**3GPP TSG RAN WG1 #102-e R1-200xxxx**

e-Meeting, August 17th – 28th, 2020

Source: Moderator (NTT DOCOMO, INC.)

Title: Summary on [102-e-NR-TEIs-01]

Agenda Item: 7.2.12

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion/approval in AI 7.2.12.

[102-e-NR-TEIs-01] Email discussion/approval for potential CR(s) for Flexible TRS bandwidth for BWP of 52 RBs (17th-21st August) – Hiroki (DCM)

* Which one of following options should be adopted based on “up to 3RBs beyond either/both of the highest RB and lowest RB of the TRS”
  + Option 1: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3 RBs beyond either of the highest RB or lowest RB of the TRS, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS are only on either side.
  + Option 2: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to X RBs beyond the highest RB and/or Y RBs beyond the lowest RB of the TRS, where X+Y<4, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS can be on both sides.
  + Option 3: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3 RBs beyond both of the highest RB and lowest RB of the TRS, i.e., total number of RBs outside TRS bandwidth is up to 6 and RBs outside TRS can be on both sides.
* Whether TP should be provided for 5.1.6.1.1 only or for both 5.1.2.2 and 5.1.6.1.1

# **Flexible TRS bandwidth for BWP of 52 RBs**

At the RAN#88e, the following agreements were made.

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| * *Task RAN1 (cc: RAN2) to define TRS bandwidth sizes of 28, 32, 36, 40, 44, 48 RBs.*   + *All TRS configured for a given BWP with the newly defined TRS bandwidth sizes for a UE span the same set of RBs.*   + *All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3RBs beyond either/both of the highest RB and lowest RB of the TRS.*   + *Only supported for 10MHz UE channel bandwidth, 52 RB BWP size, and 15kHz SCS, in FDD bands.*   + *Note: No new performance requirement on UE is introduced here.* * *A “per-band” UE capability is to be defined for this optional UE feature, that indicates per band support for one of:*   + *“All newly defined TRS bandwidth sizes”.*   + *“All newly defined TRS bandwidth sizes except 28 RB size”.* * *Introduce from Release 16 as part of TEI16.* |

According to the above agreements, companies provided their views and/or text proposals as below.

In [1], it is proposed that the number of RBs for the PDSCH resource allocation is not expected to be 3RBs greater than the size of the number of RBs occupied by CSI-RS for tracking, and corresponding TPs for 38.214 5.1.2.2 and 5.1.6.1.1 are provided.

