

Network Energy Saving Enhancements

Taipei, 15th – 16th June, 2023

Agenda item: 5

Source: Nokia, Nokia Shanghai Bell

The Nokia logo is displayed in white, uppercase letters within a dark blue circular area. This area is part of a larger graphic consisting of two concentric white circles on a dark blue background, which is set against a green-to-blue gradient background.

Overview

Motivations and key proposals for network energy saving enhancements in Rel-19

Energy efficiency is key for mobile networks in general

- **It needs to be considered system-wise as well, in all relevant WIs**

In Rel-18 only a few of the enhancements identified in TR38.864¹ are being specified

- **Given that different techniques apply to different deployment and operating points of the system, it is important to continue the work in Rel-19 with relevant techniques**
- Another aspect to consider is that Rel-18 has focused primarily on RRC Connected, and hence in Rel-19 the focus should be on RRC Idle/Inactive states and low load scenarios

Some key principles can be considered for Rel-19 normative work:

- Avoid techniques that reduce flexibility for network
- Avoid techniques that constrain gNB implementation
- Legacy devices, and coexistence with them, need to be supported, but not necessarily always on all cells
- Any techniques requiring waveform modifications should wait for 6G

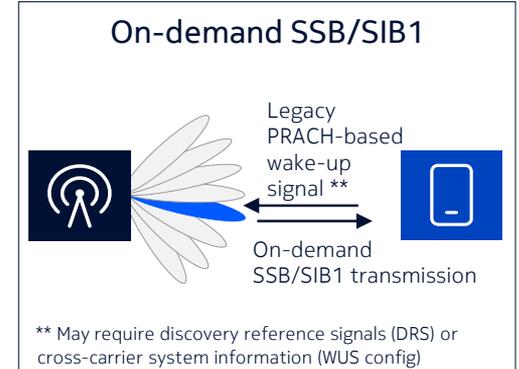
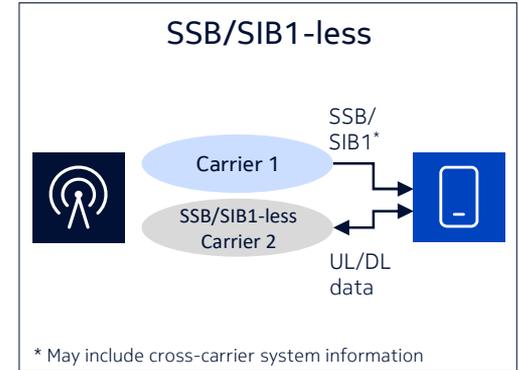
Key areas for enhancements:

- **SSB/SIB1-less cell and on-demand SSB/SIB**
- **Paging enhancements for low load scenarios**
- **Enhancements for cell shutdown**

¹TR38.864 “Study on Network Energy Savings for NR”

SSB/SIB1-less cell and On-demand SSB/SIB1

- **Motivation:** Up to Rel-18, a cell needs to transmit SSB and SIB1 regularly to be able to serve RRC IDLE and RRC INACTIVE UEs
 - In Rel-19 it would be beneficial to eliminate **unnecessary transmission of SSB and SIB1**
- **SSB/SIB1-less cell:** UE acquires time/frequency synchronization for the SSB/SIB1-less cell and system information from carrier 1 (coverage cell) and initiates UL/DL data transfer with the SSB/SIB1-less cell, i.e., carrier 2 (capacity cell) (see figure).
 - Currently, SSB-less SCell is supported for intra-band CA, and SSB-less SCell for the inter-band CA scenario is to be specified in Rel 18.
 - **In Rel-19 this technique could be extended such that is supported by UEs regardless of their RRC state.**
- **On-demand SSB/SIB1 cell:** UE triggers on-demand SSB/SIB1 transmission by sending an UL wake-up signal (UL-WUS) upon need, e.g., for UL data transmission (see figure).
 - This technique may require the cell to transmit Discovery Reference Signal DRS (e.g., simplified SSBs) to announce its presence, or to support cross-carrier system information (e.g. for UL-WUS configuration).
 - **Legacy signal or channel can be re-used for UL-WUS transmission** such as a PRACH preamble.
 - **This technique could be supported at least by UEs in RRC IDLE and RRC INACTIVE.**



