3GPP TSG-RAN WG1 Meeting #101-e R1-20xxxxx

e-Meeting, 25th May – 5th June, 2020

Agenda Item: 7.2.2.2.2

Source: Moderator (Nokia)

Title: [101-e-NR-unlic-NRU-InitAccessProc-07] Email discussion/approval

Document for: Discussion, Decision

# 1 Introduction

This document captures discussion related to the following e-mail discussion which has been kicked-off as follows:

[101-e-NR-unlic-NRU-InitAccessProc-07] Email approval of reply LS to R1-2003274 by 5/28, to be managed under 7.2.2.2.2 – Michel (Nokia)

# 2 Moderator’s summary

The Companies views are summarized has follows:

**Question 1:** Provide feedback whether monitoring within a given discovery burst transmission window all candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index is mandatory for UEs.

* **9 Companies** agree that it is mandatory for the UEs to monitor all SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window, and point out that the UE may stop SS/PBCH block monitoring for a given SS/PBCH block index in the case the UE has already detected a SS/PBCH block with the same index for a given discovery burst transmission window.
* **1 Company** agreed that it is preferred not to introduce restrictions related to monitoring but pointed out that early termination of monitoring might not be possible.
* **2 Companies object** to that statement, arguing that:
	+ It has negative impacts upon UE power consumption.
	This argument does not seem relevant in the moderator’s view, since the discovery burst transmission window shall be configured depending e.g. of the spectrum load. Hence for the “best case” the discovery burst transmission window can be as short as 0.5ms, limiting the number of candidate SS/PBCH block indexes to be monitored, hence the UE power consumption. FBE mode also brings benefits for this matter.
	+ It has negative impacts upon UE complexity.
	Indeed, and it clear that the channel selected by the network should be “the best possible one”. However, as there are no restrictions in the Specifications related to the spectrum conditions the channel quality may be as such that monitor all SS/PBCH blocks with candidate indexes might be needed. There is no reason to exclude such “worst case”.
* **Moderator’s proposal:** to go for the majority view and stick to RAN1 agreements.

**Question 2:** Provide feedback on the values of N1 and N2, considering the impact on the network performance if UEs are not monitoring all candidate positions.

* **9 Companies** agree that N1/N2 values are not applicable (see question 1). Among them, one Company mentioned that N1/N2 cannot be held as UE capabilities anyway, but as an option to have N1/N2 defined within RAN4 Specifications
* **3 Companies** proposed N1 = N2 = 1 (specially for FBE mode) or N1 = N2 = 2 or N1 = N2 = 6 (which does not seem to be relevant).
For FBE mode it is moderator’s understanding that 8 candidate positions at the most are transmitted within a FFP, hence the UE may always assume N1/N2 = 1.
* **Moderator’s proposal:** to go for the majority view and to indicate that defining N1/N2 is not relevant.

**Question 3:** Provide feedback on whether differentiation is needed for UEs operating in FBE and LBE modes

From the discussions related to questions 1 & 2 the majority view is that defining N1/N2 is not relevant. On the other hand, for FBE mode the common understanding seems to be that the UE will have always to monitor a single SS/PBCH block index.

* **Moderator’s proposal:** to go for the majority view and to indicate that defining N1/N2 is not relevant, but to point out that for FBE mode the UE will have always to monitor a single SS/PBCH block index anyway.

**Question 4:** Provide feedback for the case when Q is not provided to the UE

All Companies share the same view that:

**Moderator’s proposal:** Q is always provided to the UE.

# 3 Discussion

RAN4 has sent a LS to RAN1 on the topic of NR-U SSB monitoring capabilities [1].

In order to formulate a reply LS to RAN4, the moderator would like to receive company feedback on the following questions:

**Question 1:** Provide feedback whether monitoring within a given discovery burst transmission window all candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index is mandatory for UEs.

