**3GPP TSG RAN WG1 #122bis**  **R1-25xxxx**

**Prague, Czech, Oct 13th – 17th, 2025**

**Source: Moderator (vivo)**

**Title: Summary #1 on remaining issues of LP-WUS/LP-SS design and LP-WUS operation for connected mode**

**Agenda Item: 8.6**

**Document for: Discussion and Decision**

1. Introduction

This contribution summarizes the discussions on remaining issues of LP-WUS/LP-SS design and LP-WUS operation for connected mode in RAN1# 122bis.

The issues in this document are tagged and color coded with [H] or [M].

1. Proposals for Online Sessions
	1. Proposals for online session

1. LP-WUS/LP-SS design
	1. Alignment TP

**TP1: Align the range of configuration index for LP-SS binary sequence in TS 38.331 and TS 38.211: [8]**

Although the configuration number in the table begins with 0, the related RRC parameter *lpss-BinarySeqIndex* has the number range from 1 to 4, which is not aligned with the table in TS 38.211.

The range of configuration index for LP-SS binary sequence in table 7.4.5.1.1-1, 7.4.5.1.1-2, and 7.4.5.1.1-3 of TS 38.211 v19.1.0 and the value range of *lpss-BinarySeqIndex* should be aligned.

* Ask RAN2 to fix the value range of *lpss-BinarySeqIndex* from [1, 2 ,3 ,4] to [0, 1, 2, 3].

FL considers the alignment is necessary, and there could be two alternatives for modification, please provide your consideration on two alternatives:

* Alt 1: modify the range of configuration index for LP-SS binary sequence from [0, 1, 2, 3] to [1, 2 ,3 ,4] in table 7.4.5.1.1-1, 7.4.5.1.1-2, and 7.4.5.1.1-3 of TS 38.211
* Alt 2: Send LS to RAN2 to request updating the value range of lpss-BinarySeqIndex from [1, 2 ,3 ,4] to [0, 1, 2, 3]

**[H][FL1] Question 3.1-1: Which alternative do you support for alignment?**

* **Alt 1: modify the range of configuration index for LP-SS binary sequence from [0, 1, 2, 3] to [1, 2 ,3 ,4] in table 7.4.5.1.1-1, 7.4.5.1.1-2, and 7.4.5.1.1-3 of TS 38.211**
* **Alt 2: Send LS to RAN2 to request updating the value range of lpss-BinarySeqIndex from [1, 2 ,3 ,4] to [0, 1, 2, 3]**

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| --- | --- | --- |
| Company | Alt 1 or alt 2 | Comments |
| Huawei, HiSilicon | Slightly prefer Alt2 | Both alternatives are workable. |
| vivo |  | Either way is ok |
| Qualcomm | Slightly prefer Alt. 1 | Both work for sure, but slightly prefer Alt.1, because it is not good to spend time/resource for such a tiny LS and bother RAN2 just because of this trivial change. |
| Spreadtrum |  | Both alts are OK. |
| Appple | Slightly prefer Alt. 1 | Both would work, but Alt 1 is simpler as it does not involve another WG. |
| ZTE, Sanechips | Slightly prefer Alt2 | Usually, index starts from 0. And RAN2 still has time to modify before release frozen. |

**TP2: Align TS 38.331 and TS 38.211 for root sequence number determination: [8]**

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| ========================= TP#1 for TS 38.211 ===================================Reason for change: How to decide the root sequence number is not aligned with RRC parametersSummary of changes: Specify the case when root1 or root2 are used.Consequence if not approved: How to decide the root sequence is not clear.=========================== Start of TP#1 =====================================7.4.4.1.1 Generation of $r\_{ZC,m}(n)$===========================Unchanged Text Omitted =============================The root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$ is configured by the higher-layer parameter *root1* or *root2* in *lpwus-OverlaidSeqRoots*, where *root1* is used for the root sequence number when $\left⌊{c\_{m}}/{P}\right⌋$ is 0. Otherwise, *root2* is used.The cyclic shift $n\_{cs}$ is given by$$n\_{cs}=\left(c\_{m} mod P\right)\left⌊\frac{N\_{ZC}}{P}\right⌋$$$$P=\frac{N\_{seq}}{N\_{root}}$$where - $N\_{seq}$ is the number of sequences configured by the higher-layer parameter *lpwus-OverlaidSeqNum* or *lpwus-OverlaidSeqNum-SCS-60kHz* or *lpwus-OverlaidSeqNum-SCS-120kHz*- $N\_{root}$ is 2 when *root2* is configured in *lpwus-OverlaidSeqRoots*. Otherwise, $N\_{root}$ is 1.=============================End of TP#1 ============================== |

For easier tracking, FL updates the TP proposed by [8] with tracking changes in red, as given below:

**[H][FL1] Question 3.1-2: Do you support the below TP:**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| Huawei, HiSilicon | Y |  |
| vivo |  | We can be fine with the proposal. Alternatively, considering ASN.1 is not frozen yet, the RRC parameter name or even structure may change, we can align these parameters after ASN.1 is frozen.  |
| Qualcomm |  | Agree with vivo. |
| Apple | Y in principle | It is better to align RRC parameter names systematically.  |
| ZTE, Sanechips |  | We think ‘where *root1* is used for the root sequence number when $\left⌊{c\_{m}}/{P}\right⌋$ is 0. Otherwise, *root2* is used.’ is not needed, since RAN2 spec already clarify how to use root1 and root2. Other parts are generally fine. |

=========================== TP for TS 38.211 ===================================

Reason for change: How to decide the root sequence number is not aligned with RRC parameters

Summary of changes: Specify the case when root1 or root2 are used.

Consequence if not approved: How to decide the root sequence is not clear.

========================== Start of TP =======================================

7.4.4.1.1 Generation of $r\_{ZC,m}(n)$

=============================== Unchanged Text Omitted =========================

The root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$ is configured by the higher-layer parameter *root1* or *root2* in *lpwus-OverlaidSeqRoots*, where *root1* is used for the root sequence number when $\left⌊{c\_{m}}/{P}\right⌋$ is 0. Otherwise, *root2* is used. The cyclic shift $n\_{cs}$ is given by:

~~is obtained as entry~~ $\left⌊{c\_{m}}/{P}\right⌋\in \left\{0,1\right\}$ ~~of the root sequence numbers configured by the higher-layer parameter XXX and the cyclic shift~~ $n\_{cs}$ ~~is given by~~

$$n\_{cs}=\left(c\_{m} mod P\right)\left⌊\frac{N\_{ZC}}{P}\right⌋$$

$$P=\frac{N\_{seq}}{N\_{root}}$$

where

- $N\_{seq}$ is the number of sequences configured by the higher-layer parameter ~~XXX~~ *lpwus-OverlaidSeqNum* or *lpwus-OverlaidSeqNum-SCS-60kHz* or *lpwus-OverlaidSeqNum-SCS-120kHz*

~~-~~ $N\_{root}ϵ\left\{1,2\right\}$ ~~is the number of root sequence numbers configured by the higher-layer parameter XXX~~

- $N\_{root}$ is 2 when *root2* is configured in *lpwus-OverlaidSeqRoots*. Otherwise, $N\_{root}$ is 1.

==================================== End of TP===============================

### **TP3: Padding for sequence modulation in TS 38.212 [7]**

As per the agreement, only in case N/log2L is not an integer, bit 0 as MSB is used for padding. However, as description in clause 7.4.2.2 of TS 38.212, padding is always used for the sequence modulation even in case N/log2L is an integer.

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.1.0-----------------------7.4.2.2 Rate matching for sequence modulationInformation bits for the second bit block are delivered to the rate matching block. They are denoted by $c\_{0},c\_{1},…,c\_{K−1}$, where $K$ is the number of bits and $K\leq 5$.If the number of sequences configured by higher layer parameter *LP-WUS\_num\_overlaidSeq\_CONNECTED* or *LP-WUS\_num\_overlaidSeq\_IDLE/INACTIVE*, denoted as $L\_{1}$, is larger than one, padding is performed and the bits after padding are denoted by$ d\_{10},d\_{11},…,d\_{1\left(N\_{1}−1\right)}$, where $N\_{1}=K+L$, $L=\left(−K \right) mod log\_{2}L\_{1}$. The relation between $c\_{k}$ and $d\_{1k}$ is: $d\_{1k}=0$ for $k=0,1,…, L−1$ $d\_{1k}=c\_{k−L} $for $k=L,L+1,…, N\_{1}−1$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{1}$, where $ E\_{1}=E\_{WUS}×log\_{2}L\_{1}$, $E\_{WUS} $is as defined in Clause 7.4.2.1, and the output bit sequence after rate matching is denoted as $f\_{10},f\_{11},f\_{12},…,f\_{1\left(E\_{1}−1\right)}$. |

In current version, in case that K is integer times of $ log\_{2}L\_{1}$, i.e L = $\left(−K \right) mod log\_{2}L\_{1}=0$, padding is also performed, and $d\_{1k}=0$ for $k=0,1,…, L−1$, where L=0. To fix it and align with the agreement reached in RAN1#120bis meeting, [7] propose 2 TPs for consideration.

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| **TP#1**---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.1.0-----------------------7.4.2.2 Rate matching for sequence modulationInformation bits for the second bit block are delivered to the rate matching block. They are denoted by $c\_{0},c\_{1},…,c\_{K−1}$, where $K$ is the number of bits and $K\leq 5$.If the number of sequences configured by higher layer parameter *LP-WUS\_num\_overlaidSeq\_CONNECTED* or *LP-WUS\_num\_overlaidSeq\_IDLE/INACTIVE*, denoted as $L\_{1}$, is larger than one, and $K mod log\_{2}L\_{1}$ is an integer, padding is performed and the bits after padding are denoted by$ d\_{10},d\_{11},…,d\_{1\left(N\_{1}−1\right)}$, where $N\_{1}=K+L$, $L=\left(−K \right) mod log\_{2}L\_{1}$. The relation between $c\_{k}$ and $d\_{1k}$ is: $d\_{1k}=0$ for $k=0,1,…, L−1$ $d\_{1k}=c\_{k−L} $for $k=L,L+1,…, N\_{1}−1$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{1}$, where $ E\_{1}=E\_{WUS}×log\_{2}L\_{1}$, $E\_{WUS} $is as defined in Clause 7.4.2.1, and the output bit sequence after rate matching is denoted as $f\_{10},f\_{11},f\_{12},…,f\_{1\left(E\_{1}−1\right)}$. |
| **TP#2**---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.1.0-----------------------7.4.2.2 Rate matching for sequence modulationInformation bits for the second bit block are delivered to the rate matching block. They are denoted by $c\_{0},c\_{1},…,c\_{K−1}$, where $K$ is the number of bits and $K\leq 5$.If the number of sequences configured by higher layer parameter *LP-WUS\_num\_overlaidSeq\_CONNECTED* or *LP-WUS\_num\_overlaidSeq\_IDLE/INACTIVE*, denoted as $L\_{1}$, is larger than one, and L $>0$, padding is performed and the bits after padding are denoted by$ d\_{10},d\_{11},…,d\_{1\left(N\_{1}−1\right)}$, where $N\_{1}=K+L$, $L=\left(−K \right) mod log\_{2}L\_{1}$. The relation between $c\_{k}$ and $d\_{1k}$ is: $d\_{1k}=0$ for $k=0,1,…, L−1$ $d\_{1k}=c\_{k−L} $for $k=L,L+1,…, N\_{1}−1$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{1}$, where $ E\_{1}=E\_{WUS}×log\_{2}L\_{1}$, $E\_{WUS} $is as defined in Clause 7.4.2.1, and the output bit sequence after rate matching is denoted as $f\_{10},f\_{11},f\_{12},…,f\_{1\left(E\_{1}−1\right)}$. |

**[H][FL1] Question 3.1-3: what’s your opinion on the proposed modification above?**

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| Company | Support TP1 or TP2 or not support? | Comments |
| Huawei, HiSilicon | No | We see no need to add such kind of condition. Current spec only describes how to do the padding, but not imply that padding is always done. |
| vivo | No support | In our understanding, the spec is clear, padding is not applied when L=0. When L=0, $d\_{1k}=0$ for $k=0,1,..−1$. people can well understand that the index k can not be negative, i.e., when L=0, $d\_{1k}=0$ for $k=0,1,…, L−1$ is not applied.  |
| Qualcomm | No | Not really necessary. |
| Spreadtrum |  | Not needed. |
| Apple | No | Not needed |
| ZTE, Sanechips | No need |  |

### **TP4: Align the definition of** $c\_{m} $**in different clauses of TS 38.211 [7]**

As the description in agreement, $c\_{m}$ means the sequence index within the $N\_{seq}$ candidate sequences. However, the $c\_{m}$ is defined as sequence number in current spec. In our views, sequence number means the number of total candidate sequences. Also, in the descriptions of other clauses of TS 38.211, the sequence index is used. Those include 6.3.3.1, 6.4.1.3.3.1, and 7.4.1.5.3.

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.211 V19.1.0-----------------------7.4.4.1.1 Generation of $r\_{ZC,m}(n)$The sequence $r\_{ZC,m}(n)$ is defined by$$r\_{ZC,m}(n)=x\_{q}\left((n+n\_{cs}) mod N\_{ZC}\right)$$$$x\_{q}\left(i\right)=e^{−j\frac{πqi(i+1)}{N\_{ZC}}}$$$$n=0,1,…,M\_{ZC}−1$$where- $N\_{ZC}$ is the largest prime number such that $N\_{ZC}<M\_{ZC}$- $M\_{ZC}={N\_{sc}^{WUS}}/{M\_{WUS}}$The root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$ is obtained as entry $\left⌊{c\_{m}}/{P}\right⌋\in \left\{0,1\right\}$ of the root sequence numbers configured by the higher-layer parameter XXX and the cyclic shift $n\_{cs}$ is given by$$n\_{cs}=\left(c\_{m} mod P\right)\left⌊\frac{N\_{ZC}}{P}\right⌋$$$$P=\frac{N\_{seq}}{N\_{root}}$$where - $N\_{seq}$ is the number of sequences configured by the higher-layer parameter XXX- $N\_{root}ϵ\left\{1,2\right\}$ is the number of root sequence numbers configured by the higher-layer parameter XXXThe sequence ~~number~~ index $c\_{m}=0$ if $N\_{seq}=1$, otherwise it is given by$$c\_{m}=\sum\_{i=0}^{δ−1}f\_{1(i+δm)}2^{δ−1−i}$$$$δ=log\_{2}N\_{seq}$$$$m=0,1,…,\left({E\_{1}}/{δ}\right)−1$$ |

**[H][FL1] Question 3.1-4: what’s your opinion on the proposed modification above?**

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| Company | Support or not  | Comments |
| Huawei, HiSilicon |  | OK for the change. But we can also accept no change. |
| vivo | No support | We think no miss-understanding as mentioned by OPPO. E.g., in the same section, $N\_{root}ϵ\left\{1,2\right\}$ is the number of root sequence numbers…, and, the root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$. It can be easily differentiated what is the total number of something, what is the index.  |
| Qualcomm |  | Not essential. |
| Spreadtrum |  | Not needed. |
| Apple |  | Not essential, but also OK with the change |
| ZTE, Sanechips |  | Open to it. |

**TP5: Add definition of OOK-On symbol and OOK-Off symbol for LP-WUS waveform generation in TS 38.211[1]**

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| The bit sequence $b\left(0\right), …, b(M\_{bit}−1)$ and the number of bits $M\_{bit}$ corresponds to $g\_{00},g\_{01},…,g\_{0\left(G\_{0}−1\right)}$ and $G\_{0}$, respectively, in clause 7.4.3 of [4, 38.212]. $M\_{bit}$ OOK symbols for Wake-up signal includes OOK-ON symbol and OOK OFF symbol, where the bit sequence $b\left(m\right)=1$ is carried by OOK-On symbol and the bit sequence $b\left(m\right)=0$ is carried by OOK-Off symbol. |

In FL’s understanding, since b(m) corresponds to g0(m) in TS 38.212, and it is already clear that g0(m) is 0 or 1, as shown below. Thus, it seems no need to add OOK-ON/OFF symbol definition in TS 38.211.

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| Line coding is performed according to the following by setting $i=0,1,…, E\_{0}−1$: $g\_{0(2i)}=1−f\_{0i}$; $g\_{0(2i+1)}= f\_{0i}$; |

**[H][FL1] Question 3.1-5: what’s your opinion on the proposed modification above?**

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| Company | Support or not  | Comments |
| Huawei, HiSilicon |  | We share the similar view as FL. Seems no need for the change. |
| vivo |  | Agree with FL’s analysis that it is already clear g0(m) is 0 or 1 for OOK OFF and ON. Thus no need of the TP.  |
| Qualcomm |  | In 38.212, g(m) is “the bits after line coding”.In 38.213, a UE can be provided for LPSS/WUS reception a number of “OOK symbols” per OFDM symbol, etc.We think it is good to clarify/define OOK symbol in the spec. For example, as follows:The bit sequence $b\left(0\right), …, b(M\_{bit}−1)$ and the number of bits $M\_{bit}$ corresponds to $g\_{00},g\_{01},…,g\_{0\left(G\_{0}−1\right)}$ and $G\_{0}$, respectively, in clause 7.4.3 of [4, 38.212], and forms the $M\_{bit}$ OOK symbols of the Wake-up signal. |
| Apple |  | The change does not seem necessary. For Qualcomm’s comment, it may be better to directly add RRC parameter name in 213 description, and then there should not be any ambiguity. |
| ZTE, Sanechips | Y | We can not naturally assume that g0(m) is 0 or 1 for OOK OFF and ON if there is no any description. Therefore, clarification is needed. For Apple’s suggestion, we are not sure how RAN2 spec define a RRC parameter related to OOK-ON symbol and OOK-OFF symbol. What we can do currently is clarify it in RAN1.Qualcomm’s version clarify the OOK symbol, but did not clarify OOK ON symbol and OOK OFF symbol. We are open to any modification if it could clarify that better.  |

**TP6: Update higher-layer parameter names in TS 38.211 based on RAN2 running CR for TS 38.331: [9]**

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.211 V19.0.0-----------------------<Unchanged part is omitted>7.4.4.1.1 Generation of $r\_{ZC,m}(n)$The sequence $r\_{ZC,m}(n)$ is defined by$$r\_{ZC,m}(n)=x\_{q}\left((n+n\_{cs}) mod N\_{ZC}\right)$$$$x\_{q}\left(i\right)=e^{−j\frac{πqi(i+1)}{N\_{ZC}}}$$$$n=0,1,…,M\_{ZC}−1$$where- $N\_{ZC}$ is the largest prime number such that $N\_{ZC}<M\_{ZC}$- $M\_{ZC}={N\_{sc}^{WUS}}/{M\_{WUS}}$The root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$ is obtained as entry $\left⌊{c\_{m}}/{P}\right⌋\in \left\{0,1\right\}$ of the root sequence numbers configured by the higher-layer parameter ~~XXX~~ *lpwus-OverlaidSeqRoots*  and the cyclic shift $n\_{cs}$ is given by$$n\_{cs}=\left(c\_{m} mod P\right)\left⌊\frac{N\_{ZC}}{P}\right⌋$$$$P=\frac{N\_{seq}}{N\_{root}}$$where - $N\_{seq}$ is the number of sequences configured by the higher-layer parameter ~~XXX~~  *lpwus-OverlaidSeqNum* or *lpwus-OverlaidSeqNum-SCS-60kHz* or *lpwus-OverlaidSeqNum-SCS-120kHz.*- $N\_{root}ϵ\left\{1,2\right\}$ is the number of root sequence numbers configured by the higher-layer parameter ~~XXX~~ *lpwus-OverlaidSeqRoots*The sequence number $c\_{m}=0$ if$LN\_{seq}=1$, otherwise is given by$$c\_{m}=\sum\_{i=0}^{δ−1}f\_{1(i+δm)}2^{δ−1−i}$$$$δ=log\_{2}LN\_{seq}$$$$m=0,1,…,\left({E\_{1}}/{δ}\right)−1$$~~where~~* $L$ ~~is given by the higher-layer parameter XXX~~

