

Source: OPPO
Title: Discussion on the enhancement to support on demand SSB SCell operation
Agenda Item: 9.5.1
Document for: Discussion and Decision

1. Introduction

Enhancement to support OD-SSB SCell operation for Rel-19 NES has been discussed in previous RAN1 meetings [1]. In this contribution, we further provide our views on this topic.

2. Discussion

Determination of offset of OD-SSB burst

In RAN1 meeting #119, the following agreement was made.

Agreement

- For a cell supporting on-demand SSB SCell operation, support to configure time domain location of on-demand SSB per on-demand SSB periodicity by RRC for both Case #1 and Case #2.
 - For Case #1 (i.e., No always-on SSB on the cell),
 - Based on two parameters, where one is to indicate SFN offset from a reference point and the other is to indicate half frame index
 - The reference point is SFN which satisfies $(\text{SFN index} * 10) \bmod (\text{OD-SSB periodicity}) = 0$
 - If SFN offset parameter is NOT configured, UE assumes SFN offset set to 0.
 - If half frame index parameter is NOT configured, UE assumes half frame index set to 0.
 - The value range of SFN offset is 0 to 15 unless longer periodicity for on-demand SSB than 160 ms is introduced.
 - The value range of half frame index is 0 or 1.
 - For Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), down-select one of the following alternatives.
 - Alt A: Same as for Case #1
 - Alt B: Based on a single parameter which is to indicate the time offset between always-on SSB and on-demand SSB (e.g., similar to *ssb-TimeOffset*)

For Case #2, two alternatives are discussed on how to configure the offset of OD-SSB burst: Alt A is to configure the SFN offset and half frame index for OD-SSB burst independently, and Alt B is to configure the time offset between always-on SSB and OD-SSB. In our view, the offset of OD-SSB burst can be independent of that of always-on SSB burst. If Alt B is adopted, UE should first determine the configuration of always-on SSB before it determines the offset of OD-SSB burst. This restriction seems unnecessary. We prefer to support Alt A for Case #2.

Proposal 1: Support time domain location of OD-SSB burst being independent of that of always-on SSB.

Proposal 2: Support Alt A for Case #2 (Independently configure time domain location of OD-SSB burst).

Deactivation of OD-SSB transmission

In RAN1 meeting #119, the following agreement was made on candidate options for supporting deactivation of OD-SSB transmission.

Agreement

For a cell supporting on-demand SSB SCell operation, support at least the following options to deactivate on-demand SSB transmission from a UE perspective.

- Option 1: Explicit indication of deactivation for on-demand SSB via MAC-CE for on-demand SSB transmission indication

- Deactivation by RRC is up to RAN2
- FFS: Which scenario Option 1 is used
- Option 2: Configuration/indication of the number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
 - FFS: Whether Option 4, 4a is needed in addition to Option 2
 - FFS: Whether the value of N can be implicitly determined using a timer

If SCell is deactivated (i.e., the timer for SCell deactivation is expired) for one UE, the UE is not expected to perform L1/L3 measurement based on the OD-SSB burst on the SCell. So, the OD-SSB transmission on the SCell should be deactivated for this UE. Option 4A (On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired) is needed in addition to Option 2. On the other hand, one important motivation of introducing OD-SSB transmission is to fast UE's SCell activation procedure, we think it is beneficial to also support Option 5 (On-demand SSB transmission, if any, is deactivated when SCell activation is completed) in addition to Option 2. Besides, the value of N can be implicitly determined using a timer as there is no substantial difference between these two methods.

Proposal 3: Support Option 4A and Option 5 in addition to Option 2 for deactivation of OD-SSB transmission.

Proposal 4: Support the value of N being implicitly determined using a timer.

OD-SSB indication

For Scenario #3A, i.e., after UE receives SCell activation command (e.g., as defined in TS 38.321) until SCell activation is completed, if the OD-SSB indication is received during the period of the SCell being activated, it is still possible for UE to use the OD-SSB burst to speed up SCell activation procedure. The legacy SCell activation delay requirement for deactivated SCell may need to be extended accordingly as the indication is received after SCell activation command.

Proposal 5: Transmit OD-SSB indication in Scenario #3A is beneficial to fast SCell activation and can be supported.

For Scenario #2, i.e., SCell is configured to a UE but before the UE receives SCell activation command (e.g., as defined in TS 38.321), and Scenario #3A, in addition to MAC CE, new signaling can be introduced to indicate OD-SSB operation. Once OD-SSB is activated for a cell, UEs which are configured or being activated with this cell should be aware of the OD-SSB indication. Using GC-PDCCH would be more efficient for such kind of indication. For example, from UE perspective, each cell is associated with an OD-SSB indication, and the corresponding relationship can be configured by RRC signaling, so that one GC-PDCCH may contain multiple OD-SSB indications for multiple cells.

Proposal 6: For Scenario #2 and #3A, support GC-PDCCH for OD-SSB indication.

Frequency location of OD-SSB when always-on SSB is CD-SSB

In RAN1 meeting #119, the following agreement was made.