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| **Company** | **View/Position** |
| Nokia, NSB | In our view, it is mandatory for the UEs to monitor all SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window; it can be up to UE’s implementation to stop SS/PBCH block monitoring for a given SS/PBCH block index in the case the UE has already detected a SS/PBCH block with the same index for a given discovery burst transmission window.In our understanding, any deviation to this requirement will lead to degraded performances for both RRM and RLM/BFD/CBD measurements.See also the additional remarks provided within the draft Reply LS. |
| Samsung | As a UE capability, it is mandatory for the UEs to monitor all SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window. It can be up to UE’s implementation to stop monitoring if an SS/PBCH block is detected among the SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window. |
| LG Electronics | Agree with Nokia and Samsung. UE mandatorily monitors all candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index in the DRS transmission window. After a candidate SS/PBCH block index corresponding to a SS/PBCH block index in a given DRS transmission window is detected, UE may stop receiving a candidate SS/PBCH block index corresponding to the SS/PBCH block index in the DRS transmission window. |
| ZTE | RAN1 has agreed that the UE can assume that within a discovery burst transmission window, a number of transmitted SS/PBCH blocks with a same SS/PBCH block index is not larger than one. So it is mandatory for the UEs to monitor all SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index until the UE has detected one SS/PBCH block within a given discovery burst transmission window. |
| Spreadtrum | Agree with Nokia and Samsung. |
| Qualcomm | We strongly do not agree the UE is mandatory to monitor the whole DRS window. This will hurt the UE power consumption substantially. The early terminiation does not help as well, as the UE does not have the capability to instantly determine the SSB is transmitted or not. We understand the proposal to mandate the monitoring of whole DRS window and allow early termination is designing the procedure to cover the worst case scenario, that the UE assumes the gNB has difficulty to transmit SSB all the time. As a result, the power consumption is bad no matter gNB has problem accessing the channel or not. We are proposing to address the problem from best case scenario, where the UE assumes the gNB has no problem accessing the channel, and only spends more power monitoring the SSBs if it detects the gNB has problem accessing the channel (say the SSB is not detected for a few instances). In this case, the power consumption is optimized. |
| OPPO | Within a given discovery burst transmission window, multiple candidate SSB positions can be configured to transmit a same SSB index, so that the gNB may have a higher probability for SSB transmission in unlicensed spectrum. Under this circumstance, the gNB may transmit a SSB at any candidate SSB position. Correspondingly, the UE is expected to be able to detect a SSB at any candidate SSB position where the gNB may transmit a SSB. To reduce the implementation complexity, the UE may stop detect the remaining candidate SSB positions after it detects at least one SSB for the same SSB index within a given discovery burst transmission window. **Therefore, we think that the UE should have the capability to monitor all the candidate SSBs in a DRS window. But whether or not the UE will monitor all the candidate SSBs is up to UE’s decision.**  |
| Sharp | Agree with Nokia. Introduction of capability signalling will limit the network deployment. |
| Ericsson | Agree with many of the views presented about – it is not desirable to limit deployment flexibility by introducing N1/N2 capabilities. The gNB has several mechanism to limit the number of candidate SS/PBCH blocks the UE needs to monitor, e.g. configuring a shorter discovery burst transmission window (SMTC window) or restricting the SS/PBCH blocks to measure using ssb-ToMeasue. These values would be configured to match the deployment. For example, it is not necessary to configure a large DBTX window if operating in an environment with good LBT success rate. However, it would be unfortunate, if artificially small values of N1/N2 would prevent the network from operating well in more challenging environments.The RAN4 LS mentions N1/N2 as UE capabilities. Having UE capabilities for cell wide functionality that is even applicable in IDLE mode is highly undesirable. The only option is for the gNB to use the most conservative configuration, thus rendering the UE capability useless. Instead if RAN4 happens to still define N1/N2, they should be fixed in the RAN4 specifications as is the case with other limits on e.g. number of cells and number of SS/PBCH blocks to monitor. |
| Huawei, HiSilicon | We agree that it is beneficial for UE to monitor all candidate SSB with same SSB index in a DRS burst, which will increase the success rate of detection. On the other side, we think the SSB transmission from gNB may not be impacted by how many candidate SSB a UE will monitor. gNB will try to access the channel within the configured DRS window independent of UE’s capability. so we think it is no need to define such capability. |
| MediaTek | We share the same view and the same concern with Qualcomm. We do not agree the UE is mandatory to monitor all SSBs with candidate indexes corresponding to the same SSB index within a given DRS window. Asking UE to implement “early termination“ to terminate SSB monitoring on-the-fly is asking UE to increase its complexity. UE should not be mandated to increase neither its power consumption nor its complexity to take care of the worst case. On the contrary, we think it should be the gNB’s responsbility to increase the successful rate of LBT attempts for SSB transmission. Don’t forget that, for DRS transmission, gNB has the choice to apply Cat-2 LBT besides Cat-4 LBT. In a congested channel, gNB should consider to limit its DRS transmission duration at most 1msec so that it can apply Cat-2 LBT which can significantly increase the LBT success rate for SSB transmissions. Actually, gNB should carefully select a channel that is not too congested in the first place. Therefore, we strongly object that UE should be mandated to design for the worst case and to monitor all candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window.  |
| vivo | We agree that it is preferred to monitor all the candidate SSBs with the same SSB index, which will benefit the measurement. However, the number seems fairly large in some configuration cases as shown in the following table (see our paper R1-2003355):I think the first question which should be answered: whether early termination is possible at UE side? It seems most of companies think it is possible. However, Qualcomm indicates that UE does not have the capability to instantly determine the SSB is transmitted or not. If this is true, I understand the concern from the power consumption because early termination is not possible. In this case, the UE needs to measure 20 SSB samples in some extreme case, i.e. 5ms DRS window and Q=1.Thus if early termination is not possible, we agree that limitation of UE monitoring capabilities is reasonable.  |