<Unchanged part is omitted>7.4.5.1.1 Generation of $r\_{OOK}(n)$The sequence $r\_{OOK}\left(0\right),…,r\_{OOK}(N\_{OOK}−1)$ is defined by Tables 7.4.5.1.1-1 to 7.4.5.1.1-3 with the quantity $M\_{LPSS}$ given by the higher-layer parameter ~~XXX~~ *lpss-MvalueAndSeqConfig*.<Unchanged part is omitted>7.4.5.1.2 Generation of $r\_{ZC}(n)$If the quantity $qϵ\left\{1,…,N\_{ZC}−1\right\}$ is configured by the higher-layer parameter ~~XXX~~ *lpss-OverlaidSeqRoots*, the sequence $r\_{ZC}(n)$ is defined by<Unchanged part is omitted>--------------------------------------End of Text Proposal on 3GPP TS 38.211 V19.0.0 ------------------ |

**TP7: Update higher-layer parameter names in TS 38.212 based on RAN2 running CR for TS 38.331: [9]**

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.0.0-----------------------<Unchanged part is omitted>7.4 Wake-up informationThe wake-up information is carried by a wake-up signal as defined in clause 7.4.4 of [4, TS 38.211]. - For a UE configured with higher layer parameter *~~LP-WUS\_LP-SS\_startRB\_IDLE\_INACTIVE~~* *lpwus-LPSS-StartRB* and operating in the RRC\_IDLE or RRC\_INACTIVE state, the wake-up information bit sequence $c\_{0},c\_{1},…,c\_{K−1}$ is the binary sequence of the codepoint as defined by Clause 10.4C of [5, TS38.213], where $c\_{0}$ is the most significant bit and $K$ is<Unchanged part is omitted>7.4.2.1 Rate matching for OOK modulationThe input bit sequence to rate matching is $d\_{00},d\_{01},…,d\_{0\left(N\_{0}−1\right)}$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{0}$, where $E\_{0}=E\_{WUS}$, $E\_{WUS}=N\_{OS}×M\_{LP}/2$, where- for a UE configured with higher layer parameter *~~LP-WUS\_LP-SS\_startRB\_IDLE\_INACTIVE~~* *lpwus-LPSS-StartRB* and operating in the RRC\_IDLE or RRC\_INACTIVE state, $N\_{OS}$ is configured by higher layer parameter *~~LP-WUS\_ActualMO\_duration\_IDLE/INACTIVE~~ lpwus-ActualDuration* and $M\_{LP}$ is configured by higher layer parameter *~~LP-WUS\_Mvalue\_IDLE/INACTIVE~~ lpwus-MvalueAndSeqConfigFR1* or *lpwus-MvalueAndSeqConfigFR2;* - for a UE configured with higher layer parameter *LP-WUS\_startRB\_CONNECTED* and operating in the RRC\_CONNECTED state,$N\_{OS}$ is configured by higher layer parameter *~~LP-WUS\_ActualMO\_duration\_CONNECTED~~ lpwus-ActualDuration* and $M\_{LP}$ is configured by higher layer parameter *~~LP-WUS\_Mvalue\_CONNECTED~~* *lpwus-MvalueAndSeqConfigFR1* or *lpwus-MvalueAndSeqConfigFR2*.<Unchanged part is omitted>--------------------------------------End of Text Proposal on 3GPP TS 38.212 V19.0.0 ------------------ |

**TP8: Update higher-layer parameter names in TS 38.213 based on RAN2 running CR for TS 38.331: [9]**

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------<Unchanged part is omitted>10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVEA UE configured with DRX mode operation and operating in the RRC\_IDLE or RRC\_INACTIVE state can be provided for LPSS/WUS reception - a number of OOK symbols per OFDM symbol, a first RB, and an overlaid OFDM sequence per OOK symbol for LPSS reception, and an EPRE ratio relative to SS/PBCH blocks [4, TS 38.211], - a number of OOK symbols per OFDM symbol, the first RB, and one or more overlaid OFDM sequences per OOK symbol for WUS reception, and an EPRE ratio relative to SS/PBCH blocks [4, TS 38.211], andA UE determines to receive LPSS/WUS based on procedures defined in [17, TS 38.304]. A UE assumes that an SCS configuration for LPSS/WUS receptions is same as an SCS of the initial DL BWP and an SCS configuration of an SS/PBCH block the UE used to obtain *SIB1*. A UE receives an LPSS in consecutive symbols within a slot. The UE can be provided one or two first symbols for respective one or two LPSS reception occasions in the slot by *lpss-StartSymbol*. The UE determines slots for LPSS reception occasions based on a periodicity and a time offset, relative to a system frame with SFN 0, provided by *~~lpss-periodicityoffset~~ lpss-PeriodicityAndOffset.* Within a period of LPSS reception occasions, LPSS reception occasions are in a set of $\left⌈{K}/{L}\right⌉$ consecutive slots that have all symbols indicated as downlink by *tdd-UL-DL-ConfigurationCommon*, if provided, and start from the first slot provided by the time offset in the period, where $K$ is the number of transmitted SS/PBCH blocks indicated by *ssb-PositionsInBurst* in *SIB1* and $L$ is the number of LPSS reception occasions in a slot.LPSS reception occasions are indexed sequentially in time. An LPSS reception at the $k$-th LPSS reception occasion is quasi co-located with the $k$-th transmitted SS/PBCH block, with respect to quasi co-location ‘typeC’ or ‘typeD’ properties when applicable, where $1\leq k\leq K$. If a UE is provided *~~wus-LPSS-beamSubset~~ lpwus-LPSS-BeamSubset*, the UE receives LPSS/WUS based on the quasi co-location properties of transmitted SS/PBCH blocks indicated by *~~wus-LPSS-beamSubset~~ lpwus-LPSS-BeamSubset* [12, TS 38.331]; otherwise, the UE receives LPSS/WUS based on the quasi co-location properties for transmitted SS/PBCH blocks indicated by *ssb-PositionsInBurst* in *SIB1*. A WUS occasion includes $K⋅M$ WUS monitoring occasions that are indexed sequentially in time, where- $K$ is the number of transmitted SS/PBCH blocks indicated by *ssb-PositionsInBurst* in *SIB1*, $M$ is a number of WUS monitoring occasions associated with each of the $K$ transmitted SS/PBCH blocks provided by *~~MONumperLO~~ lpwus-MoNumPerLo*, and- a WUS monitoring occasion with index $(k−1)⋅M+m$, where $1\leq m\leq M$ and $1\leq k\leq K$, is quasi co-located with the $k$-th transmitted SS/PBCH block with respect to quasi co-location ‘typeC’ or ‘typeD’ properties, when applicableA UE can be provided, by *~~WUS\_available\_slot\_IDLE/INACTIVE~~* *lpwus-AvailableSlot*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *~~WUS\_available\_symbol\_IDLE/INACTIVE~~* *lpwus-AvailableSymbol*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_slot\_IDLE/INACTIVE~~ lpwus-AvailableSlot*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_symbol\_IDLE/INACTIVE~~* *lpwus-AvailableSymbol*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by *tdd-UL-DL-configurationCommon* - the symbol is indicated for an SS/PBCH block transmission, by *ssb-PositionsInBurst* in *SIB1*, and the SS/PBCH block transmission would overlap in frequency with the WUS transmission- the symbol is indicated for PDCCH transmissions, by *pdcch-ConfigSIB1*, and CORESET 0 for the PDCCH transmissions would overlap in frequency with the WUS transmissionA WUS monitoring occasion is over a first number of symbols, provided by *~~WUS\_NominalMO\_duration\_ IDLE/INACTIVE~~* *lpwus-NominalMoDuration*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *~~WUS\_ActualMO\_duration\_ IDLE/INACTIVE~~ lpwus-ActualDuration*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *~~WUS\_ActualMO\_duration\_ IDLE/INACTIVE~~ lpwus-ActualDuration* symbols in the WUS monitoring occasion. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion includes a symbol for LPSS reception, the UE does not monitor WUS in the WUS monitoring occasion.A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on *PO-to-LO association*. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by *~~LO-FrameOffsets~~ lpwus-LoFrameOffsetList*. The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *~~offset\_firstMO\_withinLO~~* *lpwus-OffsetFirstMoWithinLo* relative to the start of the reference frame. If multiple values for the number of frames provided by *~~LO-FrameOffsets~~* *lpwus-LoFrameOffsetList* are larger than or equal to the value of *XYZ*, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the multiple values. If all values for the number of frames provided by *~~LO-FrameOffsets~~ lpwus-LoFrameOffsetList* are smaller than the value of *XYZ*, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS.A paging occasion associated with a WUS occasion has index $i\_{PO}=\left(\left(UE\\_ID mod N\right)⋅N\_{S}+i\\_s\right) mod N\_{PO}^{WO}$ where $N\_{PO}^{WO}$ is a number of paging occasions associated with a WUS occasion, $N$, $N\_{S}$, $i\_{SG}$, and $i\\_s$ are defined in [17, TS 38.304], and $UE\\_ID$ is defined in clause 7.1 of [17, TS 38.304]. If a number of $N\_{SG}^{PO}$ subgroups per paging occasion, provided by *~~subgroupNumber-PO-WUS~~* *lp-SubgroupsNumPerPO*, is $N\_{SG}^{PO}>1$, the codepoint for the subgroup index $i\_{SG}$ in a PO $i\_{PO}$ is$ i\_{PO}∗\left(N\_{SG}^{PO}+1\right)+i\_{SG}$, and the codepoint for all subgroups in the PO is$ (i\_{PO}+1)∗\left(N\_{SG}^{PO}+1\right)−1$; otherwise, the codepoint for the PO $i\_{PO}$ is$ i\_{PO}.$If, in a WUS monitoring occasion, a UE determines a codepoint associated with the UE [17, TS 38.304], the UE performs PDCCH monitoring according to Type2-PDCCH CSS sets for the paging occasion associated with the WUS monitoring occasion when a time from the end of the WUS reception to the start of the PDCCH monitoring occasion is not smaller than the value of *XYZ*; otherwise, the UE is not required to perform the PDCCH monitoring. The UE may also perform PDCCH monitoring for Type2A-PDCCH CSS sets for DCI format 2\_7, if provided.<Unchanged part is omitted>--------------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0 ------------------ |

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------<Unchanged part is omitted>10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTEDA UE configured with DRX mode operation and operating in the RRC\_CONNECTED state can be provided for WUS reception on the primary cell of a cell group- a number of OOK symbols per OFDM symbol, a first RB, and overlaid OFDM sequences per OOK symbol for WUS reception [4, TS 38.211], and- a number of codepoints provided for the UE by the WUS [6, TS 38.212], by *WUS-codepoint\_CONNECTED* A UE assumes that a WUS is quasi co-located with an SS/PBCH block or a CSI-RS with respect to quasi co-location ‘typeC’ or ‘typeD’ properties, when applicable. If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states indicated by a most recent DCI format or MAC CE, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *~~WUS\_TCI\_states\_CONNECTED~~* *lpwus-TCI-States*. A UE assumes that an SCS configuration for WUS receptions is same as an SCS configuration for the active DL BWP.A UE does not monitor a WUS during Active Time [11, TS 38.321].A UE does not monitor WUS during DTX inactive period for the primary cell.A UE can be provided by *~~WUS-MOCONNECTED-Option1-1~~ lpwus-Mo11* a periodicity, by *periodicityMO-Option 1-1*, and a time offset, by *offsetMO-Option 1-1*, relative to the start of a system frame with SFN 0, for the UE to determine WUS monitoring occasions. The UE starts to monitor WUS in a first WUS monitoring occasion that is not earlier than a first slot that is prior to a second slot where the *drx-onDurationTimer* would start by a time provided by *timeOffsetCONNECTEDOption1-1*, and monitors WUS for a number of monitoring occasions provided by *~~numMO-Option 1-1~~ lpwus-NumOfMo11*. The UE reports a number of slots [18, TS 38.306] where the UE is not required to monitor WUS prior to the slot where the *drx-onDurationTimer* would start. The UE is not required to monitor WUS within the reported number of slots prior to the slot where the *drx-onDurationTimer* would start. If the UE determines to monitor PDCCH based on a detected WUS, the UE starts the *drx-onDurationTimer* [11, TS 38.321].A UE can be provided by *~~WUS-MOCONNECTED-Option1-2~~* *lpwus-Mo12* a periodicity, by *periodicityMO-Option 1-2*, and a time offset, by *offsetMO-Option 1-2*, relative to the start of a system frame with SFN 0, for the UE to determine first WUS monitoring occasions from a number of WUS monitoring occasions per periodicity, provided by *~~numMO-perPeriodicity-Option 1-2~~ lpwus-NumOfMo12*. The UE reports a number of slots [18, TS 38.306] and expects that a time gap, from a last WUS monitoring occasion from the number of WUS monitoring occasions per periodicity to the slot where the *wus-PDCCHMonitoringTimer* would start, is no smaller than the reported number of slots. If the UE determines to monitor PDCCH based on a detected WUS, the UE starts *wus-PDCCHMonitoringTimer* [11, TS 38.321] after a time, provided by *timeOffsetCONNECTEDOption1-2*, with respect to the start of the first WUS monitoring occasion from the number of WUS monitoring occasions per periodicity. A UE can be provided, by *~~WUS\_available\_slot\_CONNECTED~~* *lpwus-AvailableSlot*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *~~WUS\_available\_symbol\_CONNECTED~~* *lpwus-AvailableSymbol*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_slot\_CONNECTED~~* *lpwus-AvailableSlot*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_symbol\_CONNECTED~~ lpwus-AvailableSymbol*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommonA WUS monitoring occasion is over a first number of symbols, provided by *~~WUS\_NominalMO\_duration\_CONNECTED~~* *lpwus-NominalMoDuration*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *~~WUS\_ActualMO\_duration\_CONNECTED~~* *lpwus-ActualDuration*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *~~WUS\_ActualMO\_duration\_CONNECTED~~ lpwus-ActualDuration* symbols in the WUS monitoring occasion. If a UE detects a codepoint in a WUS reception, from the number of codepoints, on the primary cell of the cell group, the UE starts monitoring PDCCH on all applicable serving cells of the cell group. <Unchanged part is omitted>--------------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0 ------------------ |

TP6, 7, and 8 are updates of the higher-layer parameter names based on RAN2 running CR for TS 38.331. Considering ASN.1 would be frozen in two meetings and there would be potential changes, FL suggests handling such parameter name misalignment across specs after ASN.1 frozen.

 **[H][FL1] Question 3.1-6: Do you agree on handling higher-layer parameter name misalignment across specs after ASN.1 frozen?**

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| Company | Y/N | Comments |
| Huawei, HiSilicon | Y | It can be left to editors. |
| vivo | Y |  |
| Qualcomm | Y |  |
| Apple |  | No strong view. This can be done by the editors. Doing it now can be okay as we don’t expect the parameter names to change. |
| ZTE, Sanechips | Y |  |

* 1. Proposals which revert the agreement

[3] proposes Bit 0 as LSB is used for padding, when raw information bits are mapped to sequence(s) in case N/log2L is not an integer.

However, RAN1 already agreed Bit 0 as MSB is used for padding as shown below which can work properly. Therefore, FL suggests no further discussion on this issue.

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| **Agreement in RAN1#120bis**For WUS information carried by the overlaid OFDM sequence(s), down-select between Alt 1 and Alt2:* Alt 1: Raw information bits are mapped to sequence(s)
	+ N raw information bits are divided into K segments from MSB to LSB, where K= ceil (N/log2L), L is the number of candidate overlaid OFDM sequences for one OOK ON chip.
	+ In one OOK ON chip, a segment of information bits is mapped to one sequence sequentially, e.g., for a segment of 2 information bits, 00 is mapped to sequence #1, 01 is mapped to seq #2.
	+ **In case N/log2L is not an integer, Bit 0 as MSB is used for padding**
 |

[9] proposes to revise the equation to derive CS for different sequences to increase CS among sequences, i.e., $n\_{cs}=\left⌊\frac{N\_{ZC}}{P}\left(c\_{m} mod P\right)\right⌋$

However, RAN1 already agreed the CS determination as shown below which can work properly. Therefore, FL suggests no further discussion on this issue.

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| **Agreement in RAN1#121**For mapping between a sequence index $c\_{m}$ and root value ($q\_{c\_{m}}$) & CS value ($n\_{cs, c\_{m}}$).$$q\_{c\_{m}}=q\_{i} , i=floor(\frac{c\_{m}}{P}), P=\frac{N\_{seq}}{N\_{root}}$$$$n\_{cs, c\_{m}}=n\_{cs, k}, where k=mod\left(c\_{m}, P\right) $$where cyclic shift value $n\_{cs, k}$is determined by$$n\_{cs, k}=k∗floor \left(\frac{B\_{ZC} }{P}\right), where k=0,…, P−1$$ |

1. LP-WUS operation for connected mode
	1. CSI/L1-RSRP report and measurement

**Background**:

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| **Agreement@RAN1#119 meeting**For Option 1-2, for LP-WUS CONNECTED mode operation, the periodic CSI/L1-RSRP reporting operation is same as Rel-16 DCP, that is the UE can be configured with a parameter to enable/disable periodic CSI/L1-RSRP reporting, respectively:* If the parameter is NOT configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is not reported.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
* **If the parameter is configured:**
	+ **If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time.**
	+ **If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.**
* FFS: Whether RAN1 spec impact is required.
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**For LP-WUS operation option 1-2,**

* [1] proposed to discuss and decide whether the UE performs CSI report during new active time.
* [2] proposed to clarify the condition for the case when the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured drx-onDurationTimer in DRX-Config for the case when UE is outside C-DRX active time.
* Condition: when *WUS\_PDCCHMonitoringTimer* has not been started during the time of the previous DRX cycle, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time when the parameter to enable/disable periodic CSI/L1-RSRP reporting is configured.
* [8], [14], [15] proposed that when the higher layer parameters are configured, whether UE receiving a wake-up indication or not within a DRX cycle (previous DRX cycle or within a (current) DRX cycle) should not have any impact on reporting P-CSI/L1-RSRP.

