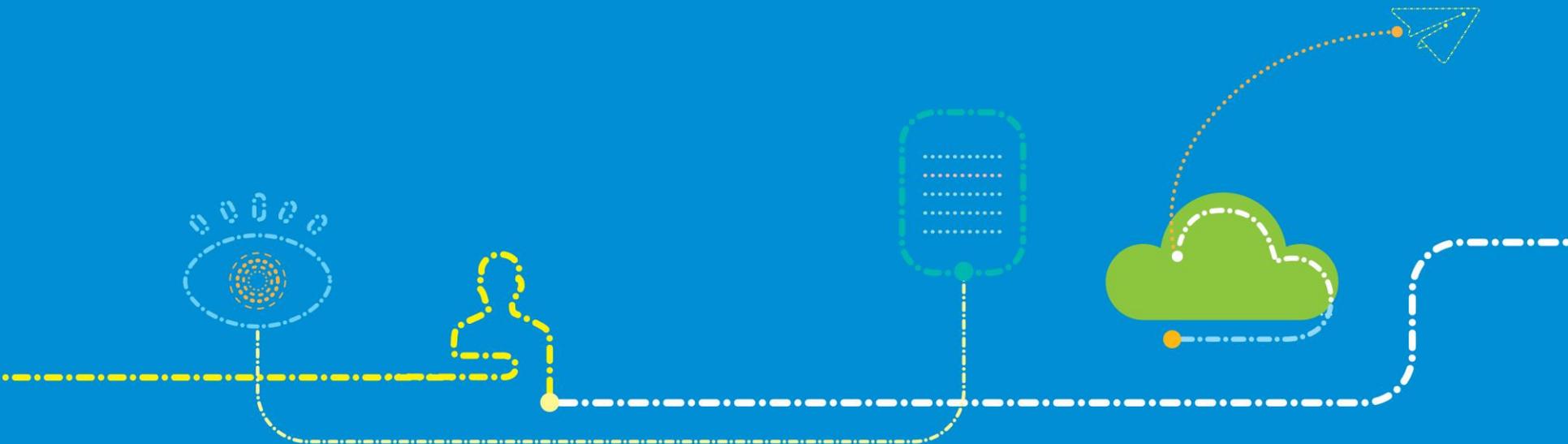
3GPP TSG RAN Rel-19 workshop
Taipei, June 15 - 16, 2023

Source: ZTE, Sanechips

Agenda: 5



Views on network energy saving in Rel-19



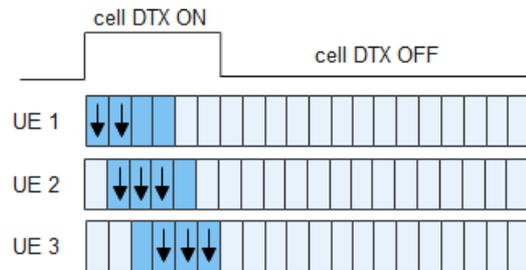
Background: NES in Rel-18

Frequency domain

- SSB-less SCell for inter-band CA for FR1 and co-located cells. Three scenarios have been identified.
 - ❑ Scenario 1: SCell without SSB transmission and with TRS transmission
 - ❑ Scenario 2: SCell without SSB transmission and without TRS transmission
 - ❑ Scenario 2a: SCell without SSB transmission and without any other DL transmissions, but with UL reception at the NW side

Time domain

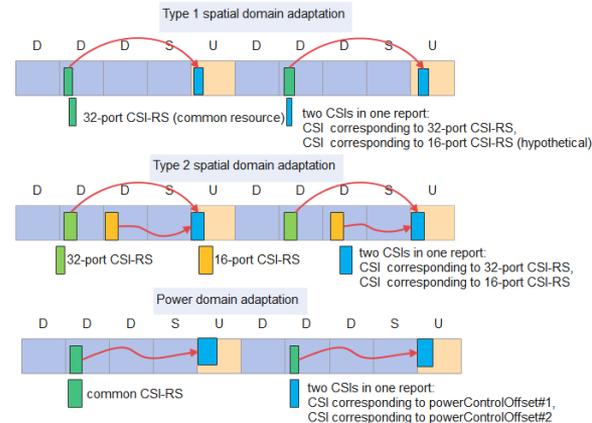
- Cell DTX/DRX mechanism are introduced to increase the sleep time of the gNB.
 - ❑ Cell DTX/DRX configuration includes periodicity, on duration, etc.
 - ❑ Cell DTX/DRX can be dynamically activated/de-activated at least by group common DCI.



