3GPP RAN WG4 Meeting #100-e R4-21xxxxx

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Agenda item: 10.2.2

Source: Apple, Skyworks Solutions Inc., Ericsson

Title: TP on using next larger channel bandwidth solution

WI/SI: FS\_NR\_eff\_BW\_util

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# 1 Introduction

During previous RAN TSG and WG4 meetings, several operators expressed an interest in enabling more efficient utilization of "non-standard" channel bandwidths, i.e. the ones which are not present now in TS 38.101 specifications. Referring to the corresponding operator requests, the following channel bandwidths were suggested by operators: 6, 7, 11, 12, 13, 33, 35, 45. Thus, for "non-standard" channel bandwidths, which are not multiple of 5MHz, a new SI was agreed at the RAN#89 meeting aiming to study further which existing solutions can be used and whether new mechanism should be devised [1].

Most solutions and methods can be coarsely classified into the ones that require introduction of new channel bandwidths (either to the BS side only, or both to the UE and BS specifications) and the ones that leverage existing mechanism. In this paper we provide a text proposal for the "*using next larger channel*" solution.

# 2 Text proposal

## 6.1 Study of larger Channel BW than licensed BW

### 6.1.1 General Aspects

This clause describes, in general terms, how to utilize an irregular Channel Bandwidth by deploying the “larger channel Bandwidth” method.

The premise idea is that the system is configured with the larger channel bandwidth (indicated in System Information broadcasts as well as gNB filter configurations), but the actual number of scheduled RBs is restricted so that it matches actual spectrum allocation ensuring sufficiently large guard bands.



**Figure 6.1.1-1: Using the next larger channel bandwidth (example for 7MHz).**

One of the first critical aspects for this approach is the size of guard bands and the anticipated number of schedulable RBs. As for the standard channel bandwidths, both values are captured in the corresponding specification to avoid any misinterpretation on how many RBs can be configured and scheduled. Following the same principle for every irregular channel bandwidth is feasible, but that will create same amount of technical specification work as if the corresponding irregular channel bandwidth were explicitly added to the specifications. Thus, the number of "available" RBs can be calculated based on certain assumptions.

The number of "available" or "schedulable" RBs for a particular irregular channel bandwidth can be calculated based on the assumption of using larger guard bands from the next *larger* channel the two channel bandwidths. As an example, according to TS 38.101-1 the 5MHz channel minimum guard bands are 242.5kHz, and the 10MHz channel minimum guard bands are 312.5kHz. If existing legacy devices are capable of meeting current requirements with these guard bands, then the same requirements can be met even with larger guard bands. As an example, while considering the 7MHz channel bandwidth it is safe to assume next larger 10MHz channel guard bands, from which number of available RBs can be calculated.

NOTE: Since a UE will be configured with the channel bandwidth, which is larger than the actual allocation and is not expected to provide the usual stop-band attenuation at the edges of the irregular channel bandwidth, it is necessary to verify the level of potential degradation of ACS/blocking. Further information on ACS/blocking should be provided to assess resulting performance.

Table 6.1.1-1 below presents number of available RBs for different irregular channel bandwidths considered in this study item.

Table 6.1.1-1: Exemplary number of RBs based on the next larger channel guard bands (15kHz SCS).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Channel (MHz) | Next larger channel (MHz) | Next larger channel guard band (kHz) | Next larger channel Nrb | Channel Nrb | Utilisation (%) |
| 6 | 10 | 312,5 | 52 | 29 | 87 |
| 7 | 10 | 312,5 | 52 | 35 | 90 |
| 11 | 15 | 382,5 | 79 | 56 | 91,6 |
| 12 | 15 | 382,5 | 79 | 62 | 93 |
| 13 | 15 | 382,5 | 79 | 67 | 92,8 |

Table 6.1.1-2 below presents similar calculations for 30kHz SCS, from which one can see that combination of 30kHz SCS and the next larger channel is not generally a good approach for small channel bandwidths. The main reason is that 30kHz SCS has much larger guard bands, which immediately impacts number of available RBs. As a small summary, assuming using guard band from the next larger channel the resulting spectrum Utilization would range from 87 to 92.8% for an SCS of 15kHz and 72 to 88.6% for an SCS of 30kHz.