**TP#1 from [15]**

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| **Reason for change:** Unaligned understanding of UE behaviors on whether *lpwus\_PDCCHMonitoringTimer* impacts determination of most recent CSI measurement occasion and UE CSI reporting behavior when higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* is configured for LP-WUS option 1-2. **Summary of change:** Remove the condition of ‘[or *lpwus\_PDCCHMonitoringTimer* ]’ to confirm that when the parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* is configured for LP-WUS option 1-2, *lpwus\_PDCCHMonitoringTimer* does not impact the CSI measurement occasion determination and the CSI reporting behavior.**Consequence if not approved:** Unaligned understanding of UE behaviors on whether *lpwus\_PDCCHMonitoringTimer* impacts determination of most recent CSI measurement occasion and the CSI reporting behavior when higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* is configured for LP-WUS option 1-2. |
| ----------------------------------------- Text proposal for TS38.214-j00 clause 5.1.6.1--------------------------------5.1.6.1 CSI-RS reception procedure<omitted text>If the UE is configured with DRX and, - if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'cri-RSRP-Index', 'ssb-Index-RSRP' and 'ssb-Index-RSRP-Index' when *drx-onDurationTimer* in *DRX-Config* ~~[or~~ *~~lpwus\_PDCCHMonitoringTimer~~* ~~in [XYZxxx]]~~ is not started, the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* or *lpwus-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP' or 'cri-RSRP-Index' when *drx-onDurationTimer* in *DRX-Config* ~~[or~~ *~~lpwus\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ is not started, the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- otherwise, the most recent CSI measurement occasion occurs in DRX active time for CSI to be reported.--------------------------------------------- End of Text proposal for TS38.214 sec 5.1.6.1--------------------------------------------------------------------- Text proposal for TS38.214-j00 clause5.2.2.5 ------------------------------5.2.2.5 CSI reference resource definition<omitted text>When the UE is configured to monitor DCI format 2\_6 or WUS,- if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index ' when *drx-onDurationTimer* ~~[or~~ *~~lpwus\_PDCCHMonitoringTimer]~~*is not started, the UE shall report CSI with the *reportQuantity* not set to ‘ssb-Index-SINR’ or ‘ssb-Index-SINR-Index’ during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise;- if the UE is configured with a CSI report configuration containing a list of sub-configurations provided by *csi-ReportSubConfigToAddModList*, and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index' when *drx-onDurationTimer* *~~[~~*~~or~~ *~~lpwus PDCCHMonitoringTimer]~~*is not started, UE shall report a CSI report including one or more sub-reports only during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* outside DRX active time or in DRX Active Time, per sub-configuration, no later than CSI reference resource and drops the report otherwise, where the sub-configuration is the configured one for P-CSI reporting;- if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* or *lpwus-TransmitOtherPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', or 'ssb-Index-RSRP- Index' when *drx-onDurationTimer* ~~[or~~ *~~lpwus\_PDCCHMonitoringTimer]~~* is not started, the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when *reportQuantity* set to '*cri-RSRP'* or *'cri-RSRP*- *Index'* if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.--------------------------------------- End of Text proposal for TS38.214 clause 5.2.2.5------------------------------ |

**TP#2 from [2]**

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| ***Reason for change:*** | Clarify the the periodic CSI/L1-RSRP reporting operation for Option 1-2 for LP-WUS CONNECTED mode operation. In addition, clarify that LP-WUS operation option 1-1 and option 1-2 is based on the configuration of *lpwus-PDCCH-MonitoringTimer*. |
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| ***Summary of change:*** | Add condition for WUS operation option 1-2 that when *WUS\_PDCCHMonitoringTimer* has not been started during the time of the previous DRX cycle, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time when the parameter to enable/disable periodic CSI/L1-RSRP reporting is configured. LP-WUS operation option 1-2 is enabled if *lpwus-PDCCH-MonitoringTimer* is configured. |
|  |  |
| ***Consequences if not approved:*** | Not aligned with the intention of the agreement made in RAN1#119 meeting and cause additional UE power consumption.**Agreement**For Option 1-2, for LP-WUS CONNECTED mode operation, the periodic CSI/L1-RSRP reporting operation is same as Rel-16 DCP, that is the UE can be configured with a parameter to enable/disable periodic CSI/L1-RSRP reporting, respectively:* If the parameter is NOT configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is not reported.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
* If the parameter is configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
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| 5.1.6.1 CSI-RS reception procedure<omitted irrelevant text>If the UE is configured with DRX and, - if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'cri-RSRP-Index', 'ssb-Index-RSRP' and 'ssb-Index-RSRP-Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP or lpwus-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP' or 'cri-RSRP-Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- otherwise, the most recent CSI measurement occasion occurs in DRX active time for CSI to be reported.<omitted irrelevant text>5.2.2.5 CSI reference resource definition<omitted irrelevant text>When the UE is configured to monitor DCI format 2\_6 or WUS,- if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* *or lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index ' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the UE shall report CSI with the *reportQuantity* not set to ‘ssb-Index-SINR’ or ‘ssb-Index-SINR-Index’ during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise. - if the UE is configured with a CSI report configuration containing a list of sub-configurations provided by *csi-ReportSubConfigToAddModList*, and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* *or lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - UE shall report a CSI report including one or more sub-reports only during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time, per sub-configuration, no later than CSI reference resource and drops the report otherwise, where the sub-configuration is the configured one for P-CSI reporting.- if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* *or lpwus-TransmitOtherPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', or 'ssb-Index-RSRP- Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when reportQuantity set to 'cri-RSRP' or *'*cri-RSRP- *Index*' if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.<omitted irrelevant text> |

Before debating on the proposed TPs, it would be helpful to understand companies’ opinions on the unclear aspects of the agreement.

**[H][FL1] Question 4.1-1: Which aspect do you think is not clear for the highlighted parts below and how to complement it?**

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| Agreement@RAN1#119 meetingFor Option 1-2, for LP-WUS CONNECTED mode operation, the periodic CSI/L1-RSRP reporting operation is same as Rel-16 DCP, that is the UE can be configured with a parameter to enable/disable periodic CSI/L1-RSRP reporting, respectively:* If the parameter is NOT configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is not reported.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
* **If the parameter is configured:**
	+ **If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time.**
	+ **If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.**
* FFS: Whether RAN1 spec impact is required.

Agreement@RAN1#118bis meetingFor **Option 1-1** of LP-WUS CONNECTED mode operation, the followings are assumed from RAN1 perspective. * LP-WUS monitoring according to the LP-WUS monitoring configuration before drx-onDurationTimer to trigger the starting of the drx-onDurationTimer
* UE is configured with legacy C-DRX configurations as Rel-18
* UE behaviors related to CDRX active time triggered by all legacy DRX timers are not affected unless included in this proposal
* No impact on RRM/RLM/BFD measurement requirements is assumed
* For periodic CSI/L1-RSRP reporting, UE can be configured with one of the following (same as Rel-16 DCP)
	+ Periodic CSI/L1-RSRP is not reported during the time given by the configured drx-onDurationTimer if UE is not indicated to wake-up
	+ Periodic CSI/L1-RSRP is periodically reported during the time given by the configured drx-onDurationTimer regardless if UE is indicated to wake-up or not
		- Note: Periodic CSI/L1-RSRP is reported during CDRX active time as in legacy specification
 |

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| Company | Comments |
| Huawei, HiSilicon | Vivo’s TP seems reasonable, which can be the starting point for discussion. |
| vivo | Comparing the above agreements for option 1-1 and option 1-2 for P-CSI/L1-RSRP reporting when the parameter is configured,* Option 1-1 is Periodic CSI/L1-RSRP is periodically reported during the time given by the configured drx-onDurationTimer regardless if UE is indicated to wake-up or not
* **While for Option 1-2, it is different from Option 1-1, Option 1-1 is that regardless if the UE is indicated to wake up or not, the P-CSI/L1-RSRP is periodically reported during the DRX on duration time. Option 1-2 further splits into following cases**
	+ Case a: If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured drx-onDurationTimer in DRX-Config for the case when UE is outside C-DRX active time.
	+ Case b: If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.

The unclear aspect for option 1-2 is for Case a **during which time duration,** the UE is not indicated to wake up by LP-WUS, then the P-CSI/L1-RSRP is reported in drx onduration time that outside the C-DRX active time. We think TP#2 is to complement the previous RAN1 agreement while TP#1 is not aligned with previous RAN1 agreement.  |
| Qualcomm | We prefer TP#1 from [15], which reflects the agreement.The agreement says, “For Option 1-2, for LP-WUS CONNECTED mode operation, the periodic CSI/L1-RSRP reporting operation **is same as Rel-16 DCP**”. That is, the UE reports P-CSI/L1-RSRP in the slot(s) where running of drx-onDurationTimer is configured, regardless of whether or not the UE is indicated to wake up by the DCP/WUS.  |
| Apple | As the proponent, we think TP#1 from [15] is the understanding of the agreement. We have the same understanding as QC in the UE behavior. For vivo’s TP, the additional adding of conditions ‘lpwus-PDCCH-MonitoringTimer has not been started during the time of the previous DRX cycle in case lpwus-PDCCH-MonitoringTimer is configured, ’ was not mentioned in the agreement. We think this goes beyond what we agreed.  |
| ZTE, Sanechips | We share similar understanding with TP2, but the wording should be more simpler and should not touch legacy behavior, i.e., DCI format 2-6. An simplified way is as follows fore reference- if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'cri-RSRP-Index', 'ssb-Index-RSRP' and 'ssb-Index-RSRP-Index' when *drx-onDurationTimer* in *DRX-Config* ~~[~~or *lpwus\_PDCCHMonitoringTimer* in [XYZxxx] in previous DRX cycle~~]~~ is not started, the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;Additionally, for TP1, if we compare with the agreement, actually it is not aligned. |

* 1. TCI state for LP-WUS

**Background:**

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| **Agreement**For LP-WUS monitoring in RRC CONNECTED mode, when Rel-17 unified TCI framework is NOT configured or UE does NOT support Rel-17 unified TCI framework* Alt1: RRC provides the CORESET ID that UE shall derive the active TCI state for LP-WUS

**Agreement**The case where a UE does NOT supports Rel-17 unified TCI framework but supports LP-WUS is supported in Rel-19. For the TCI state of LP-WUS in RRC CONNECTED mode, select one of the following in RAN1#121 for this case:* Alt1: RRC provides the CORESET ID that UE shall derive the active TCI state for LP-WUS
* Alt2: RRC configures K TCI states for LP-WUS and new MAC-CE for TCI activation activates one of them

The case where a UE supports Rel-17 unified TCI framework and supports LP-WUS is supported in Rel-19. For the TCI state of LP-WUS in RRC CONNECTED mode,* When Rel-17 unified TCI framework is configured, LP-WUS follows the activated/indicated TCI-state by MAC-CE/DCI, same as other DL channels/signals (no change to DCI format)
* When Rel-17 unified TCI framework is NOT configured, select one of the following in RAN1#121 for this case
	+ Alt1: RRC provides the CORESET ID that UE shall derive the active TCI state for LP-WUS
	+ Alt2: RRC configures K TCI states for LP-WUS and new MAC-CE for TCI activation activates one of them

Same alternative to be chosen for both cases. |

Above agreements address the interaction between the WUS TCI state and Rel-17 unified TCI state. However, it has not been discussed whether/how WUS TCI state works with the SFN based PDCCH when *sfnSchemePDCCH* is configured with/without Rel-18 enhanced unified TCI (eUTCI) framework.

[2] proposed to discuss and select one from the following two options

* Option 1: Support the case where the CORESET ID provided for a UE to derive the active TCI state for LP-WUS has two activated TCI states, and UE should use the first TCI state for LP-WUS monitoring.
* Option 2: Do not support the case where the CORESET ID provided for a UE to derive the active TCI state for LP-WUS has two activated TCI states.

[11] proposed to support option 1 that UE should use the first TCI state for LP-WUS monitoring between the two activated TCI states.

FL suggests to first discussion the options, then draft the TP based on the agreed option.

**[H][FL1] Proposal 4.2-1: Down-select from the following two options:**

* **Option 1: Support the case where the CORESET ID provided for a UE to derive the active TCI state for LP-WUS has two activated TCI states, and UE should use the first TCI state for LP-WUS monitoring.**
* **Option 2: Do not support the case where the CORESET ID provided for a UE to derive the active TCI state for LP-WUS has two activated TCI states.**
* **Note: it means the CORESET ID provided by the NW for a UE to derive the active TCI state for LP-WUS has one activated TCI state.**

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| --- | --- | --- |
| Company | Support option 1 or option 2 | Comments |
| Huawei, HiSilicon |  | Either way is fine to us. However, option 2 may restrict gNB configuration even for legacy signal. Thus option 1 may be slightly better. |
| vivo | Option 2 | In our view, even though MR can support the SFN based PDCCH reception, it may not be possible for LR to support the SFN based WUS monitoring. Therefore, both option 1 and option 2 above can work for LR monitoring WUS using one TCI state. Between option 1 and option 2, we prefer option 2. For option 1, if CORESET has two active TCI states, it is not friendly or proper for netwrok to always use the first TCI state for LP-WUS transmission.  |
| Ofinno | Option 1 | As mentioned by Huawei we feel that option 2 restricts the gNB configuration unnecessarily. For vivo’s comment we are not sure why LP-WUS should be treated with different behavior compared with other legacy default TCI state operation (e.g., for PUSCH/PUCCH power control). We feel that using the first TCI state in case the CORESET has two activated TCI states does not cause any issue for the network.  |
| Qualcomm |  | We prefer not to disable/disallow LP-WUS operation in case the UE is configured with SFN for PDCCH, especially for HST scenario. Option 1 essentially disables SFN for LP-WUS reception even when SFN is enabled for PDCCH/PDSCH. Option 2 disallows SFN for PDCCH when LP-WUS is configured.Instead, we suggest to consider the following option:**Option 3: If the CORESET ID provided for a UE to derive the active TCI state for LP-WUS where the CORESET has two activated TCI states, it is up to UE implementation which/how to use the active TCI states of the CORESET for LP-WUS reception.** |
| Apple  | Option 1 | We think the use case is needed to support LP-WUS in the high-speed scenario. Option 1 is more aligned with legacy behaviors.  |
| ZTE, Sanechips | Option 1  |  |

Another TP proposed by [11] is to Update Section 10.4D to add that the UE should refer to the most recent TCI state also indicated by RRC.

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| **10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**A UE configured with DRX mode operation and operating in the RRC\_CONNECTED state can be provided for WUS reception on the primary cell of a cell group- a number of OOK symbols per OFDM symbol, a first RB, and overlaid OFDM sequences per OOK symbol for WUS reception [4, TS 38.211], and- a number of codepoints provided for the UE by the WUS [6, TS 38.212], by *WUS-codepointCONNECTED* A UE assumes that a WUS is quasi co-located with an SS/PBCH block or a CSI-RS with respect to quasi co-location 'typeC' or 'typeD' properties, when applicable. If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI state~~s~~ indicated by a most recent DCI format, ~~or~~ MAC CE, or RRC, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*. |

**[H][FL1] Proposal 4.2-2: support the following TP**

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| Company | Y/N | Comments |
| Huawei, HiSilicon | N | Per our understanding, the sentence here only touches the case where the TCI state is indicated (activated) by dynamic signaling. Thus, this change is not needed.On the other hand, it is questionable whether RRC configuration has a clear application time. From this point of view, this change also has its own technical problem. |
| vivo | Y |  |
| Ofinno | Y | We are not sure we understand the comment from Huawei. What does the UE do if RRC configures only one TCI state and therefore there is no DCI/MAC-CE for TCI state indication/activation? UE should not use the TCI state configured by RRC for LP-WUS monitoring? For the comment on application time if necessary we could clarify this part. For example, we could update the TP as follows if it addresses the concern: If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI state~~s~~ indicated by a most recent DCI format, ~~or~~ MAC CE, or RRC, after a respective application time **if applicable**; |
| Qualcomm |  | The intention of the proposal is ok, but the TP seems needing improvement. We suggest the following:If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states provided by the *ABC*, and if applicable, indicated by a most recent DCI format or MAC CE, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*. |
| Apple |  | QC’s version seems better and does not cause confusion for the application time.  |
| ZTE, Sanechips |  | This TP or Qualcomm’s revision is fine with us. |

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| **Reason for change:** A UE may be indicated with a most recent TCI state by an RRC message. The current specification indicates the UE should use the most recent TCI state indicated by DCI or MAC-CE. However, this may lead to a UE using an outdated TCI state for monitoring the LP-WUS. Additionally, the UE can only be indicated with one TCI state in the Rel-17 unified TCI framework, whereas the current specification indicates the UE may have multiple indicated TCI states. **Summary of Change:** Change #1: Update Section 10.4D to add that the UE should refer to the most recent TCI state also indicated by RRC.Change #2: Change TCI states to TCI state to clarify only one TCI state can be indicated. **Consequences if not approved:** UE may use an incorrect TCI state for monitoring LP-WUS and may miss LP-WUS reception.  |
| **10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**A UE configured with DRX mode operation and operating in the RRC\_CONNECTED state can be provided for WUS reception on the primary cell of a cell group- a number of OOK symbols per OFDM symbol, a first RB, and overlaid OFDM sequences per OOK symbol for WUS reception [4, TS 38.211], and- a number of codepoints provided for the UE by the WUS [6, TS 38.212], by *WUS-codepointCONNECTED* A UE assumes that a WUS is quasi co-located with an SS/PBCH block or a CSI-RS with respect to quasi co-location 'typeC' or 'typeD' properties, when applicable. If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI state~~s~~ indicated by a most recent DCI format, ~~or~~ MAC CE, or RRC, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*. |

* 1. Cases where MR/LP-WUR cannot work simultaneously

**Background:**

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| **Agreement:**As the initial reply to RAN2 LS in R1-2503616, RAN1 confirms that at least the collision with Active Time, measurement gap, and RAR window monitoring for BFR can be considered for the cases/scenarios on when the UE is not able to monitor LP-WUS.**Agreement:**As the reply to RAN2 LS in R1-2503616, RAN1 assumes that UE is not able to operate LR and MR simultaneously in Rel-19. RAN1 understanding is that the terminology of LR and MR operations are for discussion purpose and will not be specified* LR operation is the UE operation for LP-WUS monitoring
* MR operation is the UE operation for all other NR signals/channels transmissions/receptions in connected mode

**Conclusion**From RAN1 perspective, for the case of potential collision (if any) in Option 1-2, when the UE is not able to monitor all the LP-WUS MO(s) in a LP-WUS periodicity,* It is up to RAN2 to further discuss and finalize the specification support, if any.
 |