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| There is one ambiguity from the way forward whether “up to 3RBs beyond either/both of the highest RB and lowest RB of the TRS” should allow the configuration of TRS 3 RSs beyond both the highest RB and lowest RB.  One of the argument is that there should be flexibility for the network to configure TRS on a 4 RB granularity but could still be able to schedule PDSCH on both side with up to 3RBs beyond the occupied RBs of CSI-RS for tracking. We don’t think this is necessary since it is already flexible for the network to configure pointA. With such flexibility, it is not necessary to support PDSCH resource allocation with 4/5/6RB larger than the bandwidth of the CSI-RS for tracking since the network could always configure TRS and pointA in a way that leave at most 3RBs outside. Thus the number of RBs for the PDSCH resource allocation is not expected to be 3RBs greater than the size of the number of RBs occupied by CSI-RS for tracking.  **Proposal1: Adopt the following TP for 38.214**   |  | | --- | | <unchanged part omitted>  **5.1.2.2 Resource allocation in frequency domain**  Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, then downlink resource allocation type 1 is used.  If the scheduling DCI is configured to indicate the downlink resource allocation type as part of the *Frequency domain resource assignment* field by setting a higher layer parameter *resourceAllocation* in *pdsch-Config* to 'dynamicswitch', for DCI format 1\_1 or setting a higher layer parameter *resourceAllocation-ForDCIFormat1\_2* in *pdsch-Config* to 'dynamicswitch' for DCI format 1\_2, the UE shall use downlink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the downlink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 1\_1 or by the higher layer parameter *resourceAllocation-ForDCIFormat1\_2* for DCI format 1\_2.  If a bandwidth part indicator field is not configured in the scheduling DCI or the UE does not support active BWP change via DCI, the RB indexing for downlink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI and the UE supports active BWP change via DCI, the RB indexing for downlink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI. The UE shall upon detection of PDCCH intended for the UE determine first the downlink bandwidth part and then the resource allocation within the bandwidth part.  For a PDSCH scheduled with a DCI format 1\_0 in any type of PDCCH common search space, regardless of which bandwidth part is the active bandwidth part, RB numbering starts from the lowest RB of the CORESET in which the DCI was received; otherwise RB numbering starts from the lowest RB in the determined downlink bandwidth part.  If the bandwidth of the CSI-RS for tracking is configured to be one value among the set of {28, 32, 36, 40, 44, 48 RBs} in a BWP with equal to 52RBs, the resource allocation of PDSCH is expected to be confined within up to 3 RBs beyond the highest RB and lowest RB occupied by the CSI-RS for tracking. The number of RBs for the PDSCH resource allocation is not expected to be 3RBs greater than the number of RBs occupied by CSI-RS for tracking.  <unchanged part omitted> |   For other restrictions endorsed in the way forward, the following TP is proposed.  **Proposal2: Adopt the following TP for 38.214**   |  | | --- | | **5.1.6.1.1 CSI-RS for tracking**  <unchanged part omitted>  Each CSI-RS resource, defined in Clause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:  - the time-domain locations of the two CSI-RS resources in a slot, or of the four CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of  - , , or for frequency range 1 and frequency range 2,  - , , , , ,  or  for frequency range 2.  - a single port CSI-RS resource with density  given by Table 7.4.1.5.3-1 from [4, TS 38.211] and higher layer parameter *density* configured by *CSI-RS-ResourceMapping.*  - the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks. For bands in paired spectrum, UE may indicate support of bandwidth {28, 32, 36, 40, 44, 48 RBs} for CSI-RS for tracking in a BWP with equal to 52RBs and *subcarrierSpacing* equal to 15kHz. UE is not expected to be configured with CSI-RS for tracking with different sets of occupied RBs in a BWP if the bandwidth of the CSI-RS for tracking is configured to be one value among the set of {28, 32, 36, 40, 44, 48 RBs} in a BWP with equal to 52RBs.  - the UE is not expected to be configured with the periodicity of  slots if the bandwidth of CSI-RS resource is larger than 52 resource blocks.  - the periodicity and slot offset for periodic NZP CSI-RS resources, as given by the higher layer parameter *periodicityAndOffset* configured b*y NZP-CSI-RS-Resource*, is one of slots where 10, 20, 40, or 80 and where µ is defined in Clause 4.3 of [4, TS 38.211].  - same *powerControlOffset* and *powerControlOffsetSS* given by *NZP-CSI-RS-Resource* value across all resources.  <unchanged part omitted> | |

In [2], same as in [1], it is proposed that a UE does not expect to be scheduled a PDSCH with more than 3 resource blocks outside the bandwidth of the CSI-RS resources, and corresponding TP for 38.214 5.1.6.1.1 is provided.

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| One remaining issue in the endorsed TEI on flexible TRS bandwidth is whether to allow PDSCH scheduling locate within up to 3RB on either side of the TRS bandwidth or both sides. Our understanding is if we allow 3RBs on both sides of TRS bandwidth, it will have maximum PDSCH scheduling BW 6 RBs larger than the TRS bandwidth. Then gNB can essentially configure a 4-RB larger TRS BW. Hence the reasonable restriction should be the bandwidth allowed for PDSCH scheduling should contain the TRS BW and be 3-RB larger than the TRS BW.  Thus we have the following TP suggestion.  ***TP 3:*** *For 38.214*   |  | | --- | | **5.1.6.1.1 CSI-RS for tracking**  <Unchanged parts are omitted>  - the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks. For operation in paired spectrum, if the channel bandwidth is 10MHz, resource blocks, and the subcarrier spacing is 15kHz, the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is 28, 32, 36, 40, 44 or 48 resource blocks, where all the CSI-RS resources configured for a given BWP occupy the same set of resource blocks, and a UE does not expect to be scheduled a PDSCH with more than 3 resource blocks outside the bandwidth of the CSI-RS resources.  <Unchanged parts are omitted> | |

In [3], same as in [1] and [2], it is proposed that the allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to a total number of 3RBs beyond both of the highest RB and lowest RB of the TRS, and corresponding TP for 38.214 5.1.6.1.1 is provided.

