

Proposal on Network Energy Savings Enhancements in Rel-19

Rakuten Mobile

Network Energy Savings Phase-2

Further Measures for Network Energy Conservation Beyond Rel-18 Initiatives

- **Enhancement of Multi-Carrier Operations:** Implement improvements in multi-carrier functionalities for increased energy efficiency.
 - Implementation of SSB/SIB1-Less Scell: Focus on integrating SSB/SIB1-less secondary cells, including the management of RACH for better energy-saving.
 - On-Demand Transmission of SSB/RS: Implement strategies for on-demand transmission of SSB/Reference Signals, reducing unnecessary energy expenditure.
- **Application of Power Domain Techniques:** Leverage power domain techniques that require gNB/UE co-ordination, specifically D2 to D5 as mentioned in 28.864.
- **Decentralized Control of Cell/Beam Activation and Deactivation:** Allow Distributed Units (DU) to control cell/beam on/off states without Central Unit (CU) involvement, considering necessary Operation & Maintenance enhancements.
- **Network Energy Savings Across All Node Types and Scenarios:** Focus on energy-saving strategies that are applicable to all types of nodes and scenarios, including Integrated Access and Backhaul (IAB), Network Controlled Repeater(NCR), Multi-TRP Scenarios
- **Enhancements for Multi-TRP Scenarios** – Extension of CSI Framework and UE Feedback based Adaptive TRPs.

Multi-Carrier Enhancements - Adaptive and SIB-Less Operation

Background

According to TR 38.864, a large percentage of energy-saving can be achieved by adapting common signals/channels based on network load. In the current operational systems, certain signals such as SSB/SIB1 are always transmitted periodically to maintain RACH performance.

However, the number of SSB/SIB1 transmissions could increase due to higher frequency and lower latency requirements, leading to higher energy consumption. Therefore, the adaptation of common signals/channels and on-demand SSB/SIB1 for low load networks could contribute to significant energy savings.

In addition, SIB-less cell operation and UE wake up signals (WUS) are promising energy-saving techniques.

Objectives:

Adaptation of Common Signals/Channels

- Identify common channels/signals that can be adapted based on the network load, e.g., SSB/SIB1.

SIB-less Cell Operation

- Specify the support of SIB-less cell operation in multi-carrier scenarios, including RACH carrier selection and anchor carrier carrying SIB for non-anchor (SIB-less) carriers.

On-demand SSB/SIB1 Mechanism

- Specify the on-demand SSB/SIB1 mechanism, including activation/de-activation mechanism and periodicity configuration.
- Define the trigger signals/mechanism for on-demand SSB/SIB1 transmission.

On-demand SSB/SIB1 by UE WUS

- Specify support for on-demand SSB/SIB1 by UE WUS, including design of WUS, procedures related to WUS, conditions for triggering WUS transmission, and UE behaviour after transmitting WUS.

Enhancements for Multi-TRP Scenario

Background:

- Multi-TRP transmission has been evolving since Release-16, with significant standardization work in Release-17/18. Dynamic spatial adaptation has been found beneficial from the outcome of Release-18 SI.
- The possibility exists for TRP muting involved in Technique C-2 to be achieved by gNB implementation with the current UE dedicated L1/L2 signalling.

Objective:

- Extend the CSI reporting framework specified in Release-18 to multi-TRP scenarios, which would require UE behavior enhancement due to dynamic adaptation of TRPs. This includes aspects like PDCCH monitoring, mTRP-based scheduling etc.
- Specify the adaptation of TRPs in multi-TRP scenarios, including specifying the mechanism of Multi-TRP adaptation triggered by UE, and the interaction between TRPs and TRP/UE to achieve multi-TRP adaptation.
- Study possible enhancements on UE-specific/group-level/cell common signaling for indicating adaptation of TRPs in mTRP operations and relevant UE behaviors.
- Evaluate potential benefits of these enhancements as well as their impact on network performance and reliability to determine the most effective strategies for implementation.

Power Domain Enhancement (D-2 to D-5 in 28.864)

Techniques D-2 to D-5 , showed efficient power saving in Rel-18 study phase. However, there were limited input to simulation.

- D-2: Over the air digital pre-distortion
- D-3: Tone reservation
- D-4: PA power bias adaptation
- D-5: UE post-distortion

Objectives:

We propose an extended exploration of UE post-distortion, over the air digital pre-distortion, tone reservation and PA Bias adaptation strategies.

- Continue Study on the Topic to explore further opportunities and performance improvements.
- Convert to WI, after conclusion on simulation - performance improvements.