Companies provide views on additional collisions caused by MR activities as follows:

|  |  |
| --- | --- |
| **MR activity** | **Companies’ views** |
| 1) Interruption caused by BWP switching  | * [3]: it is NOT collision and BWP fallback timer is stopped/suspended when UE monitors LP-WUS
* [5]: it is NOT collision
 |
| 2) PDCCH monitoring associated with PDCCH CSS/USS sets  | * [3]: viewed as collision and gNB explicitly configures whether the symbols of a CORESET/SS can be available symbol for LP-WUS, if the CORESET/SS and LP-WUS overlap in frequency domain, need new RRC parameter
* [5]: up to UE implementation to monitor the PDCCH on the resource that is non-overlapped with LP-WUS resource. No need to explicitly handle the PDCCH CSS sets except for a Type3-PDCCH CSS set considering monitoring of such CSS sets is infrequently
* [12] (Type0 CSS)
* [2]: need new RRC parameter on symbol level offset
	+ offset\_MO\_withinSlot\_Option 1-1, which is used to configure the starting time location of the first LP-WUS MO in a periodicity by a symbol level offset w.r.t. the start of the slot determined by the LPWUS\_MO\_CONNECTED\_Option1-1.
		- The candidate value range could be {0,…,13} OFDM symbols
	+ offset\_firstMO\_withinSlot\_Option 1-2, which is used to configure the starting time location of the first LP-WUS MO in a periodicity by a symbol level offset w.r.t. the start of the slot determined by the LPWUS\_MO\_CONNECTED\_Option1-2.
		- The candidate value range could be {0,…,13} OFDM symbols
 |
| 3) SPS/CG transmission  | * [3]: viewed as collision
* [5]: viewed as collision, but current description on UL symbol can already cover the CG case. SPS case needs to be covered
* [10]: considered as unavailable for LP-WUS MO
* [12], [14]: The UE is not expected to be able to monitor LP-WUS overlapping SPS PDSCH monitoring
 |
| 4) periodic CSI/L1-RSRP transmission | * [3,] [14]: UE cannot monitor LP-WUS in resources associated with periodic-CSI/L1-RSRP transmission resources
* [10]: considered as unavailable for LP-WUS MO
* [5]: viewed as collision, but current description on UL already cover such case
 |
| 5) SR, PRACH, CG-PUSCH transmission | * [3]: already agreed
* [5]: viewed as collision, but current description on UL already cover such case
* [10]: considered as unavailable for LP-WUS MO
 |
| 6) When drx-HARQ-RTT-TimerDL, drx-HARQ-RTT-TimerUL is running | * [3]: it is NOT collision. During these time duration, UE is not in C-DRX Active Time, in which MR is not working at all.
* [5]: it is NOT collision
 |
| 7) When UE is performing synchronization before C-DRX ON  | * [3],[5]: it is NOT collision and already covered by the minimum time gap
 |
| 8) During LR and MR switching time or during time gap in TDD UL/DL switching or RX/TX transition | * [3], [5]: already agreed
* [4]: If the UE receives a LP-WUS indicating PDCCH monitoring, and the ending time of LP-WUS is just before or overlapped with SPS PDSCH in time domain, the wake-up delay needed before starting PDCCH monitoring can be 0
* [5] : Time gap in TDD UL/DL switching if the UE is not capable of full-duplex communication
* [12] :
* When UE needs to transmit, it needs to have necessary functionality activated, thus WUS monitoring is not necessary, and no special handling for UL/DL symbols is needed.
* As UE can choose whether it monitors LP-WUS or PDCCH (when above entry conditions), UE can ensure that there is sufficient gap between reception and transmission to enable transmission when needed.
 |
| 9) Ongoing PDSCH reception or PUSCH transmission (dynamically scheduled) | * [3]: typically happened within DRX active time and well controlled by gNB
* [5]: up to gNB implementation to ensure there is no collision
 |
| 10) Msg3/MsgA PUSCH transmission | * [3]: covered by previous agreement that PRACH can trigger PDCCH according to the legacy UE behaviour
* [5]: same as DG PDSCH/PUSCH, no collision
 |
| 11) RRM measurement | * [3]: Support the gNB configuration of measurement windows, only in which the symbols of CSI-RS, SMTC and/or measurement gaps are regarded as unavailable symbols for LP-WUS monitoring
* [5]: no need to explicitly handle such case. It can be up to gNB implementation to configure sufficient number of CSI-RS within a period, or configure SSB as the RRM-related RS, and can up to UE implementation to monitor RRM-related RS without overlap with LP-WUS resource.
* [10]: considered as unavailable for LP-WUS MO
 |

From FL’s understanding, for the cases within active time, UE behavior is clear based on the spec 213, section 10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED that “A UE does not monitor a WUS during Active Time [11, TS 38.321].” No further discussion is needed for the cases within active time.

Then for the following cases outside active time,

* Case 1: MR is transmitting or receiving all other NR signals/channels
	+ All collision cases belong to case 1 does not need further discussion based on the agreement and LS reply to RAN2
* Case 2: MR is NOT transmitting or receiving all other NR signals/channels, but
	+ Case 2-1: MR is performing Tx/Rx switching, or BWP switching
	+ Case 2-2: MR is running BWP inactivity timer

In FL’s understanding, Case 2 is not covered by the existing agreements and further discussion is needed. Companies can provide your views, if there is a need and how to handle the case 2, e.g., follow case 1 behavior or other behavior?

**[H][FL1] Proposal 4.3-1: Confirm that all the collision cases when MR is in active time and when MR is performing transmission or reception outside active time are covered by the existed agreements , no need to further discuss the LR/MR collisions for such cases.**

**Agreement:**

As the reply to RAN2 LS in R1-2503616, RAN1 assumes that UE is not able to operate LR and MR simultaneously in Rel-19. RAN1 understanding is that the terminology of LR and MR operations are for discussion purpose and will not be specified

* LR operation is the UE operation for LP-WUS monitoring
* MR operation is the UE operation for all other NR signals/channels transmissions/receptions in connected mode

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| Company | Y/N | Comments |
| Huawei, HiSilicon | N | Though the cases can be covered by previous agreement in general, we still need to discuss which particular cases belongs to the Case 1. Also, the interruption time due to the collision should also be discussed. For example, if there are some collisions due to RRM measurement, during which symbols the LR cannot monitor LP-WUS? Should these symbols be viewed as unavailable resource, or LR skip the LP-WUS monitoring in the LP-WUS MOs overlapping with these symbols?Detailed UE behavior is missing in previous agreements, as well as current spec.Therefore, we suggest that we spend more time to discuss the details of Case 1, which is significantly essential for CONNECTED mode design. (and which may also impact the UE feature discussion.) |
| vivo | Y |  |
| CMCC |  | We share similar view with HW that previous agreement is general. Therefore, we suggest the following direction to solve this issue:* For specific DL channels/signals, companies are encouraged to figure out all potential cases and generate a unified solution to solve all issues in one shot.
* For specific UL channels/signals, since it is already agreed that UL symbols are unavailable for LP-WUS, all cases should be already included and well captured in spec.
 |
| Qualcomm | Y | Agree with FL. The agreement is clear already and no need to spend more time.Whether or not to consider MR active time as “unavailable” for LR is a separate issue. |
| Apple | Y | Same view as FL. We are wondering what are the exact proposals if further discussion are started. |
| ZTE, Sanechips |  | We should list all the cases and discuss case by case. For example, whether the UE could monitor LP-WUS when perform measurement, monitoring common search space, receiving SSB. These aspects should be reflected in the spec, not just an agreement. |

**[H][FL1] Question 4.3-2: For Case 2: MR is NOT transmitting or receiving all other NR signals/channels outside active time, but**

* **Case 2-1: MR is performing Tx/Rx switching, or BWP switching**
* **Case 2-2: MR is running BWP inactivity timer**

**Is there any missing cases belong to Case 2?**

**Whether/ how to handle Case 2, e.g., follow case 1 behavior or other behavior?**

|  |  |
| --- | --- |
| Company | Comments |
| Huawei, HiSilicon | For Tx/Rx switching, we don’t think it leads to much collision. If there is no really UL transmission in the UL slots/symbols, the switching time does not matter. If there is UL transmission, MR can wakeup in advance, but does not transmit/receive. Then there is only retuning time needed. The retuning time can be further discussed together with UL transmission.For BWP switching, we think there is no need to define the interruption caused by BWP switching as collision. Instead, BWP switching can be avoided when UE monitors LP-WUS. Technically, only timer based BWP switching (instead of DCI/RRC based BWP switching) can appear during LP-WUS monitoring, which is a fallback operation to the default/initial DL BWP for power saving purpose. However, from our point of view, the power consumption of LP-WUS monitoring in a non-default/non-initial BWP would be smaller than PDCCH monitoring in a default/initial BWP. Therefore, it is not necessary to configure a fallback timer for a BWP which is enabled with LP-WUS monitoring. Thus, we suggest to stop/suspend BWP fallback timer when UE monitors LP-WUS, and then the interruption by BWP switching does not exist, and there is no collision at all. |
| vivo | We are open to discuss Case 2 and OK to handle Case 2 in the same way as Case 1.  |
| CMCC | For Tx/Rx switching, we share similar view with HW that the retuning time between DL/UL and UL/DL should be discussed.For BWP switching, we share same view with HW and fail to see the potential issue. |
| Qualcomm | We are not sure why BWP inactivity timer is considered as the MR operation for all other NR signals/channels transmissions/receptions. It is a logical timer that is running no matter whether the UE has transmissions/receptions. Switching of MR is different; MR is switched for UE to transmit/receive something.Therefore, we think Case 2-1 is part of MR operation and case 2-2 is not part of MR operation in the agreement. We think this is already clear and no need to spend time.  |
| Apple | At least for BWP inactivity timer case, RAN2 agreed the following in last meeting: * RAN2 assume UE does not start or re-start the bwp-InactivityTimer when receiving the LP-WUS.

For Case 2-1, we think the behavior is similar to Case 1, however, keeping it general is enough as in Proposal 4.3-1.  |
| ZTE, Sanechips | For case 2-1, We do not expect to change the BWP related behavior due to LP-WUS introduction, which would introduce additional implementation difficulty. Therefore, Tx switching or BWP switching should have similar handling. Additionally, it is not only related to UE power consumption when BWP performs switching, also related to gNB resource allocation and power consumption, and common signal reception. Therefore, case 2-1 should be discussed and treated as the same way.For case 2-2, we could follow RAN2’s agreement.  |

* 1. Gap for two consecutive WUS MOs (idle/inactive same issue)

**Background**

|  |
| --- |
| **Agreement*** Update previous agreement in red:

**Agreement*** For LP-WUS MOs in connected mode for Option 1-2, support Approach 1:
	+ LP-WUS MOs, including a periodicity and a time offset3, are configured independently from the C-DRX periodicity/offset by new RRC parameter(s).
		- ~~FFS one or multiple MOs per periodicity~~
		- UE is configured with a number of MOs for the periodicity by RRC
	+ UE monitors LP-WUS in the LP-WUS MOs and, if triggered to wake up, starts a new timer for PDCCH monitoring triggered by LP-WUS
		- ~~FFS: Definition of time offset4~~
		- Alt1:
			* ~~The~~A time offset4 configured by the network indicating a time from the first LP-WUS MO per periodicity, after which the UE starts PDCCH monitoring via starting the new timer.
			* The time gap from the last LP-WUS MO per periodicity and the start of new timer is not smaller than the minimum time gap given based on UE capability
 |

Regarding the remaining discussion point for more than one LP-WUS monitoring occasions per periodicity for Option 1-2, companies provide views as follows:

* [3]: For any of the first M-1 MOs within a period in option 1-2, if the X2-th available symbol of a MO is not the last one OFDM symbol of the MO, there is no gap needed after this MO; otherwise, there is a one-OFDM-symbol gap after the MO
	+ X2 is the number of actual OFDM symbols for LP-WUS transmission
	+ M is provided by numMO-perPeriodicity-Option 1-2
* [2], [17]: UE does not expect to monitor a LP-WUS in the last symbol of a nominal MO and another LP-WUS in the first symbol of the next nominal MO.
* [12], [17]: The gap between two consecutive actual WUS and WUS and LPSS can be handled by nominal MO configuration.
* [10]: Do not introduce any gap between adjacent MOs within a periodicity in CONNECTED mode. Since without gaps, the UE still can monitor at least one WUS occasion to maintain system operation.
* [8]: Support a configurable time interval between two consecutive MOs by a new RRC parameter *lpwus-Interval-MO12.*

Consider same issue is under discussion in idle/inactive procedure, FL suggests to hold this issue here until there is progress in idle/inactive procedure

* 1. Reference point for available symbols in Connected Mode

[7],[8] proposed the similar text proposal as agreed for idle/inactive mode for adding description reference point of applied bitmap for connected mode. Therefore, following proposal is made.

**[H][FL1] Proposal 4.5-1: For RRC CONNECTED mode adopt the following TP to clarify reference point for available symbols.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| Huawei, HiSilicon | Y |  |
| vivo | Y |  |
| Qualcomm | Y |  |
| Spreadtrum | Y |  |
| Apple | Y |  |
| ZTE, Sanechips | Y |  |

|  |
| --- |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.1.0-----------------------**10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**<Unchanged parts are omitted>A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units includes a total of either 10, or 20, or 40 time units. A duration $P$, in msec, of the set of time units has maximum value of 40 msec. The first symbol of the set of time units every 40 msec/$P$ periods is a first symbol in frame $n\_{f}$ mod 4 = 0. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon |

|  |  |
| --- | --- |
| ***Reason for change:*** | The use of the bitmap for indicating unit-level unavailable resources is not defined for RRC\_CONNECTED mode |
| ***Summary of change:*** | Add the UE behavior for using the bitmap. |
| ***Consequences if not approved:*** | The UE behavior for using the bitmap is not specified.  |

* 1. Behavior for UE with basic capability for the case of WUS resource is outside the active BWP

[4] proposed to clarify that for RRC connected, for a UE with basic capability, if BWP switching happens and leads to the case that LP-WUS resource is outside of the new DL active BWP, UE will fall back to legacy C-DRX operation behaviours for both Option 1-1 and Option 1-2.

|  |
| --- |
| 38.321 **5.7 Discontinuous Reception (DRX)**2> else if LP-WUS monitoring is configured:3> if *lpwus-PDCCH-MonitoringTimer* is not configured:4> if LP-WUS indication associated with the current DRX cycle received from lower layer indicates to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or4> if the UE is unable to monitor all LP-WUS monitoring occasion(s), as specified in TS 38.213 [6], due to conflicts with other activities (e.g. all LP-WUS monitoring occasion(s) are associated with the current DRX cycle occurred in Active Time of any DRX group considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last LP-WUS occasion, or during a measurement gap, or during a MUSIM gap or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4)):5> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.2> else:3> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.1> if LP-WUS monitoring is configured and the *lpwus-PDCCH-MonitoringTimer* for this DRX group is configured:2> if LP-WUS indication received from lower layer indicates to start *lpwus-PDCCH-MonitoringTimer*, as specified in TS 38.213 [6]:3> start *lpwus-PDCCH-MonitoringTimer* from the beginning of the subframe as specified in TS 38.213 [6].NOTE 2: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration.NOTE X1c: In case LP-WUS monitoring is configured and the *lpwus-PDCCH-MonitoringTimer* for this DRX group is configured, if the UE is unable to monitor LP-WUS monitor occasion(s), it does not start the *lpwus-PDCCH-MonitoringTimer*. |

In FL’s understanding, when UE is unable to monitor WUS is due to 1) conflicts with other activities and for such case, it is clear captured in RAN2 spec., 2) due to UE capability that incapable to monitor the WUS outside the active BWP, for such case, it is better to clarify the UE behavior.

**[H][FL1] Proposal 4.6-1: For RRC connected, for a UE incapable of monitoring the LP-WUS that is configured outside the active BWP, UE will fall back to legacy C-DRX operation behaviors for both Option 1-1 and Option 1-2.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| Huawei, HiSilicon | N | As we commented below Question 4.3-2, if BWP fallback timer can be stopped/suspended, this issue does not exist at all.Most importantly, the BWP fallback timer is meaningless (which may lead to even negative power saving gain) when UE is monitoring LP-WUS. |
| vivo | Y |  |
| Qualcomm | Y | We do not think BWP inactivity timer can be stopped/suspended. This is beyond maintenance.  |
| Spreadtrum | Y |  |
| Apple | Y |  |
| ZTE, Sanechips | N | First, the gNB would not be so stupid to configure LP-WUS outside the active BWP for a UE incapable of outside BWP LP-WUS monitoring.Second, if BWP switching happens and the LP-WUS becomes outside the active BWP, the UE also is possible to fall back to always on monitoring. In this case, we can simply say UE does not monitor LP-WUS.  |

* 1. Editorial correction

[1] proposed to clarify the application time for the TCI state activated by the DCI format or MAC CE and proposed following TP

|  |
| --- |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------10.4 DPDCCH monitoring activation by WUS in RRC\_CONNECTED<Unchanged Text Omitted>If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states indicated by a most recent DCI format or MAC CE, after a respective application time in clause 5.1.5 [6, TS 38.214]; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*. <Unchanged Text Omitted>---------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0----------------------- |

**[H][FL1] Proposal 4.7-1: Adopt the TP above.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
|  Huawei, HiSilicon | Y |  |
| Qualcomm | Y |  |
| Spreadtrum | Y |  |
| ZTE, Sanechips | Y |  |

[9] proposed following TPs for connected mode

|  |
| --- |
| * **Reason for change**: The unit of minimum time gap in the specification is incorrect
* **Summary of change:** Change the unit of minimum time gap in sub-clauses 10.4D of TS 38.213
* **Consequences if not approved**: Incorrect UE report in the specification
 |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------10.4 DPDCCH monitoring activation by WUS in RRC\_CONNECTED<Unchanged parts are omitted>The UE reports a number of ~~slots~~ ms [18, TS 38.306] where the UE is not required to monitor WUS prior to the slot where the *drx-onDurationTimer* would start.<Unchanged parts are omitted>---------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0----------------------- |

**[H][FL1] Proposal 4.7-2: Adopt the TP above.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
|  Huawei, HiSilicon | Y |  |
| vivo | Y |  |
| Qualcomm | Y |  |
| Spreadtrum | Y |  |
| ZTE, Sanechips | Y with update | Maybe ‘milliseconds’ instead of ‘ms’ |

|  |
| --- |
| * **Reason for change**: The description of UE behavior on WUS monitoring in option 1-2 in the specification is not clear
* **Summary of change:** Change the description of UE behavior on WUS monitoring in option 1-2 in sub-clauses 10.4D of TS 38.213
* **Consequences if not approved**: Misleading UE behavior on WUS monitoring in option 1-2.
 |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED<Unchanged parts are omitted>A UE can be provided by *lpwus-Mo12* a periodicity, by *periodicityMO-Option 1-2*, and a time offset, by *offsetMO-Option 1-2*, relative to the start of a system frame with SFN 0, for the UE to determine the first WUS monitoring occasion~~s~~ from a number of WUS monitoring occasions per periodicity, provided by *lpwus-NumOfMo12*.<Unchanged parts are omitted>---------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0----------------------- |