**Question 2:** Provide feedback on the values of N1 and N2, considering the impact on the network performance if UEs are not monitoring all candidate positions.

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| **Company** | **View/Position** |
| Nokia, NSB | N1 and N2 are not applicable in our view (see Q1) |
| Samsung | N1 and N2 are not applicable, since the UE is monitoring all SS/PBCH blocks with candidate indexes corresponding to the same SS/PBCH block index within a given discovery burst transmission window. |
| LG Electronics | Agree with Nokia and Samsung. |
| ZTE | N1 and N2 are not applicable |
| Spreadtrum | Agree with Nokia and Samsung. |
| Qualcomm | N1=N1=1 is enough, especially in FBE mode |
| OPPO | No need to define N1 and N2 |
| Sharp | Agree with Nokia. |
| Ericsson | First preference is not to define N1, N2 at all since it is assumed N1=N2=10/20, i.e., size of discovery burst Tx window. However, please see response to Q1 regarding the case that RAN4 still decides to define these values.To address Qualcomm‘s concern about an FBE deployment, wouldn‘t the most sensible gNB implementation be to configure the discovery burst Tx window length and Q such that there is only 1 candidate SS/Block to monitor per SS/PBCH block index? |
| Huawei, HiSilicon | No need to define N1 and N2. |
| MediaTek  | In our view, N1/N2 can be specified as fixed values in the specifications as is the case with other limits on e.g. number of cells and number of SS/PBCH blocks to monitor.We propose N1 = N2 = 2 as a compromise. This would give a 90% success rate of SSB transmission, assuming a 75% LBT success rate, as specified in the existing LAA test setting (A.3.17.2, TS 36.133).  |
| vivo | We think the value of N1 and N2 should cover the typical configuration case in real deployment. For example, N1=N2=6. |

