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Views on Network Energy Savings Enhancements in Rel-19

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NES in Rel-18

- Various techniques in time, frequency, spatial and power domains have been studied and evaluated in Rel-18 NES SI. However, due to limited TU, only A-4, B-1 (B-1-1: SSB- and/or SIB1-less operation for inter-band CA), C-1, D-1 are specified in Rel-18 NES WI.

	Techniques
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

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NES enhancements in Rel-19

- NES enhancements should be studied and specified in Rel-19 to further release the heavy burden of energy consumption for operators.

- Rel-18 SI evaluated but not specified techniques could be further studied in Rel-19. However, down-selection of the long list of techniques are anyway required.
  - Rel-18 left-overs and enhancements should be further studied and specified, if needed.
  - Rel-18 focused on NES for RRC CONNECTED. Rel-19 should also address RRC IDLE and RRC INACTIVE.
  - Rel-19 should study and specify NES techniques that provide noticeable energy saving gain.

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NES enhancements in Rel-19

- **Proposal:** Specify below techniques:
  - On-demand SSB SCell operation for UEs in connected mode
    - CA, including inter-band CA, is considered, for both FR1 and FR2
    - Design of new signal/channel or use legacy signal/channel for SSB Scell demand
    - Mechanism on how the UE can be informed about cell activity or lack of activity.
  - SIB1-less operation for UEs in idle/inactive mode
    - Triggering method by uplink wake-up-signal using a new or existing signal/channel
    - Wake-up-signal configuration provisioning to UE via an anchor cell, for on-demand SIB1 operation on non-anchor NES cell
    - Activation of SIB1 of a carrier/cell based on needs, e.g., the number of RRC IDLE/INACTIVE UEs

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NES enhancements in Rel-19

- Adaptation of common signal/channel transmissions
  - Adaptation of SSB patterns in time domain, including adapting the number of SSBs within a period
  - Dynamic adaptation of PRACH
  - Adaptation of paging occasions, without impacting legacy UEs

- Further enhancements to Rel-18 spatial domain techniques
  - Extension of Rel-18 spatial domain techniques to Type-II codebook to enable supporting NES for MU-MIMO
  - Dynamic TRP on/off mechanism in multi-TRP operation, including CSI, BM and TCI enhancements.
  - Adaptation of active antennas for SSB transmission, including measurement and reporting enhancements to reduce impact on system performance

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Proposed WID for Rel-19 NES

- Specify procedures and signaling method(s) to support on-demand SSB SCell operation for UEs in connected mode configured with CA, including inter-band CA. [RAN1/2/3/4]
  - Note: on-demand SSB transmission is used by UE for SCell time/frequency synchronization, L1/L3 measurements and SCell activation, supported for FR1 and FR2.
- Specify procedures and signaling method(s) to support on-demand SIB1 for UEs in idle/inactive mode. [RAN1/2/3]
  - Triggering method by uplink wake-up-signal using a new or existing signal/channel.
  - Wake-up-signal configuration provisioning to UE via an anchor cell, for on-demand SIB1 operation on non-anchor NES cell
  - Information exchange between gNBs at least for the configuration of wake up signal, if necessary
- Specify adaptation of common signal/channel transmissions. [RAN1/2/3/4]
  - Adaptation of SSB patterns in time domain, including adapting periodicity, time-domain positions (periodicity and time resource locations within a period), and the number of SSBs within a period, including the possibility of transmission of PSS/SSS without PBCH
  - Dynamic adaptation of PRACH
  - Adaptation of paging occasions
    - Note: there shall be no impact to legacy UEs nor paging latency increase
- Specify further enhancements to spatial domain techniques specified in Rel-18. [RAN1/2]
  - Extension of Rel-18 spatial domain techniques to Type-II codebook
  - Dynamic TRP on/off mechanism in multi-TRP operation
  - Adaptation of active antennas for SSB transmission, including identification of any necessary UE measurement behavior change(s) to maintain system performance

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thanks.