**[H][FL1] Proposal 4.7-3: Adopt the TP above.**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
|  Huawei, HiSilicon | N for now | We can discuss this part after we get the agreements on how to determine the MOs (i.e., the discussion in 4.4). |
| vivo | Y |  |
| Qualcomm | Y |  |
| Apple | Y |  |
| ZTE, Sanechips | Y |  |

|  |
| --- |
| * **Reason for change**: RRC parameters in the specification are incorrect
* **Summary of change:** Fixed RRC parameter names in sub-clauses 10.4D of TS 38.213
* **Consequences if not approved**: Incorrect RRC parameter names in the specification
 |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------<Unchanged parts are omitted>10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTEDA UE configured with DRX mode operation and operating in the RRC\_CONNECTED state can be provided for WUS reception on the primary cell of a cell group- a number of OOK symbols per OFDM symbol, a first RB, and overlaid OFDM sequences per OOK symbol for WUS reception [4, TS 38.211], and- a number of codepoints provided for the UE by the WUS [6, TS 38.212], by *WUS-codepoint\_CONNECTED* A UE assumes that a WUS is quasi co-located with an SS/PBCH block or a CSI-RS with respect to quasi co-location 'typeC' or 'typeD' properties, when applicable. If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states indicated by a most recent DCI format or MAC CE, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *~~WUS\_TCI\_states\_CONNECTED~~* *lpwus-TCI-States*. A UE assumes that an SCS configuration for WUS receptions is same as an SCS configuration for the active DL BWP.A UE does not monitor a WUS during Active Time [11, TS 38.321].A UE does not monitor WUS during DTX inactive period for the primary cell.A UE can be provided by *~~WUS-MOCONNECTED-Option1-1~~ lpwus-Mo11* a periodicity, by *periodicityMO-Option 1-1*, and a time offset, by *offsetMO-Option 1-1*, relative to the start of a system frame with SFN 0, for the UE to determine WUS monitoring occasions. The UE starts to monitor WUS in a first WUS monitoring occasion that is not earlier than a first slot that is prior to a second slot where the *drx-onDurationTimer* would start by a time provided by *timeOffsetCONNECTEDOption1-1*, and monitors WUS for a number of monitoring occasions provided by *~~numMO-Option 1-1~~ lpwus-NumOfMo11*. The UE reports a number of ~~slots~~ ms [18, TS 38.306] where the UE is not required to monitor WUS prior to the slot where the *drx-onDurationTimer* would start. The UE is not required to monitor WUS within the reported number of slots prior to the slot where the *drx-onDurationTimer* would start. If the UE determines to monitor PDCCH based on a detected WUS, the UE starts the *drx-onDurationTimer* [11, TS 38.321].A UE can be provided by *~~WUS-MOCONNECTED-Option1-2~~* *lpwus-Mo12* a periodicity, by *periodicityMO-Option 1-2*, and a time offset, by *offsetMO-Option 1-2*, relative to the start of a system frame with SFN 0, ~~for the UE to determine first WUS monitoring occasions from a number of WUS monitoring occasions per periodicity~~ for the UE to determine the first WUS monitoring occasion of a number of WUS monitoring occasions per periodicity, provided by *~~numMO-perPeriodicity-Option 1-2~~ lpwus-NumOfMo12*. The UE reports a number of ~~slots~~ ms [18, TS 38.306] and expects that a time gap, from a last WUS monitoring occasion from the number of WUS monitoring occasions per periodicity to the slot where the *wus-PDCCHMonitoringTimer* would start, is no smaller than the reported number of slots. If the UE determines to monitor PDCCH based on a detected WUS, the UE starts *wus-PDCCHMonitoringTimer* [11, TS 38.321] after a time, provided by *timeOffsetCONNECTEDOption1-2*, with respect to the start of the first WUS monitoring occasion from the number of WUS monitoring occasions per periodicity. A UE can be provided, by *~~WUS\_available\_slot\_CONNECTED~~* *lpwus-AvailableSlot*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *~~WUS\_available\_symbol\_CONNECTED~~* *lpwus-AvailableSymbol*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_slot\_CONNECTED~~* *lpwus-AvailableSlot*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *~~WUS\_available\_symbol\_CONNECTED~~ lpwus-AvailableSymbol*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommonA WUS monitoring occasion is over a first number of symbols, provided by *~~WUS\_NominalMO\_duration\_CONNECTED~~* *lpwus-NominalMoDuration*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *~~WUS\_ActualMO\_duration\_CONNECTED~~* *lpwus-ActualDuration*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *~~WUS\_ActualMO\_duration\_CONNECTED~~ lpwus-ActualDuration* symbols in the WUS monitoring occasion. If a UE detects a codepoint in a WUS reception, from the number of codepoints, on the primary cell of the cell group, the UE starts monitoring PDCCH on all applicable serving cells of the cell group. <Unchanged parts are omitted>--------------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0 ------------------ |

The above TP includes updates of the higher-layer parameters based on RAN2 running CR, considering ASN.1 would be frozen in RAN2 in two meetings and there would be potential changes, FL suggests handling such parameters misalignment across specs after ASN.1 frozen.

**[H][FL1] Question 4.7-4: Do you agree on handling higher-layer parameter name misalignment across specs after ASN.1 frozen?**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| Huawei, HiSilicon | Y | It can be left to editors. |
| vivo | Y |  |
| Qualcomm | Y |  |
| Apple | Y |  |
| ZTE, Sanechips | Y | OK to left to editor |

* 1. Handling of RAN2 LS

RAN2 sent an LS to RAN1 in R2-2506550, see following:

|  |
| --- |
| **1 Overall description**In RAN2#131 meeting, RAN2 discussed the support of LP-WUS with dual DRX group in CA and the RAN1 agreement on not supporting simultaneous LR and MR operation, and made the following agreements:* **LP-WUS can be configured on the PCell with secondary DRX. LP-WUS with secondary DRX is supported with option 1-1 and 1-2, i.e. the UE monitors LP-WUS before the on-duration occasion or periodically outside ActiveTime. When LP-WUS is detected, then UE starts the drx-onDurationTimer (with option 1-1) or the lpwus-PDCCHMonitoringTimer (with option 1-2) in both DRX groups.**
* **If secondary DRX group is configured, UE monitors LP-WUS only when both DRX groups are not in DRX active time.**
* **If secondary DRX group is configured, the lpwus-PDCCH-MonitoringTimer configuration for secondary DRX group is different from that for the default DRX group.**
* **The lpwus-PDCCH-MonitoringTimer configuration for secondary DRX group is smaller than or equal to that for the default DRX group.**
* **RAN2 understand that the RAN1 agreement on not supporting simultaneous LR and MR operation is only applicable within one cell group (with or without secondary DRX group configuration).**

 **2 Actions****To RAN1:****ACTION:** RAN WG2 respectfully asks RAN WG1 to take the above agreements into account in their future work. |

[12] and [18] discussed this LS.

* [12] proposed RAN1 to discuss and agree whether the UE can support LP-WUS monitoring configuration **per DRX group**, subject capability, or whether LP-WUS monitoring can only be configured to one DRX group at a time. Depending on the outcome, send RAN2 an LS response to revise their agreements.
	+ **In FL’s understanding, for dual DRX group in CA , from the first 4 bullets in RAN2 LS, LP-WUS monitoring configuration per DRX group is not supported. Further, RAN2’s understanding on not supporting simultaneous LR and MR operation is only applicable within one cell group is for DC (Dual Connectivity) case.**
* [18] propose to confirm RAN2’s understanding that the RAN1 agreement on not supporting simultaneous LR and MR operation is only applicable within one cell group (with or without secondary DRX group configuration)

**[H][FL1] Proposal 4.8-1: Send reply LS to RAN2 to confirm RAN2’s understanding that RAN1 agreement on not supporting simultaneous LR and MR operation is only applicable within one cell group (with or without secondary DRX group configuration).**

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comments |
| Huawei, HiSilicon | Y | We share the similar view as FL that RAN2’s LS seems not to imply simultaneously monitoring of LP-WUS in both DRX group. |
| vivo | Y |  |
| Qualcomm | N | We do not think reply LS is necessary. It is not requested by RAN2 in their LS. Furthermore, RAN1 concluded the following, and the WI has been closed without further update. No new agreement or discussion is necessary from RAN1 perspective, unless we see a critical issue in RAN2 agreement, which we do not think is the case.**Conclusion*** For the case when UE is configured with CA with dual DRX groups in RRC CONNECTED mode, at least for LP-WUS procedure Option 1-1, there is no consensus in RAN1 which of the following options to support for this case in Rel-19.
	+ Alt1
		- Basic capability
			* LP-WUS can be configured only on PCell
			* LP-WUS indication is applicable to all serving cells of all DRX groups.
				+ Note: There is no impact to PDCCH monitoring behaviour related to SCell dormancy/activation/deactivation
		- Advanced capability
			* LP-WUS can be configured on PCell for primary DRX group and an activated SCell for secondary DRX group
			* LP-WUS indication is applicable to all serving cells in the DRX group where LP-WUS is monitored
				+ Note: There is no impact to PDCCH monitoring behaviour related to SCell dormancy/activation/deactivation
			* This capability has prerequisite of the above basic capability
	+ Alt2
		- LP-WUS can be configured on PCell for primary DRX group and/or an activated SCell for secondary DRX group
		- LP-WUS indication is applicable to all serving cells in the DRX group where LP-WUS is monitored
			* Note: There is no impact to PDCCH monitoring behaviour related to SCell dormancy/activation/deactivation
		- This capability has candidate values for the LP-WUS configuration with {primary DRX group, secondary DRX, both}
 |
| Spreadtrum | Y |  |
| Apple | Y | We prefer to send the LS to inform RAN2 of the same understanding. |
| ZTE, Sanechips | N | No need. RAN2 just inform us, not ask us to feedback. If we disagree with their understanding, we would have the need to send the LS. |

* 1. Others
		1. Other remaining issues

[16] proposed to introduce an optional UE capability on supporting nominal WUS MO duration (X1, in unit of OFDM symbols) > actual LP-WUS duration (X2, in unit of OFDM symbols).

* If the UE does not report the UE capability signalling, then X1 = X2, i.e.,
* A LP-WUS spans a number of consecutive OFDM symbols according to the configured LP-WUS duration
* If there is at least one OFDM symbol unavailable for the LP-WUS MO within the OFDM symbols where the LP-WUS would span, the UE does not monitor the LP-WUS in the MO

**[****M][FL1] Question 4.9-1: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon | No | Frist, ‘X1 > X2’ is probability the most popular scenario since it is difficult for gNB to reserve a clear 5MHz resource dedicated for LP-WUS. If the most popular scenario is not the basic capability, the whole feature is meaningless.Second, ‘X1 > X2’ does not increase the complexity of UE much. The available symbol can be determined based on semi-static configuration, which can be processed by MR. After that, LR just follows the timeline informed by MR. |
|  vivo | N | The same mechanism in idle/inactive mode should be used for connected mode operation.  |
| Qualcomm | Y | Different operators/networks/bands operate with different SSB periodicities/patterns, CORESET#0/SS#0 configurations, TDD UL-DL configurations, etc. ‘X1 > X2’ creates various patterns of LP-WUS mapping due to the varieties of unavailable symbols in different networks.Furthermore, ‘X1 > X2’ is not essential for OFDM-based LP-WUS, so some (or many) networks would not use ‘X1 > X2’ at all in reality. On the other hand, spec has no restriction on ‘X1 > X2’. In an extreme example, UE needs to envision X1=98 and X2=2, and in one MO the two OFDM symbols of the WUS are back-to-back an in the next MO the two OFDM symbols of the WUS are far separated (even multiple slots).Having said that, we believe enabling ‘X1 > X2’ is very hard for IoDT. |
| Spreadtrum | N |  |

[3] proposed to add “And UE can monitor LP-WUS when UE is not in Active Time.” in section 10.4D TS38.213 v19.0.0 to clarify the activation of LP-WUS monitoring.

From FL’s understanding, TS 38.300-j00 Clause 11 captures following, hence RAN1 spec change may not be needed.

|  |
| --- |
| [omit irrelevant text]One DCP can be configured to control PDCCH monitoring during on-duration for one or more UEs independently.A UE configured with DRX in RRC\_CONNECTED can be configured with LP-WUS. LP-WUS is monitored outside active-time.[omit irrelevant text] |

**[M][FL1] Question 4.9-2: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon |  | Since this is already covered by 38.300, we can give up this proposal. |
| vivo | N | It is already captured in TS 38.300.  |
| Qualcomm | N |  |
| Spreadtrum | N |  |

[8] proposed to clarify for Option 1-2, after the reception of wake-up indication, a UE does not need to monitor LP-WUS in the remaining MOs within the time timeOffsetCONNECTEDOption1-2.

**[M][FL1] Question 4.9-3: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon | No | In our view, current spec does not force UE to monitor LP-WUS after UE receive the wake-up indication. Thus, whether UE still monitors LP-WUS in the remaining MOs can be up to UE implementation. No spec change is needed. |
| vivo |   | We think the change may not be needed, as long as after the reception of the wake-up indication, the UE starts wus-PDCCHMonitoringTimer [11, TS 38.321] after a time, provided by timeOffsetCONNECTEDOption1-2, with respect to the start of the first WUS monitoring occasion from the number of WUS monitoring occasions per periodicity.  |
| Qualcomm | N | The proposal is not necessary as vivo pointed out. |
| Spreadtrum | N |  |
|  |  |  |

[15] proposed to clarify that for option 1-1, when LP-WUS is configured in cell DTX inactive period, UE does not start the corresponding drx-onDurationTimer.

From FL’s understanding, based on the last meeting discussion, specification change may not be needed given 213 already captures “A UE does not monitor WUS during DTX inactive period for the primary cell.” It should be clear that the related timers will not be started.

**[M][FL1] Question 4.9-4: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon |  | We are open to discuss this issue.However, per our understanding, according to current spec, in cell DTX inactive period, UE’s drx-onDurationTimer starts periodically, but the UE behavior is not to monitor PDCCH. Thus even drx-onDurationTimer or WUS-PDCCHMonitoringTimer is started, UE power consumption is not impacted. Therefore, we don’t see the strong need for this change. |
| vivo |  | We think current specification is clear.  |
|  |  |  |
|  |  |  |

4.8.2 Issues require new functionality

[3] proposed to support UE to report explicit feedback after the wake-up from LP-WUS monitoring in connected mode and SR resource is used for the feedback signaling to gNB

**[M][FL1] Question 4.9-5: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon | Yes | It is important to let gNB know the status of UE on whether UE is monitoring LP-WUS or not. |
| vivo | N | Based on the spirit of the conclusion that “There is no consensus in RAN1 whether to specify UE autonomous fallback to PDCCH monitoring when UE monitors LP-WUS in RRC CONNECTED mode”, this proposal is not needed.  |
| Qualcomm | N | This is beyond maintenance. |
| Spreadtrum | N |  |

[3] proposed that if UE is configured with LP-WUS and Rel-17 SSSG switching simultaneously, after LP-WUS monitoring is activated, the UE should stop/suspend the Rel-17 SSSG switching related timers.

**[M][FL1] Question 4.9-6: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon | Yes | When the Rel-17 SSSG switching related timer expires, UE fallback to a SSSG, which is usually with larger monitoring periodicity to save power. However, if during LP-WUS monitoring UE falls back to a ‘fallback SSSG’, after UE receives a LP-WUS, UE starts monitoring PDCCH based on a larger monitoring periodicity every time traffic arrives, which is not latency-friendly. Per our understanding, just like the BWP fallback timer, SSSG fallback timer is also a legacy mechanism, which is not properly compatible to LP-WUS mechanism. Therefore, we suggest to suspend/stop the SSSG timers when UE monitors LP-WUS. |
| vivo | N | As it was already discussed for several meetings, additional enhancement is not needed. |
| Qualcomm | N | This is beyond maintenance. |
| Spreadtrum | N |  |
|  |  |  |

[4] proposed that for RRC connected, the same behaviour as periodic CSI/L1-RSRP report in both Option 1-1and Option 1-2 can be applied to periodic/semi-persistent SRS transmission.

**[M][FL1] Question 4.9-7: what’s your opinion on the proposal above?**

|  |  |  |
| --- | --- | --- |
| Company | Support or not  | Comments |
| Huawei, HiSilicon |  | This issue was discussed for Rel-16 DCP. We can understand the motivation of this proposal since typically in TDD band it is SRS instead of CSI feedback that plays the role of channel/beam estimation. This is why at that time we support this direction. However, unfortunately, this is not adopted in Rel-16. If possible, we suggest to adopt this for both Re-19 LP-WUS and Rel-16 DCP. However, now it is already the CR phase of Rel-19, there seems to be little chance to support it.We sincerely recommend companies to consider this in 6G energy efficiency discussion. |
| vivo | N | DCP does not support the periodic/semi-persistent SRS transmission adopt the same behavior as periodic CSI/L1-RSRP report. It is also not necessary for LP-WUS operation.  |
| Qualcomm | N | We agree the proposal makes sense. However, we believe this is beyond maintenance and should not be considered. |
| Spreadtrum | N |  |
|  |  |  |

1. References
2. R1-2506825 Discussion on remaining issues of Rel-19 LP WUS ZTE Corporation, Sanechips
3. R1-2506876 Maintenance on Low-power wake-up signal and receiver for NR vivo
4. R1-2506921 Maintenance on LP-WUS/WUR Huawei, HiSilicon
5. R1-2506966 Remaining issues on LP-WUS operation in connected mode Xiaomi
6. R1-2507003 Discussion on maintenance issue on Low-power wake-up signal and receiver for NR (LP-WUS/WUR) CMCC
7. R1-2507098 Remaining issues on LP-WUS and LP-WUR CATT
8. R1-2507163 Remaining issues on LP-WUS/WUR OPPO
9. R1-2507232 Maintenance on Low-power wake-up signal and receiver for NR Samsung
10. R1-2507267 Maintenance on Low-power wake-up signal and receiver for NR Ericsson
11. R1-2507354 Maintenance on Low-power wake-up signal and receiver for NR LG Electronics
12. R1-2507457 Maintenance of LP-WUS Operation Ofinno
13. R1-2507528 Maintenance of LP-WUS operation Nokia
14. R1-2507567 Remaining issues on LP-WUS operation Sharp
15. R1-2507583 Maintenance on LP-WUS operation InterDigital, Inc.
16. R1-2507650 Maintenance on R19 LP-WUS/WUR Apple
17. R1-2507699 Maintenance on Low-power wake-up signal and receiver for NR Qualcomm Incorporated
18. R1-2507793 Maintenance on LP-WUS/WUR NTT DOCOMO, INC.
19. R1-2506868 Draft reply LS on not supporting simultaneous LR and MR operation vivo
20. Appendix : Proposals from contributions

## R1-2506825\_ZTE Corporation, Sanechips

In this contribution, we have discussed remaining issues on waveform design for LP-WUS and LP-SS. We make the following proposals:

**OOK symbol**

***Proposal 1: Definition of OOK-On symbol and OOK-Off symbol is necessary.***

|  |
| --- |
| **TS38.211****7.4.4.1.2 Generation of** $r\_{WUS}(n)$<Unchanged Text Omitted>The block of complex-valued symbols $r\_{WUS}(0),…,r\_{WUS}(M\_{bit}M\_{ZC}−1)$ is defined by$$r\_{WUS}\left(lN\_{sc}^{WUS}+k\right)=\frac{1}{\sqrt{N\_{sc}^{WUS}}}\sum\_{i=0}^{N\_{sc}^{WUS}−1}\tilde{r}\_{WUS}\left(lN\_{sc}^{WUS}+i\right)e^{−j\frac{2πik}{N\_{sc}^{WUS}}}$$$$k=0,1,…,N\_{sc}^{WUS}−1$$$$l=0,1,…,{M\_{bit}}/{M\_{WUS}}−1$$$$N\_{sc}^{WUS}=11N\_{sc}^{RB}$$where$$\tilde{r}\_{WUS}\left(mM\_{ZC}+n\right)=b(m)r\_{ZC,\tilde{m}}(n)$$$$\tilde{m}=\left⌊{m}/{2}\right⌋$$$$m=0,1,…,M\_{bit}−1$$$$n=0,1,…,M\_{ZC}−1$$The quantity $M\_{WUS}\in \left\{1, 2, 4\right\}$ is given by the higher-layer parameter *LP-WUS\_Mvalue\_IDLE/INACTIVE* or *LP-WUS\_Mvalue\_CONNECTED*.The bit sequence $b\left(0\right), …, b(M\_{bit}−1)$ and the number of bits $M\_{bit}$ corresponds to $g\_{00},g\_{01},…,g\_{0\left(G\_{0}−1\right)}$ and $G\_{0}$, respectively, in clause 7.4.3 of [4, 38.212]. $M\_{bit}$ OOK symbols for Wake-up signal includes OOK-ON symbol and OOK OFF symbol, where the bit sequence $b\left(m\right)=1$ is carried by OOK-On symbol and the bit sequence $b\left(m\right)=0$ is carried by OOK-Off symbol.<Unchanged Text Omitted> |

