Agenda Item: 9.5.1
Source: Moderator (LG Electronics)
Title: Summary #1 of on-demand SSB for NES
Document for: Discussion and decision

1   Introduction

This is the summary document for agenda item 9.5.1 on-demand SSB for NES and for agenda item 5 regarding RAN4 LS (R1-2500020), based on the contributions listed in reference section.

2   Remaining issues related to RAN4 LS (R1-2409350)

> **<Questions in R1-2409350>**
>
> **Obj. 1 related to on-demand SSB SCell operation**
> Based on the discussion, RAN4 identified that the relation between always-on SSB and on-demand SSB (i.e. Case#2 as agreed in RAN1) has impacts on UE's behavior and requirements in SCell. RAN4 would like RAN1 to clarify at least the following aspects:
> - Q1: What is the relation in terms of periodicity between always-on SSB and OD-SSB?
> - Q2: What is the relation in terms of time location between always-on SSB and OD-SSB?
> - Q3: What is the relation in terms of frequency location between the always-on SSB and OD-SSB?
> - Q4: What is the spatial relation between the always-on SSB and OD-SSB?

2.1   Q1 (periodicity)

Company	Views
[3] ZTE	**Proposal 1:** The periodicity of on-demand SSB can be smaller than or equal to that of the always-on SSB, and can be one of 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, or 160 ms.
[5] CATT	**Proposal 26:** Regarding the relation in terms of periodicity between always-on SSB and OD-SSB, the periodicity of on-demand SSB should be equal to or smaller than that of always-on SSB.
[14] Google	**Proposal 11:** How to configure the periodicity for on-demand SSB is up to NW implementation.
[29] NTT DOCOMO	**Proposal 3:** We support to make periodicity restriction/assumption of OD-SSB such that it is smaller than or equal to the periodicity of AO-SSB.

> **Agreement (RAN1#119)**
> Response to Q1 (What is the relation in terms of periodicity between always-on SSB and OD-SSB?) of Obj.1:
> - The periodicity of on-demand SSB is one of 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, or 160 ms.
> - The periodicity of on-demand SSB can be configured separately from the periodicity of always-on SSB.
> - RAN1 is discussing what is the relation between periodicity of always-on SSB and periodicity of on-demand SSB and it has been identified that the main use case is that the periodicity of on-demand SSB is equal to or smaller than that of always-on SSB.
> Further update to be made based on RAN1#119 progress.

[Moderator's note] Company views on Q1 of R1-2409350:

- Is the configuration limitation that the periodicity of on-demand SSB is equal to or smaller than that of always-on SSB needed?
    - YES: ZTE, CATT, NTT DOCOMO
    - NO, it's up to network: Google

Due to the lack of input from companies, this issue can be deprioritized at this meeting. However, companies can provide comments, if any.

Company	Views
Xiaomi	OK with the proposal.
LG Electronics	The configuration limitation should be specified. When the periodicity of on-demand SSB is larger than that of always-on SSB, we are wondering why OD-SSB is needed in Case 2(e.g., when the periodicity of OD-SSB is 160ms and the periodicity of AO-SSB is 40ms, why is OD-SSB with the periodicity of 160ms indicated ?)
Huawei & Hisilicon 1	Up to NW. Though NES gain is achieved only in a given number of scenarios, we see no necessity to put such restriction in spec.
Nokia, NSB	Yes, the scenario where OD-SSB periodicity would be larger than AO-SSB is unclear.
NEC	Same opinion as Huawei, there is no reason to put such restriction in the spec for this.
Lenovo	From implementation OD-SSB periodicity is mostly equal to or smaller than that of always on SSB, but from configuration point of view, limitation on OD-SSB periodicity is not needed.
TCL	No need give one restriction for the periodicity of OD-SSB
DCM	We are fine with the FL proposal.
China Telecom	Support, otherwise we don't see any NES gain.
Transsion	Since OD-SSB is complementary to AO-SSB, we agree with FL's proposal.

2.2 Q2 (time domain relation)

Company	Views
[3] ZTE	**Observation 1:** When the on-demand SSB and the always-on SSB are completely overlapped, the transmission of the on-demand SSB is meaningless. **Observation 2:** Partially overlapping between on-demand SSB and always-on SSB can achieve the effect of dense SSB transmission. **Observation 3:** When on-demand SSB and always-on SSB do not overlap, the SSB density can be effectively increased to assist UE in performing measurement. **Proposal 2:** For the time location between always-on SSB and OD SSB, except for complete overlapping, other cases are supported.
[5] CATT	**Proposal 27:** Regarding the relation in terms of time location between always-on SSB and OD-SSB, the time location of OD-SSB can be the same as or different from the time location of always-on SSB.
[7] CMCC	**Proposal 14:** The time location between always-on SSB and on-demand SSB can be the same or different.
[8] vivo	**Proposal 7:** Whether always-on SSB and on-demand SSB overlapping in time-domain is not restricted.
[10] OPPO	**Proposal 1:** Support time domain location of OD-SSB burst being independent of that of always-on SSB.
[11] Nokia	**Observation-2:** It has been agreed in RAN1#117 meeting that the time domain positions of on-demand SSBs within SSB burst and the time locations of the OD-SSB bursts are known to UE. **Observation-3:** For Case#2, when always-on SSB and OD-SSB are on the same frequency location the specification impact and UE complexity can be very much simplified if the time locations of always-on SSBs and OD-SSBs are fully overlapped in some of the time occasions, meaning that there is no transmission time offset between always-on SSB and OD-SSB. **Proposal-3:** RAN1 answer to the Q2 of OD-SSB is: When always-on SSB and OD-SSB are on the same frequency location, they are configured so that SFN offset and half frame index are the same. However, when they are in different frequency location, there are no limitations on the time location configuration.

[17] Xiaomi	**Proposal 10:** The always-on SSB and on-demand SSB should not overlap in time domain.
[22] Fujitsu	**Proposal 2:** At least support time locations of on-demand SSB to be different from the time locations of always-on SSB.
[27] Qualcomm	**Proposal 8:** At least for Case #2 in which the frequency locations of always-on SSB and on-demand SSB are identical, the time domain configuration of on-demand SSB is identical to the time domain configuration of on-demand SSB in Case #1. Furthermore, the time-domain locations of always-on SSB burst is a subset of the time-domain locations of on-demand SSB bursts.
[33] Ericsson	• **Mux-Scenario 1:** Same frequency and same time offset between on-demand and always-on SSB. • **Mux-Scenario 2:** Same frequency and different time offset between on-demand and always-on SSB. • **Mux-Scenario 3:** Different frequency and same time offset between on-demand and always-on SSB. • **Mux-Scenario 4:** Different frequency and different time offset between on-demand and always-on SSB. **Observation 5** The possible scenarios for multiplexing of on-demand SSB and always-on SSB in an SCell are Mux-Scenario 1—4. **Proposal 10** On-demand SSB and always-on SSB can be provided with the same time offset. **Proposal 11** For multiplexing of on-demand SSB and always-on SSB in an SCell, support at least Mux-Scenario 1 and Mux-Scenario 3.

==Agreement== **(RAN1#119)**
Response to Q2 (What is the relation in terms of time location between always-on SSB and OD-SSB?) of Obj.1:
- RAN1 understands the time location of OD-SSB in Q2 refers to the time location of possible OD-SSB burst
- RAN1 is still discussing the relation in terms of time location between always-on SSB and OD-SSB

[==Moderator's note==] Company views on Q2 of R1-2409350:
- Time location between always-on SSB and OD-SSB can be same or different: CATT, CMCC, vivo, OPPO
- No overlap in time domain: Xiaomi, ZTE
- Qualcomm: Subset relationship
- Ericsson: At least same
- Fujitsu: At least different
- Nokia: Same for same frequency case, independent for different frequency case

==[HIGH] Proposal #2-2 (Q2):==
Regarding the relation in terms of time location between the always-on SSB and on-demand SSB, at least for the case when the center frequency locations of always-on SSB and on-demand SSB are same, down-select one of the followings.
- Alt 1: Time locations of on-demand SSB can be ~~configured~~ independent~~ly~~ of time locations of always-on SSB.
- Alt 2: Time locations of on-demand SSB can be ~~configured~~ independent~~ly~~ of time locations of always-on SSB, but it is not allowed that time locations of on-demand SSB overlaps with those of always-on SSB.
- Alt 3: Time-domain locations of always-on SSB are a subset of time-domain locations of on-demand SSB.

Companies are encouraged to provide views on Proposal #2-2 and preference among alternatives.

Company	Views
InterDigital	Generally fine with the proposal. It would be good to clarify the alternatives as they appear to be mixing some things. Alt-1 and Alt-2 seems be referring to whether the time locations of OD-SSB are configured independently of AO-SSB, and whereas Alt-3 is specifically referring to the time locations relation. If the understanding of Alt-1 is it allows the time locations of AO-SSB to be a subset of OD-SSB (e.g. overlap with OD-SSB) then our preference is Alt-1.
Google	OK with Alt2 in general, but we think the overlap for the same SSB index should be fine.

CMCC	Support Alt1. It is up to gNB to configure time location of on-demand SSB to be overlapping or non-overlapping with always-on SSB. When time location of on-demand SSB is overlapping with always-on SSB, the parameters of two kinds of SSB except positioninburst should be the same.
Samsung	We prefer Alt 2, and could be ok with Alt 1 if always-on SSB and on-demand SSB have same cell ID and PBCH payload (other than timing information).
Qualcomm	This discussion is related to the discussion in Proposal 5-1. We suggest discussing Proposal 5-1 first. For this proposal, is "configured" here an RRC configuration? If yes, the time locations of always-on SSB are not RRC configured in the existing spec. Hence, statement "Time locations of on-demand SSB can be configured independently of time locations of always-on SSB" means the relationship from RRC configuration perspectives, which does not seem correct.
Xiaomi	We prefer alt 2 which we believe it is sufficient. We don't see strong motivation of supporting alt 1 or alt 3. However, it will complicate specifications as UE needs to determine which SSB it needs to receive on the same OFDM symbols. Furthermore, it is doesn't make sense to us to have to overlapped SSBs on the same OFDM symbols for both gNB and UE.
LG Electronics	Generally, prefer Alt 1 for flexible configurations on AO-SSB and OD-SSB if the centre frequency locations of always-on SSB and on-demand SSB are same. Additionally, when the time locations of on-demand SSB is same as those of always-on SSB and two periodicities of two different SSBs are same, it can appear to be nothing beneficial to indicate OD-SSB in Case 2. some considerations(constraints) to evade this situation can be discussed on configuration for the time locations of on-demand SSB in Case 2. So, Alt 2 can be also supported for the constrained case.
Apple	Support Alt 2
Huawei, HiSilicon 1	Support Alt 1. More generally, no matter always-on SSB and on-demand SSB are configured on the same or different frequency, time locations of on-demand SSB can be independent from those of always-on SSB. In some time intervals where always-on SSB and on-demand SSB can both exist, collision handling rules (e.g., priority) help. We suggest that Proposal #2-2 can be jointly considered with Section 8 'SSB multiplexing', enabling a more comprehensive and succinct spec discussion. Also we suggest removing configured because it is under discussion in P5-1. Hence, we propose: Regarding the relation in terms of time location between the always-on SSB and on-demand SSB, ~~at least for the case when the center frequency locations of always-on SSB and on-demand SSB are same, down select one of the followings.~~ • ~~Alt 1:~~ time locations of on-demand SSB can be ~~configured~~ independent~~ly~~ of time locations of always-on SSB. • ~~Alt 2: Time locations of on-demand SSB can be configured independently of time locations of always-on SSB, but it is not allowed that time locations of on-demand SSB overlaps with those of always-on SSB.~~ • ~~Alt 3: Time domain locations of always-on SSB are a subset of time domain locations of on-demand SSB.~~
Panasonic	In our understanding, Alt 1 is a super set of the cases framed by Alt 2 and Alt 3. At this moment, for network energy saving point of view, we see Alt 1 keeps good flexibility. From UE measurement, we think which case to support can be up to UE capability.
Nokia, NSB	We prefer Alt 3. This would simplify the operation because then UE does not need to consider SSBs transmitted with different offsets.
NEC	Support the proposal but Alt-3 may need to be phrased correctly. This is because OD-SSB can have periodicity smaller that AO-SSB and hence it is natural that even if we try aligning the transmission of AO-SSB and OD-SSB then there some occasions where OD-SSB will be transmitted on its own (i.e. not a subset of AO-SSB locations). We can check if we say that we have same SFN offset and half frame value for both OD-SSB and AO-SSB to simplify the discussion?
Lenovo	Support
ETRI	Support Alt 1
ZTE, Sanechips	It may be confusing to say whether or not the configuration is independent. We should figure out where the on-demand SSB bursts are in the end. In our view, except the case where all on-demand SSB burst are overlapped with always-on SSB burst (as following (a) illustrated), other cases are possible for configurations.

TCL	Prefer Alt.2 and we think Alt.2 could include Alt.3 in most case.
DCM	We support Alt. 1.
	This is because different allocation (overlap or non-overlap) is needed/beneficial according to QCL relationship b/w AO and OD-SSB.
	When the SSB indicies of OD-SSB and AO-SSB have the QCL assumption, it can be OK to make AO-SSB trnamissions are subset of OD-SSB transmission occasion, but if they do not have the QCL assumption, they need to be non-overlap so that UE can avoid negative impact by mixing both AO-SSB and OD-SSB.
Fujitsu	We are fine with the proposal. Among the three alternatives, we prefer Alt 2.
OPPO	we support independent configuration of the time location. But when the frequency location is same for OD-SSB and AO-SSB, the AO-SSB is a subset of OD-SSB should also be supported
China Telecom	Alt 1.
	Agree with Huawei that OD-SSB and AO-SSB can be separately configured. Though we think there shouldn't be OD-SSB and AO-SSB transmitted with both time and frequency domain overlap, it is up to gNB's implement to configure the time locations of two type SSBs correctly, or chose not to transmit one of the SSB when overlap happens. But for the CONFIGURATON, we think there should be no restriction.
Spreadtrum	We support Alt 1. Alt 1 is more flexible and can cover Alt 2 and 3.
Transsion	Support Alt 1.
Vivo	We support alt1.
CATT	We need to reframe the proposal, as it is not clear what is the definition of one type of ssb is 'independent of ' another type of ssb.

Moderator	- Alt 1
	    o Supported by InterDigital, Google?, CMCC, Samsung (also OK if AO-SSB and OD-SSB have same PCI and PBCH payload other than timing information), LG Electronics, Huawei, Panasonic, ETRI, ZTE (except for full-overlap case), NTT DOCOMO, OPPO?, China Telecom, Spreadtrum, Transsion, vivo
	- Alt 2
	    o Supported by Google, Samsung, Xiaomi, LG Electronics (for the same periodicity case), Apple, TCL, Fujitsu
	- Alt 3
	    o Supported by Nokia, NEC?

[HIGH] Proposal #2-2a (Q2):

Regarding the relation in terms of time location between the always-on SSB and on-demand SSB, at least for the case when the center frequency locations of always-on SSB and on-demand SSB are same, down-select one of the followings.

- Alt Time-A: It is not allowed that time location of an SSB index within on-demand SSB burst overlaps with time location of any SSB index within always-on SSB burst.
- Alt Time-B: Time-domain locations of always-on SSB are a subset of time-domain locations of on-demand SSB.
  - NOTE: It is assumed that the periodicity of always-on SSB is larger than that of on-demand SSB.
- Alt Time-C: The specification allows Alt A and Alt B

Companies are encouraged to provide views on Proposal #2-2a and preference among alternatives.

Company	Views

2.3 Q3 (frequency domain relation)

Company	Views
[1] Futurewei	**Observation 1:** If always-on SSB is CD-SSB on a synchronization raster and the frequency location of on-demand SSB is the same as the frequency location of always-on SSB, the legacy UEs may be impacted. **Observation 2:** If SCell allows legacy UEs access, larger periodicity of always-on SSB impacts their initial access latency. **Observation 3:** In a SCell with legacy UE and 20ms periodicity always-on SSB the on-demand SSB is not justified for NES. **Proposal 1:** Support Alt 2 only in SCells that barres legacy UE access or alternatively support Alt 3. **Proposal 2:** Support Alt B: When the always-on CD SSB is not located on sync raster the on demand SSB has the same center frequency as always-on CD SSB.
[2] Huawei	**Proposal 2:** Both Alt 1 and Alt 2 can be supported, i.e., if AO-SSB is CD-SSB on a sync raster, the frequency location of OD-SSB can be the same as or different from the frequency location of AO-SSB. **Proposal 3:** Support Alt A, i.e., If AO-SSB is CD-SSB and not on sync raster, the frequency location of OD-SSB can be same or different from the frequency location of AO-SSB, subject to its configuration.
[3] ZTE	**Proposal 3:** 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) and Alt C (Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster) are supported.
[4] Spreadtrum	**Proposal 6** For the case when always-on SSB is CD-SSB and not on a synchronization raster, the frequency location of on-demand SSB and always-on SSB subject to network configuration.
[5] CATT	**Proposal 4:** The following Alt 1 and Alt A in the agreement in RAN1#119 should be supported. - 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 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. **Proposal 28:** Regarding the frequency location of OD-SSB for the case where always-on SSB is CD-SSB, - 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. - 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.
[6] China Telecom	**Proposal 6:** Support Alt1, i.e., 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.

	Proposal 7: Support 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.
[7] CMCC	**Proposal 13:** The case where always-on SSB is SSB associated with SIB1 is not supported.
[8] vivo	**Observation 2:** There will be interruption to UE when OD-SSB is triggered in different frequency location with always-on SSB. **Proposal 5:** For on-demand SSB on the cell, support 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 where on-demand SSB is NCD-SSB. **Proposal 6:** For on-demand SSB on the cell, support 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 where on-demand SSB is NCD.
[9] Tejas	**Proposal 4:** Supporting 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. **Proposal 5:** Supporting 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.
[10] OPPO	**Proposal 7:** Support Alt 3 and Alt B for frequency location of OD-SSB when always-on SSB is CD-SSB.
[11] Nokia	**Observation-4:** Network may configure always-on SSB as CD-SSB. If OD-SSB is on the same BWP as always-on SSB, it should be in the same frequency as always-on SSB because of the requirement that at most one SSB can be configured with each BWP. Alt 2 should therefore be supported and OD-SSB should then be CD-SSB. This scenario can be viewed as the CD-SSB periodicity adaptation in SCell and this could also be discussed along with Objective#3. **Observation-5:** We see that both Alt1 and Alt2 are possible configurations when always-on SSB is CD-SSB transmitted on a synchronization raster. **Observation-6:** For simplification of the options and progress towards a feasible solution, we can deprioritize the case when always-on SSB is CD-SSB not in the synchronization raster and hence we prefer Alt C. **Proposal-4:** RAN1 prioritizes the case when always-on CD-SSB is transmitted on synchronization raster. Support both Alt-1 and Alt-2.
[12] Panasonic	**Proposal 3:** To agree on 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. **Proposal 4:** To agree on 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.
[13] InterDigital	**Proposal 4:** For AO-SSB configured as CD-SSB on a sync raster, support the frequency location of OD-SSB to be the same or different as the frequency location of AO-SSB (Alt-1 or Alt-2) **Proposal 5:** For AO-SSB configured as CD-SSB and not on sync raster, support the frequency location of OD-SSB to be the same or different from the frequency location of AO-SSB (Alt-A)
[15] NEC	**Observation 5:** Legacy UEs, connected to an NES cell, may show unpredictable behaviour and potential synchronization loss if on-demand SSB share the same frequency as always-on SSBs. **Proposal 4:** Support 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.

	Proposal 5: Support Alt A: If always-on SSB provides a CORESET for Type0-PDCCH CSS set but is 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.
[17] Xiaomi	**Proposal 9:** When always-on SSB is CD-SSB, the frequency location of on-demand SSB is same as that of always-on SSB.
[18] Apple	**Observation 6:** Different frequency locations between AO-SSB and OD-SSB are not desirable due to additional interruption and complication of UE implementation during SCell activation. **Proposal 3:** The case of different frequency locations between AO-SSB and OD-SSB is precluded. **Observation 7:** OD-SSB as NCD-SSB on sync raster is not desirable. Therefore, AO-SSB on sync raster is not preferred due to Observation 6 (Different frequencies between AO-SSB and OD-SSB are not desirable). **Proposal 4:** AO-SSB as CD-SSB on sync raster is precluded. **Proposal 5:** From Proposal 3 and Proposal 4, - Alt 3: Do not support the case where always-on SSB is CD-SSB on a synchronization raster. - 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 **Proposal 6:** The term of 'frequency location' between AO-SSB and OD-SSB needs to be clarified whether it means center frequency of SSB or active BWP on the SCell.
[21] ETRI	**Proposal 4:** Regarding whether always-on SSB is CD-SSB on a synchronization raster or not, the followings should be supported. - 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 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.
[22] Fujitsu	**Proposal 3:** The case where always-on SSB is CD-SSB on a synchronization raster should be supported. **Proposal 4:** Regarding the frequency domain relation between on-demand SSB and always on SSB, support Alt1 and Alt A. - 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 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.
[23] LG Electronics	**Proposal #4:** Adopt Alt 1 and Alt A and further discuss whether the limitation that always-on SSB and on-demand SSB are located within the same BWP is needed or not. - 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 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
[24] Transsion	**Proposal 4** It is recommended to support 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. **Proposal 5** It is recommended to support Alt C: Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster.

[25] MediaTek	**Proposal 2:** The frequency location of the on-demand SSB should be shifted if the always-on SSB is CD-SSB on the sync raster. I.e., we prefer Alt 1 agreed in RAN1 #119 below: - 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.
[27] Qualcomm	**Proposal 6:** When always-on SSB is CD-SSB, support - 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.) ○ Note: This is subject to a UE capability that is different from the UE capability on the support of the same frequency location for on-demand SSB and always-on SSB - Alt C (Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster.)

[29] NTT DOCOMO	**Proposal 2:** For the types of SSBs of AO-SSB and OD-SSB, we support following alternatives.
	- Alt. 1 with the restriction that UE does not require to do RF tuning. (E.g., AO-SSB and OD-SSB are placed on the same active BWP)
	- Alt. 2 with the restriction that OD-SSB is CD-SSB on a sync raster (same as AO-SSB)
	- Alt. A for the case where
	    ○ OD-SSB and AO-SSB are located on the same frequency.
	    ○ OD-SSB and AO-SSB are not located on the same frequency with the restriction that UE does not require to do RF tuning.

[30] ITRI	**Observation 1:** Alt 2 may cause confusion for legacy UEs performing initial access, since the frequency location of on-demand SSB is the same as the frequency location of always-on SSB. **Proposal 1:** RAN1 should at least support Alt 1 if always-on SSB is CD-SSB on a synchronization raster. - 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. **Observation 2:** Alt A and Alt B can both be supported for the frequency location of on-demand SSB in principle. **Proposal 2:** RAN 1 should at least support Alt B if always-on SSB is CD-SSB and not on a synchronization raster. - 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
[31] TCL	**Proposal 10:** Support Alt 3 or Alt C for what AO-SSB is an NCD-SSB. **Proposal 11:** If OD-SSB and AO-SSB all are NCD-SSB, how to indicate the frequency position of CD-SSB by NCD-SSB indication needs to be carefully considered. **Proposal 12:** Support same frequency location for AO-SSB and OD-SSB.
[33] Ericsson	• **Mux-Scenario 1:** Same frequency and same time offset between on-demand and always-on SSB. • **Mux-Scenario 2:** Same frequency and different time offset between on-demand and always-on SSB. • **Mux-Scenario 3:** Different frequency and same time offset between on-demand and always-on SSB. • **Mux-Scenario 4:** Different frequency and different time offset between on-demand and always-on SSB. **Observation 5** The possible scenarios for multiplexing of on-demand SSB and always-on SSB in an SCell are Mux-Scenario 1—4. **Observation 6** If always-on SSB is located on sync raster, it is preferred that on-demand SSB and always-on SSB are provided on different frequencies.

| | **Proposal 9** On-demand SSB and always-on SSB can be provided on the same frequency or on different frequencies.

Proposal 11 For multiplexing of on-demand SSB and always-on SSB in an SCell, support at least Mux-Scenario 1 and Mux-Scenario 3.