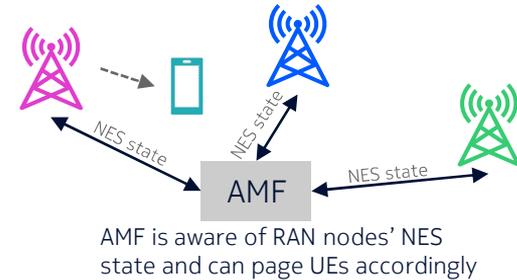
Paging enhancements for low-load scenarios

Motivation: reducing paging transmissions in low-load scenarios

- TR 38.864 discussed paging for stationary UEs in a subset of SSBs and includes results on adapting the paging pattern (A-1-4)

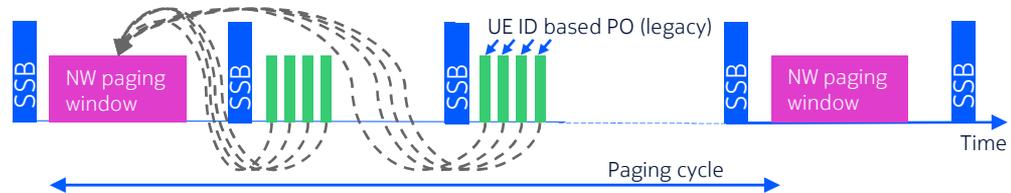
AMF-awareness of RAN nodes' NES state

- Cell shutdown and NES state of RAN nodes impacts paging
- No impact foreseen to legacy UEs



Clustered paging (technique A-1-4)

- Currently UEs' paging occasions are distributed in the time domain, which negatively impacts the RAN sleeping opportunities
- At low load, the paging can be clustered in time for Rel19 UEs
- Legacy UEs can continue using legacy paging



Enhancements for cell shutdown

Motivation:

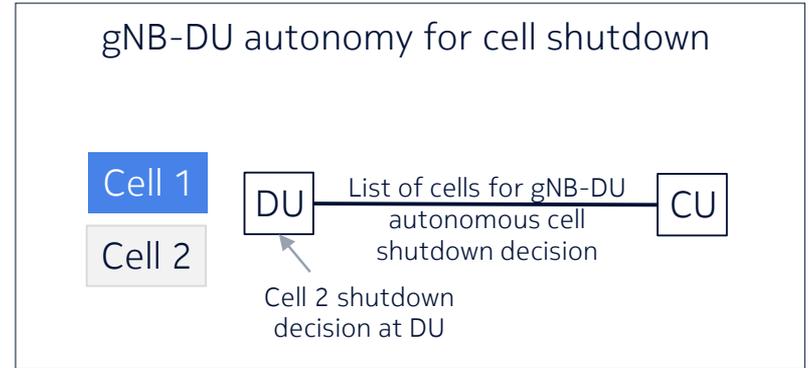
- The cell shutdown procedure is one of the most energy-effective means used to save power, but it is currently slow.
- In Rel.18, CHO enhancements are considered primarily for robustness of traffic offloading at cell shutdown.

gNB-DU autonomy for cell shutdown

- Currently, gNB-CU is responsible of cell switch OFF and ON decisions, and then gNB-CU indicates the decision to gNB-DU for the gNB-DU to initiate offloading and cell deactivation.
- However, cells are managed by the gNB-DU, which is aware of cell load and energy consumption information.
- Thus, gNB-DU autonomous decisions for cell shutdown would be beneficial as the gNB-DU is more capable of determining the possible gains, and can make the procedure faster
- **To enable gNB-DU autonomy, new F1-C signalling is necessary**

Enable faster decrease of SSB transmit power at cell shutdown

- Cell deactivation is done by multi-step SSB power ramp down (i.e. graceful shutdown), which is slow as it requires SI modification.



Enable finer control of cell reselection procedures at cell shutdown

- Currently, the network cannot flexibly control to which frequency layer UEs should reselect, after the cell in which they are camping is shutdown.

NOKIA