**Question 3:** Provide feedback on whether differentiation is needed for UEs operating in FBE and LBE modes

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| **Company** | **View/Position** |
| Nokia, NSB | As N1 and N2 are not applicable in our view (see Q1), we see no need for such differentiation |
| Samsung | There is no need to differentiate Ues operating in FBE and LBE modes, and can be up to gNB’s configuration on the discovery burst transmission window to implicitly differentiate FEB and LBE modes.  |
| LG Electronics | In our contribution (R1-2004009), we pointed out one potential difference between FBE and LBE that, for FBE case, if location of a candidate SS/PBCH block is (partially) overlapped with idle region of a fixed frame period, UE shall not perform RRM/RLM/BFD/CBD operation for the SS/PBCH block. This comes from the conclusion that we made in previous meeting. However, if the intention of RAN4 on Q3 was to ask N1/N2 capability for FBE and LBE, the answer to Q1 and Q2 shoud be the same both for FBE and LBE. |
| ZTE | There may be some differentiation for Ues operating in FBE and LBE modes. Since the FFP length is dynamically configured by gNB, it could be shorter than DRS window, and SSBs that (partially) fall in the idle region of a fixed frame period should be considered as invalid. No PDSCH rate matching and no RLM/RRM measurement will be done for those candidate SSB positions. Besides, if the LBT passed, within a fixed frame period, the gNB would transmit SSBs in the first 8 positions at most. So I wonder whether it is necessary to mandate Ues to monitor all candidate SSB positions in a DRS window for FBE. |
| Spreadtrum | Agree with Nokia and Samsung. |
| Qualcomm | For FBE, we are talking about controlled environment. The chance for gNB not being able to access the channel is minimum. We don’t see why N1 and N2 should not be 1. |
| OPPO | No need to differentiate LBE and FBE |
| Sharp | Agree with Nokia. |
| Ericsson | No need to differentiate. Please see our response to Q2 related to FBE. |
| Huawei, HiSilicon | The behavior between FBE and LBE can be differeniate. Agreed with Qualcomm that one candidate SSB per SSB index is enough. |
| MediaTek | For both LBE and FBE, we propose N1=N2=2 as a trade-off between system performance and UE complexity/power consumption. |
| vivo | No need to differentiate. Smart gNB will configure the total number of candidate SSB with the same SSB index is 1 in FBE case. |

**Question 4:** Provide feedback for the case when Q is not provided to the UE

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| **Company** | **View/Position** |
| Nokia, NSB | For both RRM and RLM/BFD/CBD measurements, Q is always provided to the UE (see [2]) |
| Samsung | For RLM/BFD/CBD, Q is always provided to the UE. More details of the indication of Q can be found in R1-2003044 [2]. |
| LG Electronics | Share the view with Nokia and Samsung. |
| ZTE | * RAN1 has reached the following agreements, and there is no case that Q is not provided to the UE.
* For RRM measurement configuration from *MeasObjectNR* and *SIB2/SIB4*, network always provides a common Q value (*ssb-PositionQCL-Common-r16*) per frequency to UE.
* For SCell addition, SCG addition, and reconfiguration with sync, the Q value of the cell to be added is always provided to UE via dedicated RRC signaling, i.e. ssb-PositionQCL-r16 in *ServingCellConfigCommon*.
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| Spreadtrum | Agree with Nokia and Samsung. |
| Qualcomm | Q is always provided |
| OPPO | Question 4 is obsolete.  |
| Sharp | Q is always provided for a carrier with shared spectrum channel access. |
| Ericsson | Q is always provided |
| Huawei, HiSilicon | It was agreed in last meeting, Q is always provided |
| MediaTek | Q is always provided according to RAN1’s agreements.  |
| vivo | Q is always provided. |

# References

1. R1-2003274, “LS on NR-U SSB monitoring capabilities” RAN4, RAN1#101-e, May 2020.
2. R1-2003044, “LS on Signalling of Q Parameter for NR-U”, Charter Communications, RAN1#100bis-e, April 2020