**3GPP TSG RAN WG1 #101 R1-200xxxx**

**e-Meeting, May 25th – June 5th, 2020**

Agenda Item: 6.2.1.1

Source: Moderator (Qualcomm Incorporated)

Title: FL summary of email discussion [101-e-LTE-eMTC5-WUS-01]

Document for: Discussion and Decision

# 1 Introduction

This email discussion followed the preparatory email discussion [101-e-Prep-LTE-eMTC5-GroupWUS] which is summarized in [1]. This document summarizes the following email discussion:

[101-e-LTE-eMTC5-WUS-01] Email discussion on the alignment of WUS resource locations between RAN1 agreement and RAN2 specification by 5/29 – Le (Qualcomm)

* Discus whether to send LS to RAN2, clarifying the intention behind the agreement for frequency allocation below and above center frequency and asking RAN2 to implement the intended functionality as suggested in TP2.2 of [R1-2004684](https://protect2.fireeye.com/url?k=a796f407-fa58f5b3-a7977f48-000babdfecba-d70b87001ed72dd3&q=1&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_101-e%2FInbox%2FR1-2004684.zip).

# 2 Alignment of WUS resource locations between RAN1 agreement and RAN2 specification

In RAN1#99, the defined WUS resource locations has been agreed as

**Agreement**

For WUS resources with up to 2-FDM and up to 2-TDM, define the WUS resource ID mapping order as WUS resource ID 0, 1 in same time location and 0, 2 in same freq location

|  |  |  |  |
| --- | --- | --- | --- |
| freqLocation of WUS resource 0 | n0 | n2 | n4 |
| WUS resource locations  |

|  |  |  |  |
| --- | --- | --- | --- |
| *f* |  2 | 0 |  |
|  | 3 | 1 |  |
|  |  |  | *t* |

 | Alt1:

|  |  |  |  |
| --- | --- | --- | --- |
| *f* |  3 | 1 |  |
|  | 2 | 0 |  |
|  |  |  | *t* |

Alt2:

|  |  |  |  |
| --- | --- | --- | --- |
| *f* |  |  |  |
|  | 2 | 0 |  |
|  | 3 | 1 | *t* |

Alt1 if NB is below center carrier; otherwise Alt2. |

|  |  |  |  |
| --- | --- | --- | --- |
| *f* |  |  |  |
|  | 3 | 1 |  |
|  | 2 | 0 | *t* |

 |

RAN1’s intention that WUS resources are allocated on PRBs towards the center of the carrier and not towards the edge of the carrier since that would increase strain on spectrum mask requirements. However, in the Table 7.5.x-1 of the most recent CR [2] of TS 36.304 (shown below with the affected elements highlighted) does not reflect the intended functionality.

**Table 7.5.x-1: WUS Resource frequency location**

|  |  |
| --- | --- |
| ***WUS Resource******(***$N\_{ID}^{resource}$***)*** | ***Frequency location of WUS Resource ID 0*** |
| ***n0*** | ***n2*** | ***n4 (Note 1)*** |
| ***NB below centre frequency*** | ***NB above centre frequency*** |
| WUS Resource 1 | n2 | n0 | n4 | n2 |
| WUS Resource 2 | n0 | n2 | n2 | n4 |
| WUS Resource 2(Note 2) | n4 | n4 | n0 | n0 |
| WUS Resource 3 | n2 | n0 | n4 | n2 |
| Note 1: This column is applicable if wus-Config is present.Note 2: This row is applicable for the resource pattern ID 7Editor Note : It is FFS whether further updates needed for WUS Resource ID 0 =n2. |

In order to capture the intended functionality in the specification, the content of the two columns can simply be interchanged such that below-center narrowbands use WUS frequency locations n2 and n4 whereas above-center narrowbands use WUS frequency locations n0 and n2 [3].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| <TP2.2 for Table 7.5.x-1 of TS 36.304>Table 7.5.x-1: WUS Resource frequency location

|  |  |
| --- | --- |
| ***WUS Resource******(***$N\_{ID}^{resource}$***)*** | ***Frequency location of WUS Resource ID 0*** |
| ***n0*** | ***n2*** | ***n4 (Note 1)*** |
| ***NB below centre frequency*** | ***NB above centre frequency*** |
| WUS Resource 1 | n2 | n4 | n0 | n2 |
| WUS Resource 2 | n0 | n2 | n2 | n4 |
| WUS Resource 2(Note 2) | n4 | n0 | n4 | n0 |
| WUS Resource 3 | n2 | n4 | n0 | n2 |
| Note 1: This column is applicable if wus-Config is present.Note 2: This row is applicable for the resource pattern ID 7Editor Note : It is FFS whether further updates needed for WUS Resource ID 0 =n2. |