**Interaction with eDRX**

***Proposal 2: For eDRX, the LO periodicity could be the same as IDRX***

* ***the UE is required to monitor LP-WUS associated with the POs within the PTW if eDRX is configured.***

***Proposal 3: Adopt the following TP.***

|  |
| --- |
| <Unchanged Text Omitted>A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on *PO-to-LO association*. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by *LO-FrameOffsets*. The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *offset\_firstMO\_withinLO* relative to the start of the reference frame. If multiple values for the number of frames provided by *LO-FrameOffsets* are larger than or equal to the value of *XYZ*, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the multiple values. If all values for the number of frames provided by *LO-FrameOffsets* are smaller than the value of *XYZ*, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS.If a UE is configured with eDRX [17, TS 38.304], it is not required to monitor WUS occasions which are not associated to the POs during a periodic Paging Time Window (PTW) configured for the UEA paging occasion associated with a WUS occasion has index $i\_{PO}=\left(\left(UE\\_ID mod N\right)⋅N\_{S}+i\\_s\right) mod N\_{PO}^{WO}$ where $N\_{PO}^{WO}$ is a number of paging occasions associated with a WUS occasion, $N$, $N\_{S}$, $i\_{SG}$, and $i\\_s$ are defined in [17, TS 38.304], and $UE\\_ID$ is defined in clause 7.1 of [17, TS 38.304]. If a number of $N\_{SG}^{PO}$ subgroups per paging occasion, provided by *subgroupNumber-PO-WUS*, is $N\_{SG}^{PO}>1$, the codepoint for the subgroup index $i\_{SG}$ in a PO $i\_{PO}$ is$ i\_{PO}∗\left(N\_{SG}^{PO}+1\right)+i\_{SG}$, and the codepoint for all subgroups in the PO is$ (i\_{PO}+1)∗\left(N\_{SG}^{PO}+1\right)−1$; otherwise, the codepoint for the PO $i\_{PO}$ is$ i\_{PO}.$<Unchanged Text Omitted> |

**TCI state**

|  |
| --- |
| <Unchanged Text Omitted>If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states indicated by a most recent DCI format or MAC CE, after a respective application time in clause 5.1.5 [6, TS 38.214]; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*. <Unchanged Text Omitted> |

**CSI report**

***Proposal 4: Discuss and decide whether the UE perform CSI report during new active time.***

## R1-2506876\_vivo

In this contribution, we discussed the remaining issues for LP-WUS operation for UEs in RRC CONNECTED modes. The observation, proposals and TP are summarized as following:

**4.1.LP-WUS operation in IDLE/INACTIVE mode**

**Proposal 1: Adopt the following text proposal in red in TS 38.213.**

|  |  |
| --- | --- |
| **Reason for change:** | For the case that PO-to-LO association < Ns, a list of frame-level offsets are configured, but it is unclear for a UE to use which one to determine its associated LO. |
| **Summary of change:** | Add a LO and PO mapping description in the specification to help UE to determine its associated LO. |
| **Consequences if not approved:** | UE cannot figure out how to determine its associated LO, causing the ambiguity between UE and gNB. |
| \*\*\* Unchanged parts are omitted \*\*\*10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE\*\*\* Unchanged parts are omitted \*\*\*A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on *PO-to-LO association*. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by *LO-FrameOffsets*. The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *offset\_firstMO\_withinLO* relative to the start of the reference frame. If multiple values for the number of frames provided by *LO-FrameOffsets* are larger than or equal to the value of *XYZ*, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the multiple values. If all values for the number of frames provided by *LO-FrameOffsets* are smaller than the value of *XYZ*, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS. For the case that *PO-to-LO association* is smaller than *Ns*, a UE applies the $(floor\left(i\_{s}/POtoLO association\right)+1) $-th value out of $\left(N\_{s}/POtoLO association\right)$ values of the higher layer configured frame-level offset list provided by *LO-FrameOffsets*, where *Ns,* $i\_{s}$ are defined in [17, TS 38.304].\*\*\* Unchanged parts are omitted \*\*\* |

**Proposal 2: Adopt the following text proposal in red in TS 38.213.**

|  |  |
| --- | --- |
| **Reason for change:** | In current spec, it uses frame-level offsets provided by *LO-FrameOffsets* which also includes the length of LO to compare with UE wake-up delay which is not aligned with RAN1 agreement made in RAN1 #118bis on the definition of the time gap between LO and PO.  |
| **Summary of change:** | To algin with RAN1 agreement on the time gap between LO and PO. |
| **Consequences if not approved:** | The current specification is not aligned with RAN1 agreement, resulting in incorrect UE monitoring behavior. |
| \*\*\* Unchanged parts are omitted \*\*\***10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE**\*\*\* Unchanged parts are omitted \*\*\*A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on *PO-to-LO association*. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by *LO-FrameOffsets*. The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *offset\_firstMO\_withinLO* relative to the start of the reference frame. If the time gap between the end of the last WUS monitoring occasion of the WUS occasion in the WUS occasion(s) associated with the one or multiple values for number of frames provided by *LO-FrameOffsets* and the start of the first of a number of paging frames associated with the WUS occasion are larger than or equal to the value of *XYZ*, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the one or multiple values. If the time gap between the end of the last WUS monitoring occasion of the WUS occasion in the WUS occasion(s) associated with all values for number of frames provided by *LO-FrameOffsets* and the start of the first of a number of paging frames associated with the WUS occasion are smaller than the value of *XYZ*, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS.A paging occasion associated with a WUS occasion has index $i\_{PO}=\left(\left(UE\\_ID mod N\right)⋅N\_{S}+i\\_s\right) mod N\_{PO}^{WO}$ where $N\_{PO}^{WO}$ is a number of paging occasions associated with a WUS occasion, $N$, $N\_{S}$, $i\_{SG}$, and $i\\_s$ are defined in [17, TS 38.304], and $UE\\_ID$ is defined in clause 7.1 of [17, TS 38.304]. If a number of $N\_{SG}^{PO}$ subgroups per paging occasion, provided by *subgroupNumber-PO-WUS*, is $N\_{SG}^{PO}>1$, the codepoint for the subgroup index $i\_{SG}$ in a PO $i\_{PO}$ is$ i\_{PO}∗\left(N\_{SG}^{PO}+1\right)+i\_{SG}$, and the codepoint for all subgroups in the PO is$ (i\_{PO}+1)∗\left(N\_{SG}^{PO}+1\right)−1$; otherwise, the codepoint for the PO $i\_{PO}$ is$ i\_{PO}.$If, in a WUS monitoring occasion, a UE determines a codepoint associated with the UE [17, TS 38.304], the UE performs PDCCH monitoring according to Type2-PDCCH CSS sets for the paging occasion associated with the WUS monitoring occasion ~~when a time from the end of the WUS reception to the start of the PDCCH monitoring occasion is not smaller than the value of~~ *~~XYZ~~*; otherwise, the UE is not required to perform the PDCCH monitoring. The UE may also perform PDCCH monitoring for Type2A-PDCCH CSS sets for DCI format 2\_7, if provided. \*\*\* Unchanged parts are omitted \*\* |

**Observation 1: No strong need to configure a time gap by RRC between two consecutive LP-WUS MOs.**

* **The LR processing time will be a value at the symbol level rather than at the millisecond level and it can be covered by the nominal MO duration.**

**Proposal 3: Adopt following TP in TS 38.213**

|  |  |
| --- | --- |
| ***Reason for change:*** | UE does not expect to monitor a back-to-back actual LP-WUS transmissions.  |
|  |  |
| ***Summary of change:*** | For both idle/inactive and connected mode oepration, avoid the case that UE needs to monitor a LP-WUS in the last symbol of a nominal MO and another LP-WUS in the first symbol of the next nominal MO. |
|  |  |
| ***Consequences if not approved:*** | UE cannot handle such case, hence cannot receive the LP-WUS timely for PDCCH monitoring. |
| \*\*\* Unchanged parts are omitted \*\*\*10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE\*\*\* Unchanged parts are omitted \*\*\*A WUS monitoring occasion is over a first number of symbols, provided by *WUS\_NominalMO\_duration\_ IDLE/INACTIVE*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *WUS\_ActualMO\_duration\_ IDLE/INACTIVE*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *WUS\_ActualMO\_duration\_ IDLE/INACTIVE* symbols in the WUS monitoring occasion. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion includes a symbol for LPSS reception, the UE does not monitor WUS in the WUS monitoring occasion. And a UE does not expect to monitor a LP-WUS in the last symbol of a nominal MO and another LP-WUS in the first symbol of the next nominal MO.\*\*\* Unchanged parts are omitted \*\*\*10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED\*\*\* Unchanged parts are omitted \*\*\*A WUS monitoring occasion is over a first number of symbols, provided by *WUS\_NominalMO\_duration\_CONNECTED*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *WUS\_ActualMO\_duration\_CONNECTED*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *WUS\_ActualMO\_duration\_CONNECTED* symbols in the WUS monitoring occasion. And a UE does not expect to monitor a LP-WUS in the last symbol of a nominal MO and another LP-WUS in the first symbol of the next nominal MO.\*\*\* Unchanged parts are omitted \*\*\* |

**Proposal 4: Adopt the following text proposal modified in red in TS 38.215.**

|  |  |
| --- | --- |
| **Reason for change:** | To clarify the SSB set based on which OFDM-based WUR perform measurement. |
| **Summary of change:** | For OFDM-based WUR, if LP-WUS/LP-SS beam subset is provided, SS-RSRP is measured only from the indicated set of SS/PBCH block(s) by LP-WUS/LP-SS beam subset, otherwise, SS-RSRP is measured only from the indicated set of SS/PBCH block(s) by ssb-PositionsInBurst. |
| **Consequences if not approved:** | Agreements are not clearly reflected in the specification. |
| \*\*\* Unchanged parts are omitted \*\*\*

|  |  |
| --- | --- |
| **Definition** | SS reference signal received power (SS-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry secondary synchronization signals. The measurement time resource(s) for SS-RSRP are confined within SS/PBCH Block Measurement Time Configuration (SMTC) window duration, except when measurement is being performed by wake-up receiver (WUR). If SS-RSRP is used for L1-RSRP as configured by reporting configurations as defined in TS 38.214 [6], the measurement time resources(s) restriction by SMTC window duration is not applicable.For SS-RSRP determination demodulation reference signals for physical broadcast channel (PBCH) and, if indicated by higher layers, CSI reference signals in addition to secondary synchronization signals may be used. SS-RSRP using demodulation reference signal for PBCH or CSI reference signal shall be measured by linear averaging over the power contributions of the resource elements that carry corresponding reference signals taking into account power scaling for the reference signals as defined in TS 38.213 [5]. If SS-RSRP is not used for L1-RSRP, the additional use of CSI reference signals for SS-RSRP determination is not applicable.SS-RSRP shall be measured only among the reference signals corresponding to SS/PBCH blocks with the same SS/PBCH block index and the same physical-layer cell identity.If SS-RSRP is not used for L1-RSRP and higher-layers indicate certain SS/PBCH blocks for performing SS-RSRP measurements, then SS-RSRP is measured only from the indicated set of SS/PBCH block(s).For SS-RSRP is being performed by wake-up receiver (WUR), SS-RSRP is measured only from the indicated set of SS/PBCH block(s) by higher-layers parameter *LP-WUS/LP-SS beam subset,* if provided*.* Otherwise, SS-RSRP is measured only from the indicated set of SS/PBCH block(s) by higher-layers parameter *ssb-PositionsInBurst*.For frequency range 1, the reference point for the SS-RSRP shall be the antenna connector of the UE. For frequency range 2, SS-RSRP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 1 and 2, if receiver diversity is in use by the UE, the reported SS-RSRP value shall not be lower than the corresponding SS-RSRP of any of the individual receiver branches. |

\*\*\* Unchanged parts are omitted \*\*\* |

**Proposal 5: The current specification on the definition of value unit for LP-RSRP and LP-RSSI is clear enough, and no specification change is needed.**

**Proposal 6: Support option3:** **Add a new RRC parameter e.g., *LO\_frame\_offset(s)\_NES* for UE supporting with NES to apply R19 LP-WUS as follows....**

* **Description: To configure the offset value(s) between an LO and a reference PO/PF, at least a frame-level offset is provided.**
	+ **The reference point (reference PO/PF) for the frame-level offset is the start of the PF, or the first PF of the PF(s) (if mapping of POs from multiple PFs to one LO is supported), associated with the LO**
* **Value range:**
	+ **1~2 LO\_frame\_offset lists. One LO\_frame\_offset list correposnding to longer UE wake-up delay, and another one LO\_frame\_offset list corresponding to shorter UE wake-up delay.**
	+ **For each offset list, it includes ceil(Ns/(PO-to-LO association)) offset values, and the value range for each is {8, 9, …, 300} in unit of frames**
* **Type: Cell specific**

**4.2.LP-WUS operation in CONNECTED mode**

**Proposal 7: Introduce following RRC parameters for configuring the symbol level offset for WUS MO for connected mode operation Option 1-1 and Option 1-2:**

* **offset\_MO\_withinSlot\_Option 1-1, which is used to configure the starting time location of the first LP-WUS MO in a periodicity by a symbol level offset w.r.t. the start of the slot determined by the LPWUS\_MO\_CONNECTED\_Option1-1.**
* **The candidate value range could be {0,…,13} OFDM symbols**
* **offset\_firstMO\_withinSlot\_Option 1-2, which is used to configure the starting time location of the first LP-WUS MO in a periodicity by a symbol level offset w.r.t. the start of the slot determined by the LPWUS\_MO\_CONNECTED\_Option1-2.**
* **The candidate value range could be {0,…,13} OFDM symbols**

**Proposal 8: Do not introduce the UE capability to restrict the configuration of LP-WUS MO and LP-WUS duration.**

**Proposal 9: Adopt the following TP for TS 38.214:**

|  |  |
| --- | --- |
| ***Reason for change:*** | Clarify the the periodic CSI/L1-RSRP reporting operation for Option 1-2 for LP-WUS CONNECTED mode operation. In addition, clarify that LP-WUS operation option 1-1 and option 1-2 is based on the configuration of *lpwus-PDCCH-MonitoringTimer*. |
|  |  |
| ***Summary of change:*** | Add condition for WUS operation option 1-2 that when *WUS\_PDCCHMonitoringTimer* has not been started during the time of the previous DRX cycle, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time when the parameter to enable/disable periodic CSI/L1-RSRP reporting is configured. LP-WUS operation option 1-2 is enabled if *lpwus-PDCCH-MonitoringTimer* is configured. |
|  |  |
| ***Consequences if not approved:*** | Not aligned with the intention of the agreement made in RAN1#119 meeting and cause additional UE power consumption.**Agreement**For Option 1-2, for LP-WUS CONNECTED mode operation, the periodic CSI/L1-RSRP reporting operation is same as Rel-16 DCP, that is the UE can be configured with a parameter to enable/disable periodic CSI/L1-RSRP reporting, respectively:* If the parameter is NOT configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is not reported.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
* If the parameter is configured:
	+ If the UE is not indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the time given by the configured *drx-onDurationTimer* in *DRX-Config* for the case when UE is outside C-DRX active time.
	+ If the UE is indicated to wake up by LP-WUS, the periodic CSI/L1-RSRP is reported during the DRX active time.
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| 5.1.6.1 CSI-RS reception procedure<omitted irrelevant text>If the UE is configured with DRX and, - if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* or *lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'cri-RSRP-Index', 'ssb-Index-RSRP' and 'ssb-Index-RSRP-Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- if the UE is configured to monitor DCI format 2\_6 or WUS and configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP or lpwus-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP' or 'cri-RSRP-Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;- otherwise, the most recent CSI measurement occasion occurs in DRX active time for CSI to be reported.<omitted irrelevant text>5.2.2.5 CSI reference resource definition<omitted irrelevant text>When the UE is configured to monitor DCI format 2\_6 or WUS,- if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* *or lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index ' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the UE shall report CSI with the *reportQuantity* not set to ‘ssb-Index-SINR’ or ‘ssb-Index-SINR-Index’ during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise. - if the UE is configured with a CSI report configuration containing a list of sub-configurations provided by *csi-ReportSubConfigToAddModList*, and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* *or lpwus-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - UE shall report a CSI report including one or more sub-reports only during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time, per sub-configuration, no later than CSI reference resource and drops the report otherwise, where the sub-configuration is the configured one for P-CSI reporting.- if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* *or lpwus-TransmitOtherPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', or 'ssb-Index-RSRP- Index' - when *drx-onDurationTimer* in *DRX-Config* is not started in case DCI format 2\_6 or *lpwus-PDCCH-MonitoringTimer* is not configured, or- when ~~[or~~ *~~WUS\_PDCCHMonitoringTimer~~* ~~[in XYZxxx]]~~ *lpwus-PDCCH-MonitoringTimer* has not been started during the time of the previous DRX cycle in case *lpwus-PDCCH-MonitoringTimer* is configured, - the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when reportQuantity set to 'cri-RSRP' or *'*cri-RSRP- *Index*' if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.<omitted irrelevant text> |

**Proposal 10: discuss and select one option from the following for LP-WUS monitoring in RRC CONNECTED mode, when Rel-18 enhanced unified TCI framework is configured.**

* **Option 1: Support the case where the CORESET ID provided for a UE to derive the active TCI state for LP-WUS has two activated TCI states, and UE should use the first TCI state for LP-WUS monitoring.**
* **Option 2: Do not support the case where the CORESET ID provided for a UE to derive the active TCI satte for LP-WUS has two activated TCI states.**

## R1-2506921\_Huawei, HiSilicon

Proposals:

1. ***The code block length is determined based on the configured resources (e.g., OFDM symbols) for LP - WUS/MO, to avoid a LP-WUS occupying non-integer number of OFDM symbols.***
2. ***Ensure that both the code length and a LP-WUS occupying number of OFDM symbols are integer numbers.***
3. ***Capture the updated parameters in Appendix A in the RRC parameter list.***
4. ***No strong need is identified to further restrict the code block length.***
5. ***For WUS information carried by the overlaid OFDM sequence(s), raw information bits are mapped to sequence(s), in case N/log2L is not an integer, Bit 0 as LSB is used for padding.***
6. ***Adopt TP1 in Appendix B.***
7. ***No need to discuss separate UE feature on LP-WUS/LP-SS frequency resource outside the initial DL BWP.***
8. ***R19 LP-WUS applies to legacy POs only, it does not apply to R19 POs configured by R19 paging configuration.***
* ***When gNB configures R19 LP-WUS and R19 NES-oriented POs simultaneously, for a UE supporting both features, the UE does not monitor LP-WUS.***
1. ***Adopt TP2 in Appendix B.***
2. ***For any of the first M-1 MOs associated with the same beam, if the X2-th available symbol of a MO is not the last one OFDM symbol of the MO, there is no gap needed after this MO; otherwise, there is a one-OFDM-symbol gap after the MO.***
* ***X2 is the number of actual OFDM symbols for LP-WUS transmission***
* ***M is the number of MOs per SSB***
1. ***Adopt TP3 in Appendix B.***
2. ***There is no need to define the RX-TX transition time and gap before RO as unavailable symbol for LP-WUS in IDLE/INACTIVE mode.***
3. ***The logical time of the UL symbol should be used to determine the UL symbols, and TA does not impact the determination of available/unavailable symbols.***
4. ***Update the following agreement as below.***

**Agreement**

If LP-SS or the next 2 OFDM symbols after a LP-SS overlap (including partial overlap) in time domain with the available symbols that may be used for LP-WUS transmission in a LP-WUS MO, UE does not monitor LP-WUS in this MO (i.e., the MO is dropped).

