

Agenda item: 9.5.1
Source: KT Corp.
Title: Discussion on On-demand SSB SCell operation
Document for: Discussion and decision

1. Introduction

During the study period, numerous techniques for achieving energy savings in NR BS were thoroughly examined [1]. It was found that reducing SSB significantly improves energy efficiency, especially in near-zero load situations. Previously, Release 18 supported SSB-less SCells for this purpose. In Release 19, a new approach is being standardized: on-demand transmission of SSB for SCells. This aims to optimize performance while mitigating the side effects of SSB-less operations, such as measurement issues.

During one year, significant progress was made on this agenda, although some issues remain under discussion. In this contribution, we present our views on the agenda, focusing on the unresolved issues.

2. Current Issues

In [2], the following issue on the OD-SSB transmission indication is discussed.

Proposal #4-2 (DCI):

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

We see the DCI is meaningful for the UEs without demand. This can be useful for the treatment of collision with another signal and rate-matching. For such UEs, broadcasting with a group-common DCI can be the most efficient.

Proposal 1: For a cell supporting on-demand SSB SCell operation, support DCI based signaling to indicate on-demand SSB transmission on the cell. Group-common DCI can be the simplest solution.

Another issue in [2] on the OD-SSB configuration is discussed as follows:

Proposal #5-2 (Case #2 config):

- For a cell supporting on-demand SSB SCell operation and for Case #2, UE assumes the followings for on-demand SSB are the same as for always-on SSB, unless explicitly configured.
 - Frequency of the on-demand SSB
 - SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst*
 - Sub-carrier spacing
 - Physical Cell ID
 - Downlink transmit power

For this issue, we don't see a need to always provide configuration for any of them..

Proposal 2: Proposal #5-2 in [2] is supported.

Another issue in [2] on the transmission indication for the demanding UE is discussed as follows:

Proposal #5-3 (RRC+MAC-CE indication):

For a cell supporting on-demand SSB SCell operation, in addition to periodicity of the on-demand SSB, for the following parameter(s), multiple candidate values can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication for the cell.

- SSB positions within an on-demand SSB burst
- The number of on-demand SSB bursts to be transmitted after on-demand SSB is indicated[, if supported]

For this issue, we agree that indicating the number of bursts to be transmitted is beneficial. However, we don't see a strong need to indicate the new SSB position, as RAN1 is still discussing whether to support the case where SSB indices within an on-demand SSB burst can be a subset of SSB indices within an always-on SSB burst. If this is not supported, the indication will become less valuable.

Proposal 3: For a cell supporting on-demand SSB SCell operation, in addition to periodicity of the on-demand SSB, for the following parameter(s), multiple candidate values can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication for the cell.

- The number of on-demand SSB bursts to be transmitted after on-demand SSB is indicated, if supported
- FFS: SSB positions within an on-demand SSB burst

Another issue in [2] about the L1/L3 measurement is discussed as follows:

Proposal #7-1 (Measurement configuration):

- For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), support at least Option 2 and further study whether to additionally support Option 1.
- Option 1: A CSI report configuration is associated with both of on-demand SSB and always-on SSB
- Option 2: A CSI report configuration is associated with one of always-on SSB and on-demand SSB
- FFS: Whether/how to differentiate always-on SSB and on-demand SSB

Proposal #7-2 (Measurement report):

- For a cell supporting on-demand SSB SCell operation and for L1 measurement based on on-demand SSB,
- For on-demand SSB indicated by RRC,
- Periodic, semi-persistent, and aperiodic CSI report are supported.
- For on-demand SSB indicated by MAC-CE,
- Semi-persistent and aperiodic CSI report are supported.
- Periodic CSI report is not supported.

Proposal #7-3 (Beam failure based on on-demand SSB):

Study whether/how to support beam failure based on on-demand SSB for Case #1 and/or Case #2

We also recognize the importance of these issues. For #7-1, we believe that Option 1 could be beneficial, but it may require complex considerations and signaling, such as whether to handle reports for always-on SSB with OD-SSB or vice versa.

Proposal 4: A CSI report configuration is NOT associated with both of on-demand SSB and always-on SSB.

Proposal 5: Proposal #7-2 in [2] is supported.

In our understanding, measurement and link management are the primary reasons for transmitting OD-SSB, and BFD/BFR must be thoroughly performed.

Proposal 6: Support beam failure based on on-demand SSB for both Case #1 and Case #2.

3. Further detailed issues

In [2], the following issues on the OD-SSB collision with other signal/data are discussed.

Q#9-1 (Collision): At least 5 companies suggested to handle the collision issue between SSB and other signals/channels (e.g., RACH occasions). Do you agree to handle this issue?

Q#9-2 (Rate-matching): At least 3 companies suggested to handle the rate-matching issue when SSB is collided with DL/UL data channels. Do you agree to handle this issue?

We believe both points are very important and need extensive discussion. For #9-1, defining a priority rule different from the legacy SSBs could be one of the solutions.

Proposal 7: OD-SSB has less priority of transmission than the previously configured periodic signals, like RACH and CSI-RS.

We give our last proposal about #9-2, related to our proposal about the DCI indication of transmission.

Proposal 8: The rate-matching is performed for the OD-SSB. For this, the resource containing (actually transmitted) OD-SSB can be scheduled for the demanding UE and UEs received DCI indication. On the other hand, the resources is not scheduled for the other UEs, including legacy UEs, as implementation.

- FFS: Rate-matching for the actually not transmitted OD-SSB

4. Conclusion

We give our proposals in this contribution as follows:

Proposal 1: For a cell supporting on-demand SSB SCell operation, support DCI based signaling to indicate on-demand SSB transmission on the cell. Group-common DCI can be the simplest solution.

Proposal 2: Proposal #5-2 in [2] is supported.

Proposal 3: For a cell supporting on-demand SSB SCell operation, in addition to periodicity of the on-demand SSB, for the following parameter(s), multiple candidate values can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication for the cell.

- The number of on-demand SSB bursts to be transmitted after on-demand SSB is indicated, if supported
- FFS: SSB positions within an on-demand SSB burst

Proposal 4: A CSI report configuration is NOT associated with both of on-demand SSB and always-on SSB.

Proposal 5: Proposal #7-2 in [2] is supported.

Proposal 6: Support beam failure based on on-demand SSB for both Case #1 and Case #2.

Proposal 7: OD-SSB has less priority of transmission than the previously configured periodic signals, like RACH and CSI-RS.

Proposal 8: The rate-matching is performed for the OD-SSB. For this, the resource containing (actually transmitted) OD-SSB can be scheduled for the demanding UE and UEs received DCI indication. On the other hand, the resources is not scheduled for the other UEs, including legacy UEs, as implementation.

- FFS: Rate-matching for the actually not transmitted OD-SSB

5. References

[1] 3GPP TR 38.864 V18.0.0, Study on network energy savings for NR.

[2] R1-2410912, Summary #5 of on-demand SSB for NES, Moderator (LG Electronics).