 |

**Proposal 1:** **Send LS to RAN2, clarifying the intention behind the agreement for frequency allocation below and above center frequency and asking RAN2 to implement the intended functionality as suggested in TP2.2.**

|  |  |
| --- | --- |
| **Company** | **Comments on Proposal 1** |
| Ericsson | We support the Feature Lead’s Proposal 1. |
| Qualcomm | We agree to clarify the intention behind the RAN1 agreement.In the RAN1 agreement, n0, n2, n4 of WUS resource 0 location is defined from up to down. However, the ‘NB below/above centre frequency’ for Atl1/2 selection is not clear.If WUS resource 0 is in n2, the intention is to use* Alt1 if NB DC is **higher** than centre frequency (so that the WUS resource in the PRB pair n4, n5 is not used)
* Alt2 if NB DC is **lower** than centre frequency (so that the WUS resource in the PRB pair n0, n1 is not used)

Therefore, it may be more accurate to say ‘NB higher/lower than centre frequency’ in Table 7.5.x-1. **Table 7.5.x-1: WUS Resource frequency location**

|  |  |
| --- | --- |
| ***WUS Resource******(***$N\_{ID}^{resource}$***)*** | ***Frequency location of WUS Resource ID 0*** |
| ***n0*** | ***n2*** | ***n4 (Note 1)*** |
| ***NB higher than centre frequency*** | ***NB lower than centre frequency*** |
| WUS Resource 1 | n2 | n0 | n4 | n2 |
| WUS Resource 2 | n0 | n2 | n2 | n4 |
| WUS Resource 2(Note 2) | n4 | n4 | n0 | n0 |
| WUS Resource 3 | n2 | n0 | n4 | n2 |

 |
| Huawei/HiSilicon | Our understanding of the RAN1 agreement is illustrated below, assuming the vertical axis refers to frequency, and the horizontal axis refers to time.So it seems the current 36304 is correct, or we miss something? Or the definition of “n0/n2/n4” is different when NB is above or below center carrier?

|  |  |
| --- | --- |
| Empty: n0 | Empty: n0 |
| 2: n2 | 0: n2 |
| 3: n4 | 1: n4 |

( NB is above center carrier, Alt 2 will be chosen)--------------------center carrier--------------------(NB is below center carrier, Alt 1 will be chosen)

|  |  |
| --- | --- |
| 3: n0 | 1: n0 |
| 2: n2 | 0: n2 |
| Empty: n4 | Empty: n4 |

 |
| Qualcomm2 | The key thing here is how to understand ‘NB above center carrier’. If center frequency is fc and NB DC is fNB, the ‘NB above center carrier’ corresponds to fNB<fc,as shown in Huawei’s figure since n0/n2/n4 within NB is increasing value from up to down in vertical axis.Therefore, it is better to say NB lower or smaller than center frequency rather than ‘NB above center carrier’. |
| Ericsson | As stated in our contribution, the agreement is not entirely clear… For that reason, our focus has been on how it should be in the RAN2 spec instead of how to interpret the agreement, since that is not entirely clear. Based on *freqLocation* n0 and n4 for WUS resource 0 in the top table above, RAN2’s interpretation is that for n2, frequency is increasing going from up to down in the table, according to:

|  |  |  |  |
| --- | --- | --- | --- |
| f | n0 |  |  |
| ↓ | n2 |  |  |
|  | n4 | t | → |

In that case, the intention with the agreement, which is to, if possible, keep the outermost PRBs free from WUS, is lost.Regarding QC’s proposed change in the table, we would be fine with it if this was only a RAN1 matter. But it is not our task to determine table descriptors in RAN2 specs. For that reason, we prefer to just change the value fields and not the descriptor fields but we can also accept the alternative if that is the majority view. |
| Nokia | We agree there is an issue when one assumes n4 is a higher frequency than n2 and so on.We have a slight preference for the Ericsson approach.We wonder if an additional note/text in that section/table would be useful for clarification. E.g.Note 3: The frequency of resources, increases in the following order, n4>n2>n0 |
| ZTE,Sanechips | We agree the need for clarification, both QC and Ericsson's method are fine. Maybe we should also clarify RAN1's original intention in a note with the table. |
| Qualcomm3 | The description ‘above/below’ in RAN2 specs is from RAN1 agreement directly, which is lack of explanation. Companies may have different understanding of ‘above/below’ For example, in Huawei/HiSi’s figure, ‘above’ is the NB has lower frequency than center one if keep same order of n0/n2/n4. Alt1: If frequency axis from up to down is from low to high, Low

|  |  |
| --- | --- |
| Empty: n0 | Empty: n0 |
| 2: n2 | 0: n2 |
| 3: n4 | 1: n4 |