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| As agreed in RP-201333 [1], the new bandwidths of CSI-RS are with 4-PRB steps from 28 to 48 RBs. If a PDSCH has more 4 PRBs than TRS, then gNB should configure larger TRS bandwidth for better UE performance. Thus we have the following the proposal:  ***Proposal 1: Clarify that the allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to a total number of 3RBs beyond both of the highest RB and lowest RB of the TRS***  Based on RP-201333 and Proposal 1, we give the following text proposal   |  | | --- | | **In TS 38. 214 Section 5.1.6.1.1**  *<omitted text>*  A UE does not expect to be configured with a *NZP-CSI-RS-ResourceSet* configured both with *trs-Info* and *repetition*.  Each CSI-RS resource, defined in Clause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:  - the time-domain locations of the two CSI-RS resources in a slot, or of the four CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of  - , , or for frequency range 1 and frequency range 2,  - , , , , ,  or  for frequency range 2.  - a single port CSI-RS resource with density  given by Table 7.4.1.5.3-1 from [4, TS 38.211] and higher layer parameter *density* configured by *CSI-RS-ResourceMapping.*  - the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks. For operation with the FDD bands where subcarrier spacing configuration is 0 and the maximum transmission bandwidth configuration NRB for UE channel bandwidth is 52 RBs [8, TS 38.101-1], *freqBand* configured by *CSI-RS-ResourceMapping* can be one of {28, 32, 36, 40, 44, 48}.  - the UE is not expected to be configured with the periodicity of  slots if the bandwidth of CSI-RS resource is larger than 52 resource blocks.  - the periodicity and slot offset for periodic NZP CSI-RS resources, as given by the higher layer parameter *periodicityAndOffset* configured b*y NZP-CSI-RS-Resource*, is one of slots where 10, 20, 40, or 80 and where µ is defined in Clause 4.3 of [4, TS 38.211].  - same *powerControlOffset* and *powerControlOffsetSS* given by *NZP-CSI-RS-Resource* value across all resources.  If *freqBand* configured by *CSI-RS-ResourceMapping* is one of {28, 32, 36, 40, 44, 48}, UE does not expect that the total number of PRBs allocated for PDSCH but not overlapped with the PRBs carrying CSI-RS for tracking is more than 3.  *<omitted text>* | |

In [4], same as [1], [2] and [3], it is proposed that the UE is not expected to receive a PDSCH allocation with more than 3 PDSCH RBs in total outside the configured TRS bandwidth, and corresponding TP for 38.214 5.1.6.1.1 is provided.

