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Document for : Discussion

# **Views on Rel-19 enhancement of Network Energy Saving for NR**

NTT DOCOMO, INC.

- In Rel-18, as first release of NW energy saving specifications, following features were selected and specified based on the study on more candidate techniques

- RP-223540, New WID: Network energy savings for NR

1. Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), and L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]
2. Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DTX/DRX and UE DRX in RRC\_CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]
  - Note: No change for SSB transmission due to cell DTX/DRX.
  - Note: The impact to IDLE/INACTIVE UEs due to the above enhancement should be avoided.
3. Specify the following techniques in spatial and power domains
  - Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains) [RAN1, RAN2]
  - Specify necessary enhancements on CSI related procedures including measurement and report, and signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS [RAN1, RAN2]
  - Note: Above objectives are only for UE specific channels/signals
  - Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements
4. Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, if necessary [RAN2]
5. Specify CHO procedure enhancement(s) in case source/target cell is in NES mode [RAN2]
6. Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3].
7. Specify the corresponding RRM/RF core requirements, if necessary, for the above features [RAN4]

# Network Energy Savings WI

References: [RWS-230488](#), [RP-231540](#), [RP-232615](#)

Potential objectives:

- On-demand SSB transmission ~~(and possibly other DL signals)~~ for Scell for connected UEs
  - Possible triggering methods (e.g., UE uplink wake-up-signal using an existing signal/channel, cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.)
  - ~~Whether to target the design of a simplified SSB~~
- On-demand SIB1/~~SSB~~ transmission for idle UEs
  - Possible triggering methods (e.g., UE uplink wake-up-signal using an existing signal/channel, cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.)
  - ~~Whether to target the design of a simplified SSB~~
- Other topics?

- ~~SSB/SIB1-less operation in multi-carrier scenario for (documented in TR38.864)~~
  - ~~SSB/SIB1-less for non-anchor NES cell for UEs in IDLE/INACTIVE state, where it is assumed that another carrier (an anchor cell) is available for the UE~~
- Adaptation of common signal/channel transmissions (documented in TR38.864)
- Specify Cell DRX/DTX for UEs in idle/inactive modes (as an extension of Rel-18 cell DRX/DTX)
- Multi-TRP adaptation mechanisms
- UE group-common or cell-specific BWP configuration, adaptation and/or switching.
- Group cell switch
- Power domains studied in R18 (techniques D-2 ~ D-5)
- Low-power SSB/SIB1/Paging
- Extension of spatial and power domain techniques in 1) high load scenarios 2) Type-II codebook types
- Semi-static beam-specific broadcast channel configuration
- Scenario 2a for SSB-less
- It was also mentioned that some proposals for multi-carrier enhancements may be beneficial for network energy savings (e.g. cross-carrier HARQ, fast DL carrier switch, multi-carrier CSI)
- Extensions to network-controlled repeaters (NCR), e.g. backhaul/control link behavior for efficient interaction between NES-capable gNB and associated NCR, to consider the case where the gNB would operate with S/P-domain adaptation or cell DTX/DRX adaptation for NW energy saving

## ■ On-demand SIB1 transmission for idle UEs [RAN1, RAN2, RAN3]

- Motivation: Since remaining always-on transmissions in NR are SSB and SIB1 that would be the bottleneck of NES, this objective can be considered to further reduce always-on transmissions from cells supporting idle UEs
- Scope:
  - » We prefer to consider triggering methods based on UE uplink wake-up-signal using existing signal/channel in addition to backhaul indication-based triggering, as it may be able to achieve standalone on/off operation
  - » We think on-demand SIB1 transmission can also enable adaptation of SIB1 transmission patterns (e.g., transmitting SIB1 only on some beams/occasions)

## ■ SSB/SIB1-less operation for non-anchor NES cell for UEs in idle mode [RAN2, RAN4, RAN3, [RAN1]]

- Motivation: In typical operation, there are multiple carriers accommodating idle UEs in same area, and SSB/SIB1-less operation for some of those carriers is possible and beneficial for NES, while UE can monitor SSB/SIB1 on anchor NES cell which has synchronization and coordination with non-anchor NES cell
- Scope:
  - » The main specification effort would be on RAN2/3/4 such as for idle mode UE behavior (e.g., cell selection), inter-cell coordination and the corresponding measurement requirements, and no/less specification impact on RAN1 is expected
  - » This objective should not include proposals for R19 MCE (e.g., cross-carrier HARQ, fast cell switching)

## ■ Adaptation of common signal/channel transmissions [RAN1, RAN2, RAN4]

- Motivation:
  - » For example, adaptation of PRACH occasion can facilitate cell DRX operation on PRACH occasion with avoiding unnecessary PRACH (re)transmission
  - » UE support of longer SSB transmission periodicity than 20ms for initial access can reduce always-on transmission periodicity
- Scope: We think at least adaptation of PRACH occasion and longer SSB transmission periodicity than 20 ms for initial access should be considered, while we are not convinced to specify simplified SSB as it would have large specification impacts while NES gain would be limited

## ■ On-demand SSB transmission for Scell for connected UEs [RAN2, RAN4, [RAN1]]

- Although on-demand SSB for SCell may help NW to get certain NES gain, even in the current specification, gNB may be able to control whether/when to transmit SSB in Scell without much negative impact on connected UEs
- Moreover, the benefit is unclear for UE to trigger Scell SSB transmission especially via L1 signaling, thus we prefer this objectives with lower priority or with less/no RAN1 impact

## ■ Cell DRX/DTX enhancements for connected UEs (as an extension of Rel-18 cell DRX/DTX)

- We are neutral on following objectives, as there are other objectives with higher priority as in previous page
  - » Support turning off TRS at least in some TRS occasions during non-active time of cell DTX/DRX for UEs in connected modes, subject to minimum UE synchronization impact
  - » Efficient handling of traffic bursts without Cell DTX/DRX de-activation

## ■ Enhancements to spatial/power domain techniques specified in Rel-18

- We are not supportive of this objective as there may be no additional major use-cases of spatial/power domain techniques than those covered by Rel-18 techniques

## ■ Further study (and if necessary specify) on power domain technique(s) such as D2~D5 in TR38.864

- From operator's perspective, specifying power domain technique(s) such as D2~D5 may be beneficial to facilitate practical implementation, but further study on them in Rel-19 should not be high priority compared with specifying techniques that have already been concluded to provide certain NES gain

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