( NB is above center carrier, Alt 2 will be chosen) --------------------center carrier--------------------(NB is below center carrier, Alt 1 will be chosen)

|  |  |
| --- | --- |
| 3: n0 | 1: n0 |
| 2: n2 | 0: n2 |
| Empty: n4 | Empty: n4 |

HighHowever, ‘above/below’ may be interpreted as from high to low.Alt2: If frequency axis from up to down is from high to low, High

|  |  |
| --- | --- |
| Empty: n4 | Empty: n4 |
| 2: n2 | 0: n2 |
| 3: n0 | 1: n0 |

( NB is above center carrier, Alt 2 will be chosen) --------------------center carrier--------------------(NB is below center carrier, Alt 1 will be chosen)

|  |  |
| --- | --- |
| 3: n4 | 1: n4 |
| 2: n2 | 0: n2 |
| Empty: n0 | Empty: n0 |

LowIf Ericsson feel more comfortable to change the values but keep the title (as Alt2), we are fine with it. But it would be helpful to clarify the meaning of ‘above/below’ and the intention of different selection for ‘above/below’ in the table if we want to send LS to RAN2. Note 3: ‘NB below centre frequency’ means that NB is in lower frequency than centre frequency. The selection in case of ‘NB below/above centre frequency’ is to keep the allocated WUS resources closer to centre frequency. |
| Huawei/HiSilicon (v009)  | Thanks for the clarifications. Similar view Nokia that if one assumes n4 is a higher frequency than n2 and so on, then there is an issue. We are fine with QC or Ericsson’s method, no strong views here.QC’s Note3 is fine for us.And we share similar view with Nokia that maybe we also need a note similar to the following? (if this is already clarified in RAN2 spec, then maybe no need)“Note 3: The frequency of resources, increases in the following order, n4>n2>n0” |
| Ericsson | Some comments on Note 3:1. The exact formulation is up to RAN2.
2. Given 1, RAN2 may appreciate some help 😊 why RAN1’s input may still be appreciated. We would suggest formulating Note 3 as follows:

Note 3: ‘NB below centre frequency’ implies that the NB is located in a lower frequency relative the carrier centre frequency and vice versa. The rationale for this differentiation is to avoid allocating MWUS on the outermost PRBs in a carrier. The frequency relations of resources is n4>n2>n0. |

# 3 Proposal

Based on the discussion in Sect. 2, the FL would like to propose:

**Proposal: Send LS to RAN2, clarifying the intention behind the agreement for frequency allocation below and above center frequency and asking RAN2 to implement the intended functionality as suggested in the following TP.**

<TP for Table 7.5.x-1 of TS 36.304>

Table 7.5.x-1: WUS Resource frequency location

|  |  |
| --- | --- |
| ***WUS Resource******(***$N\_{ID}^{resource}$***)*** | ***Frequency location of WUS Resource ID 0*** |
| ***n0*** | ***n2 (Note 3)*** | ***n4 (Note 1)*** |
| ***NB below centre frequency*** | ***NB above centre frequency*** |
| WUS Resource 1 | n2 | n4 | n0 | n2 |
| WUS Resource 2 | n0 | n2 | n2 | n4 |
| WUS Resource 2(Note 2) | n4 | n0 | n4 | n0 |
| WUS Resource 3 | n2 | n4 | n0 | n2 |
| Note 1: This column is applicable if wus-Config is present.Note 2: This row is applicable for the resource pattern ID 7Note 3: ‘NB below centre frequency’ implies that NB is located in lower frequency relative to the centre frequency and vice versa. The rationale for this differentiation is to avoid allocating WUS resources on the outermost PRBs in a carrier. The frequency relation of resources is n4>n2>n0.Editor Note : It is FFS whether further updates needed for WUS Resource ID 0 =n2. |

<TP for Table 7.5.x-1 of TS 36.304>

# References

R1-2002512

1. [R1-2004684](https://protect2.fireeye.com/url?k=a796f407-fa58f5b3-a7977f48-000babdfecba-d70b87001ed72dd3&q=1&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_101-e%2FInbox%2FR1-2004684.zip), “Feature Lead Summary of Maintenance for group MWUS,” Moderator (Qualcomm Incorporated), RAN1 #101-e, May 2020.

1. [R2-2003920](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003920.zip), “Corrections to WUS group for eMTC,” Nokia, RAN2 #109bis, April 2020.
2. [R1-2004654](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004654.zip), “Corrections for UE-group wake-up signal for LTE-MTC,” Ericsson, RAN1 #101-e, May 2020