Background: NES in Rel-18

Spatial and power domain

- Multi-CSIs in one report enabled by one or more sub-configurations are supported for efficient spatial and power domain adaptation
 - Each sub-configuration corresponds to a spatial domain adaptation pattern and/or power offset value.



Inter-node coordination

- Inter-node beam activation and enhancements on paging

Other aspects

- CHO procedure enhancement for NES cell
- Mechanisms to prevent legacy UEs camping on NES cell

- **Observation:** Due to the limited TU allocation in Rel-18 WI phase, limited NES techniques are introduced.
- **Proposal:** Further enhancements on network energy saving should be considered in Rel-19.

Common signal/channel reduction

• Motivation:

- ❑ The dense transmission of common signal/channel (especially SSB transmission) reduces network sleep opportunity and increases network power consumption. The following conclusion has been captured in TR 38.864
 -8 sources show technique A-5-1 (for non-CA) or B-1-1 (for CA) of SSB- and/or SIB1-less operation in two carriers deployment could achieve BS energy savings by *0.3%~98.4% in range on the energy saving cell/carrier and if more information, such as system information, needs to be transmitted at the anchor carrier then 2.3%~18.9% BS energy increases on the associated cell/carrier....*
- ❑ SCell without SSB is supported for intra-band CA in Rel-15, SSB-less SCell for inter-band CA are discussed in Rel-18. In Rel-18 NES WI phase, the following scenario is prioritized in RAN4.
 - Scenario 2a: No DL transmission but with UL reception at the NW side on the SSB-less SCell.

• Proposal:

- ❑ At least CA scenario should be considered for common signal/channel reduction.
- ❑ Potential Rel-18 leftover issue (depending on progress of SSB-less SCell in Rel-18) : further SCell activation enhancement to support UL only SCell, e.g. no SSB/TRS based SCell activation
- ❑ Other common signal/channel reduction are not precluded.

Rel-19 NES enhancement

- **On-demand SSB/SIB transmission**

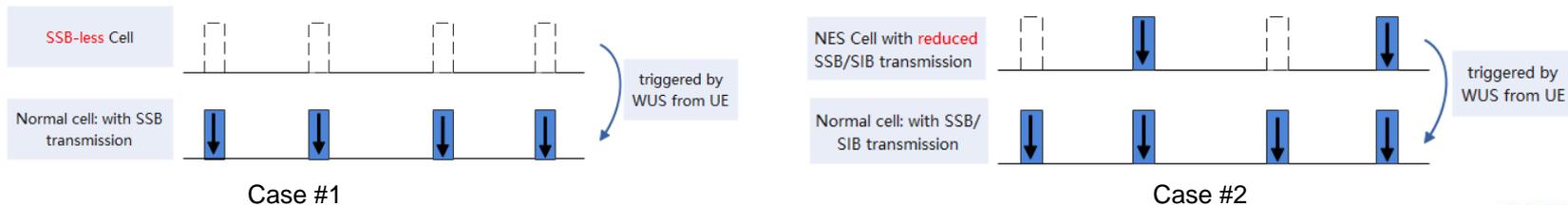
- **Motivation:**

- The dense transmission of the SSB and SIB reduces network sleep opportunity and increases network power consumption. With reduced/no SSB and/or SIB transmission, the time/frequency error correction performance of UE may be impacted. Therefore, a wake-up mechanism can be introduced to trigger the SSB and/or SIB transmission to minimize the impact on user experience. The following conclusion has been captured in TR38.864.

- ...5 sources show technique A-3-1 of UE WUS triggering gNB for SSB/SIB/RACH, with the assumption of ideal detection of UE WUS, could achieve BS energy savings by **6.2%~80.7%** in range with UPT loss by 0%~24.2%, while 1 source shows technique A-3-2 of UE WUS triggering gNB to wake up in case of uplink traffic arrival could achieve BS energy savings by 25.7%~93% in range, with latency reduction of 0%~45.5% depending on the SR periodicity assumed in the baseline...
- ... 3 sources show technique A-5-2 of on-demand SSB/SIB1 could achieve BS energy savings by **2.6%~43.4%** in range ...

- **Proposal:**

- The UE wake up signal (WUS) for gNB can be used to trigger the SSB/SIB transmission.
- Common signal adaptation (e.g., simplified SSB, SSB/SIB with large periodicity) can be part of on-demand SSB/SIB transmission procedure.