Proposal 19 Support at least 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) and 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). |
|---|---|

Agreement (RAN1#119)

Response to Q3 (What is the relation in terms of frequency location between the always-on SSB and OD-SSB?) of Obj.1:
- The frequency location of on-demand SSB is the same as the frequency location of always-on SSB at least for the case where always-on SSB is not CD-SSB. RAN1 is discussing the frequency location of OD-SSB for the case where always-on SSB is CD-SSB.

Agreement (RAN1#119)

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.

[Moderator's note] Company views on alternatives for the above agreement:
- Alt 1 (for always-on CD-SSB on sync raster, different frequencies for always-on SSB and on-demand SSB)
  - Supported by China Telecom, Tejas, Panasonic, NEC, ETRI, Fujitsu, LG Electronics, Transsion, MediaTek, Qualcomm (with separate UE capability), ITRI, Ericsson
- Alt 2 (for always-on CD-SSB on sync raster, same frequency for always-on SSB and on-demand SSB)
  - Supported by Futurewei, ZTE, vivo, Xiaomi
- Both Alt 1 and Alt 2
  - Supported by Huawei, Nokia, InterDigital, NTT DOCOMO (within the same BWP)
- Alt 3 (Do not support the case where always-on SSB is CD-SSB on a synchronization raster)
  - Supported by Futurewei, CMCC, OPPO, Apple, TCL
- Alt A (for always-on CD-SSB not on sync raster, same or different frequencies for always-on SSB and on-demand SSB)
  - Supported by Huawei, Spreadtrum, China Telecom, Tejas, Panasonic, InterDigital, NEC, ETRI, Fujitsu, LG Electronics, NTT DOCOMO (within the same BWP), Ericsson
- Alt B (for always-on CD-SSB on sync raster, same frequency for always-on SSB and on-demand SSB)
  - Supported by Futurewei, vivo, OPPO, Xiaomi, Apple, ITRI
- Alt C (Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster)
  - Supported by ZTE, CMCC, Nokia?, Transsion, Qualcomm, TCL
- Apple: To clarity that "frequency location" means center frequency of SSB

[HIGH] Proposal #2-3 (Q3):

Regarding the relation in terms of frequency location (i.e., center frequency) between the always-on SSB and on-demand SSB,
- Support the followings

- o 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
- o 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.
- o FFS: Additional conditions, e.g., optional UE capability, confined within the same BWP

Companies are encouraged to provide views on Proposal #2-3.

Company	Views
InterDigital	Generally fine with the proposal. However, to avoid fragmenting the solutions depending on the whether AO-SSB is located on or off sync-raster, a unified approach is preferable. For example, Alt-A can be modified to be applicable for the case where AO-SSB is located on and off sync raster.
Google	OK
CMCC	Firstly, we need to align that the periodicity of always-on SSB is probably larger than 20ms for NES gain. Then, if always-on SSB is CD-SSB on a synchronization raster, UE may fail to perform initial access with default periodicity of 20ms. This increases initial access delay of R19 UEs and legacy UEs. Thus, always-on SSB shall not be CD-SSB on a synchronization raster. There seems no motivation for always-on SSB to be SSB associated with SIB1 and not on a synchronization raster. R19 UEs and legacy UEs will not perform initial access or acquire SIB1 through SSB not on synchronization raster, the transmission of scheduling information of SIB1 in SSB is meaningless. Above all, always-on SSB can only be NCD-SSB.
Qualcomm	What is the main use case of "always-on SSB is CD-SSB and not on a synchronization raster" that proponents have in mind? Why "always-on SSB is CD-SSB on a synchronization raster" can't support such use case?
Xiaomi	In our view, when always-on SSB is CD-SSB, the frequency location of on-demand SSB is same as that of always-on SSB, i.e., Alt 2 for always-on CD-SSB on sync raster. For the both of above cases, i.e., always-on SSB is CD-SSB on a synchronization raster and not on a synchronization raster, we don't see motivation on having an on-demand SSB with a different frequency location from that of always-on SSB. Considering it has been agreed that the frequency location of on-demand SSB is the same as the frequency location of always-on SSB for the case where always-on SSB is not CD-SSB, the same principle can be reused for the other cases. For the case CD-SSB not on a synch raster, maybe we need to first align the understanding whether it is a valid case for CD-SSB. Looking into the specification, CD-SSB is defined as there is an associated RMSI. However, if it is allowed off raster, UE cannot receive it on synch raster and the followed up RMSI is meaningless. From this perspective, we are also fine to don't support this case, i.e., lt C (Do not support the case where always-on SSB is CD-SSB and not on a synchronization raster).
LG Electronics	We prefer the proposal which is based on the majority view. Additionally, when the frequency location of on-demand SSB is different from the frequency location of always-on SSB, we think that the frequency location of on-demand SSB is within the bandwidth of the BWP configured in BWP-DownlinkCommon where the CD-SSB is
Apple	We do not support the proposal for the following reasons. 1/ It is preferred that OD-SSB and AO-SSB are located in the same frequency to avoid interruption time in case of different frequency locations. If AO-SSB is CD-SSB on sync raster, it results in different frequencies between AO- and OD-SSB since OD-SSB cannot be on sync raster. Therefore, we prefer **Alt 3 (Do not support the case where always-on SSB is CD-SSB on a synchronization raster)**. 2/ The main use case of Case #2 is AO-SSB with larger periodicity (e.g. 160ms) and OD-SSB smaller periodicity (e.g. 20ms). If AO-SSB is on sync raster, to avoid impact on cell selection and reselection, the periodicity of AO-SSB should be 20ms or less. If periodicity of AO-SSB is 20ms or less, there is no need to transmit OD-SSB and it rather increases network power without any benefit. Therefore, we prefer **Alt 3 (Do not support the case where always-on SSB is CD-SSB on a synchronization raster).**

	3/ It is preferred that OD-SSB and AO-SSB are located in the same frequency to avoid interruption time in case of different frequency locations. Therefore, we prefer **Alt B (for always-on CD-SSB on sync raster, same frequency for always-on SSB and on-demand SSB)**. Also, we suggest to discuss what 'same/frequency locations' means – **same/different center frequency of SSBs or active BWP**.
Huawei, HiSilicon 1	We support Alt A. If always-on SSB is CD-SSB on a synchronization raster, both Alt 1 and Alt 2 (from our previous agreement) can be supported. On newly-deployed spectrums (e.g., U6GHz), no legacy UE exists so that the negative impact of on-demand SSB on sync raster on idle legacy UEs' initial access is avoided. Therefore, Alt 1 can be used on existing spectrum where legacy UEs exist while Alt 2 can be used on newly-deployed spectrum. There should not be restriction in spec because NW deployment can handle the issue. Hence, we suggest adding back Alt2.
Panasonic	Support
Nokia, NSB	Alt 2 should be supported as well. Regarding AO-SSB not on sync raster we think that it may be down prioritized if there are more urgent issues.
NEC	Support
Lenovo	Support
ETRI	Support
ZTE, Sanechips	There are several problems for this proposal as CMCC and Qualcomm point out, I also think Alt C makes more sense than Alt A. Thus we don't support this proposal.
DCM	At least support Alt. 1 and Alt. A. Also, we support Alt. 2 as well. Imagine that a cell is working only as Scell (e.g., by setting MIB as cellbarred to avoid legacy UE to camp on). In such scenario, even if OD-SSB is located on CD-SSB on a sync raster, legacy UE does not affect negative impact since legacy UEs are not in the cell.
Fujitsu	We support this proposal on the premise that the on-demand SSB is NCD-SSB or not transmitted on the sync rater. In addition, Alt 2 can also be supported in the case that the on-demand SSB is CD-SSB on sync rater, if this case is agreed upon.
China Telecom	Support. Besides, we also support Alt2 as DCM and Huawei said. Actually, we don't see the need to add any restriction to the configuration of time/frequency location for OD-SSB, regardless of AO-SSB.
Transsion	We have reservations about whether Alt A is a valid case. From our understanding, CD-SSB should be SSB on a synchronization raster.
Vivo	We are fine with alt2/3 and altB/C, OD-SSB and always-on SSB should not be on different frequency to avoid UE interruption.
CATT	Support all the alternatives.

Moderator	- Supported by InterDigital, Google, LG Electronics, Huawei, Panasonic, NEC, Lenovo, ETRI, Fujitsu, China Telecom
	    o InterDigital: Extend the use case to always-on NCD-SSB
	    o Huawei, NTT DOCOMO, Fujitsu, China Telecom: Also support Alt 2
	- Objected by CMCC (Alt 3/C), Qualcomm (Alt C), Xiaomi (Alt 2/C), Apple (Alt 3/B), Nokia (Alt 2/C), ZTE (Alt C), vivo (Alt 2/3/B/C)
	
	If Alt 3 (Do not support the case where always-on SSB is CD-SSB on a synchronization raster) is adopted,
	- if a UE is configured with only one always-on CD-SSB on sync raster, then the UE cannot be configured with on-demand SSB for this cell.
	- if a UE is configured with one always-on CD-SSB on sync raster + NCD-SSB configured by *nonCellDefiningSSB*, then the UE can be configured with on-demand SSB associated with that NCD-SSB for this cell.
	
	@ All,
	Hope we can have the same understanding as above, if Alt 3 is taken.

2.4 Q4 (spatial domain relation)

Company	Views
[1] Futurewei	**Proposal 3:** Support <u>only</u> the case where SSB indices within on-demand SSB burst are identical to SSB indices within always-on SSB burst.
[2] Huawei	**Proposal 4:** Support Alt 1, i.e., SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst, subject to its configuration. **Proposal 5:** The QCL relationship between SS/PBCH blocks with the same SSB indexes of AO-SSB and OD-SSB can be configured by RRC, for the case when the center frequency locations of AO-SSB and OD-SSB are not the same.
[3] ZTE	**Proposal 4:** Support the case where SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst. **Proposal 23:** There is no need to restrict the OD-SSB and always on SSB have same beams.
[5] CATT	**Proposal 29:** Regarding the spatial relation between the always-on SSB and OD-SSB, it is up to gNB implementation whether SSB indices within on-demand SSB burst are or are not the subset of SSB indices within always-on SSB burst.
[7] CMCC	**Proposal 15:** SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst.
[10] OPPO	**Proposal 9:** Support SSB indexes within OD-SSB burst being subset of SSB indexes within always-on SSB burst.
[13] InterDigital	**Proposal 13:** Support configuring the same set of beams when both OD-SSB and AO-SSB are configured for L1 measurements
[14] Google	**Proposal 12:** When always-on SSB and on-demand SSB are in the same serving cell with different central carrier frequency, 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
[17] Xiaomi	**Proposal 11:** When the centre frequency locations of always-on SSB and OD-SSB are different, SS/PBCH blocks with the same SSB indexes for always-on SSB and on-demand SSB are quasi co-located.
[20] Lenovo	**Proposal 5:** Support the case where SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst.
[21] ETRI	**Proposal 6:** Regrading the spatial relation between always-on SSB and on-demand SSB, it is proposed NOT to support the subset of SSB indices within always-on SSB burst.
[22] Fujitsu	**Proposal 5:** Regarding the spatial domain relation between on-demand SSB and always-on SSB, support Alt 1. - Alt 1: SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst, subject to its configuration.
[27] Qualcomm	**Proposal 7:** For the case when the frequency location of on-demand SSB is different from the frequency location of always-on SSB, if both always-on SSB and on-demand SSB are configured for measurement, - SSB indices within on-demand SSB burst are identical to SSB indices within always-on SSB burst - The on-demand SSB transmit power is identical to the always-on SSB transmit power.
[29] NTT DOCOMO	**Proposal 4:** For the applicable SSB-index arrangements for OD-SSB in case2, we support following options. - Option 1: The set of SSB indices of AO-SSB and those of OD-SSB are identical. - Option 2: The set of SSB indices of OD-SSB is a subset of the set of SSB indices of AO-SSB.

	Proposal 5: For the spatial relationship between AO-SSB and OD-SSB,
	- When AO-SSB and OD-SSB have the same centre frequency
	    o Support the QCL assumption for the same SSB-index
	- When AO-SSB and OD-SSB have different centre frequencies
	    o QCL between OD-SSB and AO-SSB should not be assumed.

[34] CEWiT	**Observation 2:** SSB indices within on-demand SSB equal to SSB indices within always-on SSB burst cause unnecessary SSB transmissions in areas with non uniform UE density. **Proposal 2:** Support the SSB indices within on-demand SSB burst as a subset of SSB indices within always-on SSB burst.
[33] Ericsson	**Proposal 13** On-demand SSB positions in burst can be the same or a subset of always-on SSB positions in burst.

Agreement (RAN1#119)

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.
  - o 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
  - o 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.

[Moderator's note] Company views on Q4 of R1-2409350:

- Do you support the case where SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst?
  - o YES: Huawei, ZTE, CMCC, OPPO, Lenovo, Fujitsu, NTT DOCOMO, CEWiT, Ericsson
    - ▪ + Configurable QCL relationship for on-demand SSB: Huawei, ZTE?
  - o NO: Futurewei, InterDigital, ETRI
- Up to gNB implementation: CATT
- QCL relationship between always-on SSB and on-demand SSB when they are located on the different frequencies: Google, Xiaomi
  - o NO: NTT DOCOMO
- Qualcomm: For the case when the frequency location of on-demand SSB is different from the frequency location of always-on SSB, if both always-on SSB and on-demand SSB are configured for measurement, SSB indices within on-demand SSB burst are identical to SSB indices within always-on SSB burst
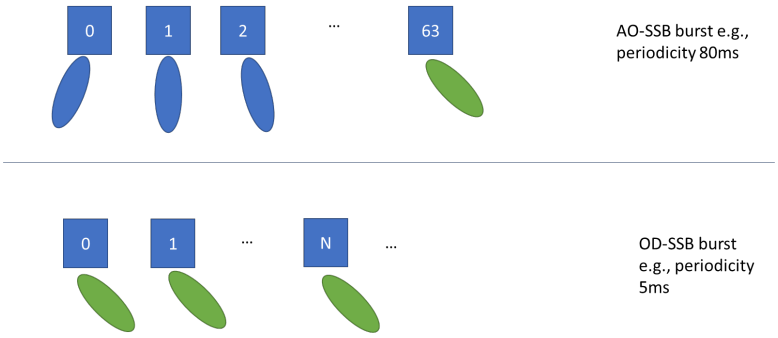

[HIGH] Proposal #2-4 (Q4):

At least for the case where the centre frequency locations of always-on SSB and on-demand SSB are same,
- It is supported that SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst.

Companies are encouraged to provide views on Proposal #2-4.

Company	Views
InterDigital	While our preference is for using the same SSB indices for both AO-SSB and OD-SSB to avoid any UE complexity during measurements, we are fine to go with majority.
Google	OK
CMCC	Support.
Samsung	Support

Qualcomm	It is premature to decide this aspect since whether only one or both types of SSB can be used for L1 measurement is still under discussion. The proposal shall generate deployments in which different SSB index may have different transmission occurrence in time. If both types of SSB are used/configured for the measurement, the UE will have to generate different tracking for different SSBs, which contradicts to the legacy operation when a single tracking across transmitted/configured SSB indices.
Xiaomi	We are fine with the proposal. Considering that always-on SSB and on-demand SSB are separately configured, the SSB indices within on-demand SSB burst can be subset or universal set of SSB indices within always-on SSB burst, which is subject to its configuration.
LG Electronics	We support it
Huawei, HiSilicon 1	Support. Further, we support a flexible QCL relationship between AO-SSB and OD-SSB. An AO-SSB normally carries a coverage beam that is intended for serving all UEs within the coverage area of its beam, while OD-SSB can be indicated for certain UEs for certain scenarios, hence OD-SSB can be enabled to carry a more flexible beam. For example, multiple OD-SSB beams can be mapped to a certain AO-SSB beam to enable a finer sync and more accurate reporting by the end of Scell activation. Or, flexible mapping, e.g., OD-SSB beam #1,2,3,4 is QCL-ed to AO-SSB beam #64 so that a certain beam direction can be mapped to the first beam of an OD-SSB burst, and the faster beam transmission is achieved. The cost for such benefits is rather marginal: An RRC configured mapping. UE implementation complexity would not be increased since the beam index detection and reporting procedure still follows legacy. The proposal can be modified as: **[HIGH] Proposal #2-4 (Q4):** At least for the case where the centre frequency locations of always-on SSB and on-demand SSB are same, • It is supported that SSB indices within on-demand SSB burst can be subset of SSB indices within always-on SSB burst. The quasi-colocation relationship of on-demand SSB and always-on SSB can be configured; If not, it is assumed that candidate SS/PBCH blocks with same indices are quasi co-located between always-on SSB and on-demand SSB.
Panasonic	We do not object to support such case. But if the intention is to only support such relation, we need a more complete proposal regarding the spatial relation.
CEWiT	Support
NEC	Support. We can also consider the case where OD-SSB is transmitted for fewer SSB indices as compared to AO-SSB
Lenovo	Support
ETRI	We can live with the majority view even though we do not expect much benefit with this.
ZTE, Sanechips	I share the view with InterDigital regarding the SSB indices. Besides, for the L1 measurement based on-demand SSB, we can consider it together with this proposal, for example one note or FFS bullet can be added.
TCL	Support
DCM	We support the FL proposal. We want to support the case when OD-SSB indicies are transitted only for Rel-19 UE exist, which canbe that OD-SSB indicies are the subset of AO-SSB indicies.
Fujitsu	Support
China Telecom	Support.

Spreadtrum	Support
Transsion	Support
Vivo	Support
CATT	OK

3 General aspects (including use cases or scenarios)

3.1 Scenarios and Cases

Company	Views
[3] ZTE	**Proposal 5:** Whether or not support scenario #3A, #3B should be discussed and concluded. **Proposal 6:** There is no need to support Scenario #3A. **Observation 4:** Scenario #3B in conjunction with case #1 can achieve a good tradeoff between network energy saving and system performance. **Proposal 7:** Scenario #3B in conjunction with case #1 should be supported.
[4] Spreadtrum	**Proposal 1** Not support Scenario #3A and #3B in Rel-19.
[5] CATT	**Observation 1:** In the current system, after UE receives SCell activation command, for a known SCell, UE acquires SSB for fine time tracking. For an unknown SCell, UE acquires SSB to perform AGC, synchronization and L1 measurement report. **Proposal 1:** For the identified scenarios and cases (as per RAN1#116 and RAN1#116-bis agreements), on-demand SSB can be triggered by gNB for the following scenarios/cases: - Scenario #3A and Case #1 - Scenario #3A and Case #2 - Scenario #3B and Case #1 - Scenario #3B and Case #2 **Observation 2:** Since the new MAC CE for OD-SSB transmission indication and the legacy MAC CE for SCell activation/deactivation are two independent MAC CEs, the gNB can trigger OD-SSB when needed via the new MAC CE, irrespective of the timing relationship with SCell activation/deactivation. **Proposal 2:** It is up to gNB implementation when OD-SSB is triggered, irrespective of the timing relationship with SCell activation/deactivation. **Observation 3:** In order to support scenario 2A, the new MAC CE for OD-SSB transmission indication and the legacy MAC CE for SCell activation/deactivation can be sent together in one PDSCH.
[6] China Telecom	**Proposal 2:** Support Scenario #3B and Case #1 for on-demand SSB for SCell operation. **Observation 2:** Support Scenario #3A and Case #1 for on-demand SSB if Scenario #3B and Case #1 is supported doesn't cause extra spec impact. **Observation 3:** Scenario #3A and Case #2 can also be supported for on-demand SSB for SCell operation if Scenario #3B and Case #2 is supported. **Proposal 3:** Support Scenario #3B and Case #2 for on-demand SSB for SCell operation.
[7] CMCC	**Proposal 3:** On-demand SSB SCell operation in Scenario #3A is not supported. **Proposal 4:** On-demand SSB SCell operation in Scenario #3B and Case #1/Case #2 can be supported.

[8] vivo	**Proposal 1:** For on-demand SSB SCell operation, support Scenario #3A and it is up to gNB implementation to indicate on-demand SSB in Scenario #2A or Scenario #3A. **Proposal 2:** For on-demand SSB SCell operation, do not support Scenario #3B, i.e., on-demand SSB should not be indicated by gNB after SCell activation is complete. **Observation 1:** RAN4 input on the problem of SSB-less Scell is needed to verify the motivation to support on-demand SSB in SSB-less Scell. **Proposal 3:** Do not discuss support of on-demand SSB in SSB-less SCell where reference cell is configured until more RAN4 input is available.
[9] OPPO	**Proposal 5:** Transmit OD-SSB indication in Scenario #3A is beneficial to fast SCell activation and can be supported.
[12] Panasonic	**Proposal 1:** On-demand SSB triggering timing is up to network implementation irrespective of UE situation. Therefore, scenario #3A/3B and Case 1/2 should be also supported for on-demand SSB.
[13] InterDigital	**Observation 1:** Since the SCell can be transitioned to NES mode after SCell activation is completed, triggering OD-SSB transmission can be beneficial to improve synchronization, timing reference and AGC at the UE, especially when last AO-SSB transmission is outdated. **Proposal 1:** Support on-demand SSB transmission in Scenario #3B at least for Case #2
[15] NEC	**Observation 1:** For Scenario #3B and Case#2, on-demand SSB transmission can improve the beam management performance for an activated SCell when the always-on SSB is transmitted with longer periodicity. **Proposal 1:** Support on-demand SSB operation for Scenario #3B Case #1 and Scenario #3B Case#2. Further discuss the applicability of Scenario#3A.
[17] Xiaomi	**Proposal 2:** On-demand SSB can be triggered by gNB for the following scenarios/cases wherein gNB explicitly indicates UE whether SSB is on or off: - Scenario #3A and Case #1 - Scenario #3A and Case #2 - Scenario #3B and Case #1 - Scenario #3B and Case #2
[18] Apple	**Observation 1:** There is no use case for Scenario #3A/3B with Case #1. **Observation 2:** There is no clear use case for Scenario #3A/3B with Case #2 in the context of SCell activation. **Observation 3:** There is no use case for Scenario #3A with Case #2 in the context of L1 measurement. **Observation 4:** There could be use case for Scenario #3B with Case #2 to accelerate L1 measurement. However, the same goal can be achieved by using AO-SSB periodicity adaptation even without OD-SSB. **Proposal 1:** Scenario #3A and #3B for both Case #1 and Case #2 are deprioritized.
[20] Lenovo	**Proposal 1:** Support OD-SSB for Scenario #3B. OD-SSB for Scenario #3A is not supported.
[21] ETRI	**Proposal 1:** In addition to previous agreed scenarios, it is proposed to consider #3A for further discussion for on-demand SSB SCell operation and preclude Scenario #3B.
[23] LG Electronics	**Proposal #2:** In addition to agreed scenarios and cases, on-demand SSB can be indicated by gNB at least for the following scenarios/cases. - Scenario #3B and Case #1

	- Scenario #3B and Case #2
[24] Transsion	**Proposal 1** Scenario 3A could be considered for exclusion. **Proposal 2** Scenarios 3B and Case #1 and Scenario #3B and Case #2 should be supported.
[28] Sharp	**Proposal 1** Support Scenario 3B and at least Case #1 for on-demand SSB for SCell operation.
[29] NTT DOCOMO	**Proposal 10:** In scenario #3A, indication of OD-SSB which may change SSB properties that a UE uses for SCell activation procedure is NOT necessary **Observation 1:** On-demand SSB during activated SCell operation (in scenario #3B) can be used for normal SCell operation e.g., for monitoring PDCCH on SCell. **Proposal 11:** Support indication mechanism to activate or deactivate OD-SSB during activated SCell operation (in scenario #3B and case #1) in terms of practical NES operation. - With some restriction on UE behavior on SCell operation, o FFS: some restrictions, e.g., during UE DRX or cell DTX.
[33] Ericsson	**Proposal 5** Support adaptation of on-demand SSB periodicity via MAC CE while SCell is in an activated state, at least for Scenario #3B. **Observation 3** Each on-demand SSB MAC CE indication is for the monitoring behavior of a specific UE, what that specific UE can expect. The actual gNB transmission of on-demand SSBs may be more often than what is indicated to that UE.