Table 6.1.1-2: Exemplary number of RBs based on the next larger channel guard bands (30kHz SCS).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Channel (MHz) | Next larger channel (MHz) | Next larger channel guard band (kHz) | Next larger channel Nrb | Channel Nrb | Utilisation (%) |
| 6 | 10 | 665 | 24 | 12 | 72 |
| 7 | 10 | 665 | 24 | 15 | 77,1 |
| 11 | 15 | 645 | 38 | 26 | 85,1 |
| 12 | 15 | 645 | 38 | 29 | 87 |
| 13 | 15 | 645 | 38 | 32 | 88,6 |

Figure 6.1.1-2 presents a more detailed overview of how the next larger standard channel can be applied to irregular channel bandwidth using 7MHz as an example. For the sake of simplicity, the centre of the 10MHz channel with 52RBs is placed right in the middle of the 7MHz allocation. And since there are 35 schedulable RBs (effective transmission bandwidth of which is 6.3MHz), 9 and 8 RBs blanked on the left and the right edge respectively. In this particular case asymmetric number of RBs is blanked at edges which results in guard bands of different size. Should the network decide to have large guard bands of the same size, then 9 RBs can be blanked at both edges. Nevertheless, it is effectively up to the network configuration to decide where the channel raster is and how many RBs should be blanked at which edge, which will also depend on where exactly a particular spectrum allocation resides.



**Figure 6.1.1-2: Detailed overview of using next larger channel (example for 7MHz).**

When the network operator is aware of potential blockers that could degrade ACS performance, the UE is capable of offsetting it’s carrier frequency to utilize an off-centre portion of its PRBs for the desired spectrum. This allows the UE’s existing filter to fully eliminate blocker energy on one side, as if the UE had a custom filter of the irregular BW on one side. For instance, the gNB may provide certain higher layer network assistance to the UE on the possible location of the blocker signal with respect to the UE CBW. For these cases, the NW should provide assistance to the UE on the blocker location and UE can adjust the BWP PRBs to be {left, right or centred} within the UE Rx filter and utilize the existing capabilities of the UE Rx filter to eliminate ACS degradation due to these known blockers.

### 6.1.2 Signalling and configuration aspects

In this section we provide further signaling details on how to support irregular channels given the 7MHz allocation as an example.

The gNB broadcasts the DL carrier bandwidth and the bandwidth of the initial BWP (BWP#0) in SIB1. For the 7MHz allocation, SIB1 can indicate DL next larger standard channel bandwidth, i.e. 10 MHz, and that the initial DL BWP can be set to 5 MHz:

- SIB1-> servingCellConfigCommon-> downlinkConfigCommon-> frequencyInfoDL-> scs-SpecificCarrierList-> carrierBandwidth = 52 PRBs / subcarrierSpacing = 15 kHz

- SIB1-> servingCellConfigCommon-> downlinkConfigCommon-> initialDownlinkBWP-> genericParameters-> locationAndBandwidth = 25 PRBs

Once the UE established the RRC connection, the gNB can account for the UE capabilities and re-configure the UE accordingly. At this point the gNB may override the carrier bandwidth value that the UE obtained from SIB1 and configure a dedicated BWP with a bandwidth that differs from the bandwidth of BWP#0. gNB may configure a larger bandwidth part, that will cover the whole 7MHz allocation.

- ServingCellConfig-> downlinkChannelBW-PerSCS-List-> carrierBandwidth = 52 PRBs, subcarrierSpacing = 15 kHz

- ServingCellConfig-> downlinkBWP-ToAddModList-> bwp-Common-> genericParameters-> locationAndBandwidth = [35] PRBs

# 3 Conclusions

In this discussion paper we have presented the TP for TR 38.844 describing the number of "schedulable" RBs for a solution based on using the next larger NR standard channel bandwidth.

# 4 References

1. RP-202103, "New SID: Study on Efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths", T-Mobile USA, Ericsson