Agreement

Down-select at least one of the following alternatives.

- Alt 1: If always-on SSB is CD-SSB on a synchronization raster, the frequency location of on-demand SSB is different from the frequency location of always-on SSB.
- Alt 2: If always-on SSB is CD-SSB on a synchronization raster, the frequency location of on-demand SSB is the same as the frequency location of always-on SSB
- Alt 3: Do not support the case where always-on SSB is CD-SSB on a synchronization raster.

Down-select at least one of the following alternatives.

- Alt A: If always-on SSB is CD-SSB and not on a synchronization raster, the frequency location of on-demand SSB can be same or different from the frequency location of always-on SSB, subject to its configuration.
- Alt B: If always-on SSB is CD-SSB and not on a synchronization raster, the frequency location of on-demand SSB is the same as the frequency location of always-on SSB
- Alt C: Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster.

If always-on SSB is CD-SSB on a synchronization raster for one cell, then there may be legacy UEs capable of accessing the cell through initial access procedure. The configured always-on SSB density for this cell should guarantee the performance of legacy UEs. We do not see a strong motivation to introduce additional OD-SSB. Alt 3 is preferred for this case.

If always-on SSB is CD-SSB and not on a synchronization raster for one cell, OD-SSB burst can be supported in addition to always-on SSB as long as there is no misunderstanding for UEs. In this case, we prefer to support Alt B to restrict same frequency location of OD-SSB and always-on SSB for simplicity.

Proposal 7: Support Alt 3 and Alt B for frequency location of OD-SSB when always-on SSB is CD-SSB.

QCL relationship between OD-SSB and always-on SSB

In RAN1 meeting #118bis and #119, the following agreements were made.

Agreement

For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), consider only one or both of the following options for UE to perform L1 measurement based on on-demand SSB.

- *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 OD-SSB and always on SSB have same beam or not*

Agreement

Response to Q4 (What is the spatial relation between the always-on SSB and OD-SSB?) of Obj.1:

- *SS/PBCH blocks with the same SSB indexes for always-on SSB and on-demand SSB are quasi co-located with respect to Doppler spread, Doppler shift, average gain, average delay, delay spread, and when applicable, spatial RX parameters.*
 - *Applies at least for the case when the centre frequency locations of always-on SSB and OD-SSB is same*
- *When a signal/channel is configured to be QCLed with a SSB index, the signal/channel is QCLed with the same SSB index of always-on SSB and on-demand SSB (if transmitted) with the same QCL parameters according to existing specifications*
 - *Applies at least for the case when the centre frequency locations of always-on SSB and OD-SSB is same*
- *At least the case where SSB indices within on-demand SSB burst are identical to SSB indices within always-on SSB burst is supported. RAN1 is discussing whether to support the case where SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst.*

If always-on SSB is CD-SSB or is located on synchronization raster, frequency location of always-on SSB may be different from that of OD-SSB if supported. In this case, a CSI report configuration should be associated with one of always-on SSB and OD-SSB for L1 measurement based on OD-SSB, otherwise, the implementation complexity of SSB measurement would be increased. If frequency location of always-on SSB is same as that of OD-SSB, a CSI report configuration may be associated with both OD-SSB and always-on SSB. For unified design, we prefer a CSI report configuration is associated with one of always-on SSB and OD-SSB.

On the other hand, we think SSB indexes in on-demand SSB burst should be a subset of SSB indexes in always-on SSB burst, as always-on SSB burst should target for coverage of the whole cell, while on-demand SSB burst could be triggered only for partial UEs for fast SCell activation.

Proposal 8: Support Option 2 (A CSI report configuration is associated with one of always-on SSB and on-demand SSB) for L1 measurement based on OD-SSB.

Proposal 9: Support SSB indexes within OD-SSB burst being subset of SSB indexes within always-on SSB burst.

3. Conclusion

In this contribution, we provide our views on OD-SSB SCell operation for Rel-19 NES. The following proposals are listed.

Proposal 1: Support time domain location of OD-SSB burst being independent of that of always-on SSB.

Proposal 2: Support Alt A for Case #2 (Independently configure time domain location of OD-SSB burst).

Proposal 3: Support Option 4A and Option 5 in addition to Option 2 for deactivation of OD-SSB transmission.

Proposal 4: Support the value of N being implicitly determined using a timer.

Proposal 5: Transmit OD-SSB indication in Scenario #3A is beneficial to fast SCell activation and can be supported.

Proposal 6: For Scenario #2 and #3A, support GC-PDCCH for OD-SSB indication.

Proposal 7: Support Alt 3 and Alt B for frequency location of OD-SSB when always-on SSB is CD-SSB.

Proposal 8: Support Option 2 (A CSI report configuration is associated with one of always-on SSB and on-demand SSB) for L1 measurement based on OD-SSB.

Proposal 9: Support SSB indexes within OD-SSB burst being subset of SSB indexes within always-on SSB burst.

4. Reference

[1] R1-2410074, Discussion on the enhancement to support on-demand SSB SCell operation, OPPO.