==Agreement (RAN1#116)==

For the following identified scenarios for on-demand SSB SCell operation, focus future RAN1 discussion to down-select (both may be selected) between the two scenarios.
- Scenario #2: SCell is configured to a UE but before the UE receives SCell activation command (e.g., as defined in TS 38.321)
- Scenario #3: After UE receives SCell activation command (e.g., as defined in TS 38.321)
  - This does not preclude SCell for which activation is completed
  - FFS: The case where SCell activation is completed

FFS: Application timing between NW triggering message and on demand SSB transmission

==Agreement (RAN1#116bis)==

For the identified scenarios and cases (as per RAN1#116 agreement), on-demand SSB can be triggered by gNB at least for the following scenarios/cases:
- Scenario #2 and Case #1
- Scenario #2 and Case #2
- Scenario #2A and Case #1
- Scenario #2A and Case #2
- FFS: Scenario #3A and Case #1
- FFS: Scenario #3A and Case #2
- FFS: Scenario #3B and Case #1
- FFS: Scenario #3B and Case #2
- For Case #1, once on-demand SSB is triggered, its transmission is in a periodic manner.
  - Note: This does not imply periodic on-demand SSB is transmitted indefinitely after triggered.
- Notes:
  - Scenario #2A refers to
    - "When UE receives SCell activation command (e.g., as defined in TS 38.321)"
  - Scenario #3A refers to
    - "After UE receives SCell activation command (e.g., as defined in TS 38.321) until SCell activation is completed"
  - Scenario #3B refers to
    - "When SCell activation is completed and SCell is activated" or
    - "After SCell activation is completed and SCell is activated"
  - For discussion purpose under AI 9.5.1, always-on SSB is SSB supported in Rel-18 specifications.
  - Timing for on-demand SSB transmission (e.g. when the triggered SSB starts and ends) will be separately discussed.

Company views for scenarios/cases with FFS in the above agreement made in RAN1#116bis are as follows.

- Scenario #3A and Case #1
  - Supported by CATT, vivo, OPPO, Panasonic, Xiaomi, ETRI
  - Objected by ZTE, Spreadtrum, CMCC, Apple, Lenovo, Transsion, NTT DOCOMO
- Scenario #3A and Case #2
  - Supported by CATT, vivo, OPPO, Panasonic, Xiaomi, ETRI
  - Objected by ZTE, Spreadtrum, CMCC, Apple, Lenovo, Transsion, NTT DOCOMO
- Scenario #3B and Case #1
  - Supported by ZTE, CATT, China Telecom, CMCC, Panasonic, Xiaomi, Lenovo, LG Electronics, Transsion, Sharp, NTT DOCOMO, Ericsson
  - Objected by Spreadtrum, vivo, Apple, ETRI
- Scenario #3B and Case #2
  - Supported by CATT, China Telecom, CMCC, Panasonic, InterDigital, Xiaomi, Lenovo, LG Electronics, Transsion, Ericsson
  - Objected by Spreadtrum, vivo, Apple, ETRI
- vivo: Do not discuss support of on-demand SSB in SSB-less SCell where reference cell is configured until more RAN4 input is available

Although compony views are split, it's time to conclude which scenarios/cases are supported for on-demand SSB transmission indication. Considering that different UEs can encounter different scenarios at the same time, it would be desirable to support all scenarios/cases without distinction.

[HIGH] Proposal #3-1 (Scenario):

For the identified scenarios and cases (as per RAN1#116 agreement), on-demand SSB transmission can be indicated by gNB for the following scenarios/cases:

- Scenario #2 and Case #1 (agreed in RAN1#116bis)
- Scenario #2 and Case #2 (agreed in RAN1#116bis)
- Scenario #2A and Case #1 (agreed in RAN1#116bis)
- Scenario #2A and Case #2 (agreed in RAN1#116bis)
- Scenario #3A and Case #1
- Scenario #3A and Case #2
- Scenario #3B and Case #1
- Scenario #3B and Case #2

Companies are encouraged to provide views on Proposal #3-1.

Company	Views
InterDigital	Ok with proposal
CMCC	Since scenario 2A has been agreed, scenario 3A is not necessary. Scenario #3B can be supported at least for Case2. Considering one SCell may belong to multiple UEs, when the number of UE is comparatively large, it is probably that the SCell will be activated at least for one UE. If on-demand SSB transmission lasts for a long time until SCell deactivation, from NW's perspective, there will be no NES gain without on-demand operation in scenario 3B. At least for Case 2, if on-demand SSB is deactivated in scenario 3B for NES, UE can still rely on TRS or always-on SSB for AGC, synchronization and L1 measurement. Thus, on-demand SSB shall be supported at least for Scenario#3B and Case 2.
Samsung	OK with the proposal.
Qualcomm	We don't support this proposal. We understand the proponents of this proposal is to provide flexibility for NW configuration. However, it is unclear whether such flexibility is really needed for SSB transmission. Therefore, the existing agreements should be sufficient for the feature.
Xiaomi	Fine with the proposal.
LG Electronics	We are fine with FL's proposal. we can't see the reasons why 2 Scenarios are excluded on indication of OD-SSB differently from S#2 and S#2A.
Apple	No support beyond Scenario #2/2A
Huawei, HiSilicon 1	we support indicating OD-SSB in Scenario #3B for both Case #1 and Case #2. When an SCell is successfully activated, it should be preferable and feasible that the gNB can decide to turn OFF the on-demand SSB, in order to preserve NW energy saving. At any time when gNB identifies

	necessity, e.g., fine BM is needed, it can re-start the on-demand SSB transmission and indicate this triggering to the UEs. Although, the motivation of indicating (ON/OFF/or adaptation) OD-SSB in Scenario #3A is not clear. We do not see a harm in supporting it. Hence, in order to push the FL efforts to conclude on this issue and make progress, we are fine to support the proposal as a compromise.
Panasonic	Support
Nokia, NSB	At least #3B for Case #1 and #2 should be supported.
NEC	We are okay with the proposal. We think that OD-SSB is more relevant for Scenario 3B, but we are also open to discuss applicability of 3A as well.
Lenovo	We don't support #3A, but we can follow majority.
ETRI	We can live with this proposal even though we do not support Scenario 3B.
TCL	Fine with this proposal
DCM	We are fine with the proposal.
Fujitsu	We support scenario #3B and Case #1 for adapting the periodicity of on-demand SSB. For other scenarios, we don't think they are necessary.
China Telecom	Support at least #3B with case #1/2.
Spreadtrum	It was agreed that Scenario 2A is supported, we think Scenario #3A with case#1/2 should not be support.
Transsion	Support
Vivo	Scenario 3B should not be supported, the motivation to support 3B is not clear for us.

3.2 *Whether on-demand SSB is CD-SSB or not*

Company	Views
[2] Huawei	**Proposal 1:** Support OD-SSB being CD-SSB, on sync raster or not on sync raster.
[4] Spreadtrum	**Proposal 7** RAN1 to discuss whether to support OD-SSB for CD-SSB on sync-raster or not.
[5] CATT	**Observation 4:** The motivation of supporting OD-SSB for CD-SSB located on sync-raster is not clear. **Proposal 3:** Deprioritize the discussion of additional support of OD-SSB for CD-SSB located on sync-raster in Rel-19.
[6] China Telecom	**Proposal 8:** On-demand SSB should be supported for CD-SSB located on sync-raster. - Cells adopting on-demand SSB won't be serving as PCell for any UE with network's scheduling.
[7] CMCC	**Proposal 1:** For a cell supporting on-demand SSB SCell operation, on-demand SSB can not be CD-SSB located on sync-raster. - Note that the cell can only be a SCell for both R19 NES-capable UEs and other UEs.
[8] vivo	**Proposal 4:** For a cell supporting on-demand SSB SCell operation, do not support that on-demand SSB on the cell is CD-SSB located on synchronization raster.
[12] Panasonic	**Proposal 2:** OD-SSB for CD-SSB located on sync-raster is not supported.
[13] InterDigital	**Proposal 2:** Support CD-SSB located on sync-raster for a cell supporting OD-SSB SCell operation
[15] NEC	**Observation 2:** For Case#1, gNB does not need to newly trigger on-demand SSB for a UE if the SCell is already active for another UE (FFS: indication). **Observation 3:** For Case#1, on-demand SSB is not expected to be deactivated as long as at least one UE is active on the Cell even when the SCell is deactivated for a UE for which the network triggered the on-demand SSB.

	Observation 4: On-demand SSB would be transmitted periodically for a while as long as at least one UE is active on the cell, as SCell is a capacity cell and traffic on the capacity cell would not be low. **Proposal 2:** When on-demand SSB is transmitting periodically, NES cell can be used as an SCell for non-NES UEs irrespective of whether on-demand SSB is CD-SSB. **Proposal 3:** At least for case#1, on-demand SSB can be CD-SSB and transmitted on synch-raster with assumption the network ensures periodic CD-SSB transmission when NES cell is activated for any UE.
[17] Xiaomi	**Proposal 1:** On-demand SSB can be CD-SSB located on sync-raster.
[18] Apple	**Observation 5:** CD-SSB on sync-raster should be precluded as OD-SSB SCell operation to avoid impact on initial cell selection / cell reselection for both legacy and Rel-19 UE. **Proposal 2:** CD-SSB on sync-raster is not supported for OD-SSB.
[19] Samsung	**Proposal 2:** On-demand SSB should not be cell-defining SSB located on synchronization raster entries.
[21] ETRI	**Proposal 2:** Regarding whether on-demand SSB is cell-defining or not, additional support of CD-SSB located on sync-raster as OD-SSB is not necessary.
[22] Fujitsu	**Proposal 1.** For on-demand SSB transmitted on the SCell, support on-demand SSB for CD-SSB on synchronization raster.
[23] Transsion	**Proposal 3** On-demand SSB for CD-SSB located on synchronization raster cannot be supported.
[25] MediaTek	**Observation 1:** For a UE performing initial cell search, it would search SSB on the synchronization raster as defined in 38.101-1 [3] Clause 5.4.3. As the on-demand SSB is only transmitted temporarily, it is needed to ensure the on-demand SSB would not be used for initial cell search. **Observation 2:** For on-demand SSB to be cell-defining SSB of an SCell, as one SCell of UE A can be PCell of UE B, it may still cause impact to legacy UEs. **Proposal 1:** RAN1 does not support OD-SSB for CD-SSB located on sync-raster.
[27] Qualcomm	**Observation 1:** Having on-demand SSB configured as cell-defining SSB has negative impact to both legacy idle/inactive UEs and R19 idle/inactive UEs. **Proposal 1:** On-demand SSB for cell defining SSB located on synchronization raster is not supported
[28] Sharp	**Proposal 9** Support that OD-SSB can be CD-SSB located on sync raster.
[29] NTT DOCOMO	**Proposal 1:** Support OD-SSB for CD-SSB located on sync-raster.
[33] Ericsson	**Proposal 20** Support on-demand SSB that is cell defining or not cell defining, and that is not located on the sync raster.

For a cell supporting on-demand SSB SCell operation, at least the following is supported

- On-demand SSB on the cell is not located on synchronization raster.
- On-demand SSB on the cell is non-cell-defining SSB

FFS: Additional support of OD-SSB for CD-SSB located on sync-raster

[Moderator's note] Regarding FFS point for additional support of OD-SSB for CD-SSB located on sync-raster, company views are summarized as follows.

- Supported by
  - China Telecom, InterDigital, NEC, Xiaomi, Fujitsu, Sharp, NTT DOCOMO
- Objected by
  - CATT, CMCC, vivo, Panasonic, Apple, Samsung, ETRI, Transsion, MediaTek, Qualcomm, Ericsson

Considering that this topic is correlated with RAN4 LS questions, it is suggested to defer the discussion on this topic until RAN4 LS related discussion in Section 2.3 is finalized. Nevertheless, please provide your feedback, if any.

Company	Views

4 Signalling methods for on-demand SSB TX indication

Company	Views
[1] Huawei	**Proposal 8:** For Option 1, support that the OD-SSB deactivation MAC CE can be applied in all scenarios. **Proposal 9:** For Option 2, support that the value of N can be implicitly determined using a timer, and this OD-SSB deactivation timer is to set the maximum expected transmission window of OD-SSB bursts after on-demand SSB is indicated. **Proposal 11:** No need to introduce DCI based signaling to indicate OD-SSB transmission.
[3] ZTE	**Proposal 10:** Option 1 can be used at least for scenario #2 and scenario #2A. **Proposal 11:** Option 2 can be used for scenario #2 and scenario #2A. **Proposal 12:** Option 1 and option 2 can also be used for scenario #3B. **Proposal 13:** Support the combination of option 1 and option 2. **Proposal 14:** Option 4 and 4a are not needed. **Observation 5:** Using timer to implicitly indicate the value of N leads to a large overhead. **Proposal 15:** Introduce the timer to implicitly determine the value of N is not supported. **Proposal 16:** The determination of candidate values of N is up to RAN4. **Proposal 20:** Do not support RRC based signaling for other cases. **Proposal 22:** Discuss whether the DCI based signaling is applicable to scenario #3B.
[4] Spreadtrum	**Proposal 4** For on-demand SSB deactivation, Option 1 can be used for Scenarios #2 and #2A. **Proposal 5** For on-demand SSB deactivation, Option 4 and 4A can be considered. - Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell - Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired

[5] CATT	**Proposal 5:** A unified group-common DCI could be designed to indicate on-demand SSB transmission. **Proposal 6:** Deactivation for on-demand SSB via MAC-CE can be applied to Scenario 2/2A/3A/3B. **Proposal 7:** Deactivation for on-demand SSB via MAC-CE could also be applied to Option 2 (Configuration/indication of the number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated). **Proposal 8:** For Option 2, the value of N is preferred to be configured explicitly. **Proposal 9:** In addition to Option 2, support the following options: - Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell. - Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired.
[6] China Telecom	**Proposal 1:** Support to introduce a separate signaling to re-indicate UE the on-demand SSB for SCell after the transmission of on-demand SSB restarts after a period of de-activation. - FFS: whether the MAC CE based initial indication for on-demand SSB can be reused. **Observation 4:** There is no benefit to support DCI based initial indication for on-demand compared with RRC/MAC CE based signalling for scenario #2 and #2A. **Observation 5:** For the re-indication of on-demand SSB for SCell operation, DCI based signalling can be more beneficial with high efficiency. **Proposal 4:** Support DCI based signalling for on-demand SSB indication if scenario #3A and/or #3B are/is supported. **Proposal 14:** For the deactivation of on-demand SSB, Option 1, i.e., Explicit indication of deactivation for on-demand SSB via MAC-CE, can be applied to all the scenarios. **Proposal 15:** For the deactivation of on-demand SSB, Option 4 and 4A, i.e., the deactivation of SCell, can be used as the deactivation signal in addition to Option 2. **Proposal 16:** For the deactivation of on-demand SSB, there is no need to further support to indicate value of N can be implicitly using a timer for Option 2.
[7] CMCC	**Proposal 2:** For on-demand SSB SCell operation in Scenario #2, group common DCI can be considered to indicate on-demand SSB on NES SCell. **Proposal 5:** For on-demand SSB SCell operation in Scenario #3B, group common DCI and/or UE-specific DCI can be considered to indicate on-demand SSB on NES SCell. **Proposal 11:** For option 1 of deactivation of on-demand SSB, the applicable scenarios are scenario 3B. **Proposal 12:** For a cell supporting on-demand SSB SCell operation, option 4 and 4A are not supported to deactivate on-demand SSB transmission. - Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell - Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired
[8] vivo	**Proposal 11:** Option 1 is not applied to Case #1. **Proposal 12:** Support Option 4 and 4a for Case #1 in addition to Option 2. **Proposal 14:** Do not support that the value of N can be implicitly determined using a timer.

[9] Tejas	**Proposal 1:** Supporting option4 i.e., On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell. **Proposal 2:** Support Option 4a i.e., On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired. **Proposal 3:** FFS: Combination of Option 1 and Option 2.
[10] OPPO	**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 6:** For Scenario #2 and #3A, support GC-PDCCH for OD-SSB indication.
[11] Nokia	**Proposal-9:** Besides Option 1 and Option 2 no other options are specified for OD-SSB deactivation **Proposal-10:** In Option 2 the duration of OD-SSB transmission can be based on timer and the value of N is then determined implicitly.
[12] Panasonic	**Proposal 12:** On-demand SSB triggering indication can be before, at the same time with or after the SCell activation without limitation. The validity period can be RRC configurable. If not configured, on-demand SSB is default to be valid until gNB indicates to turn OFF the SSB. **Proposal 13:** In addition to RRC and MAC CE based SSB trigging, DCI-based on-demand SSB triggering and deactivation indication is supported. By RRC configuration, separate bits for SSB ON/OFF of each SCell and joint indication for each SCell group can be supported. **Proposal 14:** For on-demand SSB transmission deactivation, Option 1 (MAC CE-based), 1A (RRC-based) and Option 6 (DCI-based) should be supported. We are also open to discuss Option 2 and 3 to define and configure a validity period/duration for on-demand SSB.
[13] InterDigital	**Proposal 7:** Support explicit indication of deactivation for OD-SSB via MAC-CE for all supported scenarios **Proposal 8:** Deactivation of OD-SSB when the UE received SCell deactivation (Option 4) or expiry of SCell deactivation timer (Option 4A) are not supported **Proposal 9:** An additional timer for implicitly determining the value of N for the number of OD-SSB bursts is not introduced **Proposal 11:** DCI based signalling to indicate OD-SSB transmission is not introduced in Rel-19
[14] Google	**Proposal 4:** Support option 1 for on-demand SSB deactivation
[15] NEC	**Observation 6:** Using MAC CE or RRC based indication for on-demand start indication is expected to increase signalling overhead when indication is sent for scenarios not involving SCell activation. **Proposal 6:** Support on-demand SSB indication via group-common DCI for Scenario#2 and Scenario#3. **Proposal 7:** On-demand SSB for SCell may be enabled via DCI format 1_x on PCell with a carrier indication field to indicate the applicable carrier. **Proposal 8:** Support Option 4 or Option 4A in addition: On-demand SSB transmission, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell or when the timer for SCell deactivation is expired.

	Proposal 9: Support Option 2: Configuration/indication of the number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated. **Proposal 10:** Support explicit RRC configuration for the value of N.
[16] KT	**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.

[17] Xiaomi	**Observation 1:** Different triggering method for on-demand SSB has diverse impacts on UE:
	  - Cell on/off indication based SSB triggering is transparent to UE.
	  - SCell activation/deactivation based SSB triggering is fully gNB implementation while non-transparent to UE.
	
	Proposal 4: Cell on/off indication based SSB triggering method should be deprioritized as there are many negative impacts on legacy procedures if UE follows legacy behaviours without knowing that SSB is shut down.
	
	Proposal 5: For other cases other than the following case, support RRC based signaling to indicate on-demand SSB transmission.
	  - This RRC also configures the SCell, activates the SCell, and provides on-demand SSB configuration.
	
	Proposal 6: For a Scell supporting on-demand SSB operation, Option 1 can be used to deactivate on-demand SSB transmission in scenario 2, 2A, 3A, and 3B.
	
	Proposal 7: For a Scell supporting on-demand SSB operation, Option 4, 4A are not supported.
	  - Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell
	  - Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired

[18] Apple	**Observation 6:** RRC based OD-SSB activation/deactivation could be beneficial before SCell activation command. **Observation 7:** There seems no benefit of RRC based OD-SSB activation/deactivation after SCell activation command, compared to MAC-CE based OD-SSB activation/deactivation. **Proposal 7:** RRC based OD-SSB activation/deactivation after SCell activation is not supported.

[19] Samsung	**Proposal 3:** The indication of activating/deactivating on-demand SSB transmission by RRC and/or MAC CE shall be in a group of UEs manner.
	  - Send an LS to RAN2.
	  - RAN1 can revisit the need of group common DCI format based indication of on-demand SSB if such indication cannot be achieved by RAN2 design.

[20] Lenovo	**Proposal 2:** In addition to the agreed RRC and MAC CE based signaling methods, support group common DCI based signalling to indicate on-demand SSB transmission at least for Scenario #2 and Scenario #3B. **Proposal 3:** Option 1 of using explicit indication of deactivation for on-demand SSB can be used for L3 measurement in at least scenario #2 and #3B. **Proposal 4:** From a UE perspective, if deactivation signaling of on-demand SSB is not received, UE can assume on-demand SSB is still available after SCell is deactivated.
[21] ETRI	**Proposal 7:** In case of RRC based signaling to indicate on-demand SSB transmission, it is not necessary to consider other cases except for the agreed case where the RRC also configures the SCell, activates the SCell, and provides on-demand SSB configuration. **Proposal 8:** In case of MAC CE based signaling to indicate on-demand SSB transmission, it is up to RAN2 discussion.

	Proposal 9: In addition to RRC based and MAC CE based signaling to indicate on-demand SSB transmission, it is proposed to support DCI based signaling to indicate on-demand SSB transmission. - DCI based signaling is separate signaling and only applicable to indicate on-demand SSB transmission. - Details can be discussed further. **Proposal 11:** It is proposed to support Option 2 as the default operation and Option 1 as supplementary mechanism for Option 2. - Option 1 is supported when the number of N for on-demand SSB bursts is not configured. **Proposal 12:** It is not necessary to support Option 4, 4A in addition to Option 2. **Proposal 13:** For Option 2, it is not necessary to use timer instead of the number of N.
[22] Fujitsu	**Proposal 6:** Regarding the scenario(s) at which Option 1 (explicit deactivation indication for on-demand SSB via MAC-CE) is used, at least support the following scenario. - Case#1: the scenario when or after the SCell deactivation is completed and SCell is deactivated. - Case#2: all SCell activation/deactivation scenarios **Proposal 7:** Regarding option 2 (configuration/indication of the number of N for on-demand SSB butsts to be transmitted) - Do not support using SCell deactivation MAC CE (option 4) and/or SCell deactivation timer (option 4A) as implicit indication for on-demand SSB deactivation. - Support implicit determination of the value of N based on a timer which is provided by on-demand SSB configuration. **Observation 1.** Group-common DCI can achieve less signaling overhead than that of the RRC / MAC-CE based signaling. **Observation 2.** Using group-common DCI can enable notifying the intended receiving UEs about the on-demand SSB transmission while also making other UEs aware of it. **Proposal 8.** Group common DCI can be considered for on-demand SSB transmission indication.
[24] Transsion	**Proposal 6** DCI based signaling to indicate on-demand SSB transmission can be supported. **Proposal 7** If DCI based signaling support on-demand SSB transmission, DCI is UE-specific. **Proposal 8** Option 4, 4a can be used to deactivate on-demand SSB transmission.
[26] Mavenir	**Proposal 1:** For the deactivation of on-demand SSB transmission, MAC CE and RRC signal are both supported. **Proposal 2:** For the deactivation of on-demand SSB transmission, option 4, 4A are not preferred. **Proposal 3:** For the value of N, it is not necessary to indicate implicitly. **Proposal 4:** Triggered by UE for on-demand Scell SSB should be supported.
[27] Qualcomm	**Proposal 2:** DCI based signaling to indicate on-demand SSB transmission on the cell is not supported. **Proposal 9:** For MAC-CE based deactivation of OD-SSB transmission in Case #1, the deactivation is only signaled in Scenario 2. The timing of the deactivation is - Before the time UE receives the Scell activation signaling, or - At the same time or later than the time that UE receives the Scell deactivation signaling or timer for SCell deactivation is expired. **Proposal 10:** For the MAC-CE based deactivation of OD-SSB transmission in Case #2, the deactivation can be signaled in Scenario 2 or Scenario 3B. In particular, the timing of the

	deactivation is before the time UE receives the Scell activation signaling or after the Scell activation is completed (e.g., after the UE successfully sends the first CSI report). **Observation 2:** For Option 2 in Case #1, gNB may not be able to configure the value of N properly to ensure sufficient SSB transmission in activated cell. Therefore, Option 4 or Option 4A should be used in addition to Option 2. **Proposal 11:** For Option 2 in Case #1, UE assumes OD-SSB transmission is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell (Option 4) or the timer for SCell deactivation is expired (Option 4A) if the Nth SSB transmission is after Scell activation completion and before the time UE receives Scell deactivation command or the timer for SCell deactivation is expired.