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| In the RAN#88e meeting, there is an open issue for the following condition:   * *All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3RBs beyond either/both of the highest RB and lowest RB of the TRS.*   The background for the condition is that, in the 10 MHz bandwidth case, the newly introduced TRS bandwidth is from 28 RBs (or from 32 RBs) to 48 RBs with the granularity of 4 RBs. However, the gNB may choose to schedule a maximum of 34 RBs (as an example) for PDSCH allocation, in which case the largest bandwidth of the PDSCH is not a multiple of 4 RBs. A principle for TRS bandwidth configuration is to match the configured bandwidth for transmission as much as possible, because the larger the bandwidth for TRS, then the better the performance for channel information tracking. For example, if the maximum scheduled bandwidth for PDSCH is 34 RBs, the TRS bandwidth could be configured as 32 RBs or 28 RBs, but the TRS with 32 RBs provides better performance than 28 RBs. So, it was agreed at RAN#88e to restrict the TRS bandwidth selection for each transmission band configuration such that the PDSCH RBs can only exceed the TRS bandwidth by up to 3 RBs.    Figure 1. TRS Band is no more than 3 RBs in total beyond PDSCH allocation  In the RAN#88e agreement, it may not be clear whether up to 3 RBs is permitted beyond each of the highest and lowest RB, or the up to 3 RBs is a limit in total considering both sides.  In our understanding, if both sides exceed the TRS bandwidth by up to 3 RBs, the total number of PDSCH RBs outside of TRS could be up to 6 RBs. It does not make sense to leave so many RBs without TRS tracking and QCL assumption. Since the granularity of the newly introduced TRS bandwidth is 4 RBs, 4 RBs within those 6 RBs could be used for TRS transmission. As an example, if the PDSCH allocation bandwidth is 34RBs, the TRS bandwidth can be 32RBs, but not for 28 RBs.  ***Proposal 1: When a UE is configured with a 10 MHz carrier with 52 RB BWP size, 15 kHz SCS and TRS of bandwidth*** s***ize among {28, 32, 36, 40, 44, 48} RBs in a FDD band, the UE is not expected to receive a PDSCH allocation with more than 3 PDSCH RBs in total outside the configured TRS bandwidth.***  ***Text proposal 1: In Section 5.1.6.1.1 of TS38.214***   |  | | --- | | Each CSI-RS resource, defined in Clause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:  - the time-domain locations of the two CSI-RS resources in a slot, or of the four CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of  - , , or for frequency range 1 and frequency range 2,  - , , , , ,  or  for frequency range 2.  - a single port CSI-RS resource with density  given by Table 7.4.1.5.3-1 from [4, TS 38.211] and higher layer parameter *density* configured by *CSI-RS-ResourceMapping.*  - the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. Based on the UE capability, for 10 MHz channel bandwidth, 52 RB BWP size, and 15 kHz SCS in a FDD band, the bandwidth of the CSI-RS resource can be configured with one of {28, 32, 36, 40, 44, 48} resource blocks by the higher layer parameter *freqBand* in *CSI-RS-ResourceMapping*; and the UE is not expected to receive a PDSCH allocation with more than 3 PDSCH RBs in total outside the configured TRS bandwidth where all TRS configured for a given BWP for a UE span the same set of RBs. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks.  - the UE is not expected to be configured with the periodicity of  slots if the bandwidth of CSI-RS resource is larger than 52 resource blocks.  - the periodicity and slot offset for periodic NZP CSI-RS resources, as given by the higher layer parameter *periodicityAndOffset* configured b*y NZP-CSI-RS-Resource*, is one of slots where 10, 20, 40, or 80 and where µ is defined in Clause 4.3 of [4, TS 38.211].  - same *powerControlOffset* and *powerControlOffsetSS* given by *NZP-CSI-RS-Resource* value across all resources. | |

In [5], the TP for 38.214 5.1.6.1.1 is provided, and the TP includes the part “the UE does not expect to receive PDSCH in resource blocks of the active BWP which are more than 3 RBs above the highest resource block of the CSI-RS or more than 3 RBs below the lowest resource block of the CSI-RS” which may be same as above proposals and TPs from other companies.

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| **Proposal:** *Adopt the following TP for TS38.214 to address RP-201333 in RAN1*   |  | | --- | | 5.1.6.1.1 CSI-RS for tracking  <unchanged text parts omitted>  Each CSI-RS resource, defined in Clause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:  - the time-domain locations of the two CSI-RS resources in a slot, or of the four CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of  - , , or for frequency range 1 and frequency range 2,  - , , , , ,  or  for frequency range 2.  - a single port CSI-RS resource with density  given by Table 7.4.1.5.3-1 from [4, TS 38.211] and higher layer parameter *density* configured by *CSI-RS-ResourceMapping.*  - if carrier , , and the carrier is configured in paired spectrum, the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is *X* resource blocks, where resources if the UE indicates *allTRS* for the *trs-BandwidthSize-15kHz* capability and if the UE indicates *allTRS-Except28PRB* for the *trs-BandwidthSize-15kHz* capability; in these cases, if the UE is configured with CSI-RS comprising X<52 resource blocks, the UE does not expect to receive PDSCH in resource blocks of the active BWP which are more than 3 RBs above the highest resource block of the CSI-RS or more than 3 RBs below the lowest resource block of the CSI-RS and all CSI-RS resource configurations shall span the same set of resource blocks. Otherwise, the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks.  <unchanged text parts omitted> | |

In [7], same as [1], [2], [3], [4] and [5], it is proposed that the option of extra 3RBs at both ends, giving a total of 6 excess RBs, is not needed. In addition, two sub-options are provided, whether PDSCH RBs outside TRS bandwidth are only on either side or can be on both sides.

