3GPP TSG RAN Meeting #101
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Agenda Item: 8A.2.5
Document for: Discussion

Enhancement of Network Energy Saving for NR

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Background: Scope of R18 NES WI

- 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]

Discussion

- **For network energy saving, following enhancements should be considered in Rel-19**
  - Multiple TRP adaptation
    - » Motivation: R18 already supports the antenna or antenna ports adaptation of single TRP scenario. But the beam and TCI enhancement is not supported due to limited time. They can be considered in R19. Furthermore, with the evolution of MIMO techniques, large scale antenna and multiple TRP is becoming more promising deployment for gNB. Then, efficient multiple TRP adaptation for network energy saving should be considered in R19.
  - Wakeup signal for gNB (e.g., for on-demand SSB/SIB1)
    - » Motivation: WUS for gNB can be introduced as PHY layer indication by UE to inform gNB whether it needs to wake-up its Tx(/Rx) unit. With this techniques, the network energy consumption can be reduced by dynamically power on/off its Tx(/Rx) unit.
  - SSB adaptation
    - » Motivation: SSB is one of the DL signals constantly transmitted by gNB for the initial cell search and other purposes such as RRM measurement. Thus, it is possible to reduce gNB power consumption by adopting SSB periodicity (e.g., extending SSB periodicity). The trade-off between power saving gain and initial access and handover performance should be considered.

Proposals

- **Proposed objectives and responsible WG(s)**
  - Multiple TRP adaptation [RAN1, RAN2]
    - » CSI feedback and DCI scheduling for multiple TRP
    - » Beam management for both single TRP and multiple TRP
  - Wakeup signal for gNB (e.g., for on-demand SSB/SIB1) [RAN1, RAN2]
    - » Wakeup signal design and configuration
    - » gNB/UE behaviors related to wakeup e.g., wakeup signal transmission/reception, after transmitting wakeup signal, etc.
  - SSB adaptation [RAN4, RAN1, RAN2]
    - » Adopting SSB periodicity for cells supporting initial access
    - » Enhancement of RRM based on adopted SSB

- **Suggested TU**
  - RAN1 [2] TU per quarter
  - RAN2 [0.5-1] TU per quarter
  - RAN4 [0.5] TU per quarter

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