[29] NTT DOCOMO	**Proposal 5:** For the spatial relationship between AO-SSB and OD-SSB,
	- When AO-SSB and OD-SSB have the same centre frequency
	   o Support the QCL assumption for the same SSB-index
	- When AO-SSB and OD-SSB have different centre frequencies
	   o QCL between OD-SSB and AO-SSB should not be assumed.
	
	Proposal 8: In scenario #2, support RRC signaling for indication of OD-SSB transmission separately from SCell activation/deactivation indication.
	
	Proposal 9: In scenario #2/#3B, support group-common DCI signaling for indication of OD-SSB transmission separately from SCell activation/deactivation indication.
	
	Proposal 12:
	- Support indication mechanism to activate or deactivate OD-SSB during activated SCell operation (in scenario #3B and case #1) in terms of practical NES operation.
	- For MAC-CE deactivation indication, we support the following scenarios and cases,
	   o In scenario 2 and case #1/#2
	       ▪ After UE finishes conducting L3 measurement
	   o In scenario #3B and at least case #2
	       ▪ After UE complete SCell activation without implicit OD-SSB deactivation, but NW find it unnecessary.
	- In addition to MAC CE, we support option 4/4a.
	
	Proposal 13: For OD-SSB deactivation mechanisms,
	- support group-common DCI signaling (option 6)

[31] TCL	**Proposal 1:** For the explicit indication of deactivation for on-demand SSB via MAC-CE, scenario #3 at least should be supported. **Proposal 2:** Support option 4 or 4a for OD-SSB deactivation. **Proposal 3:** Not support the value of N is implicitly determined using a timer.
[32] ASUSTeK	**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.

[33] Ericsson	**Proposal 1** Support Option 1 for both deactivated and activated SCells.
	Observation 1 The functionality of Option 4 can be realized by Option 1 if a MAC CE that deactivates the on-demand SSB can also deactivate the SCell.
	Proposal 2 Support restarting or prolonging an on-demand SSB transmission at the same time as the SCell deactivation timer is restarted.
	Observation 2 The functionality of Option 4A can be realized by Option 2 if the on-demand-SSB transmission is restarted when the SCell deactivation timer is restarted.
	Proposal 3 Support NW providing on-demand SSB transmission indication (i.e., that SSB is turned ON or OFF) and on-demand SSB configuration indication (e.g., SSB periodicity) at the same time.
[34] CEWiT	**Observation 1:** Option 4 causes unneccasry transmission of SSB when Scell is active for longer period and reduces flexibility at the gNB to deactivate the OD-SSB transmissions.
	Proposal 2: Do not support option 4 to use SCell deactivation MAC-CE for deactivation of OD-SSB.

For a cell supporting on-demand SSB SCell operation, further study the following options.
- Option 1: Separate signaling between legacy/existing signaling (e.g., RRC, MAC CE) providing SCell activation/deactivation and signaling providing On-demand SSB transmission indication.
- Option 2: A single signaling in which both SCell activation/deactivation and On-demand SSB transmission indication are provided.
  - FFS: Details of the signaling
- Other options are not precluded.
- FFS: Details on On-demand SSB transmission indication

- 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

For a cell supporting on-demand SSB SCell operation,
- Support RRC based signaling to indicate on-demand SSB transmission on the cell at least for the case where this RRC also configures the SCell, activates the SCell, and provides on-demand SSB configuration.
  - FFS: Whether to support RRC based signaling for other cases.
- Support MAC CE based signaling to indicate on-demand SSB transmission on the cell for Scenarios #2 and #2A.
Note: Deactivation and adaptation of on-demand SSB transmission can be separately discussed.

For a cell supporting on-demand SSB SCell operation, deactivation of on-demand SSB transmission is supported. In order to deactivate on-demand SSB transmission from a UE perspective, support at least one of the following options.
- Option 1: Explicit indication of deactivation for on-demand SSB via MAC-CE for on-demand SSB transmission indication
- Option 1A: Explicit indication of deactivation for on-demand SSB via RRC for on-demand SSB transmission indication
- Option 2: Configuration/indication of the number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
- Option 3: Configuration/indication of the duration of on-demand SSB transmission window

- Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell
- Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired
- Option 5: On-demand SSB transmission, if any, is deactivated when SCell activation is completed
- Option 6: Explicit indication of deactivation for on-demand SSB via [group-common] DCI
- FFS: Each option is applicable to which Cases or Scenarios
- FFS: Details related to each of the above options

Agreement (RAN1#119)

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

[Moderator's note] Regarding signaling methods for on-demand SSB transmission indication, company views are summarized as follows.
- For Option 1
  - Apply to all scenarios: Huawei, CATT, China Telecom, InterDigital, Xiaomi, Fujitsu (for Case #2), Ericsson
  - Apply to Scenarios #2/2A/3B: ZTE
  - Apply to Scenarios #2/2A: Spreadtrum
  - Apply to Scenarios #2/3B: Fujitsu (for Case #1), Qualcomm (for Case #2), NTT DOCOMO (for Case #2)
  - Apply to Scenarios #2: Qualcomm (for Case #1), NTT DOCOMO (for Case #1)
  - Apply to Scenario 3B: CMCC
  - Apply only to Case #2: vivo
  - Apply to at least Scenario 3: TCL
- For Option 2
  - Implicitly determine N by using timer: Huawei, OPPO, Nokia, NTT DOCOMO (integer multiples of SMTC periodicity)
    - NO: ZTE, China Telecom, vivo, InterDigital, ETRI, Mavenir, TCL
  - Apply to Scenarios #2/2A/3B: ZTE
- For Option 1 and Option 2
  - ETRI: Option 2 as default and Option 1 when N is not configured
- Further support
  - Option 4: Huawei, Spreadtrum, China Telecom, vivo (for Case #2), Tejas, Transsion, Qualcomm (for Case #1), NTT DOCOMO, TCL
    - NO: ZTE, CMCC, Nokia, InterDigital, Xiaomi, Lenovo, ETRI, Fujitsu, Mavenir, CEWiT, Ericsson
  - Option 4A: Huawei, Spreadtrum, China Telecom, vivo (for Case #2), Tejas, OPPO, Transsion, Qualcomm (for Case #1), NTT DOCOMO, TCL
    - NO: ZTE, CMCC, Nokia, InterDigital, Xiaomi, Lenovo, ETRI, Fujitsu, Mavenir, Ericsson
  - Option 5: OPPO
    - NO: Nokia
  - Option 6: NTT DOCOMO
- For DCI based signaling
  - Supported by CATT, China Telecom (for Scenario #3A/3B), CMCC, OPPO (for Scenario #2/3A), Panasonic, NEC (via DCI format 1_x), KT, Lenovo, ETRI, Fujitsu, Transsion, NTT DOCOMO, ASUSTeK
    - Group-common DCI: CATT (unified design with 9.5.3), CMCC (for Scenario #2/3B), OPPO (Scenario #2/3A), NEC (Scenario #2/3), KT, Lenovo (for Scenario #2/3B), Fujitsu, NTT DOCOMO (for Scenario #2/3B), ASUSTeK

- Panasonic: RRC configures separate bits for each SCell or each SCell group
  - o Samsung: RAN1 to revisit the need of group common DCI format based indication of on-demand SSB if such indication cannot be achieved by RAN2 design.
  - o Negative: Huawei, InterDigital, Qualcomm
- For RRC
  - o Support other cases: Xiaomi, NTT DOCOMO (independent from SCell (de)activation via RRC)
  - o Against supporting additional case: ZTE, Apple, ETRI
- For MAC CE
  - o Ericsson: Support NW providing on-demand SSB transmission indication (i.e., that SSB is turned ON or OFF) and on-demand SSB configuration indication (e.g., SSB periodicity) at the same time

Proposal #4-1 (Deactivation):

For a cell supporting on-demand SSB SCell operation,
- Explicit indication of deactivation for on-demand SSB via MAC-CE for on-demand SSB transmission indication is supported for all scenarios/cases.

Companies are encouraged to provide views on Proposal #4-1.

Company	Views
InterDigital	Fine for at least the supported scenarios (i.e. #2 and #2A)
CMCC	We prefer to down-select scenario in proposal 3-1 first, then discuss the applicable scenario of MAC CE deactivation signaling. Moreover, we think that MAC CE deactivation signaling in scenario 2/2A/3A is not needed on top of implicit indication for the number N since no obvious benefit can be obtained.

Qualcomm	We don't support this proposal.
	
	For Case #1, it is not reasonable to have such deactivation signaling in Scenario 3A or in the middle of Scenario 3B leaving the remaining time of the activated Scell without SSB as being illustrated below:
	
	Hence, for Case #1, we think that the deactivation is only signaled in Scenario 2. The timing of the deactivation is
	   - Before the time UE receives the Scell activation signaling, or - At the same time or later than the time that UE receives the Scell deactivation signaling or timer for SCell deactivation is expired.
	For Case #2, it may be fine to have it for Scenarios 2 and 3B since SSB-based operation is still working based on always-on SSB if there is no on-demand SSB transmission.
	
	Furthermore, is it common understanding of the group that the existing agreements on OD-SSB deactivation are only applied to MAC-CE based indication of OD-SSB transmission?
	
	Suggested proposal for discussion:
	
	- **For Case #1, the MAC-CE based deactivation can be signalled**
	  - o **in Scenario 2, or**
	  - o **at the time that UE receives the Scell deactivation signaling or timer for SCell deactivation is expired.**

	• For Case #2, the MAC-CE based deactivation can be signalled in Scenario 2 and 3B.
Xiaomi	Fine with the proposal.
LG Electronics	Fine with it. Explicit indication of deactivation for OD-SSB via MAC-CE can be supported for all scenarios/cases. And we are wondering what the maximum value of N is. For instance, N can be one of finite values and infinite/non-numerical value. If on-demand SSB is indicated by infinite value, OD-SSB will be transmitted before Explicit indication of deactivation is signalled. Finite values for N will be decided by RAN4.
Huawei, HiSilicon 1	Support
Panasonic	Support
Nokia, NSB	Support
Lenovo	Support, but maybe we need to first settle down which scenarios should (not) be supported.
ZTE, Sanchips	Fine with this proposal. I think that Qc's suggested version is also acceptable although it may compromise the use of the deactivation functionality.
TCL	Fine with this proposal
DCM	We do not support on deactivation indication in scenario #2A. When the timimnig that Scell activation is indicated, OD-SSB transmission is required, so deactivating OD-SSB during this scenario does not have any advantage for Scell activation procedure.
Fujitsu	We share the same view as Qualcomm that the applicable scenarios for case #1 should be limited to the ones where the SCell is in deactivated status.
OPPO	Not support. For Case 1, the OD-SSB is not only for RRM (in SCell deactivated phase) and fast SCell activation (in Scell being activated phase), but also for necessary synchronization in SCell activated phase. Therefore, when the OD-SSB is activated, the UE expects that the OD-SSB stops after N times OD-SSB transmission before UE receives SCell activation indication. After UE receives SCell activation indication, then the UE expects that the OD-SSB is deactivated only after the SCell deactivation. Thus, there is no need for MAC-CE based deactivation. For Case 2, the OD-SSB is only for fast SCell activation, thus, when the OD-SSB is activated, the UE expects that the OD-SSB stops after N times OD-SSB transmission before UE receives SCell activation indication. After UE receives SCell activation indication, then the UE expects that the OD-SSB is deactivated only after the SCell activation is complete. Thus, there is no need for MAC-CE based deactivation.
China Telecom	Support.
Vivo	Do not support the explicit deactivation on on-demand SSB for case 1. For case 1, in scenario 3A and 3B, if the OD-SSB is deactivated, UE has no SSB for sync, agc, etc. For the implicit deactivation, the OD-SSB will transmit N times, we think an nonnumerical value can be defined for N, which means the SSB is transmitted until the Scell is deactivated. Then the implicit deactivation can work for all the valid scenarios/cases.

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

Companies are encouraged to provide views on Proposal #4-2.

Company	Views
InterDigital	Since semi static-based and dynamic MAC CE based signaling is already supported for indicating OD-SSB transmission, we do not see there is any need or good motivation to further support DCI-based signaling for indicating the same.
CMCC	Support the proposal.
Qualcomm	RRC/MAC-CE based signaling should be sufficient to support this feature. We don't think DCI based signaling is needed for NES deployments. Furthermore, while benefit of DCI approach is

	not clear and quantified, DCI always has reliability issue and no feature using UE-group common DCI in earlier releases has strong commercial traction.
Xiaomi	Fine with the proposal.
LG Electronics	We can be open to discuss it, if option 6 is also supported in order to deactivate on-demand SSB transmission from a UE perspective.
Huawei, HiSilicon 1	We do not support the proposal. The DCI based signaling to be deprioritized due to: 1. No advantage is foreseen since MAC CE has been agreed so there is a dynamic signaling-based solution. Such redundant introduction of DCI will increase unnecessary spec workload and UE complexity. The time left for this AI is limited. The format of DCI, payload of DCI and other designing details might be too heavy and occupies the time for other more important issues.
Panasonic	Support
Nokia, NSB	We think DCI based signaling is not needed.
NEC	Support
Lenovo	Support group common DCI for OD-SSB. UE specific DCI is not supported since we already have MAC CE signaling.
TCL	Support DCI used for indicating OD-SSB transmission on Scell
DCM	We support group-common DCI. By indicating to multiple UEs with only one indication, NW can reduce the number of signallings.
Fujitsu	Support
OPPO	although we have supported DCI signaling, given the limited time, we probably can focus on one deactivation method. We would suggest to prioritize timer/event based deactivation method e.g., our comment in proposal 4-1.
China Telecom	Support the proposal only if Scenario #3A/#3B is supported first.
Vivo	We are negative on the proposal, the motivation is not clear.

5 Contents of on-demand SSB configuration/indication

Company	Views
[1] Futurewei	**Proposal 4:** For time domain allocation in Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), support Alt A: Same as for Case #1.
[2] Huawei	**Proposal 7:** For Case #2, support Alt B: configure a single parameter which is to indicate the time offset between AO-SSB and OD-SSB. Introduce one additional time offset value of 2.5ms, in addition to currently supported values by *ssb-TimeOffset*.
[3] ZTE	**Proposal 17:** For the determination of the time domain location, Alt A is supported. **Proposal 18:** One parameter e.g., on-demand SSB transmission pattern can be configured for the SCell to UE, to reduce the overhead of indication the UE specific signalling. **Proposal 19:** For the case that the RRC based signaling can be used to indicate on-demand SSB transmission on the SCell at least for the case where this RRC also configures the SCell, activates the SCell, and provides on-demand SSB configuration: - A target on-demand SSB transmission pattern index can be configured by RRC signaling. **Proposal 21:** The target Physical Cell ID of the on-demand SSB and target on-demand SSB transmission pattern index can be indicated by the MAC CE.
[5] CATT	**Proposal 10:** More than one on-demand SSB configurations can be configured for the cell to UE. **Proposal 11:** Besides periodicity, for the following parameters, multiple candidate values can also be configured by RRC and the applicable value is indicated by MAC-CE: - The number N of SSB bursts that will be transmitted. - SSB positions within an on-demand SSB burst.

	Proposal 12: 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. - Sub-carrier spacing - Physical Cell ID - Downlink transmit power **Proposal 13:** The time domain location configuration of on-demand SSB for Case #1 is also applied for Case #2.
[6] China Telecom	**Proposal 9:** For Case #2, support reuse the same configuration method of time domain location for on-demand SSB as Case #1. **Proposal 10:** At least for the RRC-indicated on-demand SSB, there should be only one set of RRC configuration for on-demand SSB. **Proposal 11:** Sub-carrier spacing shouldn't be absent for Case #1; And for Case#2, this parameter should reuse that of always-on SSB if it is absent. **Proposal 12:** Not support the parameters in Info-Set 1 to be carried in the MAC CE signalling for on-demand SSB transmission indication. **Observation 7:** There is no need to configure/update the parameters already configured with RRC configuration for on-demand SSB in Info-Set 2 in the MAC CE indication. **Proposal 13:** Only Index of on-demand SSB config and parameters related to the deactivation of on-demand SSB should be carried by MAC CE signalling for on-demand SSB indication.

[7] CMCC	**Proposal 6:** For Case 1, SCS of the on-demand SSB configured by RRC can be absent or configurable depending on operating band of SCell.
	
	Proposal 7: For Case 2, the following parameters are the same for on-demand SSB and always-on SSB.
	- Sub-carrier spacing of the on-demand SSB
	- Physical Cell ID of the on-demand SSB
	- Downlink transmit power of on-demand SSB
	
	Proposal 8: For Case 2, the following parameters are provided for on-demand SSB configuration by RRC.
	- SSB positions within an on-demand SSB burst
	   o can be absent
	- Periodicity of the on-demand SSB
	   o can be absent
	- Number of SSB bursts
	   o can be absent
	- Absolute SFN offset and half frame index (Alt A of the previous agreement in RAN1#119)

[8] vivo	**Proposal 13:** A nonnumerical indication of N indicates that on-demand SSB transmission is deactivated along with the deactivation of SCell. **Proposal 15:** For Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), support Alt A that the configuration method of time domain location of on-demand SSB is same as for Case #1. **Proposal 16:** For a cell supporting on-demand SSB SCell operation, at least the following parameters for on-demand SSB configuration can be referred to the configuration of always-on SSB for Case #2: - Frequency of the on-demand SSB - Sub-carrier spacing of the on-demand SSB - Physical Cell ID of the on-demand SSB - Downlink transmit power of on-demand SSB

	Proposal 17: For a cell supporting on-demand SSB SCell operation, support to independently provide at least the following parameters for on-demand SSB configuration by RRC for Case #2: - Periodicity of the on-demand SSB - SFN offset - half frame index - SSB positions within an on-demand SSB burst - The number N of on-demand SSB bursts to be transmitted **Proposal 18:** The parameters for on-demand SSB configuration are configured by new parameters for both Case #1 and Case #2. **Proposal 19:** For a cell supporting on-demand SSB SCell operation, the on-demand SSB transmission number N and SSB positions in burst can be configured with multiple candidate values by RRC and the applicable value can be indicated by MAC CE.
[9] Tejas	**Proposal 9:** Supporting Alt A: Same as for Case #1.
[10] OPPO	**Proposal 2:** Support Alt A for Case #2 (Independently configure time domain location of OD-SSB burst).
[11] Nokia	**Observation-1:** For some of the parameters like absolute frequency, ssb-PositionsInBurst, ss-PBCH-BlockPower the value can be obtained from legacy configuration if not explicitly provided with the on-demand SSB configuration, e.g. with Case#2 when both always-ON SSB and OD-SSB are configured in the same frequency carrier. **Proposal-2:** RAN1 to clarify if/when the value of some of the parameters for on-demand SSB can be obtained from the legacy always-on SSB configuration. **Proposal-6:** For Case#2, RAN1 to discuss whether or not UE can be configured with both always-on SSB and OD-SSB transmissions in the same BWP. And if OD-SSB configuration will be BWP-specific or cell-specific.
[12] Panasonic	**Proposal 15:** For both Case 1(i.e., No always-on SSB on the cell) and Case 2(i.e., Always-on SSB is periodically transmitted on the cell), support to configure time domain location of OD-SSB per OD-SSB period by RRC 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 (SFN index *10) modulo (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. **Proposal 16:** 9.5.1 only supports that periodicity of the on-demand SSB can be indicated.
[13] InterDigital	**Proposal 3:** For cell supporting OD-SSB SCell operation, support configuring the same time domain location parameters (i.e. reference point, SFN offset, half frame index) for Case #2 as that of Case #1 **Proposal 10:** Indication of the number N of OD-SSB bursts is not supported in the MAC CE for OD-SSB
[14] Google	**Proposal 2:** Support the MAC CE based on-demand SSB indication for SCell to provide the following information in addition to the periodicity of the on-demand SSB: - SCell index - Activation/deactivation status for each on-demand SSB for the SCell - The value of the action delay T **Proposal 3:** Support the NW configures one on-demand SSB configuration and introduce new RRC parameters for the agreed configuration for on-demand SSB including - 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

[15] NEC	**Proposal 23:** For Case#1, on-demand SSB configuration can reuse the SCell SSB IEs (*absoluteFrequencySSB*, *ssb-periodicityServingCell*, *ssb-periodicityServingCell*, *ssbSubcarrierSpacing*, *ss-PBCH-BlockPower*) included within *ServingCellConfigCommon*.
	    - Additional IEs can be introduced for remaining aspects specific to on demand SSB operation.
	
	Proposal 24: For Case#2, if on-demand SSB is transmitted in the same frequency as always-on SSB, the on-demand SSB and always-on SSB can share some of the transmission parameters (*absoluteFrequencySSB*, *ssb-periodicityServingCell*, *ssb-periodicityServingCell*, *ssbSubcarrierSpacing*, *ss-PBCH-BlockPower*).
	    - Additional IEs can be introduced for other remaining aspects specific to on-demand SSB operation.
	
	Proposal 25: For Case#2, if on-demand SSB is not transmitted in the same frequency as always-on SSB, the on-demand SSB configuration can be provided using *NonCellDefiningSSB-r17*
	-Additional IEs can be introduced for remaining aspects specific to on-demand SSB operation.
	
	Proposal 26: For a cell supporting on-demand SSB SCell operation, gNB indicates the following to the UE:
	    - Whether a configured SSB is always-on or on-demand transmitted. FFS whether this indication is provided explicitly or implicitly using another parameter.
	    - Time domain location of on-demand SSB
	    - The number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
	
	Proposal 27: For Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), support Alt B to configure time domain location of on-demand SSB per on-demand SSB periodicity by RRC: 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*).
	
	Proposal 28: For Case#2, gNB configures the periodicity of on-demand SSB in addition to the periodicity of always-on SSB.

[16] KT	**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

[17] Xiaomi	**Proposal 8:** For Case#2, Alt B is used to determine the time domain location of on-demand SSB, i.e., based on a single parameter which is to indicate the time offset between always-on SSB and on-demand SSB.
[19] Samsung	**Proposal 5:** For parameters of on-demand SSB, adopt the following delivery methods correspondingly (highlighted parts are from previous agreements).

Parameter of on-demand SSB	Case 1	Case 2
Frequency of the on-demand SSB	By RRC	By RRC, or same as always-on SSB if not provided
Periodicity(ies) of the on-demand SSB	By RRC	By RRC
Physical cell ID of the on-demand SSB	By RRC	Same as always-on SSB
Subcarrier spacing of the on-demand SSB	By RRC	Same as always-on SSB

	Transmission power of the on-demand SSB	By RRC	Same as always-on SSB
	SSB positions in burst	By RRC	By RRC, or same as always-on SSB if not provided
	Time domain location (SFN offset and half frame index)	By RRC	By RRC, or same as always-on SSB if not provided
	A number of bursts for the on-demand SSB (for Option 3)	By RRC	By RRC

[21] ETRI	**Proposal 3:** For Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), - Alt A: Same as for Case #1 **Proposal 10:** For on-demand SSB operation, - Most of parameters except for time location of on-demand SSB burst are already present in existing RRC IE, ServingCellConfigCommon or ServingCellConfig and can be reused for Case #1 and Case #2. In addition to the existing parameters, the following parameters should be added. o SFN offset and half frame index - FFS: how to configure the parameters depending on Case #1 and Case #2 **Proposal 14:** For Option 2, it is proposed to include the value of N for on-demand SSB bursts in the on-demand SSB configuration information.
[22] Fujitsu	**Proposal 9:** For time domain location of on-demand SSB per on-demand SSB periodicity in Case#2, support Alt 1 which is same as Case#1. **Proposal 10:** 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 Note: How to indicate one out of multiple candidate values is up to RAN2.

[23] LG Electronics	**Proposal #1:** Support on-demand SSB configuration per BWP similar to NCD-SSB configured with the higher layer parameter *nonCellDefiningSSB*.
	
	Proposal #3: Consider the infinite/non-numerical value as one of candidate N values.
	 - If a UE is configured/indicated with this infinite/non-numerical value for N, the UE expects continuous and periodic transmission of on-demand SSB.
	
