**3GPP TSG RAN WG1 Meeting #100bis-e R1-200xxxx**

**April 20th – April 30th, 2020**

**Agenda item: 7.2.2.1.1**

**Source: Moderator (Qualcomm Incorporated)**

**Title: Email discussion on k\_SSB indication in PBCH for SSB on sync raster and off-sync raster**

**Document for: Discussion and Decision**

# Introduction

For agenda item 7.2.2.1.1 on NR-U initial access signals and channels, after preparation stage email discussion, it was agreed to discuss the following in email discussion.

[100b-e-NR-unlic-NRU-InitSignalChannel-01] Email discussion/approval on k\_SSB indication in PBCH for SSB on sync raster and off-sync raster by 4/22; if necessary, followed by endorsing the corresponding TP by 4/28 – Jing (Qualcomm)

# Discussion on k\_SSB indication

The LSB of k\_SSB in MIB is used for indication of *ssbPositionQCL-Relationship-r16* for Rel.16 NR-U. As a result, need to determine k\_SSB LSB with default interpretations.

During the preparation stage of the email discussion, there are two alternatives collected.

* Alt 1. The assumed value for LSB of k\_SSB is SSB center frequency dependent
	+ If LSB of *ssb-SubcarrierOffset* is used for signalling of *ssbPositionQCL-Relationship-r16*, LSB of k\_SSB is set to ‘0’ for SS/PBCH on a sync raster.
	+ If LSB of *ssb-SubcarrierOffset* is used for signalling of *ssbPositionQCL-Relationship-r16*, for a SS/PBCH not on a sync raster,
		- If the distance between a synchronization raster for NR-U and the center frequency of the SS/PBCH is equal to integer multiple of 30 kHz, LSB of k\_SSB is set to ‘0’.
		- Otherwise, if the distance between a synchronization raster for NR-U and the center frequency of the SS/PBCH is not equal to integer multiple of 30 kHz but equal to integer multiple of 15 kHz, LSB of k\_SSB is set to ‘1’.
* Alt 2. The LSB of k\_SSB is set to 0, and restrict the center frequency of SSB on both sync raster and non-sync raster to be multiple of 30KHz away from the sync raster SSB

------------------------------------Alt 1 TP for 38.211, 7.4.3.1----------------------------------

7.4.3.1 Time-frequency structure of an SS/PBCH block

In the time domain, an SS/PBCH block consists of 4 OFDM symbols, numbered in increasing order from 0 to 3 within the SS/PBCH block, where PSS, SSS, and PBCH with associated DM-RS are mapped to symbols as given by Table 7.4.3.1-1.

In the frequency domain, an SS/PBCH block consists of 240 contiguous subcarriers with the subcarriers numbered in increasing order from 0 to 239 within the SS/PBCH block. The quantities  and  represent the frequency and time indices, respectively, within one SS/PBCH block. The UE may assume that the complex-valued symbols corresponding to resource elements denoted as 'Set to 0' in Table 7.4.3.1-1 are set to zero. The quantity  in Table 7.4.3.1-1 is given by $v=N\_{ID}^{cell} mod 4$. The quantity  is the subcarrier offset from subcarrier 0 in common resource block $N\_{CRB}^{SSB}$ to subcarrier 0 of the SS/PBCH block, where $N\_{CRB}^{SSB}$ is obtained from the higher-layer parameter *offsetToPointA* and the 4 least significant bits of  are given by the higher-layer parameter *ssb-SubcarrierOffset* and for SS/PBCH block type A the most significant bit of  is given by $\overbar{a}\_{\overbar{A}+5}$ in the PBCH payload as defined in clause 7.1.1 of [4, TS 38.212]. For operation with shared spectrum channel access, the least significant bit of $k\_{SSB}$ is set to 0 if the frequency offset between the lowest subcarrier of the SS/PBCH block and the lowest subcarrier of a SS/PBCH block located at the GSCN of a synchronization raster entry as defined in [X, TS 38.101-1] is equal to 0 or integer multiple of 30 kHz, otherwise, the least significant bit of $k\_{SSB}$ is set to 1.If *ssb-SubcarrierOffset* is not provided, $k\_{SSB}$ is derived from the frequency difference between the SS/PBCH block and Point A.