1. ***Adopt TP4 in Appendix B.***
2. ***Update the Note of the agreement for determining the LP-SS occasions as***
* ***Note: For a TDD band, a slot is a DL slot if all the symbols in the slot are indicated as DL symbols in tdd-UL-DL-ConfigurationCommon; For a FDD band, any slot is a DL slot.***
1. ***If all MOs associated with one SSB beam are dropped, UE fallback to legacy PO monitoring.***
2. ***RAN1 concludes that both the unit of the LP-RSRP value and the LP-RSSI value are dBm per 11 RBs.***
* ***The value range of LP-RSRP related threshold is INTEGER(0..127), and the actual value of LP-RSRP related threshold is (IE value – 135) dBm.***
1. ***RAN1 concludes that CP should be excluded for LP-RSRP measurement***
2. ***Adopt TP5 in Appendix B.***
3. ***If the symbol-level bitmap is not configured, the unit is one slot.***
4. ***Adopt TP6 in Appendix B.***
5. ***When one frame-level offset is configured, if the gap from the end of LO to the start of PO is larger than wake-up delay, the UE shall monitor LO.***
6. ***When multiple frame-level offsets are configured, if all gaps from the end of LOs to the start of PO are larger than the wake-up delay, the UE shall monitor LO corresponding to the smallest gap.***
7. ***Adopt TP7 in Appendix B.***
8. ***Specify that UE does not monitor LP-WUS during the following time durations:***
* ***The symbols for SPS/CG transmission;***
* ***The symbols for periodic CSI/L1-RSRP measurement/report during the time duration of on-durationTimer, if gNB configures UE to report periodic CSI/L1-RSRP even when on-durationTimer is not started.***
1. ***BWP fallback timer is stopped/suspended when UE monitors LP-WUS.***
2. ***Adopt TP8 in Appendix B.***
3. ***To achieve the agreement of “LP-WUS monitoring by UE is known to gNB”, it should be specified for UE to report explicit feedback after the wake-up from LP-WUS monitoring:***
* ***SR resource is used for the feedback signaling to gNB to minimize the specification impact.***
1. ***Support the gNB configuration of measurement windows, only in which the symbols of CSI-RS, SMTC and/or measurement gaps are regarded as unavailable symbols for LP-WUS monitoring.***
2. ***gNB explicitly configures whether the symbols of a CORESET/SS can be available symbol for LP-WUS, if the CORESET/SS and LP-WUS overlap in frequency domain.***
3. ***Adopt TP9 in Appendix B.***
4. ***If UE is configured with LP-WUS and Rel-17 SSSG switching simultaneously, after LP-WUS monitoring is activated, the UE should stop/suspend the Rel-17 SSSG switching related timers.***
5. ***Adopt TP10 in Appendix B.***
6. ***For any of the first M-1 MOs within a period in option 1-2, if the X2-th available symbol of a MO is not the last one OFDM symbol of the MO, there is no gap needed after this MO; otherwise, there is a one-OFDM-symbol gap after the MO***
	* ***X2 is the number of actual OFDM symbols for LP-WUS transmission***
	* ***M is provided by numMO-perPeriodicity-Option 1-2***
7. ***Adopt TP11 in Appendix B.***
8. ***Adopt TP12 in Appendix B.***

## R1-2506966\_Xiaomi

For remaining issues on LP-WUS operation in connected mode, we have the following proposals,

***Proposal 1: If the UE receives a LP-WUS indicating PDCCH monitoring, and the ending time of LP-WUS is just before or overlapped with SPS PDSCH in time domain, the wake-up delay needed before starting PDCCH monitoring can be 0.***

***Proposal 2: For RRC connected, the same behaviour as periodic CSI/L1-RSRP report in both Option 1-1 and Option 1-2 can be applied to periodic/semi-persistent SRS transmission.***

***Proposal 3: For RRC connected, for a UE with basic capability, if BWP switching happens and leads to the case that LP-WUS resource is outside of the new DL active BWP, UE will fall back to legacy C-DRX operation behaviours for both Option 1-1 and Option 1-2.***

## R1-2507003\_CMCC

In this contribution, we discussed maintenance issue of Rel-19 LP-WUS/WUR, and the following proposals are made:

**Proposal 1: To solve the issue on potential collision between LP-WUS resource and existing NR activities, RAN1 follow the procedure as follows:**

* **Firstly, search out all the potential cases that will significantly impact the MR/LR system.**
* **Secondly, strive for a unify solution for all cases to solve multiple collision issues in one-shot.**

**Proposal 2: The following collisions can be considered for the cases/scenarios on when the UE is not able to monitor LP-WUS in CONNECTED mode, in addition to those agreed previously.**

* **SPS resources.**
* **Time gap in TDD UL/DL switching.**

**Proposal 3: Adopt the following Text Proposal in TS 38.213 for LP-WUS occasion determination:**

|  |
| --- |
| **Summary of change:**Specify that during LP-WUS occasion determination in CONNECTED mode, the resource overlap with SPS is unavailable for LP-WUS, and the symbol within $N\_{Rx-Tx}$ before an UL symbol or within $N\_{Tx-Rx}$after an UL symbol is unavailable for LP-WUS if the UE is UE not capable of full-duplex communication.**Consequence if not approved:**May cause potential collision between LP-WUS and SPS/UL transmission in CONNECTED mode, which will significantly impact the system performance.---------------------------- Start of Text Proposal for TS 38.213 -----------------------------< Unchanged parts are omitted >10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED < Unchanged parts are omitted >A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by *tdd-UL-DL-configurationCommon* or *tdd*-*UL-DL-ConfigurationDedicated* - the symbol is indicated for transmission of SS/PBCH blocks, by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*- PDSCHs with SPS activated by a DCI format 1\_0- the symbol is within $N\_{Rx-Tx}$ before an UL symbol if the UE is not capable of full-duplex communication [4, TS 38.211], or the symbol is within $N\_{Tx-Rx}$after an UL symbol, if the UE is not capable of full-duplex communication [4, TS 38.211]< Unchanged parts are omitted >--------------------------------------- End of Text Proposal ---------------------------------- |

**Proposal 4: The following collision can be considered for the cases/scenarios on when the UE is not able to monitor LP-WUS in IDLE/INACTIVE mode, in addition to those agreed previously.**

* **Time gap in TDD UL/DL switching.**

**Proposal 5: Adopt the following Text Proposal in TS 38.213 for LP-WUS occasion determination:**

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| --- |
| **Summary of change:**Specify that during LP-WUS occasion determination in IDLE/INACTIVE mode, the symbol within $N\_{Rx-Tx}$ before an UL symbol or within $N\_{Tx-Rx}$after an UL symbol is unavailable for LP-WUS if the UE is UE not capable of full-duplex communication.**Consequence if not approved:**May cause potential collision between LP-WUS and UL transmission in IDLE/INACTIVE mode, which will significantly impact the system performance.---------------------------- Start of Text Proposal for TS 38.213 -----------------------------< Unchanged parts are omitted >10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE < Unchanged parts are omitted >A UE can be provided, by *WUS\_available\_slot\_IDLE/INACTIVE*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units includes a total of either 10, or 20, or 40 time units. A duration $P$, in msec, of the set of time units has maximum value of 40 msec. The first symbol of the set of time units every 40 msec/$P$ periods is a first symbol in frame $n\_{f}$ mod 4 = 0. The UE can be additionally provided, by *WUS\_available\_symbol\_IDLE/INACTIVE*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_IDLE/INACTIVE*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_IDLE/INACTIVE*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by *tdd-UL-DL-configurationCommon* - the symbol is indicated for an SS/PBCH block transmission, by *ssb-PositionsInBurst* in *SIB1*, and the SS/PBCH block transmission would overlap in frequency with the WUS transmission- the symbol is indicated for PDCCH transmissions, by *pdcch-ConfigSIB1*, and CORESET 0 for the PDCCH transmissions would overlap in frequency with the WUS transmission- the symbol is within $N\_{Rx-Tx}$ before an UL symbol if the UE is not capable of full-duplex communication [4, TS 38.211], or the symbol is within $N\_{Tx-Rx}$after an UL symbol, if the UE is not capable of full-duplex communication [4, TS 38.211]< Unchanged parts are omitted >--------------------------------------- End of Text Proposal ---------------------------------- |

**Proposal 6: For LP-SS occasion determination, further discuss and down-select from the following options:**

* **Option 1: Up to gNB implementation to ensure that LP-SS and SSB, LP-SS and PDCCH transmissions for SIB1 will not be overlapped in both time and frequency domain, and ensure that LP-SS and UL symbol will not be overlapped in time domain, and ensure that the time gap between LP-SS and UL symbol (including valid RO) is equal or larger than the predefined value.**
	+ **FFS whether there is impact on** **Stage 2 specification.**
* **Option 2: Reuse the methodology of LP-WUS occasion determination, i.e., assume the symbol is not available for LP-SS transmission when the corresponding resource is overlapped with SSB or PDCCH transmissions for SIB1 in both time and frequency domain, or the symbol is overlapped with UL symbol, or the symbol is within the time gap of the UL symbol (including valid RO).**

## R1-2507098\_CATT

**Proposal 1：No need to support additional actual MO duration for OFDM-based LP-WUR only scenario.**

**Proposal 2: If the processing delay of LP-WUR is an issue, the LP-WUS detection/processing time should be determined by RAN4. Send LS to RAN4 and ask whether LP-WUR can monitor LP-WUS in two back-to-back MOs without any gap.**

## R1-2507163\_OPPO

***Proposal 1: For the*** $c\_{m}$***, adopt following TP to align the definition of*** $c\_{m}$ ***between agreement and clause 7.4.4.1.1 of TS 38.211.***

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.211 V19.1.0-----------------------7.4.4.1.1 Generation of $r\_{ZC,m}(n)$The sequence $r\_{ZC,m}(n)$ is defined by$$r\_{ZC,m}(n)=x\_{q}\left((n+n\_{cs}) mod N\_{ZC}\right)$$$$x\_{q}\left(i\right)=e^{−j\frac{πqi(i+1)}{N\_{ZC}}}$$$$n=0,1,…,M\_{ZC}−1$$where- $N\_{ZC}$ is the largest prime number such that $N\_{ZC}<M\_{ZC}$- $M\_{ZC}={N\_{sc}^{WUS}}/{M\_{WUS}}$The root sequence number $q\in \left\{1, …, N\_{ZC}−1\right\}$ is obtained as entry $\left⌊{c\_{m}}/{P}\right⌋\in \left\{0,1\right\}$ of the root sequence numbers configured by the higher-layer parameter XXX and the cyclic shift $n\_{cs}$ is given by$$n\_{cs}=\left(c\_{m} mod P\right)\left⌊\frac{N\_{ZC}}{P}\right⌋$$$$P=\frac{N\_{seq}}{N\_{root}}$$where - $N\_{seq}$ is the number of sequences configured by the higher-layer parameter XXX- $N\_{root}ϵ\left\{1,2\right\}$ is the number of root sequence numbers configured by the higher-layer parameter XXXThe sequence ~~number~~ index $c\_{m}=0$ if $N\_{seq}=1$, otherwise it is given by$$c\_{m}=\sum\_{i=0}^{δ−1}f\_{1(i+δm)}2^{δ−1−i}$$$$δ=log\_{2}N\_{seq}$$$$m=0,1,…,\left({E\_{1}}/{δ}\right)−1$$ |

***Proposal 2: For the padding of sequence modulation, adopt following TP#1 or TP#2 to align with the agreement reached in RAN1#120bis meeting.***

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| **TP#1**---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.1.0-----------------------7.4.2.2 Rate matching for sequence modulationInformation bits for the second bit block are delivered to the rate matching block. They are denoted by $c\_{0},c\_{1},…,c\_{K−1}$, where $K$ is the number of bits and $K\leq 5$.If the number of sequences configured by higher layer parameter *LP-WUS\_num\_overlaidSeq\_CONNECTED* or *LP-WUS\_num\_overlaidSeq\_IDLE/INACTIVE*, denoted as $L\_{1}$, is larger than one, and $K mod log\_{2}L\_{1}$ is an integer, padding is performed and the bits after padding are denoted by$ d\_{10},d\_{11},…,d\_{1\left(N\_{1}−1\right)}$, where $N\_{1}=K+L$, $L=\left(−K \right) mod log\_{2}L\_{1}$. The relation between $c\_{k}$ and $d\_{1k}$ is: $d\_{1k}=0$ for $k=0,1,…, L−1$ $d\_{1k}=c\_{k−L} $for $k=L,L+1,…, N\_{1}−1$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{1}$, where $ E\_{1}=E\_{WUS}×log\_{2}L\_{1}$, $E\_{WUS} $is as defined in Clause 7.4.2.1, and the output bit sequence after rate matching is denoted as $f\_{10},f\_{11},f\_{12},…,f\_{1\left(E\_{1}−1\right)}$. |
| **TP#2**---------------------------------Start of Text Proposal on 3GPP TS 38.212 V19.1.0-----------------------7.4.2.2 Rate matching for sequence modulationInformation bits for the second bit block are delivered to the rate matching block. They are denoted by $c\_{0},c\_{1},…,c\_{K−1}$, where $K$ is the number of bits and $K\leq 5$.If the number of sequences configured by higher layer parameter *LP-WUS\_num\_overlaidSeq\_CONNECTED* or *LP-WUS\_num\_overlaidSeq\_IDLE/INACTIVE*, denoted as $L\_{1}$, is larger than one, and L $>0$, padding is performed and the bits after padding are denoted by$ d\_{10},d\_{11},…,d\_{1\left(N\_{1}−1\right)}$, where $N\_{1}=K+L$, $L=\left(−K \right) mod log\_{2}L\_{1}$. The relation between $c\_{k}$ and $d\_{1k}$ is: $d\_{1k}=0$ for $k=0,1,…, L−1$ $d\_{1k}=c\_{k−L} $for $k=L,L+1,…, N\_{1}−1$.Rate matching is performed according to Clause 5.4.3 by setting the rate matching output sequence length $E=E\_{1}$, where $ E\_{1}=E\_{WUS}×log\_{2}L\_{1}$, $E\_{WUS} $is as defined in Clause 7.4.2.1, and the output bit sequence after rate matching is denoted as $f\_{10},f\_{11},f\_{12},…,f\_{1\left(E\_{1}−1\right)}$. |

***Proposal 3: For RRC CONNECTED mode adopt the TP to clarify that WUS monitoring occasions are continuous sets of symbols.***

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| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.1.0-----------------------10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED<Unchanged parts are omitted>~~A~~ WUS monitoring occasions ~~is~~are over a ~~first number~~continous set of symbols, each set provided by *WUS\_NominalMO\_duration\_CONNECTED*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *WUS\_ActualMO\_duration\_CONNECTED*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *WUS\_ActualMO\_duration\_CONNECTED* symbols in the WUS monitoring occasion.  |

***Proposal 4: For RRC CONNECTED mode adopt the TP to clarify reference point for available symbols.***

|  |
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| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.1.0-----------------------10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED<Unchanged parts are omitted>A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units can be {10, 20 or 40} time units, but maximum of 40 msec. The first symbol of a set of time units every 40 msec/P periods is a first symbol in frame mod 4 = 0, where P is the duration of a set of time units in msec. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon |

## R1-2507232\_Samsung

**Proposal 1: For root sequence number determination, TS 38.211 and TS 38.331 should be aligned.**

* **Adopt TP#1 for TS 38.211.**

**Proposal 2: The range of configuration index for LP-SS binary sequence in table 7.4.5.1.1-1, 7.4.5.1.1-2, and 7.4.5.1.1-3 of TS 38.211 v19.1.0 and the value range of *lpss-BinarySeqIndex* should be aligned.**

* **Ask RAN2 to fix the value range of *lpss-BinarySeqIndex* from [1, 2 ,3 ,4] to [0, 1, 2, 3].**

**Proposal 3: A common gap can be configured between two LP-WUS nominal MOs to determine the start time location of a subsequent LP-WUS MO based on the previous LP-WUS MO.**

* **Adopt TP#2 for TS 38.213.**

**Proposal 4: For the gap between a LP-WUS MO and a LP-SS occasion, it can be up to gNB’s configuration to reserve the gaps, if needed.**

**Proposal 5: Suggest to capture time location of LO in TS 38.213 following the same logic for PEI.**

**Proposal 6: Adopt TP#3 for TS 38.213.**

**Proposal 7: The symbols for a gap before UL SDT transmission, the symbols indicated by sdt-SearchSpace and DL SDT transmission is not available to monitor WUS.**

* **Adopt TP#4 for TS 38.213.**

**Proposal 8: For MO configuration in Option 1-2, support a configurable time interval between two consecutive MOs by RRC, when multiple MOs are configured per periodicity.**

* **Adopt TP#5 for TS 38.213.**

**Proposal 9: For Option 1-2, after the reception of wake-up indication, a UE does not need to monitor LP-WUS in the remaining MOs within the time timeOffsetCONNECTEDOption1-2.**

* **Adopt TP#6 for TS 38.213.**

**Proposal 10: Adopt TP#7 for TS 38.213.**

**Proposal 11: Adopt TP#8 for TS 38.214.**

**Proposal 12:**

* **Adopt TP#9 (editorial and alignment) for TS 38.211.**
* **Adopt TP#10 (editorial and alignment) for TS 38.212.**
* **Adopt TP#11 (editorial and alignment) for TS 38.213.**

## R1-2507267\_Ericsson

Based on the discussion in the previous sections we propose the following:

**[Proposal 1 Adopt the text proposal in Section 2.1 of this paper regarding cyclic shift (CS) equation for OFDM sequences.](#_Toc210396399)**

**[Proposal 2 Adopt the text proposal in Section 2.2 of this paper regarding RRC parameter names.](#_Toc210396400)**

**[Proposal 3 No explicit gap is introduced between two consecutive LP-WUS nominal MOs.](#_Toc210396401)**

**[Proposal 4 No explicit gap is introduced between adjacent LP-WUS MO and LP-SS.](#_Toc210396402)**

**[Proposal 5 Adopt the TP (in Table 1 of this paper) for Clause 10.4C in TS 38.213 for UE behavior on WUS monitoring with regard to the configured LO-FrameOffsets.](#_Toc210396403)**

**[Proposal 6 Support that gNB can configure both Rel-19 LP-WUS and Rel-19 paging adaptation, and when they are configured, two LP-WUS configurations are provided, where one is for legacy POs, the other one is for Rel-19 POs (if the discussion is done in RAN1).](#_Toc210396404)**

**[Proposal 7 Adopt the ms unit of minimum time gap for Clause 10.4D in TS 38.213.](#_Toc210396405)**

**[Proposal 8 Adopt the TP provided in Section 4 of this paper for Clause 10.4D in TS 38.213 for UE behavior on WUS monitoring in option 1-2.](#_Toc210396406)**

**[Proposal 9 Adopt the text proposal in Section 4 of this paper regarding RRC parameter names for RRC\_CONNECTED mode in TS 38. 213.](#_Toc210396407)**

## R1-2507354\_LG Electronics

In this contribution, we shared our views on the remaining issues regarding maintenance on Low-power wake-up signal and receiver for NR. Followings are proposed for the remaining issues regarding maintenance on Low-power wake-up signal and receiver for NR.