	Proposal #5: For Case #2, adopt Alt B (i.e., 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)).
	 - If the parameter is NOT configured, UE assumes the parameter set to 0
	
	Proposal #9: Support more than one on-demand SSB configurations that are provided by RRC signalling.
	 - One index of multiple on-demand SSB configurations is indicated by signalling for on-demand SSB transmission indication.
	 - One on-demand SSB configuration includes a set of the following parameters for which multiple candidate values can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication
	     o On-demand SSB periodicity
	     o Time domain location (i.e., SFN offset and half frame index for Case #1 and offset between always-on SSB and on-demand SSB for Case #2) of on-demand SSB burst
	     o The number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
	     o SSB positions within an on-demand SSB burst

	Proposal #15: Introduce NEW higher layer parameters to configure at least the followings for on-demand SSB, both for Case #1 and Case #2. For Case #2, if the following parameter is NOT provided, the corresponding value configured for always-on SSB is applied for on-demand SSB. - Frequency of the on-demand SSB - SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst* - Sub-carrier spacing of the on-demand SSB - Physical Cell ID of the on-demand SSB - Downlink transmit power of on-demand SSB **Proposal #16:** Introduce a NEW higher layer parameter (e.g., *od-ssb-ConfigList*) in which a set of parameters for on-demand SSB at least including the followings are included. A signaling (i.e., MAC CE or RRC) for on-demand SSB activation indicates an index within *od-ssb-ConfigList*. - On-demand SSB periodicity - Time domain location (i.e., SFN offset and half frame index for Case #1 and offset between always-on SSB and on-demand SSB for Case #2) of on-demand SSB burst
[24] Transsion	**Proposal 9** For case #2, it is recommended to support 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).
[27] Qualcomm	**Proposal 8:** At least for Case #2 in which the frequency locations of always-on SSB and on-demand SSB are identical, the time domain configuration of on-demand SSB is identical to the time domain configuration of on-demand SSB in Case #1. Furthermore, the time-domain locations of always-on SSB burst is a subset of the time-domain locations of on-demand SSB bursts.
[29] NTT DOCOMO	**Proposal 7:** For OD-SSB parameters related to time location in case #2, we support the same agreed mechanism for case #1, i.e., OD-SSB time locations in case #2 are determined based on SFN-offset and half-frame index.
[31] TCL	**Proposal 6:** Same parameter like frequency, SCS, SSB positions within an on-demand SSB burst could be configured for AO-SSB and OD-SSB for case #2. **Proposal 7:** Periodicity of the on-demand SSB/location of on-demand SSB burst may need configure separately for AO-SSB and OD-SSB for case #2. **Proposal 8:** Support multiple OD-SSB configurations and consider how to activate/deactivate configured multiple OD-SSB. **Proposal 9:** Support multiple OD-SSB configurations with same frequency position.
[33] Ericsson	**Observation 4** NW can save energy by transmitting on-demand SSB only in the direction(s) of the configured UE(s). **Proposal 6** Multiple candidate values of SSB positions in burst can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication for the cell. **Proposal 7** On-demand candidate SSB positions in a burst are restricted to legacy candidate SSB positions in a burst. **Proposal 8** Multiple candidate values of number of SSB bursts (or length of timer) can be configured by RRC and the applicable value can be indicated by MAC CE for on-demand SSB transmission indication for the cell.
[33] Ericsson	**Proposal 17** For Case #2, support Alt A (same as for Case #1).
[34] CEWiT	**Proposal 3:** Support the configuration of the SFN offset and half-frame index for the UE in Case 2, similar to Case 1.

Agreement (RAN1#117)

- 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

<mark>Agreement (RAN1#117)</mark>
- For a cell supporting on-demand SSB SCell operation, at least the followings for on-demand SSB are known to UE.
  - Sub-carrier spacing of the on-demand SSB
  - Physical Cell ID of the on-demand SSB
  - Location of on-demand SSB burst
  - Downlink transmit power of on-demand SSB
  - FFS: Other parameters
  - FFS: Whether each of above parameters is configured/indicated explicitly or not

<mark>Agreement (RAN1#118)</mark>
For a cell supporting on-demand SSB SCell operation, at least 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.
- Periodicity of the on-demand SSB
- FFS: Any other relevant parameters

<mark>Agreement (RAN1#118bis)</mark>
For a cell supporting on-demand SSB SCell operation, support to provide at least the following parameters for on-demand SSB configuration by RRC at least for Case #1.
- Sub-carrier spacing of the on-demand SSB
  - FFS if this can be absent
- Physical Cell ID of the on-demand SSB
- FFS: Time domain location of on-demand SSB burst such as SFN offset and half frame index
- Downlink transmit power of on-demand SSB
- FFS: The number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
- FFS whether the above parameters are configured by reusing legacy RRC parameters or new RRC parameters

<mark>Agreement</mark> (RAN1#119)
- 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 (SFN index *10) modulo (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*)

[<mark>Moderator's note</mark>] Regarding contents of on-demand SSB configuration/indication, company views are summarized

as follows.

- Case #2
  - Alt A: Futurewei, ZTE, CATT, China Telecom, CMCC, vivo, Tejas, OPPO, Panasonic, InterDigital, ETRI, Fujitsu, Qualcomm, NTT DOCOMO, CEWiT, Ericsson
  - Alt B: Huawei, NEC, Xiaomi, LG Electronics, Transsion
- Multiple on-demand SSB configurations
  - Supported by ZTE, CATT, China Telecom, TCL, LG Electronics
    - Also, indication of configuration index is supported by ZTE, China Telecom (only index within MAC CE), LG Electronics
  - Single configuration for RRC-initiated on-demand SSB: China Telecom
- Multiple candidate configuration + one applicable value indication
  - Only Periodicity
    - InterDigital
  - SSB position in burst
    - CATT, vivo, Fujitsu, LG Electronics, Ericsson
      - Ericsson: On-demand candidate SSB positions in a burst are restricted to legacy candidate SSB positions in a burst.
  - The on-demand SSB transmission number N
    - CATT, vivo, KT, ETRI, Fujitsu, LG Electronics, Ericsson
  - SFN offset and half frame index for on-demand SSB
    - LG Electronics
- Details on higher layer parameter signaling
  - Cell-specific vs. BWP-specific: Nokia
    - LG Electronics: BWP-specific
  - New or legacy RRC parameters
    - Reuse legacy parameters as much as possible: NEC, ETRI, TCL
    - New RRC parameters: vivo, Google, LG Electronics, Samsung
  - Frequency of the on-demand SSB
    - For Case #2, unless explicitly configured, reuse always-on SSB configuration: KT
    - For Case #2, reuse always-on SSB configuration: vivo
  - SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst*
    - For Case #2, independent configuration: CMCC, vivo
    - For Case #2, unless explicitly configured, reuse always-on SSB configuration: KT
  - Sub-carrier spacing of the on-demand SSB
    - For Case #2, unless explicitly configured, reuse always-on SSB configuration: CATT, China Telecom, KT
    - CMCC: Can be absent for Case #1
    - For Case #2, reuse always-on SSB configuration: CMCC, vivo, Samsung
  - Physical Cell ID of the on-demand SSB
    - ZTE: MAC CE indication
    - For Case #2, unless explicitly configured, reuse always-on SSB configuration: CATT, KT
    - For Case #2, reuse always-on SSB configuration: CMCC, vivo, Samsung
  - Downlink transmit power of on-demand SSB
    - For Case #2, unless explicitly configured, reuse always-on SSB configuration: CATT, KT
    - For Case #2, reuse always-on SSB configuration: CMCC, vivo, Samsung
    - Qualcomm: For the case when the frequency location of on-demand SSB is different from the frequency location of always-on SSB, if both always-on SSB and on-demand SSB are configured for measurement, the on-demand SSB transmit power is identical to the always-on SSB transmit power.
  - Others
    - # of SSB bursts: vivo
      - Non-numerical indication of N: vivo (on-demand SSB is deactivated when SCell is deactivated), LG Electronics
    - On/Off status of on-demand SSB: Google

==[HIGH] Proposal #5-1 (Time location config):==

- For a cell supporting on-demand SSB SCell operation, to provide time domain location of on-demand SSB by RRC,

- o For Case #2, adopt Alt A in the previous RAN1 agreement, i.e.,
  - ▪ 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 (SFN index *10) modulo (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.

Companies are encouraged to provide views on Proposal #5-1.

Company	Views
InterDigital	Fine
Google	OK
CMCC	Support the proposal.
Samsung	We support the proposal.
Qualcomm	We support the proposal
Xiaomi	In our view, for Case#2, Alt B has merit of less signaling overhead compared with Alt A. Hence, we prefer to adopt Alt B to determine time location of additional SSB.
LG Electronics	We do not prefer it. We think that Alt B is still beneficial in Case 2. It is not needed that 2 parameters are configured in Case 2. And Alt B is nothing new, it is similar to the way the time location for between CD-SSB and NCD-SSB is configured in R17. At least, the parameter of Half frame index does not need to be configured/indicated in Case 2
Huawei, HiSilicon 1	For Case #2, we support Alt B, i.e., there can be a single RRC parameter to indicate the time offset between OD-SSB and AO-SSB. This is aligned with the RRC IE design of *NonCellDefiningSSB* in Rel-17 era, where *ssb-TimeOffset-r17* is used to configure the offset between two SSBs. Moreover, we'd like to point out that, if OD-SSB and AO-SSB are configured on a same frequency, the value of the offset can be properly set to enable fast SCell activation. In current spec, it takes at least a half frame (5ms) to perform one round of SSB burst scan if applying legacy SSB pattern. If the time needed for an SSB burst scan is cut down, the delay of SCell activation is decreased and better UE experience can be achieved. This can be realized by setting a suitable time offset (e.g., 2.5ms) between OD-SSB and AO-SSB if they are configured on the same frequency, and UE consolidates the meas results of the two kinds of SSB in a <5ms time window. Alt B can provide a chance for such procedure for fast SCell activation. For more details, please refer to [2] R1-2500077.
Panasonic	Support
CEWiT	Support
Nokia, NSB	Support
Lenovo	Support
ETRI	Support
ZTE, Sanechips	We support the proposal
TCL	Support
DCM	We support the FL proposal. In terms of specification complexity point of view, NW should use the same parameters for both case#1/2. Since Alt. A is supported for case #1, we support the same alternative for the case #2.
Fujitsu	Support
China Telecom	Support.
Spreadtrum	Support
Transsion	Support
Vivo	OK
CATT	OK
Moderator	- Supported by InterDigital, Google, CMCC, Samsung, Qualcomm, Panasonic, CEWiT, Nokia, Lenovo, ETRI, ZTE, TCL, NTT DOCOMO, Fujitsu, China Telecom, Spreadtrum, Transsion, vivo, CATT

	- Objected by Xiaomi, LG Electronics, Huawei

[HIGH] Proposal #5-2 (RRC parameter framework):

- For a cell supporting on-demand SSB SCell operation, introduce NEW higher layer parameter (i.e., *od-ssb-config*) as parent IE for on-demand SSB configuration, for both Case #1 and Case #2.
    - More than one on-demand SSB configurations can be provided.
    - If more than one on-demand SSB configurations are provided, index of on-demand SSB configuration is indicated by on-demand SSB transmission indication signalling (i.e., RRC or MAC CE).

Companies are encouraged to provide views on Proposal #5-2.

Company	Views
Google	Support
CMCC	Ok.
Samsung	OK
Qualcomm	We don't support two sub-bullets. It should be noted that OD-SSB configuration contains many parameters. We don't think adapting all these parameters is needed. We agreed that indication of OD-SSB periodicity with multiple OD-SSB periodicities configured, which should be sufficient for the feature.
Xiaomi	Not sure the motivation of having more than one on-demand SSB configurations, especially similar mechanisms are considered for SSB adaptation. More clarification is needed.
LG Electronics	OK
Apple	Negative. Other than SSB periodicity, OD-SSB configuration is preferred not to be changed.
Huawei, HiSilicon 1	We support that multiple OD-SSB configs can be provided and one of which can be indicated by MAC CE-based indication signaling. However, the exact RRC signaling structure design (i.e., whether NEW *od-ssb-config* parameter framework) is out of RAN1 work scope, and it should be handed to RAN2.
NEC	We support the proposal, but we also need to check that for Case#1 in absence of CD-SSB parameters is there any impact on specification procedure for UE sync operation. This is because in the current spec UE assumes SCell as SSB-less cell in absence of CD-SSB parameters and hence UE uses SSB of another serving cell for sync purposes.
ETRI	We also prefer to reuse the existing parameters as much as possible except for the additional ones for example, multiple periodicity values.
ZTE, Sanechips	We support this proposal. It may make discussion easier if we finalize what new parameters are firstly.
TCL	Support
DCM	We support of FL proposa. We want to introduce new IE for OD-SSB and multiple parameters can be configured in the new IE. For example, by setting multiple type of positionsinbursts, OD—SSB can adaptively give OD-SSB to Rel-19 UEs who moves around in a cell.
Fujitsu	Support
China Telecom	Support.
CATT	OK

[HIGH] Proposal #5-3 (New or legacy parameter):

- For a cell supporting on-demand SSB SCell operation, introduce NEW higher layer parameters to configure each of the followings, for both Case #1 and Case #2.
    - Frequency of the on-demand SSB (i.e., *od-ssb-absoluteFrequency*)
        - If absent for Case #2, center frequency location of on-demand SSB is the same as that of always-on SSB.
    - SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst* (i.e., *od-ssb-PositionsInBurst*)
        - If absent for Case #2, SSB positions within on-demand SSB burst are the same as those within always-on SSB burst.
    - Periodicity of the on-demand SSB (i.e., *od-ssb-Periodicity*)

- o Sub-carrier spacing of the on-demand SSB (i.e., *od-ssbSubcarrierSpacing*)
  - ▪ If absent for Case #2, sub-carrier spagcing of on-demand SSB is the same as that of always-on SSB.
- o Physical Cell ID of the on-demand SSB (i.e., *od-ssb-physCellId*)
  - ▪ If absent for Case #2, physical cell ID of on-demand SSB is the same as that of always-on SSB.
- o Time location of on-demand SSB burst (i.e., *od-ssb-sfn-Offset* and *od-ssb-halfFrameIndex*)
- o Downlink transmit power of on-demand SSB (i.e., *od-ss-PBCH-BlockPower*)
  - ▪ If absent for Case #2, downlink transmit power of on-demand SSB is the same as that of always-on SSB.
- o Number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated (i.e., *od-ssb-nrofTx*)

Companies are encouraged to provide views on Proposal #5-3.

Company	Views
InterDigital	Support
Google	OK
CMCC	Generally ok. The number N of SSB bursts may be absent when on-demand SSB is deactivated by MAC-CE.
Samsung	OK in general. Periodicity and time domain location should be a list of RRC parameters.
Qualcomm	The list of parameters is fine for Case #1. However, the following parameters need further discussion for Case #2: - Frequency of the on-demand SSB: Further RAN1 discussion in Proposal #2-3 is needed - SSB positions within an on-demand SSB burst: Further RAN1 discussion in Proposal #2-4 is needed - Sub-carrier spacing of the on-demand SSB: We don't see the use case of having different SCS for OD-SSB and always-on SSB - Physical Cell ID of the on-demand SSB: We don't see the use case of having different PCIs for OD-SSB and always-on SSB - Downlink transmit power of on-demand SSB: We don't see the use case of having different Tx power for OD-SSB and always-on SSB
Xiaomi	The configuration of time domain location of on-demand SSB burst is still under discussing in proposal #5-1 and whether same or different frequency center for always on SSB and on-demand SSB is under discussion in proposal#2-3, proposal#5-3 can be deferred until we have conclusion on the mentioned proposals.
LG Electronics	We are fine with it
Huawei, HiSilicon 1	Generally OK. It should be also be FFS that which parameter(s) among these should be configured with multiple candidate values, while others should not. In our view, at least the frequency, periodicity and SSB positions within a burst can be provided with multiple values (as different types of on-demand SSB).
NEC	We are not completely sure about "Physical Cell ID of the on-demand SSB" because if this IE is present within the ServingCellConfigCommon then UE already knows the cell where which this configuration is applicable. Other parameters seem okay.
ZTE, Sanechips	We support this proposal. We also prefer to have the parameter 'number N of SSB bursts'.
TCL	Generally support this proposal
DCM	We support FL proposal.
Fujitsu	Support
China Telecom	Support.
Spreadtrum	Support
Vivo	OK
CATT	In principle ok

Proposal #5-4 (Cell-specific vs. BWP-specific):
- Discuss whether on-demand SSB configuration is cell-specific or BWP-specific.

Companies are encouraged to provide views on Proposal #5-4.

Company	Views

CMCC	Similar as always-on SSB, on-demand SSB is cell-specific.
Xiaomi	We prefer cell-specific configuration.
LG Electronics	OD-SSB configuration is BWP-specific. For instance, as you know, R17 NCD-SSB is one of AO-SSBs. R17 NCD-SSB is configured in dedicated BWP. So, the OD-SSB which is located in the same frequency of R17 NCD-SSB can be also configured in dedicated BWP.
Huawei, HiSilicon 1	We think cell-specific is fine. There can be many possible solutions to mitigate the impact on UE RF, including gNB configures an adequate BWP for UE, or (some types of UE) performing meas gap without interruption, and so on. No further benefit to confine on-demand SSB to be BWP-specific.
Panasonic	We are okay to discuss this aspect and would like to clarify this may be related to before or after Scell activation.
Nokia, NSB	This should be discussed. 38.300 says "A UE may be configured with multiple SSBs provided that each BWP is configured with at most one SSB (CD-SSB or NCD-SSB)". It should be clarified if OD-SSB can be in the different frequency location but in the same BWP than AO-SSB.
NEC	Support
Fujitsu	We are open for discussion, and we prefer cell-specific.
Vivo	We prefer cell-specific

6 TX behavior of on-demand SSB burst

Company	Views
[3] ZTE	**Proposal 8:** Confirm the working assumption that T = T_min. **Proposal 9:** For the RRC based signaling, time instance A can be the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst which is at least T_RRC slots after the last slot of the RRC message. - FFS values of T_RRC. - Note: The T_RRC should be no less than the timeline required for UE's RRC processing.
[4] Spreadtrum	**Proposal 2** RRC message (for on-demand SSB activation) reception timing can be considered as time reference A. **Proposal 3** For on-demand SSB transmission, Option 2 and 3 can be supported in Rel-19. - Option 2: UE expects that on-demand SSB burst(s) is transmitted from time instance A to time instance B and not transmitted after time instance B. - Option 3: UE expects that on-demand SSB burst(s) is transmitted N times after time instance A and not transmitted after N on-demand SSB bursts are transmitted.
[5] CATT	**Proposal 14:** Considering time instance A for MAC-CE, confirm the working assumption T=T_min. **Proposal 15:** For SSB burst(s) indicated by on-demand SSB SCell operation via a RRC, UE expects that on-demand SSB is transmitted from time instance A_RRC which is determined as follows. - Time instance A_RRC is the beginning of the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst which is at least T_RRC slots after the last slot where UE receives PDSCH containing the RRC message from gNB to indicate on-demand SSB transmission. - T_RRC should be dependent on the RRC procedure delay.
[7] CMCC	**Proposal 9:** The following working assumption is confirmed: - (Working assumption): T=T_min **Proposal 10:** The time instance A for RRC indication is not explicitly defined.
[8] vivo	**Proposal 8:** Time instance A is the beginning of the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst which is least T' slots after the slot where UE receives a RRCReconfiguration message from gNB to indicate on-demand SSB transmission.

	Proposal 9: T' is not less than $T\_min' = T_{RRC\_process} + T1 + T2$, where $T_{RRC\_process}$ is the RRC procedure delay. T1 is the delay from slot $n' + \frac{T_{RRC\_Process}}{NR\ slot\ length}$ until the transmission of RRCReconfigurationcomplete message and slot n' is the last slot overlapping with the PDSCH containing the RRC reconfiguration message. In addition, T2 is the RRCReconfigurationcomplete message processing delay in network. **Proposal 10:** When SCell with on demand SSB transmission and cell with signalling transmission have different numerologies, the value of T is determined with the numerology of the cell with signalling transmission.
[11] Nokia	**Observation-8:** The numerology considered for the T_min calculations are with respect to the carrier on which UE receives MAC-CE. **Proposal-7:** RAN1 to confirm that the agreement on the T slots apply to the cell transmitting the MAC-CE signaling and applies irrespective of the SCell numerology. **Observation-9:** UE cannot assume the time slot of RRC signaling reception as the time reference for the first OD-SSB time domain position. **Proposal-8:** For RRC-based signaling to activate the on-demand SSB transmission, the time reference for the first SSB time domain position can be based on the slot and system frame number in PCell.
[12] Panasonic	**Proposal 11:** The texts of working assumptions in the above agreement should be confirmed.
[14] Google	**Proposal 1:** For MAC CE based on-demand SSB indication, confirm the first working assumption that T is not less than T_min and revert the second working assumption that T is T_min.
[15] NEC	**Proposal 11:** RAN1 to discuss the case where SCell with on-demand SSB transmission and cell with on-demand SSB indication have different numerology. **Observation 7:** NR currently supports indication of smtc within SCellConfig during SCell addition which allows UE to optimise the SSB search. The smtc time reference is with respect to the PCell and contains the same periodicity value as ssbperiodicityServingCell indicated in sCellConfigCommon. **Proposal 12:** For the case where SCell and the reference cell (where UE receives on-demand SSB indication) have different numerology, discuss further what time/numerology reference is used for the configuration of SSB time domain positions provided to the UE.
[17] Xiaomi	**Proposal 3:** Time instance A and value of T can be defined as below if on-demand SSB is triggered by RRC-based signalling. - If triggering message is carried by RRC signalling, instance A is the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst after slot n, slot n is the last downlink slot overlaps with uplink slot on which UE transmit ACK for the RRC signalling. T at least includes the RRC processing delay.
[18] Samsung	**Proposal 4:** For deactivation of on-demand SSB, other than Option 1A to be discussed in RAN2, there is no need to support additional options in addition to Option 1 and Option 2. - For Option 1, the time instance B corresponds to the end of the slot containing the last actually transmitted SSB within the first "possible" on-demand SSB burst which is at least T slots after the slot where UE receives the MAC CE; - For Option 2, N shall be determined as a counter to describe the number of SSB bursts for on-demand SSB transmission, and the value of N can be provided by RRC parameter.
[23] LG Electronics	**Proposal #6:** When PDSCH including RRC for on-demand SSB transmission indication is received at slot n, UE can expect on-demand SSB is periodically transmitted from time instance A which is the beginning of the first slot containing candidate SSB index 0 of on-demand SSB burst from the slot that is after slot $n + X \cdot N_{slot}^{subframe,\mu}$.

	- FFS: The value of X by taking 16+K(if additional consideration is not needed, K=0) as the starting point **Proposal #7:** If a UE receives MAC CE in slot n for deactivating on-demand SSB via MAC-CE, the UE expects that on-demand SSB is not transmitted after slot n+Y. - Further discuss the value of Y.
[24] Transsion	**Proposal 10** For RRC, we also need to discuss the definition of time instance A.
[27] Qualcomm	**Proposal 3:** Confirm the working assumptions in determining T with understanding that T_min equals to $m + 3N_{slot}^{subframe,\mu}+1$ from network transmission perspective. **Proposal 4:** The SCS for determining the value of T is the SCS of the active DL BWP that UE receives the OD-SSB transmission indication signaling. **Proposal 5:** For SSB burst(s) indicated by on-demand SSB SCell operation via RRC, UE expects on-demand SSB is transmitted from the first on-demand SSB burst after receiving RRC carrying indication of OD-SSB transmission.
[29] NTT DOCOMO	**Proposal 14:** For RRC based transmission indication of OD-SSB, we support to define the transmission timing.
[31] TCL	**Proposal 4:** UE expects that multiple on-demand SSB is transmitted from time instance A plus potential time offset. - FFS: how to configure potential time offset. **Proposal 5:** Support dynamic offset indicated by MAC CE to indicate same or different position of OD-SSB transmission. - FFS how to indicate dynamic offset for different scenarios.
[33] Ericsson	**Proposal 18** Timing of on-demand SSB transmissions that are turned ON by RRC configuration follows legacy behavior for always-on SSB configured by RRC.
[35] LG Electronics	**Proposal #1:** Confirm the following working assumption based on RAN4's agreement that T_min equals to $m + 3N_{slot}^{subframe,\mu}+1$ from network transmission perspective. - (Working assumption): T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}+1$ where slot $n+m$ is a slot indicated for PUCCH transmission with HARQ-QCK information when the UE receives MAC CE signaling to indicate on-demand SSB transmission ending in slot n, and $N_{slot}^{subframe,\mu}$ is as defined in current specification. **Observation:** From RAN1 agreement related to time instance A determination, it is understood that "UE expects that on-demand SSB is transmitted from time instance A" doesn't necessarily imply "UE is ready to process on-demand SSB from time instance A". **Proposal #2:** Confirm the following working assumption based on the above observation. - (Working assumption) T=T_min **Proposal #3:** Discuss whether UE starts counting the number of on-demand SSB transmissions from the SSB after T_min (i.e., from gNB transmission perspective) or from the SSB after {T_min + additional UE processing time that can be defined by RAN4} (i.e., from UE reception perspective).
[36] Nokia	**Observation 1:** T_min value of the OD-SSB timeline needs to be defined from UE perspective. **Proposal 1:** RAN1 concludes that T_min= $m + 3N_{slot}^{subframe,\mu}$ +1 + additional UE processing/preparation time defined in RAN4. **Proposal 2:** RAN1 assumes that additional UE processing/preparation time will be defined in RAN4 when describing T_min value in RAN1 specifications.