Rel-19 NES enhancement

• Spatial and power domain adaptation enhancements

• Motivation:

- ❑ Multi-CSI in one report is introduced in Rel-18 NES to support efficient spatial/power domain adaptation with minimal impact on system performance loss. However, due to the limited TU in WI phase, further CSI overhead and UE complexity reduction may not be specified in Rel-18 NES.
- ❑ Semi-static TRP configuration can not flexibly adapt to the traffic load and data rate requirement, while UE specific signaling indication of m-TRP adaptation results in large signaling overhead and increases gNB power consumption. The enhancement on the efficient m-TRP adaptation can be considered for network energy saving.

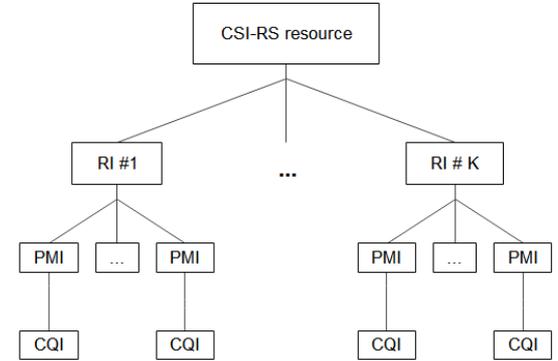
• Proposal:

❑ Leftover issues (depending on Rel-18 progress)

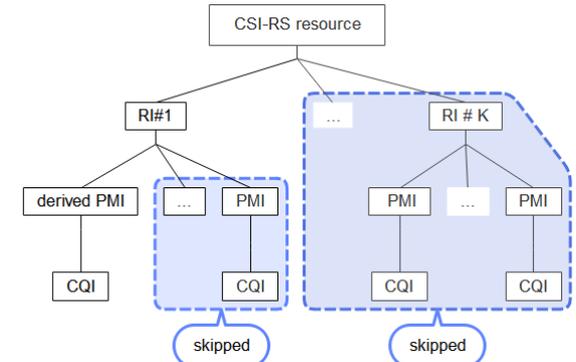
- Overhead/complexity reduction for multi-CSIs in one reporting occasion by exploring the high correlation of CSIs for different spatial domain patterns or power offset values.

❑ Enhancements on efficient m-TRP adaptation

- For example, group common indication, CSI measurement/reporting enhancement for m-TRP adaptation, SRS transmission enhancement for m-TRP adaptation.



Complexity reduction



Rel-19 NES enhancement

- **Inter-node NES state exchange (high layer aspects)**

- **Motivation:**

- RAN3 discussed NES state coordination during the Rel-18 normative phase and reached the following working assumption. Where an energy-saving state is defined as "energySaving state: state in which some functions of a cell or network function are powered-down" in TS 28.310.

- Working assumption: " The inter-node exchange of NES states or more detailed cell status information, if defined by RAN1/RAN2, is necessary if the benefits are confirmed. "

- It is beneficial to exchange NES states and more detailed cell status information, e.g., cell capacity, energy efficiency. By shutting down some components, such as symbol shutdown, carrier shutdown, or channel shutdown, a cell can enter an NES state and provide a certain capacity. By shutting down more or fewer components, the cell can enter into another NES state and provide a different capacity accordingly. The booster cell can notify its NES state and cell capacity to neighboring cells. The node providing basic coverage is aware of all supported NES states of the booster cell. If there is a need for energy saving or providing better capacity for a specific coverage area in line with network load, the node providing basic coverage can request the booster cell transfer to another NES state.

- **Proposal:**

- Support exchange on supported/current NES state(s) information of cells between gNBs.

- A gNB providing basic coverage can request the neighbour booster cell transfer to another NES state.

Rel-19 NES enhancement

- **Common signal/channel reduction**

- ❑ Further common signal/channel reduction, including further SCell activation enhancement to support UL only Scell
- ❑ Other common signal/channel reduction are not precluded.

- **On-demand SSB/SIB transmission requested by UE(s)**

- ❑ UE wake up signal for gNB to trigger the SSB/SIB1 transmission
- ❑ Common signal adaptation, including simplified SSB or SSB/SIB with larger periodicity, can be part of on-demand SSB/SIB1 transmission procedure

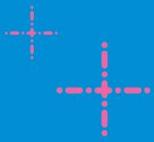
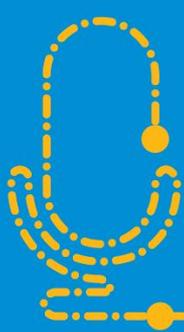
- **Spatial and power domain adaptation**

- ❑ Rel-18 leftover issues, i.e., overhead/complexity reduction for multi-CSIs in one reporting occasion.
- ❑ Enhancements on efficient m-TRP adaptation

- **Inter-node coordination**

- ❑ Enhancements on NES state coordination between NG-RAN nodes.

Thank you



Tomorrow never waits