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------------------------------------Alt 2 TP for 38.211, 7.4.3.1----------------------------------

7.4.3.1 Time-frequency structure of an SS/PBCH block

In the time domain, an SS/PBCH block consists of 4 OFDM symbols, numbered in increasing order from 0 to 3 within the SS/PBCH block, where PSS, SSS, and PBCH with associated DM-RS are mapped to symbols as given by Table 7.4.3.1-1.

In the frequency domain, an SS/PBCH block consists of 240 contiguous subcarriers with the subcarriers numbered in increasing order from 0 to 239 within the SS/PBCH block. The quantities  and  represent the frequency and time indices, respectively, within one SS/PBCH block. The UE may assume that the complex-valued symbols corresponding to resource elements denoted as 'Set to 0' in Table 7.4.3.1-1 are set to zero. The quantity  in Table 7.4.3.1-1 is given by $v=N\_{ID}^{cell} mod 4$. The quantity  is the subcarrier offset from subcarrier 0 in common resource block $N\_{CRB}^{SSB}$ to subcarrier 0 of the SS/PBCH block, where $N\_{CRB}^{SSB}$ is obtained from the higher-layer parameter *offsetToPointA* and the 4 least significant bits of  are given by the higher-layer parameter *ssb-SubcarrierOffset* and for SS/PBCH block type A the most significant bit of  is given by $\overbar{a}\_{\overbar{A}+5}$ in the PBCH payload as defined in clause 7.1.1 of [4, TS 38.212]. For operation with shared spectrum channel access, the least significant bit of $k\_{SSB}$ is 0. If *ssb-SubcarrierOffset* is not provided, $k\_{SSB}$ is derived from the frequency difference between the SS/PBCH block and Point A.

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Please provide company views below

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| Company | Comments |
| Nokia, NSB | We think that there is no need to restrict R15 SSB placement for Scell. We prefer that restriction on 30kHz granularity applies only to *ssb-SubcarrierOffset* provided by MIB. This can be formulated asFor operation with shared spectrum channel access, the least significant bit of $k\_{SSB}$, provided by *ssb-SubcarrierOffset,* is set 0. |
| Samsung | Alt 2, but with some clarification. First we agree with Nokia’s comment. Then, we have the following further clarification. The indication of Q should be only applicable to SSB with k\_SSB values in the range 0 to 23, and should not impact the SSB with k\_SSB values in the range 24 to 31 wherein those SSBs use k\_SSB for other purpose instead of determining the subcarrier offset. Genetically setting LSB of k\_SSB as 0 cannot make k\_SSB from {25, 27, 29, 31}, but SSBs with k\_SSB as such value should not be impacted by indication of Q. Hence, the UE procedure for determining the k\_SSB should be, the UE first calculate a value $\overbar{k}\_{SSB}= 16\*\overbar{a}\_{\overbar{A}+5}$+ *ssb-SubcarrierOffset*, if $\overbar{k}\_{SSB}\geq 24$, $k\_{SSB}=\overbar{k}\_{SSB}$; otherwise, $k\_{SSB}=2\*floor(\overbar{k}\_{SSB}/2)$ (i.e., set LSB of k\_SSB as 0). To summarize, our revised proposal TP for Alt 2 is as follow. Alt 2. For operation with shared spectrum channel access, 4 least significant bits of $\overbar{k}\_{SSB}$ are given by the higher-layer parameter *ssb-SubcarrierOffset* and the most significant bit of $\overbar{k}\_{SSB}$ is given by $\overbar{a}\_{\overbar{A}+5}$ in the PBCH payload as defined in clause 7.1.1 of [4, TS 38.212]. If $\overbar{k}\_{SSB}\geq 24$, $k\_{SSB}=\overbar{k}\_{SSB}$; otherwise, $k\_{SSB}=2⋅floor(\overbar{k}\_{SSB}/2)$. |
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# References

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[3]. R1-2001756, Discussion on the remaining issues of initial access signal/channel, OPPO

[4]. R1-2001932, Remaining issues of initial access signals and channels for NR-U, LG Electronics

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