	Proposal 3: RAN1 sends a reply LS to RAN4 informing that RAN1 specifications will refer to RAN4 specifications when describing additional UE processing/preparation time of T_min value.

- For SSB burst(s) triggered by on-demand SSB SCell operation, study at least the following options.
  - Option 1: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A.
  - Option 1A: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A until gNB turns OFF the on demand SSB
  - Option 2: UE expects that on-demand SSB burst(s) is transmitted from time instance A to time instance B and not transmitted after time instance B.
  - Option 3: UE expects that on-demand SSB burst(s) is transmitted N times after time instance A and not transmitted after N on-demand SSB bursts are transmitted.
  - Option 4: UE expects that on-demand SSB burst(s) is transmitted with a periodicity from time instance A to time instance B and with the other periodicity after time instance B.
  - FFS: The combination of above options
  - FFS: How to define time instance A/B and the value of N per option
  - FFS: Each option is applicable to which Cases or Scenarios (as per the previous agreement)

The previous RAN1 agreement is partly confirmed and further revised as follows.
- For SSB burst(s) indicated by on-demand SSB SCell operation via a 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 beginning of the first slot containing [candidate SSB index 0 or the first actually transmitted SSB index] ofwithin the first "possible" on-demand SSB burst which is at least T slots after the slot 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.
      - The location(s) (e.g., SFN offset, half frame index) in the time domain of "possible" on-demand SSB burst and SSB position within the burst should be configured by the gNB
  - Note: The value of T is not less than existing timeline required for UE's MAC CE processing for SCell activation
  - (Working assumption): T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}$+1 where slot $n+m$ is a slot indicated for PUCCH transmission with HARQ-QCK information when the UE receives MAC CE signaling to indicate on-demand SSB transmission ending in slot n, and $N_{slot}^{subframe,\mu}$ is as defined in current specification.
    - RAN4 to confirm that T_min can be equal to $m + 3N_{slot}^{subframe,\mu}$+1
  - (Working assumption) T=T_min
- Above applies at least for the case where SCell with on demand SSB transmission and cell with signalling transmission have the same numerology.
-

[Moderator's note] Company views regarding time instance A are as follows.
- T = T_min
  - Confirm WA1 (T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}$+1): Panasonic, Google, LG Electronics, Qualcomm
    - Nokia: T_min=$m + 3N_{slot}^{subframe,\mu}$+1 + additional UE processing/preparation time defined in RAN4
  - Confirm WA2 (T=T_min): ZTE, CATT, CMCC, Panasonic, LG Electronics, Qualcomm
    - Google, TCL: revert WA2 and T is signalled via MAC CE
- Numerology to determine T
  - vivo, Nokia, Qualcomm: Based on MAC CE transmitting cell
- RRC based time instance A
  - Similar to MAC CE, by replacing T_min as RRC processing time: ZTE, CATT, LG Electronics, Transsion, NTT DOCOMO
  - RRC message reception timing as time instance A: Spreadtrum

- o CMCC: No explicit definition
- o vivo: T_min' considering RRC procedure delay, UL RRC complete message transmission, and processing delay in network
- o Nokia: Slot/SFN-based timing indication in PCell
- o Ericsson: Follows legacy behavior for always-on SSB configured by RRC
- o Qualcomm: UE expects on-demand SSB is transmitted from the first on-demand SSB burst after receiving RRC carrying indication of OD-SSB transmission.
- Time instance B
  - o Samsung: For MAC CE based deactivation, the time instance B corresponds to the end of the slot containing the last actually transmitted SSB within the first "possible" on-demand SSB burst which is at least T slots after the slot where UE receives the MAC CE
  - o LG Electronics: If a UE receives MAC CE in slot n for deactivating on-demand SSB via MAC-CE, the UE expects that on-demand SSB is not transmitted after slot n+Y
- How to count N
  - o LG Electronics: Discuss whether UE starts counting the number of on-demand SSB transmissions from the SSB after T_min (i.e., from gNB transmission perspective) or from the SSB after {T_min + additional UE processing time that can be defined by RAN4} (i.e., from UE reception perspective)

[HIGH] Proposal #6-1 (Confirm WA):

Confirm the following two working assumptions.
- For SSB burst(s) indicated by on-demand SSB SCell operation via a MAC CE, UE expects that on-demand SSB is transmitted from time instance A which is determined as follows.
  - o Alt 3-1: Time instance A is the beginning of the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst which is at least T slots after the slot 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.
      - The location(s) (e.g., SFN offset, half frame index) in the time domain of "possible" on-demand SSB burst and SSB position within the burst should be configured by the gNB
  - o Note: The value of T is not less than existing timeline required for UE's MAC CE processing for SCell activation
  - o (Working assumption): T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}+1$ where slot $n+m$ is a slot indicated for PUCCH transmission with HARQ-QCK information when the UE receives MAC CE signaling to indicate on-demand SSB transmission ending in slot n, and $N_{slot}^{subframe,\mu}$ is as defined in current specification.
    - ▪ RAN4 to confirm that T_min can be equal to $m + 3N_{slot}^{subframe,\mu}+1$
  - o (Working assumption) T=T_min
- Above applies at least for the case where SCell with on demand SSB transmission and cell with signalling transmission have the same numerology.

Companies are encouraged to provide views on Proposal #6-1.

Company	Views
Google	We suggest confirming the first WA
CMCC	Since time instance A is at least T slots after the slot n where UE receives a MAC CE, time instance A will be after n+T. UE can determine time instance A based on RRC configured SFN offset and half frame index, n and T_min. T can be equal to T_min instead of larger than T_min. Thus, only T=T_min is confirmed.
Qualcomm	We suggest updating the proposal as follows: - Confirm the following two working assumptions **according to RAN4 LS reply R4-2420192**.
Xiaomi	Fine with the proposal.
LG Electronics	The two working assumptions should be confirmed without change
Apple	We suggest to wait for further RAN4 input. The incoming LS R1-2500020 does not give information in UE perspective as it describes network perspective only. We would need further input in UE perspective.
Huawei, HiSilicon 1	OK with it

Nokia, NSB	RAN4 LS says T_min value is ok from network perspective We think T_min timing should be specified from UE perspective. OD-SSB transmissions sent before UE can process them should be avoided.
NEC	Support
Lenovo	Support
ETRI	Support
ZTE, Sanechips	Fine with Qc's updated proposal
DCM	We support FL proposal.
Fujitsu	Support
China Telecom	Support.
Spreadtrum	Support
Transsion	First WA can be confirmed
CATT	Support

[HIGH] Proposal #6-2 (Time instance A for RRC):

- For SSB burst(s) indicated by on-demand SSB SCell operation via RRC, UE expects that on-demand SSB is transmitted from time instance A which is determined as follows.
    - Time instance A is the beginning of the first slot containing the first actually transmitted SSB index within the first "possible" on-demand SSB burst which is at least T_RRC slots after the slot 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.
            - The location(s) (e.g., SFN offset, half frame index) in the time domain of "possible" on-demand SSB burst and SSB position within the burst should be configured by the gNB
        - Down-select one of the followings:
            - Alt 1: It is left to RAN2 and/or RAN4 to decide the value of T_RRC
            - Alt 2: T_RRC = 0

Companies are encouraged to provide views on Proposal #6-2 and preference among alternatives. Please add another alternative you have, if any.

Company	Views
Google	We think the action delay for RRC should be discussed by RAN2
CMCC	After RRC response, UE can search on-demand SSB based on SFN offset and half frame index similar as legacy behavior, there is no need to explicitly define the time position for time instance A.
Samsung	OK in general.
Xiaomi	We are generally fine with the proposal. As for the T_RRC, Alt 1 is preferred, i.e., it is left to RAN2 and/or RAN4 to decide the value of T_RRC.
LG Electronics	Same as Xiaomi
Apple	It is up to UE implementation to confirm RRC complete – i.e. processing time to confirm is not specified. Therefore, our understanding is it is difficult to define exact time instance A. In this sense, while not specifying time instance A for RRC based OD-SSB activation, the better way would be that gNB starts to transmit OD-SSB at least at the time to transmit RRC based OD-SSB activation.
Huawei, HiSilicon 1	Alt 1 is preferred.
NEC	We need to rephrase "slot where UE receives a signalling from gNB" because RRC message can comprise of multiple slots. We can instead use a more precise time reference like "last slot overlapping with the PDSCH containing the RRC message" (which is also used in RAN4 specification)
ETRI	Support with Alt 1
ZTE, Sanechips	Alt 1 is preferred.
TCL	Support Alt.1.
DCM	We support Alt. 1. At least UE needs to know when the OD-SSB transmission start. Whether T_RRC should be 0 or other values, we can let RAN2/RAN4 handle.
Fujitsu	We are fine with the proposal.
China Telecom	Support.
Spreadtrum	Support Alt1.
Transsion	Support Alt1.

CATT	"where UE receives a signalling from gNB to indicate on-demand SSB transmission", what is exactly of this signalling ?

Proposal #6-3 (SCS of T):

When UE determines time instance A, the SCS of $N_{slot}^{subframe,\mu}$ is the SCS of the active DL BWP where UE receives MAC CE for on-demand SSB transmission indication.

Companies are encouraged to provide views on Proposal #6-3.

Company	Views
Google	It seems such SCS is better to be based on the minimum SCS for the active DL BWP for the MAC-CE and the target SCell, like cross-CC scheduling?
CMCC	Ok.
Xiaomi	Fine with the proposal.
LG Electronics	OK
Nokia, NSB	Support
NEC	Support
Lenovo	Support
ZTE, Sanechips	Fine with the proposal.
TCL	Support
DCM	Calculation of T_min should be based on signaling numerlogy. When the SCS of the transmitted OD-SSB and that of the OD-SSB transmission indication are different, UE should calculate T_min based on the SCS of the signalling.
Fujitsu	Based on the existing spec, the SCS of $N_{slot}^{subframe,\mu}$ is the SCS of the UL where the UE transmit HARQ-ACK corresponding to the activation command. By following the legacy, we would like to propose that the SCS of $N_{slot}^{subframe,\mu}$ is the SCS of the active UL BWP where the UE transmits ACK corresponding to the MAC-CE for on-demand SSB. TS 38.213 clause 4.3 With reference to slots for PUCCH transmissions, when a UE receives in a PDSCH an activation command for a secondary cell ending in slot *n*, the UE applies the corresponding actions in [38.321] no later than the minimum requirement defined in [38.133] and no earlier than slot *n+k*, except for the following: … The value of k is $m + 3N_{slot}^{subframe,\mu} + 1$ where n+m is a slot indicated for PUCCH transmission with HARQ-ACK information for the PDSCH reception as described in clause 9.2.3 and $N_{slot}^{subframe,\mu}$ is a number of slots per subframe for the SCS configuration μ of the PUCCH transmission.
China Telecom	Support.
Transsion	Support
Vivo	Support

Proposal #6-4 (Time instance B for MAC CE):

- Upon the reception of MAC CE for deactivating on-demand SSB, UE expects that on-demand SSB is NOT transmitted from time instance B.
  - FFS: How to determine time instance B

Companies are encouraged to provide views on Proposal #6-4.

Company	Views
Google	OK. Maybe we can say the OD-SSB is deactivated.
CMCC	Similar approach on the definition of time instance A can be reused, i.e., UE expects that on-demand SSB is NOT transmitted after T_min slots after the slot where UE receives deactivation MAC CE.
Xiaomi	Fine with the proposal.
LG Electronics	OK
Nokia, NSB	Support
TCL	Okay

DCM	We are fine with the FL proposal.
Transsion	Since time instance B is used to deactivate OD-SSB transmission, it can be discussed together with the method for deactivating OD-SSB transmission agreed upon in the last meeting, for example, MAC CE deactivates OD-SSB.
Vivo	OK

7 L1/L3 measurement based on on-demand SSB

Company	Views
[1] Futurewei	**Proposal 5:** Support Option 2: A CSI report configuration is associated with one of always-on SSB and on-demand SSB.
[2] Huawei	**Proposal 13:** RAN1 to consider the needed modification on existing L3 measurement procedure/requirement.
[3] ZTE	**Proposal 24:** At least for Case #2, Option 2, a CSI report configuration is associated with one of always-on SSB and on-demand SSB, is supported. **Proposal 25:** For Rel-19, support LTM for on-demand SSB SCells should be deprioritized.
[5] CATT	**Proposal 16:** Deprioritize the discussion of LTM based on on-demand SSB in Rel-19. **Proposal 17:** Consider two candidate solutions to add on-demand SSB resource configuration to existing CSI resource configuration. - Alt-1: The existing IE *CSI-ResourceConfig* should include the on-demand SSB resource configuration information. - Alt-2: A new dedicated resource configuration IE for on-demand SSB resource configuration should be introduced, e.g. *CSI-ResourceConfig-NES*. **Proposal 18:** Consider two candidate solutions to add on-demand SSB reporting configuration to existing CSI reporting configuration. - Alt-1: The existing IE *CSI-ReportConfig* should include the on-demand SSB reporting configuration information. - Alt-2: A new dedicated reporting configuration IE for on-demand SSB reporting configuration should be introduced, e.g. *CSI-ReportConfig-NES*. **Proposal 19:** For a cell supporting OD-SSB SCell operation and for Case #2, both the following options should be supported for UE to perform L1 measurement based on OD-SSB: - Option 1: A CSI report configuration is associated with both of OD-SSB and always-on SSB. - Option 2: A CSI report configuration is associated with one of always-on SSB and OD-SSB. **Proposal 20:** In order to support both the two options in the agreement in RAN1#118-bis using a single *CSI-ReportConfig* IE, the reporting configuration for AO-SSB and OD-SSB in the *CSI-ReportConfig* IE should be optional. **Proposal 21:** It is up to gNB implementation whether OD-SSB and always-on SSB have same beam or not. **Proposal 22:** Consider two candidate solutions to activate and deactivate semi-persistent L1 measurement reporting on PUCCH for on-demand SSB. - Alt-1: The existing *SP CSI reporting on PUCCH Activation/Deactivation* MAC CE should include the activation and deactivation of SP CSI reporting on PUCCH for on-demand SSB, e.g., one of the reserved bits can be used to indicate whether the MAC CE applies to SP CSI reporting on PUCCH Activation/Deactivation for on-demand SSB or not. - Alt-2: A new dedicated MAC CE should be introduced for activation and deactivation of semi-persistent L1 measurement reporting on PUCCH for on-demand SSB.

	Proposal 23: Consider two candidate solutions to trigger semi-persistent L1 measurement reporting on PUSCH for on-demand SSB. - Alt-1: The existing DCI field CSI request is reused to trigger semi-persistent L1 measurement reporting on PUSCH for on-demand SSB, and the existing DCI field Transform precoding indicator is used to indicate the DCI is used to trigger semi-persistent L1 measurement reporting on PUSCH for on-demand SSB, or for legacy MIMO/LTM. - Alt-2: A new dedicated RNTI (e.g., OD-SSB-SP-Reporting-RNTI) for DCI format 0_1 and 0_2 should be introduced for triggering of semi-persistent L1 measurement reporting on PUSCH for on-demand SSB. **Proposal 24:** Consider two candidate solutions to support the semi-persistent L1 measurement reporting on PUSCH for multiple on-demand SSBs from multiple SCells. - Alt-1: The existing IE *CSI-SemiPersistentOnPUSCH-TriggerState* should include multiple *CSI-ReportConfigIds*. Each *CSI-ReportConfigId* is associated with one on-demand SSB resource configuration information.\\ - Alt-2: A new dedicated trigger state IE for on-demand SSB should be introduced, e.g. *CSI-SemiPersistentOnPUSCH-TriggerState-NES*. **Proposal 25:** Consider the following solution to trigger aperiodic L1 measurement reporting on PUSCH for on-demand SSB. - A new dedicated RNTI (e.g., OD-SSB-Aperiodic-Reporting-RNTI) for DCI format 0_1 and 0_2 should be introduced for triggering of aperiodic L1 measurement reporting on PUSCH for on-demand SSB.
[6] China Telecom	**Proposal 17:** For a cell supporting on-demand SSB SCell operation and for Case #2, CSI report configuration can be associated with both of on-demand SSB and always-on SSB or only with on-demand SSB.

[7] CMCC	**Proposal 16:** Update the previous RAN1 agreement as follows.
	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.
	    o FFS on potential enhancements of CSI report configuration and/or triggering/activation mechanisms for L1 measurement based on on-demand SSB
	    o The support of LTM is a separate discussion point
	
	Proposal 17: For Case 2, when both always-on SSB and on-demand SSB are transmitted, L1 measurement is based on on-demand SSB.
	
	Proposal 18: For Case 2, both of the following options are considered for 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
	
	Proposal 19: For Case 2, with CSI report configuration Option 1, two alternatives are considered for the association of CSI report configuration and SSB.
	- Alt 1: separate resource set are configured for always-on SSB and on-demand SSB, different resource set is associated with different reporting periodicity
	- Alt 2: one resource set is associated with always-on SSB or on-demand SSB implicitly, different SSB is associated with different reporting periodicity

[8] vivo	**Proposal 20:** For UE to perform L1 measurement based on on-demand SSB when always-on SSB is periodically transmitted on the cell, Option 2, i.e. a CSI report configuration is associated with one of always-on SSB and on-demand SSB, is supported. **Proposal 21:** Semi-persistent and aperiodic CSI report configuration can be associated with any kind of on-demand SSB.

	Proposal 22: Periodic CSI report configuration can only be associated with on-demand SSB that is activated through RRC signalling and will be deactivated along with the deactivation of SCell. **Proposal 23:** Deprioritize the discussion on support of LTM based on OD-SSB before OD-SSB for Scell measurement and activation is finalized. **Observation 3:** SSB is not used for BFD on Scell in legacy. **Proposal 25:** Do not support on-demand SSB for BFD on Scell.
[9] Tejas	**Proposal 6:** Supporting option 2: A CSI report configuration is associated with one of always-on SSB and on-demand SSB.
[10] OPPO	**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.
[11] Nokia	**Proposal-1:** RAN1 to confirm that Scenario#3B is supported for L1 measurements based on network triggered on-demand SSB. **Observation-10:** L1 measurements based on on-demand SSB has been agreed but it is still unclear in which scenarios it is to be considered, i.e. whether the L1 reporting is referring to the CSI reporting during the SCell activation procedure or L1 reporting in the activated SCell. **Proposal-10:** RAN1 to discuss and clarify the operation scenario for L1 measurements based on OD-SSB. **Observation-11:** The CSI resources are associated with a DL BWP. As per the current specification, the csi-SSB-ResourceList is the list of SSB-Index values which identify an SS-Block within the SSB burst. We do not see the need to modify the Resource setting. **Observation-12:** For L1 measurements based on OD-SSB for the activated SCells, the periodic or semi-persistent reporting may be configured with the OD-SSB that is periodically available once being triggered. **Proposal-11:** The MAC CE used for triggering OD-SSB transmission can also be considered as the trigger for the CSI reporting associated with OD-SSB resources. **Observation-13:** gNB may configure a dedicated CSI report configuration associated with OD-SSB possibly with a shorter reporting periodicity, if network requires quick L1 reports based on OD-SSB **Proposal-12:** RAN1 to discuss if OD-SSB would have a dedicated report configuration associated with OD-SSB transmission. **Observation-14:** It is still not clear when and for what purpose the gNB may enable aperiodic reporting for on-demand SSB based measurements. **Observation-15:** Considering the SCell activation scenario, we don't see the benefits from the network energy saving perspective for gNB sending the additional DCI signaling for triggering OD-SSB based aperiodic reporting, as it increases network energy consumption. **Proposal-13:** RAN1 to discuss and clarify the scenario for utilizing OD-SSB based aperiodic reporting. **Proposal-14:** Considering Case 2 with OD-SSB on top of always-on SSB on SCell, RAN1 shall discuss on how to handle the CSI reporting when both always-on SSB and OD-SSB are applied, i.e. shall the UE reporting consist of both reports, or shall the UE report only one of the CSI reports. **Proposal-15:** On-demand SSB work is intended to enhance SCell operation, and we propose to keep mobility measurements and LTM out of scope of on-demand SSB.

[12] Panasonic	**Proposal 5:** L3 measurement based on on-demand SSB should be supported at least for Scenario #2. To facilitate the SCell deactivation and on-demand SSB ON/OFF, other scenarios can also be supported. **Proposal 6:** L1 measurement when on-demand SSB is ON should be supported at least for Scenario 2A, 3A and 3B i.e., after the SCell is activated. On Scenario 2, further clarification is needed on whether to support on-demand SSB based L1 measurement for LTM and the supported type of CSI. **Proposal 7:** For RRC triggered/indicated on-demand SSB, the periodic, semi-persistent and aperiodic CSI report should be supported with current CSI mechanism. **Proposal 8:** For MAC CE triggered/indicated on-demand SSB, semi-persistent and aperiodic CSI report should be supported with enhancement that on-demand SSB is expected to be available when CSI report is active. On periodic CSI report, although our first preference is not to support, we can be flexible if the specification impact can be minimized. **Proposal 9:** For group common DCI triggered/indicated on-demand SSB, only semi-persistent and aperiodic CSI report should be supported. **Proposal 17:** For a cell supporting on-demand SSB Scell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), both options are supported: - When always-on and on-demand SSB have same beams, Option 1 should be supported that a CSI report configuration is associated with both of on-demand SSB and always-on SSB - When always-on and on-demand SSB have different beams, Option 2 should be supported that a CSI report configuration is associated with one of always-on SSB and on-demand SSB
[13] InterDigital	**Proposal 12:** Support a CSI report configuration that is associated with - one of OD-SSB and AO-SSB (Option 1) when the SSB resources are in different BWPs, or - both OD-SSB and AO-SSB (Option 2) when the SSB resources are within the same BWP
[14] Google	**Proposal 7:** Support to configure the on-demand SSB for RLM/BFD/CBD. **Proposal 8:** For L1-RSRP/L1-SINR report based on on-demand SSB, support the UE to report the SSBRI based on the activated SSBs. **Proposal 9:** Support to dynamically activate/deactivate the CSI report configuration with on-demand SSB configured. **Proposal 10:** Support the on-demand SSB based L1-RSRP measurement and report for LTM
[15] NEC	**Proposal 15:** Support Option 2: A CSI report configuration is associated with one of always-on SSB and on-demand SSB. **Proposal 16:** The on-demand SSB indication shall be provided to the UE before the start of the corresponding CSI report transmissions. **Proposal 17:** Before SCell activation, gNB to indicate one of on-demand SSB or always-on SSB for all configured periodic SSB measurements. **Proposal 18:** After SCell activation, only aperiodic on-demand SSB measurements are supported for NES SCell operation. **Proposal 19:** For aperiodic CSI reporting based on on-demand SSB consider one of the following options: - Option-1: Support group-common based DCI indication for on-demand SSB indication - Option-2: Support indication of on-demand SSB within the CSI report trigger indication **Proposal 20:** Discuss other cases (e.g. RACH initiation upon TAT expiry) for which on-demand SSB transmission may be required.