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| The reason for allowing up to 3 RBs at either/both ends of the TRS is that the usable number of PDSCH RBs is not a multiple of 4 while the TRS BW is. The assumption has been that both the beginning and the end of the TRS is on a fixed 4 RB grid that can be up to 3 RBs offset from the start and end of the actual usable channel BW.  This; however, doesn’t consider the so-called Reference Point A, from which the common RB numbering starts, being itself settable. Therefore, the channel BW can be aligned at either end with the TRS start RB or the TRS end RB. Therefore, the option of extra 3 RBs at both ends, giving a total of 6 excess RBs, is not needed.  In order to streamline the configuration, we propose the following change:  **Proposal 1: Adopt either of the following options:**   * **Option 1: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3 RBs beyond either~~/both~~ of the highest RB ~~and~~or lowest RB of the TRS.** * **Option 2: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to X RBs beyond the highest RB and/or Y RBs beyond the lowest RB of the TRS, where X+Y<4.**   **Option 2 is preferred.** |

In [8], the TPs for 38.214 5.1.2.2 and 5.1.6.1.1 are provided, and the TP includes the part “the UE is not expected to receive a PDSCH allocation spanning more than 3RBs below the lowest RB and 3 RBs above the highest RB of the corresponding CSI-RS resource” which may or may not be same as above proposals and TPs from other companies.

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| <<START OF CHANGES>>  5.1.2.2 Resource allocation in frequency domain  ~  For operation in paired sprectrum with , = 52 , and reported UE capability *trsAdditionalBandwidth*, the UE is not expected to receive a PDSCH allocation spanning more than 3RBs below the lowest RB and 3 RBs above the highest RB of the corresponding CSI-RS resource as described in Clause 5.1.6.1.1.  <<SECTIONS SKIPPED>>  5.1.6.1.1 CSI-RS for tracking  ~  - for operation in paired sprectrum with , = 52 , and reported UE capability *trs-AdditionalBandwidth-r16*, the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is minimum 28 or 32 resource blocks depending on whether the value of *trs-AdditionalBandwidth-r16* is set to *trs-AddBW-Set1* or *trs-AddBW-Set2*,and maximum resource blocks and all CSI-RS resource configurations shall span the same set of resource blocks, otherwise, the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks, or is equal to resource blocks.  ~  <<END OF CHANGES>> |

Based on the above contributions, it is agreed to discuss following points in the email discussion [9].

**Discussion point**

* **Which one of following options should be adopted based on “up to 3RBs beyond either/both of the highest RB and lowest RB of the TRS”**
  + **Option 1: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3 RBs beyond either of the highest RB or lowest RB of the TRS, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS are only on either side.**
  + **Option 2: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to X RBs beyond the highest RB and/or Y RBs beyond the lowest RB of the TRS, where X+Y<4, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS can be on both sides.**
  + **Option 3: All allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to 3 RBs beyond both of the highest RB and lowest RB of the TRS, i.e., total number of RBs outside TRS bandwidth is up to 6 and RBs outside TRS can be on both sides.**
* **Whether TP should be provided for 5.1.6.1.1 only or for both 5.1.2.2 and 5.1.6.1.1**

Companies provided following views during the preparation phase discussion [9].

