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做方案创新专家

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Agenda Item: 9.1.1.5

Considerations on Rel-19 Network Energy Savings

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Potential objectives for Rel-19 Network Energy Savings

According to 3GPP RAN chair's summary in RP-232745, several potential objectives for Rel-19 Network Energy Savings (NES) WI have been proposed:

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

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Proposed scopes for Rel-19 Network Energy Savings

The Rel-19 NES WI should focus on areas which can provide significant power savings with reasonable standardization efforts. Our views on the scope for Rel-19 NES are listed as follows:

- **Support to specify time-domain adaptation of common signal/channel transmissions for NES at gNB:**
  - **On-demand SSB transmission for Scell for connected UEs**
    - In Rel-18, common channels and signals such as SSB, SIBs, Paging and RACH are transmitted even in cell DTX/DRX.
    - On-demand SSB transmission for Scell can provide further energy savings according to the result in TR 38.864, which shows 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.
    - The possible triggering method should at least include UE uplink wake-up-signal using an existing signal/channel, open discussion for other methods including cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.
    - Possible negative performance impact on UPT and delay/latency should be further investigated in Rel-19.
  - **On-demand SIB1 transmission for idle/inactive UEs**
    - The focus has been on UE-specific channels/signals for RRC connected UEs in Rel-18, while further enhancement is necessary for common channel/signal for RRC IDLE/RRC INACTIVE UEs in Rel-19. The reason behind this objective is that a cell needs to regularly transmit SSB and SIB1 to be able to serve RRC IDLE/RRC INACTIVE UEs in legacy behaviour. Thus on-demand SIB1 transmission for RRC IDLE/RRC INACTIVE UEs is certainly beneficial to energy savings.
    - Similar as RRC_CONNECTED UEs, common channels and signals adaptation such as on-demand SIB1 transmission for RRC IDLE/RRC INACTIVE UEs should be enabled to be beneficial in energy savings. According to the result for on-demand SIB1 at empty load with baseline of 20ms SSB/SIB1 periodicity in TR38.864, which shows that 5.8%~8.6% BS energy savings can be achieved at SIB1 transmission rate of 20%~5% for one SSB beam, and the gains can increase to 32.1%~38.8% for 8 beams case for a same SIB1 transmission rate range.
    - The possible triggering method should at least include UE uplink wake-up-signal using an existing signal/channel, open discussion for other methods including cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.

Proposed scopes for Rel-19 Network Energy Savings

The Rel-19 NES WI should focus on areas which can provide significant power savings with reasonable standardization efforts. Our views on the scope for Rel-19 NES are listed as follows (continued):

- **Support to specify time-domain adaptation of cell DTX/DRX for UEs in idle/inactive mode**
  - The focus has been on cell DTX/DRX mechanism in time domain for UEs in RRC_CONNECTED mode due to backward compatibility issue in Rel-18, while further enhancement is necessary for RRC IDLE/RRC INACTIVE UEs to further explore benefits from cell DTX/DRX in Rel-19.
- **Support to specify frequency-domain adaptation of SSB/SIB1-less operation in multi-carrier scenario**
  - A cell needs to regularly transmit SSB and SIB1 to be able to serve RRC IDLE/RRC INACTIVE UEs in legacy behaviour. According to the result in TR 38.864, it is observed that in general, for SSB and/or SIB saved from one carrier of two carriers, BS energy savings gain is observed by 5.1%~98.4% for empty load, 3.0%~58.4% for low load, and 1.0%~7.9% for light load, 0.3%~5.7% for medium load. When traffic load is low, network may turn off SCell for energy saving. This justifies the reason for its specification.
  - The Rel-19 focused scenario should involve extension of current Rel-18 co-located and/or RRC_CONNECTED case to non-collocated and/or RRC IDLE/RRC INACTIVE case.
- **Support to specify spatial-domain adaptation for NES at gNB: multi-TRP adaptation mechanisms**
  - Dynamically adapting the number of TRPs is beneficial to energy savings when a UE is configured with multiple TRPs.
  - The signalling and enhancements to UE behaviours should be specified.
  - The impact on UPT should be further investigated.
- **Considering that only ~2 TUs are allocated to Rel-19 NES, other potential objectives listed in 3GPP RAN chair's summary in RP-232745 for NES WI in Rel-19 are suggested to be put in lower priority compared to the above listed ones.**

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Thanks

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