[16] KT	**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.
[17] Xiaomi	**Proposal 12:** UE should preclude measurement result associated to a SSB which is turned off by gNB. **Proposal 13:** For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), both option 1 and option 2 are supported for UE to perform L1 measurement. - 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
[18] Apple	**Proposal 8:** After OD-SSB transmission is indicated, UE uses OD-SSB only for L1 measurement. **Proposal 9:** The spatial relation between AO-SSB and OD-SSB is not specified. That is, Support modified Option 2: A CSI report configuration is associated with ~~one of always on SSB and~~ on-demand SSB only. **Proposal 10:** Together with Proposal 8 and Proposal 9, the RRC configuration for OD-SSB SCell operation to include one set of BFD parameters for OD-SSB per the SCell. Once UE receives RRC or MAC-CE based OD-SSB indication for both Case #1 (No always-on SSB on the cell) and Case #2 (Always-on SSB is periodically transmitted on the cell), UE shall use BFD parameters for OD-SSB.
[19] Samsung	**Proposal 7:** For Case 2 (i.e., with always-on SSB), the resource and reporting configuration for L1 measurement can be associated with the cell ID and SSB index, without differentiating the resource is an always-on SSB or on-demand SSB. - How to select resource to perform L1 measurement is up to RAN4. **Proposal 8:** For L1 measurement based on on-demand SSB: - Before on-demand SSB is indicated to be transmitted, the UE is not required to perform L1 measurement or CSI reporting even though it receives the configuration on L1 measurement and reporting; - When on-demand SSB is indicated to be transmitted in Scenario #2, the UE can be required to perform CSI reporting in Scenario #2.
[21] ETRI	**Proposal 15:** Regarding measurement based on on-demand SSB, it is proposed to postpone the discussion until multiplexing between always-on SSB and on-demand SSB for Case #2 is determined.
[22] Fujitsu	**Proposal 11:** RAN1 to consider either one or both options of CSI report configuration based on the outcome of relation between on-demand SSB and always on SSB. - If the configurations of on-demand SSB except for periodicity, such as transmission power, frequency position and beam, are the same as the configurations of always-on SSB, both option 1 and option 2 can be supported. - Otherwise, only option 2 can be supported. **Proposal 12:** For option 1 where a CSI report configuration is associated with both on-demand SSB and always-on SSB, the following solutions for CSI resource configuration can be considered - The existing CSI resource configuration is re-interpreted to indicate both on-demand SSB and always-on SSB. - The CSI resource configuration enhancement is introduced to differentiate on-demand SSB and always-on SSB.

	For Option 2 where a CSI report configuration is associated with one on-demand SSB and always-on SSB, the following solution for CSI resource configuration can be considered
	    - The CSI resource configuration enhancement is introduced to differentiate on-demand SSB and always-on SSB.
	
	Proposal 13. For CSI resource configuration enhancement for on-demand SSB associated with CSI report configuration, the following two options can be considered.
	    - Option A: CSI resource enhancement at the level of the resource set list
	        o To specify a dedicated resource set list for on-demand SSB.
	    - Option B: CSI resource enhancement at the level of CSI-SSB resource set
	        o To introduce an on-demand SSB indicator within the CSI-SSB-ResoureSet.
	
	Proposal 14. If a newly defined resource set parameter, e.g., CSI-OD-SSB-ResourceSet, is supported, the corresponding enhancement in the aperiodic trigger state list should be considered as well.
	    - E.g., CSI-OD-SSB-ResourceSet should be included in CSI-AperiodicTriggerStateList.
	
	Observation 3: In the existing spec on SCell, only periodic CSI-RS can be configured for beam failure detection purposes, while either SSB or periodic CSI-RS can be configured for beam failure recovery.
	
	Proposal 15: At least support candidate beam selection based on on-demand SSB in Case#1.

[23] LG Electronics	**Proposal #10:** For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), take Option 2 (i.e., A CSI report configuration is associated with one of always-on SSB and on-demand SSB) as the baseline for CSI report configuration for L1 measurement. **Proposal #11:** Discuss the relationship between the frequency position of on-demand SSB and the frequency range of the first active BWP given by the higher layer parameter firstActiveDownlinkBWP-Id. **Proposal #12:** Discuss UE behaviour to perform the measurement/report based on on-demand SSB after the on-demand SSB is deactivated
[27] Qualcomm	**Observation 3:** Whether a CSI report configuration is associated with one or both of on-demand SSB and always-on SSB depends on whether on-demand SSB and always-on SSB are located in the same frequency or not.

[28] Sharp	**Proposal 2** Support L3 measurement based on OD-SSB for SCell operation in Scenario 3B and Case #1.
	
	Observation 1 The UE cannot receive OD-SSB if the OD-SSB is outside the UE's active DL BWP in scenario 3B, i.e., SCell activation has been completed.
	
	Proposal 3 RAN1 to study whether and how to support OD-SSB-based L1 measurement in scenario 3B, taking BWP aspects into account.
	
	Proposal 4 RAN1 to study the following options for OD-SSB-based L1 measurement in scenario 3B in the cases where the triggered OD-SSB is outside the active DL BWP:
	    - Solution #1: Ignoring the triggered OD-SSB
	    - Solution #2: Using measurement gap to perform OD-SSB-based L1-RSRP measurement
	    - Solution #3: Supporting BWP change due to OD-SSB triggering
	    - Solution #4: Supporting BWP-specific OD-SSB configuration
	
	Proposal 5 For L1 measurement based on on-demand SSB, both Option 1 and Option 2 shall be supported depending on different deployment scenarios.
	
	Proposal 6 For L1 measurement based on on-demand SSB, if Option 1 is supported, the report periodicity for OD-SSB based measurement is introduced within the CSI report configuration that is associated with both OD-SSB and always-on SSB.

	Proposal 7 For L1 measurement based on on-demand SSB, regardless of Option 1 or Option 2, multiple report periodicities for OD-SSB based measurement are introduced within the CSI report configuration that is associated with OD-SSB. **Proposal 8** OD-SSB based BFD is supported for both Case 1 and Case 2.
[29] NTT DOCOMO	**Proposal 15:** In terms of CSI report configuration for L1 measurement, - We support both option 1 and option 2, which option to use is up to NW implementation.
[33] Ericsson	**Proposal 16** A CSI report configuration can be associated with one or both of always-on SSB and on-demand SSB depending on NW configuration.

Agreement (RAN1#118)
- Update the previous RAN1 agreement as follows.
    - 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
        - The support of LTM is a separate discussion point

Agreement (RAN1#118)
Support L3 measurement based on on-demand SSB
- Further work on L3 measurement is up to RAN2/RAN4

Agreement (RAN1#118bis)
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

[Moderator's note] Below are company views on L1/L3 measurement based on on-demand SSB.
- Option 1 vs. Option 2
    - Option 2: Futurewei, ZTE, vivo, Tejas, OPPO, Nokia?, NEC, KT, Apple (by modifying to on-demand SSB only), LG Electronics
    - Both Option 1 and Option 2: CATT, China Telecom, CMCC, Panasonic, InterDigital, Xiaomi, Sharp, NTT DOCOMO, Ericsson
        - CMCC: Configuring separate resource sets or separate reporting periodicity
        - Panasonic: Different options depending on whether always-on and on-demand SSB have same or different beams
        - InterDigital: Different options depending on whether always-on and on-demand SSB are located within the same BWP or not
    - Nokia, Samsung: No differentiation between always-on SSB and on-demand SSB resources, in RAN1
    - Fujitsu, Qualcomm: Different options depending of on-demand SSB configuration
- Scenario where L1 measurement based on on-demand SSB is performed
    - Panasonic: Scenario #2A/3A/3B
    - Clarify the operation scenario for L1 measurements based on on-demand SSB: Nokia
    - Deprioritize LTM: ZTE, CATT, vivo, Nokia
        - Support: Google
- Whether to use one of always-on SSB and on-demand SSB or both of them
    - Use on-demand SSB only: CMCC, Apple
    - Samsung: Up to RAN4
    - Need clarification: Nokia

<L1 measurement reporting>
- How configure/indicate on-demand SSB as a measurement resource for L1 measurement reporting
    - CATT (CSI resource config level), Fujitsu (resource set level, resource set list level)

- Panasonic, vivo, KT and NTT DOCOMO suggested the relation between on-demand SSB indication signal and CSI reporting type
  - Periodic CSI reporting is associated with on-demand SSB indicated by RRC
  - Semi-persistent and aperiodic CSI reporting can be associated with on-demand SSB indicated by RRC or MAC CE
- Samsung suggested that
  - Before on-demand SSB is indicated to be transmitted, the UE is not required to perform L1 measurement or CSI reporting even though it receives the configuration on L1 measurement and reporting;
  - When on-demand SSB is indicated to be transmitted in Scenario #2, the UE can be required to perform CSI reporting in Scenario #2.
- Different reporting periodicity depending on whether on-demand SSB is activated or not: Sharp
- Nokia
  - Use on-demand SSB MAC CE to trigger CSI report based on on-demand SSB
  - Discuss the necessity/use case of aperiodic reporting based on on-demand SSB
- Google suggested to support SSBRI based on on-demand SSB
- CATT and NEC
  - How to support the triggering of aperiodic L1 measurement reporting on PUSCH for on-demand SSB
- CATT suggested further details on CSI reporting mechanism
  - How to support the activation and deactivation of semi-persistent L1 measurement reporting on PUCCH for on-demand SSB
  - How to support the triggering of semi-persistent L1 measurement reporting on PUSCH for on-demand SSB
  - How to support the semi-persistent L1 measurement reporting on PUSCH for multiple on-demand SSBs from multiple SCells

\<Beam failure\>
- Apple suggested to support beam failure operation based on on-demand SSB for Case #2
- Fujitsu, LG Electronics suggested to support beam failure operation based on on-demand SSB at least for Case #1
- Google, KT, and Sharp suggested to configure the on-demand SSB for BFD
- vivo, Fujitsu: SSB is not used for BFD on Scell in legacy

\<Others\>
- LG Electronics and Sharp (for Scenario #3B) suggested to clarify the relationship between BWP of always-on SSB and BWP of on-demand SSB
- How to handle CSI reporting if the corresponding on-demand SSB is absent: LG Electronics
- Enhancement for L3 measurement: Huawei

[LOW] 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

Considering that this topic is correlated with RAN4 LS questions, it is suggested to defer the discussion on Proposal #7-1 until RAN4 LS related discussion in Sections 2 is finalized. Nevertheless, please provide your feedback, if any.

Company	Views
Xiaomi	In our view, both option 1 and option 2 should be supported for UE to perform L1 measurement. First of all, there is no difference in terms of measurement between on-demand SSB and always on SSB. With the assumption that NES UE has full information of on-demand SSB transmission, UE can measure SSB and derive associated CSI report according to CSI report configuration. In the other words, UE can conduct measurement with the associated SSB index provided by CSI report configuration. It doesn't matter whether it is always-on SSB or on-demand SSB.
NEC	Support
DCM	Support
China Telecom	Support.

- 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.

Companies are encouraged to provide views on Proposal #7-2.

Company	Views
CMCC	No matter the indication signaling, periodic CSI report is not supported due to semi-persistent transmission of on-demand SSB.
Xiaomi	Fine with the proposal.
LG Electronics	In general, we are supportive of the proposal
NEC	Here, we need to check with the UE vendors on simultaneous measurement/monitoring of periodic OD-SSB and AO-SSB as some UE vendors raised the concern in the previous meeting that such a operation is not feasible form UE perspective. Based on the given discussion we can check that what are the possible scenarios where periodic measurements can be configured and supported by the UE for OD-SSB.
DCM	We are fine wih proposal.
Fujitsu	Support
China Telecom	Support.
Transsion	For on-demand SSB indicated by RRC or MAC CE, since the CSI report is triggered by another CSI report trigger signaling, periodic, semi-persistent and aperiodic CSI reporting can be supported.
Vivo	Support

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

Companies are encouraged to provide views on Proposal #7-3.

Company	Views
Xiaomi	Fine with the proposal.
LG Electronics	We are open to discuss it
Huawei, HiSilicon 1	Support
NEC	Support
DCM	For case#1, we support BFD based on OD-SSB only. For case#2, we think that the idea of how to support CSI reporting based on OD-SSB in case#2 can be a baseline for BFD based on OD-SSB in case#2.
Fujitsu	We are open to discuss.
China Telecom	Support.
Vivo	We should note that the legacy SCell BFD is not based on SSB. BFD based on OD-SSB has no motivation for now.

8 SSB multiplexing

Company	Views
[2] Huawei	**Proposal 6:** Introduce priority-based rules for collision handling between OD-SSB and AO-SSB. - When AO-SSB and OD-SSB are on a same frequency, AO-SSB is prioritized over OD-SSB when collision happens. - When AO-SSB and OD-SSB are on different frequencies, UE is not expected to monitor AO-SSB when OD-SSB is transmitted on the cell.
[5] CATT	**Proposal 30:** There is no need to limit the overlapping between always-on SSB and on-demand SSB in time or frequency domain.

		- It is up to gNB implementation on how to configure time/frequency domain relation between always-on SSB and on-demand SSB. - If always-on SSB and on-demand SSB overlap in both time domain and frequency domain, always-on SSB should be prioritized over on-demand SSB to avoid the collision between always-on SSB and on-demand SSB.
[6] China Telecom		**Observation 6:** OD-SSB and always-on SSB transmitted close to each other in time domain should also be avoided to save energy. **Proposal 5:** There should be no on-demand SSB and always-on SSB transmitted within a specific time period so that the largest NES gain can be acquired.
[9] Tejas		**Proposal 7:** Supporting Mux-Case #1: No time-domain overlap between always-on SSB and on-demand SSB.
[12] Panasonic		**Proposal 19:** At least Mux-Case #1 (No time-domain overlap between always-on SSB and on-demand SSB) should be supported.
[13] InterDigital		**Proposal 6:** For multiplexing of AO-SSB and OD-SSB in SCell, support overlap in time domain and/or frequency domain
[15] NEC		**Proposal 13:** For Case#2, when on-demand SSB and always-on SSB overlap in time domain, consider always-on SSB is given higher priority than on-demand SCell SSB request. **Proposal 14:** For Case#1 and Case#2, within a time window, combine multiple on-demand SSB transmissions due to multiple on-demand SSB requests into one in order to maximize network energy saving.
[19] Samsung		**Proposal 6:** For always-on SSB as NCD-SSB, in addition to restricting on-demand SSB having the same frequency location as always-on SSB, support: - on-demand SSB is also a NCD-SSB, with same cell ID and PBCH payload (other than timing information) - The same frequency location can be either on a sync raster or off sync raster - Time locations of on-demand SSB and always-on SSB are non-overlapping (together may not be a periodic pattern)
[21] ETRI		**Proposal 5:** Regarding multiplexing between always-on SSB and on-demand SSB for Case #2, it is proposed to support - Mux-Case #2: Always-on SSB and on-demand SSB overlap at least in time or frequency domain - When the overlap between always-on SSB and on-demand SSB occurs, only one of them is transmitted. o It will be better to drop on-demand SSB rather than always-on SSB in order to minimize the impact on legacy UEs.
[23] LG Electronics		**Proposal #8:** When on-demand SSB and always-on SSB overlap both in time domain and frequency domain, on-demand SSB is dropped.
[33] Ericsson		**Observation 7** If an always-on SSB burst collides with an on-demand SSB burst, all SSBs in the always-on SSB burst must be transmitted to not confuse legacy UEs. **Proposal 12** If an SSB in an on-demand SSB burst fully overlap in frequency and time with an SSB in an always-on SSB burst, then the SSB in the on-demand SSB burst is identical to the corresponding SSB in the always-on SSB burst. **Proposal 14** Further discuss collision between on-demand SSB and always-on SSB that are fully overlapping in time but not overlapping or partially overlapping in frequency.

<mark>**Agreement (RAN1#118bis)**</mark> For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell), study at least the following Mux-Cases.

- Mux-Case #1: No time-domain overlap between always-on SSB and on-demand SSB
- Mux-Case #2: Always-on SSB and on-demand SSB overlap at least in time or frequency domain

[Moderator's note] Company views on SSB multiplexing are as follows.

- Mux-Case #1: Tejas, Panasonic, Xiaomi, Samsung
- Mux-Case #2: InterDigital
- CATT: Up to NW configuration
- Samsung: Consistent MIB between always-on SSB and on-demand SSB, except for timing related information
- If overlapped,
    o When always-on SSB and on-demand SSB are on a same frequency,
        ▪ Prioritize always-on SSB: Huawei
    o When always-on SSB and on-demand SSB are on different frequencies,
        ▪ Huawei: UE is not expected to monitor always-on SSB when on-demand SSB is transmitted on the cell.
        ▪ Ericsson: FFS
    o CATT, NEC, ETRI, LG Electronics, Ericsson: Prioritize always-on SSB

Considering that this topic is correlated with RAN4 LS questions, it is suggested to defer the discussion on this topic until RAN4 LS related discussion in Sections 2.2 and 2.3 is finalized. Nevertheless, please provide your feedback, if any.

Company	Views

9 Further details on on-demand SSB operation

Company	Views
[2] Huawei	**Proposal 12:** To handle the inter-cell interference in cell edge introduced by the dynamic ON/OFF/adaptation of OD-SSB, RAN1 to enhance the legacy rate matching framework to adapt the interference pattern as OD-SSB adjusts.
[5] CATT	**Proposal 31:** Rate-matching issue needs to consider on-demand SSB transmission of both serving cell and neighboring cell.
[8] vivo	**Proposal 24:** To support on-demand SSB operation, prioritize the on-demand SSB transmission if there is collision between on-demand SSB and other transmission.
[9] Tejas	**Proposal 8:** Collision handling of OD-SSB with other channels should be discussed.
[11] Nokia	**Observation-7:** It may depend on the UE bandwidth capability, the ability to measure SSB outside the active BWP and the location of OD-SSB, if the UE is able to measure both always-on and OD-SSB. **Proposal-5:** RAN1 to discuss the UE capabilities needed to measure OD-SSB within or outside active BWP.
[12] Panasonic	**Proposal 10:** For time/frequency synchronization and TCI state using on-demand SSB as reference resource, only Scenario #3B is supported. **Proposal 18:** When always-on SSB is transmitted on the reference cell of a SCell for SSB-less operation and on-demand SSB is then triggered and transmitted in the SCell, the relation and the QCL of two sets of SSBs should be further discussed and clarified.
[14] Google	**Proposal 5:** For non-UE dedicated signals, the rate matching pattern should be based on the activated SSBs. **Proposal 6:** For UE-dedicated signals, the rate matching pattern should be based on SSB configured in *ssb-positionInBurst*.

[15] NEC	**Proposal 21:** Discuss the UE behaviour for the case of failure to receive or detect the on-demand SSB. The following options can be considered: - On-demand SSB failure indication may be sent to the network. - UE can reinitiate the on demand SSB procedure by sending the UE request for on-demand SSB **Proposal 22:** RAN1 to discuss UE behaviour on PDSCH rate matching around on-demand SSB.
[16] KT	**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
[18] Apple	**Observation 8:** Rate-matching behavior around OD-SSB needs to be specified. **Proposal 11:** Support the following rate-matching behavior: - Rate-matching for PDSCH around OD-SSB is applied from time instance A when UE receives OD-SSB activation. - Rate-matching for PDSCH around OD-SSB is not applied from time instance A when UE receives OD-SSB deactivation, or not applied after N OD-SSB bursts if configured/indicated.
[19] Samsung	**Proposal 1:** SSB structure and SSB mapping pattern in a half frame for the on-demand SSB maintain the same as legacy.
[23] LG Electronics	**Proposal #13:** Discuss how to utilize SSB transmitted after on-demand SSB procedure, for the purposes of time/frequency synchronization, path-loss estimation, QCL reference signal, beam failure, and so on. **Proposal #14:** Discuss how UE performs RACH occasion validation, PDCCH monitoring, and DL/UL signals/channels reception/transmission, if the SSB transmission can be (de)activated based on on-demand SSB procedure.
[24] Transsion	**Proposal 11** It is recommended that the feasibility of joint use of on-demand SSB transmission and cell DTX can be studied.
[33] Ericsson	**Proposal 4** An on-demand SSB transmission indication for an SCell (e.g., ON/OFF or parameter change) overrides a potentially ongoing on-demand SSB transmission configuration for that SCell. **Proposal 15** On-demand SSB burst patterns are restricted to legacy SSB burst patterns.
[34] CEWiT	**Observation 3:** UE not receiving the SSB after on-demand SSB operation leads to unnecessary monitoring by the UE and negative impacts on performance. **Proposal 4:** Support handling of the case where the UE cannot receive SSB after the on-demand SSB operation. **Observation 4:** On-demand SSB impacts the need and validity of periodic RACH occasions and their association with SSBs, requiring adjustments to ensure efficient RRC connection establishment. **Proposal 5:** Support handling the impacts of on-demand SSB on RACH occasions for RRC connection establishment.

[Moderator's note] Further details on on-demand SSB operation from above proposals can be summarized as below.

- **Issue 1) Whether/how to handle rate-matching issue**

- o Huawei (from the perspective of inter-cell interference), CATT (considering on-demand SSB both of serving and neighbor cells), Google, NEC, KT, Apple, LG Electronics
- **Issue 2) Whether/how to handle collision issue between SSB and other signals/channels**
  - o Huawei, vivo, Tejas, KT, LG Electronics, CEWiT
- Issue 3) Whether to change the structure of SSB triggered by on-demand SSB operation
  - o NO: Samsung, Ericsson
- Issue 4) Whether/how to handle the case where UE cannot receive SSB after on-demand SSB operation
  - o NEC, CEWiT
- Issue 5) Whether/how to use on-demand SSB for time/frequency synchronization and TCI state/QCL
  - o Panasonic (only for Scenario #3B), LG Electronics
- Issue 6) Joint operation of cell DTX and on-demand SSB
  - o Transsion
- Issue 7) Whether/how to allow overlapping of multiple on-demand SSB activation MAC CEs
  - o Ericsson
- Issue 8) Panasonic: When always-on SSB is transmitted on the reference cell of a SCell for SSB-less operation and on-demand SSB is then triggered and transmitted in the SCell, the relation and the QCL of two sets of SSBs should be further discussed and clarified.
- Issue 9) Nokia: UE capability issue depending on whether on-demand SSB is located outside or within active BWP

Proposal #9-1 (Rate-matching):

- For a cell supporting on-demand SSB SCell operation, support the following rate-matching behavior.
  - o Rate-matching for PDSCH around on-demand SSB is applied from time instance A when UE receives on-demand SSB activation signaling.
  - o Rate-matching for PDSCH around OD-SSB is not applied from time instance B when UE receives on-demand SSB deactivation signaling, or not applied after N on-demand SSB burst transmissions if configured/indicated.

Companies are encouraged to provide views on Proposal #9-1.

Company	Views
Google	We think the proposal is fine for dedicated PDSCH. But for some other PDSCH, e.g., paging, the rate matching should not consider OD-SSB.
CMCC	Fine to discuss.
Xiaomi	We are fine with the proposal.
LG Electronics	We prefer it
Huawei, HiSilicon 1	Rate-matching within the serving cell can be handled by proper gNB implementation. What is more critical is the rate-matching across the (NES) serving cell and (legacy) neighboring cell, and vice versa. UEs at cell edge, no matter is served by which cell, may not properly handle the occasional ON/OFF of the on-demand SSB on the NES cell. Interference from the on-demand SSB can be unbearable for such a UE's PxSCH Tx/Rx, if no rate-matching co-operation between cells is done. This issue should be examined.
NEC	Support. UE behavior on PDSCH rate matching around on-demand SSB should also be discussed: • Option 1: PDSCH is always rate-matched around SSB according to on-demand SSB configuration irrespective of transmission of on-demand SSB. • Option 2: PDSCH is rate-matched around SSB according to actual transmission of on-demand SSB.
TCL	Support
DCM	Fine with FL proposal.