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| Company | Comment |
| Ericsson | This should be discussed based on RAN plenary agreement.  The intention of the RAN agreement on the PDSCH bandwidth was that it shall be possible to schedule the PDSCH on all the resource blocks available to the operator even if the TRS bandwidth and starting position has a granularity of 4 resource blocks. As long as this is fulfilled, the actual solution is less important. Not that this should be possible without having to move the frequency location of the carrier and the 10 MHz BWP.  PDSCH resource allocation restriction should be in 5.1.2.2 and additional TRS bandwidths should be in 5.1.6.1.1. |
| Intel | Agree to discuss. |
| Nokia | The topic should be discussed as mandated by RAN #88e. points of discussion should be:   1. whether the PDSCH is allowed to be scheduled for up to 6 (up to 3 RBs on each side) or only up to 3 RBs outside the TRS BW. 2. placement of the new spec text within the TS38.214. We prefer to keep the change in one place, i.e. all restrictions are at the same place in the TS38.214. |
| ZTE | Agree to discuss it. We support option 2 in FL’s summary. In addition, to capture it in one place, i.e., sub-clause of CSI-RS for tracking, seems better. |
| vivo | Agree to discuss the two points. |
| OPPO | Support FL proposal. We also share the same view as Nokia that all restrictions are at the same place in the TS38.214. |
| Huawei, HiSilicon | Ok to be discussed.  For the Alternatives, we support Alt.2. TRS bands should be aligned with PDSCH to guarantee the performance of channel estimation for the case less than 10MHz bandwidth. Since the granularity of the additional TRS band is 4, the PDSCH RBs outside of TRS band should not be more than 3. So, we do not support Alt.3. Then, for Alt-1, seems not flexible as Alt.2, while PDSCH RBs may beyond both highest and lowest TRS RBs.  Then, for the TPs, the TP should be based on the agreed alternative, and all the conditions agreed in RANP should be clear captured. For the TP to be captured in Section 5.1.6.1.1 or separately in 5.1.6.1.1 and 5.2.2, we slightly prefer only in Section 5.1.6.1.1, which seems more clear on the conditions for the feature. |

## 2.1 Proposal and discussion

Based on contributions and above inputs during preparation phase discussion, following proposals are made.

Regarding the first discussion point, it seems Option 2 is preferred by multiple companies.

### **FL proposal 1:**

* **Clarify that all allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to X RBs beyond the highest RB and/or Y RBs beyond the lowest RB of the TRS, where X+Y<4, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS can be on both sides.**

Companies are encouraged to check above FL proposal and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
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Regarding the second discussion point, it seems TP for one place is preferred by multiple companies.

### **FL proposal 2:**

* **TP is prepared for 5.1.6.1.1 in TS38.214 based on [R1-2005453, R1-2005982, R1-2006408, R1-2006431].**

Companies are encouraged to check above FL proposal and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
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# **Conclusion**

**FL proposal 1:**

* **Clarify that all allocated PDSCH RBs are confined within the bandwidth spanned by TRS + up to X RBs beyond the highest RB and/or Y RBs beyond the lowest RB of the TRS, where X+Y<4, i.e., total number of RBs outside TRS bandwidth is up to 3 and RBs outside TRS can be on both sides.**

**FL proposal 2:**

* **TP is prepared for 5.1.6.1.1 in TS38.214 based on [R1-2005453, R1-2005982, R1-2006408, R1-2006431].**

# **References**

[1] R1-2005362 Discussion on flexible NR bandwidth vivo

[2] R1-2005453 Maintenance of Rel-16 NR TEIs ZTE

[3] R1-2005982 Discussion on the introduction of new bandwidths of CSI-RS for tracking OPPO

[4] R1-2006408 Flexible TRS bandwidth configuration for 10 MHz in Rel-16 Huawei, HiSilicon

[5] R1-2006431 On remaining NR TEI issues Nokia, Nokia Shanghai Bell

[6] R1-2006585 Discussion on UCI bit sequence generation ASUSTeK

[7] R1-2006837 Discussion of flexible NR UE bandwidth TEI and UL skipping Qualcomm Incorporated

[8] R1-2006906 Introduction of Flexible TRS bandwidth for BWP of 52 RBs Vodafone

[9] R1-2006716 Summary on Rel-16 NR TEI related discussion Moderator (NTT DOCOMO, INC.)