**Proposal #1: Do not introduce any gap between adjacent MOs within LO in IDLE/INACTIVE mode.**

**Proposal #2: Do not introduce any gap between adjacent MOs within a periodicity in CONNECTED mode.**

**Proposal #3: The following DL/UL symbols/slots should be considered as unavailable for LP-WUS MO in CONNECTED modes,**

* **SPS PDSCH reception**
* **CG-PUSCH transmission**
* **Periodic CSI/L1-RSRP reporting**
* **RRM measurement.**

**Proposal #4: Not support to introduce a new RRC parameter for OFDM-based LR only in addition to the similar parameter of ActualMO\_duration.**

## R1-2507457\_Ofinno

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**Proposal 1**: Agree to TP#1 to TS 38.213 in Annex A.

**Proposal 2**: Endorse TP#2 to TS 38.213 in Annex B.

## R1-2507528\_Nokia

**Proposal 1: For OFDM-based WUR SS-RSRQ measurement metric, clarify that *measurementSlots* and *endSymbol* are not applicable and that RSSI is measured over the fixed set of symbols in the slots containing the SSB(s). Down select among following options for the RSSI measurement symbols:**

* **same symbols as for the SSB, or**
* **symbols as determined for configuration *endSymbol*=1 (i.e. {0,1,2..,11} for SCS<480kHz) is the slot where SSB is received.**

**Proposal 2: LP-RSRP and LP-RSRQ measurements should be associated to a particular beam. Update the LP-RSRP and LP-RSRQ metric definitions for example as follows: “LP-RSRP shall be measured only among the reference signals corresponding to LP-SS associated with serving cell and the same SS/PBCH block index.”, as per draft TP to TS38.215:**

|  |
| --- |
| **Change reason:** The definition of restricting LP-RSRP measurements to reference signals associated to the same SS/PBCH block and Cell ID is missing. **Change summary:** Introduce text conveying the restriction to limit a LP-RSRP to same beam. **Consequence if not approved**: There may be ambiguity how LP-RSRP measurement is carried out by an UE leading to inconsistent UE behaviour. |
| **5.1.53 Low power reference signal received power (LP-RSRP)**

|  |  |
| --- | --- |
| **Definition** | Low power reference signal received power (LP-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry on-off keying (OOK) ON symbols of Low power synchronization signals (LP-SS). LP-RSRP shall be measured only among the reference signals corresponding to LP-SS associated the same SS/PBCH block index and the same physical-layer cell identity.For frequency range 1, the reference point for the LP-RSRP shall be the antenna connector of the UE. For frequency range 2, LP-RSRP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 1 and 2, if receiver diversity is in use by the UE, the reported LP-RSRP value shall not be lower than the corresponding LP-RSRP of any of the individual receiver branches. |
| **Applicable for** | RRC\_IDLE for serving cell,RRC\_INACTIVE for serving cell, |

 |

In Section 3 we discuss aspects related to LP-WUS monitoring, and observe and propose as follows:-

**Proposal 3: The gap between two consecutive actual WUS and WUS and LPSS can be handled by nominal MO configuration.**

**Proposal 4: If UE needs or chooses to omit WUS monitoring in a MO due to UL transmission, it should monitor paging PDCCHs as it would have received indication by WUS in IDLE/Inactive, and in CONNECTED mode determine this a collision event where UE behaviour for option 1-1 and option 1-2 is determined by RAN2**.

**Proposal 5: The UE is not expected to be able to monitor LP-WUS overlapping SPS PDSCH monitoring. Adopt following TP to TS38.213:**

|  |
| --- |
| **Change reason:** Ambiguity on how the UE should handle SPS receptions that collide with LP-WUS MOs. **Change summary:** Introduce text clarifying that LP-WUS is not expected to be monitored during receptions supporting SPS. **Consequence if not approved**: Ambiguity on how the UE should handle SPS receptions that collide with LP-WUS MOs |
| 10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED[Text omitted]A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon- the symbol is indicated for SPS PDSCHA WUS monitoring occasion is over a first number of symbols, provided by *WUS\_NominalMO\_duration\_CONNECTED*. If a number of available symbols for the UE to monitor WUS in a WUS monitoring occasion is smaller than a second number of symbols, provided by *WUS\_ActualMO\_duration\_CONNECTED*, the UE does not monitor WUS in the WUS monitoring occasion. The UE monitors WUS in a WUS monitoring occasion over the earliest available *WUS\_ActualMO\_duration\_CONNECTED* symbols in the WUS monitoring occasion.   |

Other, aspects, including RAN2 LS, is discussed in Section 4:-

**Proposal 6: If LP-WUS operation is configured together with eDRX, the WUS monitoring is determined based on paging occasions so that UE can monitor WUS associated to the POs that valid based on the eDRX configuration.**

**Proposal 7: Consider adopting following TP to TS38.213 or sending an LS to RAN2 to account the eDRX configuration implications in LP-WUS monitoring.**

|  |
| --- |
| **Change reason:** The UE behaviour for WUS monitoring when eDRX is configured is not defined. **Change summary:** Introduce a text determining that UE is expected to monitor WUS only for PO’s determined by the eDRX configuration. **Consequence if not approved**: There may be ambiguity for the UE for the expected WUS monitoring behaviour. |
| If UE is configured with eDRX [17, TS 38.304], UE is expected to monitor WUS only for PO’s determined by the eDRX configuration. |

**based LR may be a separate HW module.**

**Proposal 8: RAN1 to discuss and agree whether the UE can support LP-WUS monitoring configuration per DRX group, subject capability, or whether LP-WUS monitoring can only be configured to one DRX group at a time. Depending on the outcome, send RAN2 an LS response to revise their agreements**.

## R1-2507567\_Sharp

In this contribution, we have the following proposal:

**Proposal 1: Adopt TP1 to correct the WUS monitoring occasion index starting from 0.**

|  |  |
| --- | --- |
| **Reason for change:** | The index of physical resource is normally starting with 0 in 38.213(e.g. paging occasion index $i\_{PO}$/ subgroup index $i\_{SG}$ in the same paragraph) and index k is corresponding to the (k+1)th value. WUS monitoring occasion index start from 1, which is not align the rule of other part. |
| **Summary of change:** | Change WUS monitoring occasion index to start from 0. |
| **Consequences if not approved:** | UE cannot figure out how to determine its WUS monitoring occasion, can cause the ambiguity. |

---------------begin of draft TP1 on TS 38.213---------------------------------------------

**10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE**

\*\*\* Unchanged parts are omitted \*\*\*

If a UE is provided *wus-LPSS-beamSubset*, the UE receives LPSS/WUS based on the quasi co-location properties of transmitted SS/PBCH blocks indicated by *wus-LPSS-beamSubset* [12, TS 38.331]; otherwise, the UE receives LPSS/WUS based on the quasi co-location properties for transmitted SS/PBCH blocks indicated by *ssb-PositionsInBurst* in *SIB1*. A WUS occasion includes $K⋅M$ WUS monitoring occasions that are indexed sequentially in time, where

- $K$ is the number of transmitted SS/PBCH blocks indicated by *ssb-PositionsInBurst* in *SIB1*, $M$ is a number of WUS monitoring occasions associated with each of the $K$ transmitted SS/PBCH blocks provided by *MONumperLO*, and

- a WUS monitoring occasion with index $\left(k−1\right)⋅M+m−1$, where $1\leq m\leq M$ and $1\leq k\leq K$, is quasi co-located with the $k$-th transmitted SS/PBCH block with respect to quasi co-location 'typeC' or 'typeD' properties, when applicable

---------------end of draft TP1 on TS 38.213-------------------------------------------------

**Proposal 2: Adopt TP2 to clarify the frame-level offset values selection for WUS occasion.**

|  |  |
| --- | --- |
| **Reason for change:** | *LO-FrameOffsets* is provided as a two-dimensional structure, consisting of *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay*. Each of these includes *CEIL(Ns / lpwus-PoNumPerLo)* values. it is not clear how to get the “multiple values” from *LO-FrameOffsets* for comparison with XYZ. |
| **Summary of change:** | Add the values selection procedures for offset comparison. |
| **Consequences if not approved:** | UE cannot figure out how to determine its associated LO, can cause the ambiguity. |

---------------begin of draft TP2 on TS 38.213---------------------------------------------

**10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE**

\*\*\* Unchanged parts are omitted \*\*\*

A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on *PO-to-LO association*. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by *LO-FrameOffsets*. The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *offset\_firstMO\_withinLO* relative to the start of the reference frame. If multiple values for the number of frames provided by *LO-FrameOffsets* are larger than or equal to the value of *XYZ*, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the multiple values. If all values for the number of frames provided by *LO-FrameOffsets* are smaller than the value of *XYZ*, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS. For the case where *PO-to-LO association* is not smaller than *N*s, the multiple values are the first value(s)  *of* the higher layer configured frame-level offsets with *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* if provided by *lpwus-LoFrameOffsetList, and* in the case that *PO-to-LO association* is smaller than *Ns* , the multiple values are the $(floor\left(i\_{s}/POtoLO association\right)+1) $-th value(s) of the higher layer configured frame-level offsets with *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* if provided by *lpwus-LoFrameOffsetList,* where *Ns,* $i\_{s}$ are defined in [17, TS 38.304].

---------------end of draft TP2 on TS 38.213-------------------------------------------------

**Proposal 3: Define XYZ using the UE-reported delay along with duration of the nominal MO and the distance between the PO and the reference PF.**

**Proposal 4: Consider one of options on the configured two frame-level offset values for one PO**

* **Option 1:** Leave it to the gNB’s configuration, and the UE follows the indication when monitoring LP-WUS in an associated LO.
* **Option 2:** Impose restrictions on the configured values with a same index in *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay*  to avoid overlapping LOs.

## R1-2507583\_InterDigital, Inc.

***Proposal 1:*** *For reporting periodic CSI/L1-RSRP based on higher layer parameters, support TP#1.*

***Proposal 2:*** *UE cannot monitor LP-WUS in resources associated with SPS/CG and periodic-CSI/L1-RSRP transmission resources.*

## R1-2507650\_Apple

For **idle/inactive mode**, we have the following proposals:

**Proposal 3-1: If the last symbol a UE monitors in a LP-WUS MO is adjacent to the first symbol a UE monitors in the next LP-WUS MO, the UE is not required to monitor the second LP-WUS MO.**

* **Note: this provides the UE a minimum of one symbol gap between the monitored symbols of two adjacent LP-WUS MOs.**

**Proposal 3-2: The LO determination based on *lpwus-LoFrameOffsetList* is clarified as follows:**

* **If the number of POs associated with a LO is less than *Ns* (the number of POs per PF), the UE uses the (**$\left⌊\frac{i\\_s}{N\_{PO}^{WO}}\right⌋+1$**)-th value in *offsetForLongerWakeUpDelay* (if configured) and *offsetForShorterWakeUpDelay* (if configured) provided by *lpwus-LoFrameOffsetList*.**
* **If both *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* are configured,**
	+ **If the gap between the end of the last WUS monitoring occasion the UE would monitor in the LO associated with the value in *offsetForShorterWakeUpDelay* and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO associated with the value in *offsetForShorterWakeUpDelay*;**
	+ **Otherwise if the gap between the end of the last WUS monitoring occasion the UE would monitor in the LO associated with the value in *offsetForLongerWakeUpDelay* and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO associated with the value in *offsetForLongerWakeUpDelay*;**
	+ **Otherwise, the UE monitors legacy PO.**
* **If only one of *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* is configured,**
	+ **If the gap between the end of the last WUS monitoring occasion the UE would monitor in the LO associated with the value in *offsetForLongerWakeUpDelay* or *offsetForShorterWakeUpDelay* (whichever is configured) and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO;**
	+ **Otherwise, the UE monitors legacy PO.**

**Proposal 3-3: The LO determination based on *lpwus-LoFrameOffsetList* is captured in TS 38.304. Adopt the following TP for TS 38.213:**

|  |
| --- |
| 10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE<unchanged text omitted>A UE determines the first frame for the WUS occasion according to the procedure defined in [17, TS 38.304] ~~A UE assumes that WUS occasions occur with a periodicity equal to the I-DRX cycle in the RRC\_IDLE/RRC\_INACTIVE state [17, TS 38.304]. The UE determines WUS occasions associated with a paging occasion based on~~ *~~PO-to-LO association~~*~~. A reference frame of a WUS occasion starts a number of frames prior to the first of a number of paging frames associated with the WUS occasion. Each number of frames is provided by~~ *~~LO-FrameOffsets~~*~~.~~ The first WUS monitoring occasion of a WUS occasion starts at an offset provided by *offset\_firstMO\_withinLO* relative to the start of the first ~~reference~~ frame. ~~If multiple values for the number of frames provided by~~ *~~LO-FrameOffsets~~* ~~are larger than or equal to the value of~~ *~~XYZ~~*~~, the UE monitors WUS starting at a WUS occasion corresponding to the smallest of the multiple values. If all values for the number of frames provided by~~ *~~LO-FrameOffsets~~* ~~are smaller than the value of~~ *~~XYZ~~*~~, the UE monitors PDCCH according to Type2-PDCCH CSS sets associated with the paging occasion and does not monitor WUS.~~ |

**Proposal 3-4: Adopt the following TP for TS 38.213:**

|  |
| --- |
| 10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE<unchanged text omitted>A UE can be provided, by *WUS\_available\_slot\_IDLE/INACTIVE*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units includes a total of either 10, or 20, or 40 time units. A duration $P$, in msec, of the set of time units has maximum value of 40 msec. The first symbol of the set of time units every 40 msec/$P$ periods is a first symbol in frame $n\_{f}$ mod 4 = 0. The UE can be additionally provided, by *WUS\_available\_symbol\_IDLE/INACTIVE*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_IDLE/INACTIVE*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_IDLE/INACTIVE*, the UE assumes a time unit of one slot, ~~that,~~ and for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when- the symbol is indicated as uplink, by *tdd-UL-DL-configurationCommon* - the symbol is indicated for an SS/PBCH block transmission, by *ssb-PositionsInBurst* in *SIB1*, and the SS/PBCH block transmission would overlap in frequency with the WUS transmission- the symbol is indicated for PDCCH transmissions, by *pdcch-ConfigSIB1*, and CORESET 0 for the PDCCH transmissions would overlap in frequency with the WUS transmission<unchanged text omitted> |

**Proposal 3-5: For OFDM-based LP-WUR, if overlaid OFDM sequence is not configured (M=1), it is up to UE implementation whether the LP-WUR can perform LP-SS based LP-RSRP/LP-RSRQ measurement. There is no spec impact.**

**Proposal 3-6: The definition of LP-RSRQ is modified to be N \* LP-RSRP / LP-RSRI.**

For **connected mode**, we have the following observations and proposals:

**Observation 4-1: LP-WUS MOs and the *WUS-PDCCHMonitoringTimer* for Option 1-2 does not have 1-1 correspondence with the time defined by *drx-onDurationTimer.***

**Observation 4-2: It is not clear in the previous RAN1 agreement that which *WUS-PDCCHMonitoringTimer* determines the reporting behavior in the time given by the configured *drx-onDurationTimer* in *DRX-Config*.**

**Proposal 4-1: RAN1 to discuss the understanding of P-CSI/L1-RSRP reporting behaviour during the *drx-onDurationTimer* that is outside DRX Active Time and whether/which *WUS-PDCCHMonitoringTimer* determines the reporting behavior during this period.**

**Proposal 4-2: From UE implementation complexity perspective and providing NW with Periodic CSI results in a periodic manner without depending on the traffic profile, it is proposed to**

* **Confirm the understanding (understanding #1) that if the parameter ‘*lpwus-TransmitPeriodicL1-RSRP*’ or ‘*lpwus-TransmitOtherPeriodicCSI*’ is configured, UE still reports P-CSI/L1-RSRP during Duration A, B, and C.**
* **Adopt TP#1 and TP#2 in section 4.3 for TS 38.214.**

**Proposal 4-3: For LP-WUS configured in cell DTX inactive period, UE does not start the corresponding *drx-onDurationTimer.***

The corresponding TPs are provided in Section 4.3.

## R1-2507699\_Qualcomm Incorporated

**Proposal 2-1: The RRC parameter “LP-WUS/LP-SS beam subset” is only applicable to OOK-based LP-WUS and LP-SS. OFDM-based LP-WUS is transmitted in all beams according to *ssb-PositionsInBurst* in SIB1**

* **No new RRC parameter needs to be introduced.**

**Proposal 3-1:**

* **Update the RAN1#121 agreement as follows:**

|  |
| --- |
| **Agreement:**Nominal MO duration (X1, in unit of OFDM symbols) and actual LP-WUS duration (X2, in unit of OFDM symbols) are configured for LP-WUS in connected mode. (Alt C)* A LP-WUS MO spans the nominal MO duration (i.e., the LP-WUS MO duration is the same as the nominal MO duration.)
* If the number of available OFDM symbols within the nominal MO duration is no less than the actual LP-WUS duration, UE monitors LP-WUS on the first X2 available symbols within the LP-WUS MO.
* Otherwise, UE does not monitor LP-WUS in this MO (i.e., the MO is dropped).
* Note: Any symbols that are not defined as unavailable are available symbols for LP-WUS.
* This is subject to an optional ~~Further discuss possible introduction of~~ UE capability signalling ~~to restrict configuration of LP-WUS MO and LP-WUS duration~~. If the UE does not report the UE capability signalling, then X1 = X2, i.e., ~~For example,~~
	+ A LP-WUS spans a number of consecutive OFDM symbols according to the configured LP-WUS duration
	+ If there is at least one OFDM symbol unavailable for the LP-WUS MO within the OFDM symbols where the LP-WUS would span, the UE does not monitor the LP-WUS in the MO
 |

* **Details of the UE capability signalling for X1 > X2 will be discussed in the UE feature session**

## R1-2507793\_NTT DOCOMO, INC.

In this contribution, remaining issues on LP-WUS operation in IDLE/INACTIVE modes and CONNECTED mode were discussed. Based on the discussion, the following proposals were made:

**Proposal 1:**

* **For LP-WUS MOs in IDLE/INACTIVE modes, support Option 1-1 or Option 2**
	+ **Option 1: UE expects at least one OFDM symbol gap between two LP-WUS MOs.**
		- **Option 1-1: This is ensured by gNB configuration.**
	+ **Option 2: No gap is introduced between two LP-WUS MOs. No specification impact.**

**Proposal 2:**

* **For LP-WUS MOs in connected mode for Option 1-2, for the case of more than one MOs per periodicity,**
	+ **Alt3: UE does not expect to monitor a LP-WUS in the last symbol of a nominal MO and another LP-WUS in the first symbol of the next nominal MO.**
	+ **Alt4: The MOs per periodicity are contiguous without any gap in between**