

Athens, Greece, February 17th – 21st, 2025

Agenda Item: 9.5.1

Source: ASUSTeK

Title: DCI based signaling for on-demand SSB

Document for: Discussion and Decision

1. Introduction

Along with the previous study in Rel-18, network energy saving is investigated via reducing constantly transmitted common signaling in time domain. One of the options being studied is on-demand SSB. Since SSB-less operation has been available for several releases, the scope is restricted to SCell for connected mode UE to avoid significant on the existing operation as has been agreed as part of Rel-19 WI [1]:

1. Specify procedures and signaling method(s) to support on-demand SSB SCell operation for UEs in connected mode configured with CA, for both intra-/inter-band CA. [RAN1/2/3/4]
 - Specify triggering method(s) (select from UE uplink wake-up-signal using an existing signal/channel, cell on/off indication via backhaul, SCell activation/deactivation signaling)
 - Note1: On-demand SSB transmission can be used by UE for at least SCell time/frequency synchronization, L1/L3 measurements and SCell activation, and is supported for FR1 and FR2 in non-shared spectrum.

In RAN1#117, RAN1 agree to support indicating presence of on-demand SSB via RRC/MAC CE and further investigate whether to additionally support DCI to indicate presence of on-demand SSB [2]:

Agreement

- For a cell supporting on-demand SSB SCell operation,
 - Support RRC based signaling to indicate on-demand SSB transmission on the cell.
 - Support MAC CE based signaling to indicate on-demand SSB transmission on the cell.
 - FFS: Whether to support DCI based signaling to indicate on-demand SSB transmission on the cell.
 - This DCI signaling does not provide SCell activation/deactivation.
 - If supported, details on DCI including UE-specific or group-common DCI, DCI contents, etc.
 - FFS: Scenarios where the above signalings are applicable

Agreement

- For a cell supporting on-demand SSB SCell operation, at least the following for on-demand SSB via higher layer RRC signaling is supported.
 - Frequency of the on-demand SSB
 - SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst*
 - Periodicity of the on-demand SSB
 - FFS: Whether more than one on-demand SSB configurations can be configured for the cell to UE
 - FFS: Whether the RRC is newly introduced or existing RRC is reused

Agreement

For SSB burst(s) indicated by on-demand SSB SCell operation via MAC CE, UE expects that on-demand SSB burst(s) is transmitted from time instance A which is determined as follows.

- Alt 3-1: Time instance A is [the slot boundary of] the first SSB time domain position [of actually transmitted on-demand SSB burst] which is T [slots or symbols] after the [slot or symbol] where UE receives a signalling from gNB to indicate on-demand SSB transmission
 - The SSB time domain positions of on-demand SSB burst are configured by gNB.
- FFS: Details of the value of T (≥ 0) including possibility of T comprising of multiple components

- Note: The value of T is not less than existing timeline required for UE's MAC CE processing for SCell activation
- FFS: Whether the value of T is predefined or indicated/configured by gNB
- FFS: Details of "the [slot or symbol] where UE receives a signalling from gNB" or "the [slot or symbol] where UE transmits HARQ-ACK corresponding to a signalling from gNB to trigger on-demand SSB"

Above applies at least for the case where SCell with on demand SSB transmission and cell with signalling transmission have the same numerology.

Agreement

- At least support L1 measurement based on on-demand SSB
 - For L1 measurement based on on-demand SSB, periodic, semi-persistent, [and aperiodic] L1 measurement reports based on existing CSI framework are supported.
 - FFS on potential enhancements of CSI report configuration and/or triggering/activation mechanisms for L1 measurement based on on-demand SSB

In this contribution, we discuss issues related to on-demand SSB and provide our view related to the support of DCI based signal to indicate presence of on-demand SSB.

2. Discussion

As mentioned in the background, since the main trigger for on-demand SSB is SCell activation, at least RRC-based or MAC CE based signaling could be utilized to indicate presence of on-demand SSB. Whether additional adaptation is required on top of the two supported signaling may depend on two design aspects. A first aspect is that whether to on-demand SSB is constantly available once triggered. That is, on-demand SSB is present only during a certain periods or occasions once triggered or on-demand SSB on an SCell is constantly available as long as there is one UE with the SCell activated. The network energy saving gain of on-demand SSB could be dramatically decreased if transmitting on-demand SSB on an SCell is mandatory as long as there is one UE consider the SCell as an activated Cell. On the other hand, if on-demand SSB is only available at certain period(s)/occasion(s) once triggered, since the triggering message of RRC/MAC CE based signaling is UE-specifically transmitted for activating/deactivating an SCell to a UE, other UE may not be able to realize there is further period(s)/occasion(s) where UE could expect on-demand SSB. Under such situation, a group common DCI may be utilized to inform UE the presence of on-demand SSB in further period(s)/occasion(s). A second design aspect to consider is whether there is a single periodicity for on-demand SSB or periodicity of on-demand SSB could be adapted. Similarly, using a single periodicity could simplify the design, while decreasing the energy saving gain. Since L1 measurement based on SSB may not be constantly required, e.g. may be based on an event-driven based, fix the periodicity of on-demand SSB to a single value would result in unnecessary on-demand SSB transmission. Under this situation, group common DCI is also a good candidate to indicate adjustment of periodicity, e.g. indicating one value out of candidate values. Of course, using group common DCI to indicate on-demand SSB transmission may increase the possibility of misalignment/misunderstanding between UE and gNB. This of course could rely on gNB implementation to ensure that group common DCI is transmitted with sufficient reliability, similar as other existing feature indicated by group common DCI. RAN1 could of course investigate whether there would be severe issue caused by such misalignment/misunderstanding.

Observation 1: Fixing on-demand SSB transmission with a single periodicity for an SCell whenever there is at least one UE consider the SCell as activated is harmful to the network energy saving gain of on-demand SSB.

Observation 2: there are be two cases where a group common DCI could be utilized to indicate on-demand SSB transmission:

1. when the on-demand SSB on a SCell is triggered due to activation of the SCell to other UEs
2. when the periodicity of on-demand SSB is adjusted

Proposal 1: RAN1 further discuss whether using group common DCI to indicate on-demand SSB transmission for the case of:

1. when the on-demand SSB on a SCell is triggered due to activation of the SCell to other UEs
2. when the periodicity of on-demand SSB is adjusted

Proposal 2: If group common DCI indicating on-demand SSB transmission is supported, RAN1 further investigates whether there is any misalignment issue between UE and gNB.

3. Conclusion

In this contribution, we discuss issues related to on-demand SSB for SCell and have the following observations/proposals:

Observation 1: Fixing on-demand SSB transmission with a single periodicity for an SCell whenever there is at least one UE consider the SCell as activated is harmful to the network energy saving gain of on-demand SSB.

Observation 2: there are be two cases where a group common DCI could be utilized to indicate on-demand SSB transmission:

1. when the on-demand SSB on a SCell is triggered due to activation of the SCell to other UEs
2. when the periodicity of on-demand SSB is adjusted

Proposal 1: RAN1 further discuss whether using group common DCI to indicate on-demand SSB transmission for the case of:

1. when the on-demand SSB on a SCell is triggered due to activation of the SCell to other UEs
2. when the periodicity of on-demand SSB is adjusted

Proposal 2: If group common DCI indicating on-demand SSB transmission is supported, RAN1 further investigates whether there is any misalignment issue between UE and gNB.

Reference

- [1] RP-234065, “New WID: Enhancements of network energy savings for NR”, Ericsson.
- [2] RAN1#117 Chair’s note