Proposal #9-2 (Collision):

- Study whether/how to handle the case where on-demand SSB is collided with DL/UL signals/channels

Companies are encouraged to provide views on Proposal #9-2.

Company	Views
CMCC	Fine to discuss.
Xiaomi	We think this issue is important as SSB transmission is a key factor on whether UL transmission is available or not. For DL transmission, we think part of this issue already addressed by proposal #9-1. The leftovers may be the impacts on PDCCH transmission, e.g., UE drops the PDCCH

		candidate monitoring if a RE of the PDCCH candidate overlaps with SSB. More clarification is helpful for collision issue for DL.
LG Electronics	We are open to discuss it	
Huawei, HiSilicon 1	Fine to discuss. This topic can start with the discussion on: - (Valid) RO - Periodic CSI-RS.	
CEWiT	Fine to discus starting with the ROs.	
NEC	Support	

Please provide views on issues 3 to 9 listed up above, if any.

Company	Views
LG Electronics	If there are enough time in this meeting, we prefer to discuss Issue 3 first.
NEC	Support to discuss Issue 4) & Issue 6).

10 Higher layer signalling

[8], vivo

Sub-feature group	RAN2 Parent IE	Parameter name in the spec	New or existing?	Description	Value range	Default value aspect	Per (UE, cell, TRP, …)	Required for initial access or IDLE/INACTIVE
OD-SSB	ServingCellConfigCommon	On-demandSSBConfig	New	Configure parameters of on-demand SSB. The parameters include: 0) Frequency 1) Periodicity 2) SSB positions within an on-demand SSB burst 4) Sub-carrier spacing 5) Physical Cell ID 6) Downlink transmit power 7) SFN offset 8) half frame index 9) The number N of on-			Per cell	No

				demand SSB bursts to be transmitted			
OD-SSB	On-demandSSBConfig	odssbFrequency	New	Indicates the frequency of the On-demand SSB.	ARFCN-ValueNR	Per cell	No
OD-SSB	On-demandSSBConfig	odssb-periodicity	New	Indicates the periodicity of the On-demand SSB	ENUMERATED {ms5, ms10, ms20, ms40, ms80, ms160}	Per cell	No
OD-SSB	On-demandSSBConfig	odssb-PositionsInBurst	New	Indicates the time domain positions of the transmitted On-demand SS-blocks in a half frame with On-demand SS/PBCH block as defined in TS 38.213 [13], clause 4.1. The first/leftmost bit corresponds to On-demand SS/PBCH block index 0, the second bit corresponds to On-demand SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding On-	CHOICE { BIT STRING (SIZE (4)), BIT STRING (SIZE (8)), BIT STRING (SIZE (64)))	Per cell	No

				demand SS/PBCH block is not transmitted while value 1 indicates that the corresponding On-demand SS/PBCH block is transmitted.				
OD-SSB	On-demandSSBConfig	odssbSubcarrierSpacing	New	Subcarrier spacing of On-demand SSB	SubcarrierSpacing		Per cell	No
OD-SSB	On-demandSSBConfig	physCellId	New	Indicates the cell related to On-demand SSB	PhysCellId		Per cell	No
OD-SSB	On-demandSSBConfig	odssbPower	New	Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for On-demand SSB transmission, see TS 38.213 [13], clause 7	INTEGER (-60..50)		Per cell	No
OD-SSB	On-demandSSBConfig	Sfn-odssb-offset	New	Indicates the SFN offset of the transmitted On-demand SSB relative to the start of the On-demand SSB period. Value 0 indicates that the On-demand	INTEGER (0..15)	0	Per cell	No

				SSB is transmitted in the first system frame, value 1 indicates that On-demand SSB is transmitted in the second system frame and so on.				
OD-SSB	On-demandSSBConfig	HalfFrameIndex-odssb	New	Indicates whether On-demand SSB is in the first half or the second half of the frame. Value zero indicates the first half and value 1 indicates the second half.	ENUMERATED {zero, one}	0	Per cell	No
OD-SSB	On-demandSSBConfig	Odssb-transmissionNumber	New	Indicates the number N of on-demand SSB bursts to be transmitted			Per cell	No

[19] Samsung

New or existing?	Parameter name in the text	Description	Value range	Default value aspect	Per (UE, cell, TRP, …)
New	odssb-periodicityServingCellList	List of periodicities for on-demand SSB	SEQUENCE (SIZE (1..maxNrofODSSBPeriodicity)) OF ssb-periodicityServingCell		Per cell
New	odssb-frequency	Frequency location for on-demand SSB	ARFCN-ValueNR		Per cell
New	odssb-physCellId	Physical cell ID for on-demand SSB	PhysCellId		Per cell

New	odssb-subcarrierSpacing	Subcarrier spacing for on-demand SSB	SubcarrierSpacing		Per cell

New	odssb-PositionsInBurst	Actually transmitted SSB in burst for on-demand SSB	CHOICE {
			    shortBitmap BIT STRING (SIZE (4)),
			    mediumBitmap BIT STRING (SIZE (8)),
			    longBitmap BIT STRING (SIZE (64))
			}
					Per cell

New	odss-PBCH-BlockPower	Transmission power for on-demand SSB	INTEGER (-60..50)		Per cell
New	odssb-SFN-List	List of SFN for on-demand SSB	SEQUENCE (SIZE (1..maxNrofODSSBPeriodicity)) OF INTEGER (0..15))		Per cell
New	odssb-HalfFrameList	List of Half frame index for on-demand SSB	SEQUENCE (SIZE (1..maxNrofODSSBPeriodicity)) OF INTEGER (0, 1))		Per cell

[37] Rapporteur (Ericsson)

Parameter name in the spec	New or existing ?	Description	Value range	Default value aspect
[od-ssb-Config]	New	On-demand SSB (OD-SSB) configuration	FFS: Whether more than one on-demand SSB configurations can be configured for the cell to UE	
od-ssb-Periodicity	New	Indicate the periodicity of OD-SSB	Same as ssb-Periodicity	
od-ssb-sfn-Offset	New	Indicate SFN offset from the SFN which satisfies (SFN index *10) modulo (OD-SSB periodicity) = 0, at least for Case #1, i.e., no always-on SSB on this serving cell	INTEGER (0..15) Note: The network configures this field according to the field od-ssb-Periodicity such that the indicated system frame does not exceed the OD-SSB periodicity.	UE assumes 0 if not configured
od-ssb-halfFrameIndex	New	Indicate whether OD-SSB is in the first half or the second half of the frame, at least for Case #1, i.e., no always-on SSB on this serving cell	ENUMERATED {zero, one}	UE assumes 0 if not

				configured
od-ssb-nrofTx	New	Indicate the number of OD-SSB bursts to be transmitted after on-demand SSB is indicated		
[od-ssb-absoluteFrequency or absoluteFrequencySSB]	FFS	Indicate frequency of OD-SSB	Same as absoluteFrequencySSB	
[od-ssb-PositionsInBurst or ssb-PositionsInBurst]	FFS	Indicate the time domain positions of the transmitted SS-blocks for OD-SSB in a half frame with SS/PBCH blocks as defined in TS 38.213 [13], clause 4.1	Same as ssb-PositionsInBurst	
[od-ssbSubcarrierSpacing or ssbSubcarrierSpacing]	FFS	Indicate subcarrier spacing of OD-SSB, <mark>at least for Case #1, i.e., no always-on SSB on this serving cell</mark>	Same as ssbSubcarrierSpacing	
[od-ssb-physCellId or physCellId]	FFS	Indicate physical cell identity of a cell in the cell list, <mark>at least for Case #1, i.e., no always-on SSB on this serving cell</mark>	Sams as physCellId	
[od-ss-PBCH-BlockPower or ss-PBCH-BlockPower]	FFS	Indicate average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for OD-SSB transmission, see TS 38.213 [13], clause 7, <mark>at least for Case #1, i.e., no always-on SSB on this serving cell</mark>	Same as ss-PBCH-BlockPower	

[<mark>Moderator's note</mark>] Companies can provide views on RRC parameter sheet captured above, if any.

Company	Views

11 Reference

[1] R1-2500053   Discussion of on-demand SSB Scell operation   FUTUREWEI

[2] R1-2500077   On-demand SSB SCell operation for eNES   Huawei, HiSilicon

[3] R1-2500128   Discussion on on-demond SSB for NES   ZTE Corporation, Sanechips

[4] R1-2500173   Discussion on on-demand SSB SCell operation   Spreadtrum, UNISOC

[5] R1-2500228   Discussion on on-demand SSB SCell operation   CATT

[6] R1-2500263   Discussion on on-demand SSB operation for SCell   China Telecom

[7] R1-2500291   Discussion on on-demand SSB SCell operation   CMCC

[8] R1-2500353   Discussion on on-demand SSB Scell operation   vivo

[9] R1-2500400   On demand SSB for connected UEs   Tejas Networks Limited

[10] R1-2500440   Discussion on the enhancement to support on demand SSB SCell operation   OPPO

[11] R1-2500476   On-demand SSB SCell Operation   Nokia, Nokia Shanghai Bell

[12] R1-2500489   Discussion on on-demand SSB SCell operation   Panasonic

[13] R1-2500525   Discussion on on-demand SSB SCell operation   InterDigital, Inc.

[14] R1-2500552   On-demand SSB SCell Operation   Google

[15] R1-2500621   Discussion on on-demand SSB for SCell operation   NEC

[16] R1-2500682   Discussion on On-demand SSB SCell operation   KT Corp.

[17] R1-2500736   Discussion on on-demand SSB SCell operation   Xiaomi

[18] R1-2500785   On-demand SSB SCell Operation   Apple

[19] R1-2500854   On-demand SSB SCell operation   Samsung

[20] R1-2500884   On-demand SSB SCell operation   Lenovo

[21] R1-2500913   Discussion on On-demand SSB SCell operation   ETRI

[22] R1-2500940   Discussion on on-demand SSB SCell operation   Fujitsu

[23] R1-2500953   On-demand SSB SCell operation   LG Electronics

[24] R1-2500967   Discussion on On-Demand SSB SCell operation   Transsion Holdings

[25] R1-2501020   On-demand SSB SCell operation   MediaTek Inc.

[26] R1-2501123   Discussion of On-demand SSB SCell operation   Mavenir

[27] R1-2501160   On-demand SSB operation for Scell   Qualcomm Incorporated

[28] R1-2501186   Discussion on remaining details of on-demand SSB operation on SCell   Sharp

[29] R1-2501206   Discussion on on-demand SSB SCell operation   NTT DOCOMO, INC.

[30] R1-2501233   Discussion on on-demand SSB SCell operation   ITRI

[31] R1-2501238   Discussion on on-demand SSB Scell operation for NES   TCL

[32] R1-2501242   DCI based signaling for on-demand SSB   ASUSTeK

[33] R1-2501251   On-demand SSB SCell operation   Ericsson

[34] R1-2501277   Discussion on on-demand SSB Scell operation   CEWiT

[35] R1-2500948   Discussion on RAN4 LS on timeline for On-demand SSB operation on SCell   LG Electronics

[36] R1-2500975   Discussion on RAN4 Reply LS on Timeline for On-demand SSB Operation on Scell   Nokia, Nokia Shanghai Bell

[37] R1-2501249   Initial list of RRC parameters for R19 NES WI   Rapporteur(Ericsson)

Appendix: Previous agreements

RAN1#116

Agreement

Regarding the UE assumption on SSB transmission on a cell supporting on-demand SSB SCell operation, the following cases are identified for further study:

- Case #1: No always-on SSB on the cell
- Case #2: Always-on SSB is periodically transmitted on the cell
- FFS: Whether always-on SSB and on-demand SSB are not cell-defining SSB if transmitted.

FFS: Which scenario the above applies for

Agreement

RAN1 to strive for a common design for on-demand SSB operation considering all applicable CA configurations.

For the following identified scenarios for on-demand SSB SCell operation, focus future RAN1 discussion to down-select (both may be selected) between the two scenarios.
- Scenario #2: SCell is configured to a UE but before the UE receives SCell activation command (e.g., as defined in TS 38.321)
- Scenario #3: After UE receives SCell activation command (e.g., as defined in TS 38.321)
  o This does not preclude SCell for which activation is completed
  o FFS: The case where SCell activation is completed

FFS: Application timing between NW triggering message and on demand SSB transmission

Support on-demand SSB SCell operation triggered by gNB.
- FFS Details of associated signaling/indication/configuration provided to UE

- For SSB burst(s) triggered by on-demand SSB SCell operation, study at least the following options.
  o Option 1: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A.
  o Option 1A: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A until gNB turns OFF the on demand SSB
  o Option 2: UE expects that on-demand SSB burst(s) is transmitted from time instance A to time instance B and not transmitted after time instance B.
  o Option 3: UE expects that on-demand SSB burst(s) is transmitted N times after time instance A and not transmitted after N on-demand SSB bursts are transmitted.
  o Option 4: UE expects that on-demand SSB burst(s) is transmitted with a periodicity from time instance A to time instance B and with the other periodicity after time instance B.
  o FFS: The combination of above options
  o FFS: How to define time instance A/B and the value of N per option
  o FFS: Each option is applicable to which Cases or Scenarios (as per the previous agreement)

RAN1#116bis

For the identified scenarios and cases (as per RAN1#116 agreement), on-demand SSB can be triggered by gNB at least for the following scenarios/cases:
- Scenario #2 and Case #1
- Scenario #2 and Case #2
- Scenario #2A and Case #1
- Scenario #2A and Case #2
- FFS: Scenario #3A and Case #1
- FFS: Scenario #3A and Case #2
- FFS: Scenario #3B and Case #1
- FFS: Scenario #3B and Case #2
- For Case #1, once on-demand SSB is triggered, its transmission is in a periodic manner.
  o Note: This does not imply periodic on-demand SSB is transmitted indefinitely after triggered.
- Notes:
  o Scenario #2A refers to
    ▪ "When UE receives SCell activation command (e.g., as defined in TS 38.321)"
  o Scenario #3A refers to
    ▪ "After UE receives SCell activation command (e.g., as defined in TS 38.321) until SCell activation is completed"
  o Scenario #3B refers to
    ▪ "When SCell activation is completed and SCell is activated" or
    ▪ "After SCell activation is completed and SCell is activated"
  o For discussion purpose under AI 9.5.1, always-on SSB is SSB supported in Rel-18 specifications.
  o Timing for on-demand SSB transmission (e.g. when the triggered SSB starts and ends) will be separately discussed.

- For a cell supporting on-demand SSB SCell operation,
  - o Note: It is up to gNB implementation whether always-on SSB (if transmitted) on the cell is cell-defining SSB or not.
  - o For on-demand SSB on the cell, downselect between the following alternatives
    - ▪ Alt-1: It is up to gNB implementation whether on-demand SSB is cell-defining SSB or not.
    - ▪ Alt-2: On-demand SSB is limited to non-cell-defining SSB.
      - • FFS: Further limitations to on-demand SSB

Agreement
- For a cell supporting on-demand SSB SCell operation,
  - o L1 and/or L3 measurement based on on-demand SSB is supported for the cell.
    - ▪ FFS further details on L1 and/or L3 measurement

Agreement
The following agreement from RAN1#116 is modified (in red)
- For SSB burst(s) ~~triggered~~indicated by on-demand SSB SCell operation, study at least the following options.
  - o Option 1: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A.
  - o Option 1A: UE expects that on-demand SSB burst(s) is periodically transmitted from time instance A until gNB turns OFF the on demand SSB
  - o Option 2: UE expects that on-demand SSB burst(s) is transmitted from time instance A to time instance B and not transmitted after time instance B.
  - o Option 3: UE expects that on-demand SSB burst(s) is transmitted N times after time instance A and not transmitted after N on-demand SSB bursts are transmitted.
  - o Option 4: UE expects that on-demand SSB burst(s) is transmitted with a periodicity from time instance A to time instance B and with the other periodicity after time instance B.
  - o FFS: The combination of above options
  - o FFS: How to define time instance A/B and the value of N per option
  - o FFS: Each option is applicable to which Cases or Scenarios (as per the previous agreement)

Agreement
For a cell supporting on-demand SSB SCell operation, further study the following options.
- Option 1: Separate signaling between legacy/existing signaling (e.g., RRC, MAC CE) providing SCell activation/deactivation and signaling providing On-demand SSB transmission indication.
- Option 2: A single signaling in which both SCell activation/deactivation and On-demand SSB transmission indication are provided.
  - o FFS: Details of the signaling
- Other options are not precluded.
- FFS: Details on On-demand SSB transmission indication

RAN1#117

Agreement
- For a cell supporting on-demand SSB SCell operation,
  - o Support RRC based signaling to indicate on-demand SSB transmission on the cell.
  - o Support MAC CE based signaling to indicate on-demand SSB transmission on the cell.
  - o 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.
  - o 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.
  - o Frequency of the on-demand SSB
  - o SSB positions within an on-demand SSB burst by using signaling similar to *ssb-PositionsInBurst*
  - o Periodicity of the on-demand SSB
  - o FFS: Whether more than one on-demand SSB configurations can be configured for the cell to UE
  - o FFS: Whether the RRC is newly introduced or existing RRC is reused

- 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

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.

- For a cell supporting on-demand SSB SCell operation, at least the followings for on-demand SSB are known to UE.
  - Sub-carrier spacing of the on-demand SSB
  - Physical Cell ID of the on-demand SSB
  - Location of on-demand SSB burst
  - Downlink transmit power of on-demand SSB
  - FFS: Other parameters
  - FFS: Whether each of above parameters is configured/indicated explicitly or not

RAN1#118

- Update the previous RAN1 agreement as follows.
  - 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
      - The support of LTM is a separate discussion point

For a cell supporting on-demand SSB SCell operation,
- Support RRC based signaling to indicate on-demand SSB transmission on the cell at least for the case where this RRC also configures the SCell, activates the SCell, and provides on-demand SSB configuration.
  - FFS: Whether to support RRC based signaling for other cases.
- Support MAC CE based signaling to indicate on-demand SSB transmission on the cell for Scenarios #2 and #2A.

Note: Deactivation and adaptation of on-demand SSB transmission can be separately discussed.

For a cell supporting on-demand SSB SCell operation, at least 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.
- Periodicity of the on-demand SSB

- FFS: Any other relevant parameters

Agreement
For a cell supporting on-demand SSB SCell operation, at least the following is supported
- On-demand SSB on the cell is not located on synchronization raster.
- On-demand SSB on the cell is non-cell-defining SSB

FFS: Additional support of OD-SSB for CD-SSB located on sync-raster

Agreement
Support L3 measurement based on on-demand SSB
- Further work on L3 measurement is up to RAN2/RAN4

Agreement
LS to RAN2 for on-demand SSB SCell operation is agreed. Final LS in R1-2407438.

Agreement
The previous RAN1 agreement made in RAN1#117 is revised as follows.
- 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 beginning of the first slot containing [candidate SSB index 0 or the first actually transmitted SSB index] of on-demand SSB burst [the slot boundary of] the first SSB time domain position [of actually transmitted on-demand SSB burst] which is at least 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
  - (Working assumption): T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}$+1 where slot $n+m$ is a slot indicated for PUCCH transmission with HARQ-QCK information when the UE receives MAC CE signaling to indicate on-demand SSB transmission ending in slot n, and $N_{slot}^{subframe,\mu}$ is as defined in current specification.
    - RAN4 to confirm that T_min can be equal to $m + 3N_{slot}^{subframe,\mu}$+1
  - FFS: Whether the value of T is predefined or indicated/configured by gNB
  - (Working assumption) T=T_min
  - 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
LS on timeline for On-demand SSB operation on SCell is agreed in R1-2407565.

RAN1#118bis

Agreement
For a cell supporting on-demand SSB SCell operation, deactivation of on-demand SSB transmission is supported. In order to deactivate on-demand SSB transmission from a UE perspective, support at least one of the following options.
- Option 1: Explicit indication of deactivation for on-demand SSB via MAC-CE for on-demand SSB transmission indication
- Option 1A: Explicit indication of deactivation for on-demand SSB via RRC for on-demand SSB transmission indication
- Option 2: Configuration/indication of the number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
- Option 3: Configuration/indication of the duration of on-demand SSB transmission window
- Option 4: On-demand SSB transmission, if any, is deactivated when UE receives SCell deactivation MAC-CE for the activated SCell
- Option 4A: On-demand SSB transmission, if any, is deactivated when the timer for SCell deactivation is expired

- Option 5: On-demand SSB transmission, if any, is deactivated when SCell activation is completed
- Option 6: Explicit indication of deactivation for on-demand SSB via [group-common] DCI
- FFS: Each option is applicable to which Cases or Scenarios
- FFS: Details related to each of the above options

For a cell supporting on-demand SSB SCell operation, support to provide at least the following parameters for on-demand SSB configuration by RRC at least for Case #1.
- Sub-carrier spacing of the on-demand SSB
  - FFS if this can be absent
- Physical Cell ID of the on-demand SSB
- FFS: Time domain location of on-demand SSB burst such as SFN offset and half frame index
- Downlink transmit power of on-demand SSB
- FFS: The number N of on-demand SSB bursts to be transmitted after on-demand SSB is indicated
- FFS whether the above parameters are configured by reusing legacy RRC parameters or new RRC parameters

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

Conclusion
No consensus on the support of on-demand SSB SCell operation triggered by UE.

Agreement
The previous RAN1 agreement is partly confirmed and further revised as follows.
- For SSB burst(s) indicated by on-demand SSB SCell operation via a 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 beginning of the first slot containing [candidate SSB index 0 or the first actually transmitted SSB index] of within the first "possible" on-demand SSB burst which is at least T slots after the slot 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.
      - The location(s) (e.g., SFN offset, half frame index) in the time domain of "possible" on-demand SSB burst and SSB position within the burst should be configured by the gNB
  - Note: The value of T is not less than existing timeline required for UE's MAC CE processing for SCell activation
  - (Working assumption): T is not less than T_min=$m + 3N_{slot}^{subframe,\mu}+1$ where slot $n+m$ is a slot indicated for PUCCH transmission with HARQ-QCK information when the UE receives MAC CE signaling to indicate on-demand SSB transmission ending in slot n, and $N_{slot}^{subframe,\mu}$ is as defined in current specification.
    - RAN4 to confirm that T_min can be equal to $m + 3N_{slot}^{subframe,\mu}+1$
  - (Working assumption) T=T_min
- Above applies at least for the case where SCell with on demand SSB transmission and cell with signalling transmission have the same numerology.

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), study at least the following Mux-Cases.
- Mux-Case #1: No time-domain overlap between always-on SSB and on-demand SSB
- Mux-Case #2: Always-on SSB and on-demand SSB overlap at least in time or frequency domain

RAN1#119

Agreement
Response to Q1 (What is the relation in terms of periodicity between always-on SSB and OD-SSB?) of Obj.1:

- The periodicity of on-demand SSB is one of 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, or 160 ms.
- The periodicity of on-demand SSB can be configured separately from the periodicity of always-on SSB.
- RAN1 is discussing what is the relation between periodicity of always-on SSB and periodicity of on-demand SSB and it has been identified that the main use case is that the periodicity of on-demand SSB is equal to or smaller than that of always-on SSB.

Further update to be made based on RAN1#119 progress.

<mark>Agreement</mark>

Response to Q3 (What is the relation in terms of frequency location between the always-on SSB and OD-SSB?) of Obj.1:
- The frequency location of on-demand SSB is the same as the frequency location of always-on SSB at least for the case where always-on SSB is not CD-SSB. RAN1 is discussing the frequency location of OD-SSB for the case where always-on SSB is CD-SSB.

<mark>Agreement</mark>

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.

<mark>Agreement</mark>

- 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 (SFN index *10) modulo (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*)

<mark>Agreement</mark>

- New periodicity value for on-demand SSB other than the legacy values (i.e., 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, or 160 ms) is NOT introduced in Rel-19.

<mark>Agreement</mark>

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.

<mark>Agreement</mark>
Response to Q2 (What is the relation in terms of time location between always-on SSB and OD-SSB?) of Obj.1:
- RAN1 understands the time location of OD-SSB in Q2 refers to the time location of possible OD-SSB burst
- RAN1 is still discussing the relation in terms of time location between always-on SSB and OD-SSB

<mark>Agreement</mark>
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