**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-TEIs-01]

Agenda Item: 7.2.11.12

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

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.12 regarding UE features for NR TEIs.

[100b-e-NR-UEFeatures-TEIs-01] Email discussion/approval on feature group structure for NR TEI (20th-24th April) – Hiroki (DCM)

* Confirm to keep FG14-1/2/3/4/5/6
* Discuss whether the bracket for FG14-1a is removed or FG14-1a is removed
* Discuss whether FG14-5 includes component 2 “Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS” (i.e., 14-5a is removed) or 14-5a is separately defined (i.e., component 2 for FG14-5 is removed)
* Discuss whether the bracket for FG14-7 is removed or FG14-7 is removed
* Discuss whether the FG for CSI trigger states containing non-active BWP is introduced or not. If there is no consensus to add the new feature group at the end of this email discussion, the new feature group is not introduced in Rel-16.

# **14-1: Multiple LTE-CRS rate matching patterns**

In [1], FG14-1 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-1 | Multiple LTE-CRS rate matching patterns | 1. Maximum number of LTE-CRS rate matching patterns in total within a NR carrier

[2] Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier] | 5-28 (Rate-matching around LTE CRS) | Yes | N/A |  | Per band | N/A | N/A |  | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot] | Optional with capability signallingComponent 1:{2, 3, 4, 5, 6}[Component 2: {2, 3}] |

Following views are provided in contributions for the RAN1#100bis-e meeting.

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| [4] | MediaTek Inc. | For FG14-1 and FG14-1a, clarify that they are for FR1 only in the column of “Need of FR1/FR2 differentiation”.

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| 14-1 | Multiple LTE-CRS rate matching patterns | 1. Maximum number of LTE-CRS rate matching patterns in total within a NR carrier
 | 5-28 (Rate-matching around LTE CRS) | Yes | N/A |  | Per band | N/A | N/A (FR1 only) |  | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot] | Optional with capability signallingComponent 1:{2, 3, 4, 5, 6} |

 |
| [6] | Ericsson | The FSS proposal to add “Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier” is ok |
| [7] | Qualcomm Incorporated | For FG 14-1 Multiple LTE-CRS rate matching patterns, enable signaling a capability of supporting 2 overlapping CRS within a single LTE CC.

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| 14-1 | Multiple LTE-CRS rate matching patterns | 1. Maximum number of LTE-CRS rate matching patterns in total within a NR carrier

[2] Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier] | 5-28 (Rate-matching around LTE CRS) | Yes | N/A |  | Per band | N/A | N/A |  | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot] | Optional with capability signallingComponent 1: {2, 3, 4, 5, 6}Component 2: {1, 2, 3}] |

 |
| [8] | Huawei, HiSilicon | Current description in the component column is missing the maximum number of LTE-CRS non-overlapping rate matching patterns within a NR carrier. Thus, we feel it is necessary to add a bullet as “Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier”

|  |  |  |  |  |  |  |
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| 14-1 | Multiple LTE-CRS rate matching patterns | 1. Maximum number of LTE-CRS rate matching patterns in total within a NR carrier

~~[2]~~ 2) Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier~~]~~ | 5-28 (Rate-matching around LTE CRS) | Per band | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot] | Optional with capability signallingComponent 1:{2, 3, 4, 5, 6}~~[Component 2: {2, 3}]~~ |

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## 2.1 Discussion 1

**The proposal is to confirm that FG14-1 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Apple | We agree to keep FG14-1 |
| Huawei, HiSilicon | Fine to keep FG14-1. Then, the component-2 also should be kept, which is aligned the previous agreement. |
| OPPO | Ok to keep FG 14-1, but the candidate values of Component 2 should include 1. The capability {Component 1, Component 2, 14-1a} of {2, 1, Yes} can be used for M-TRP transmission overlapping with a single LTE CC |
| Intel  | Agree to keep 14-1. The component 2 should be discussed together with 14-1a |
| Nokia, NSB | We agree to keep it. |
| ZTE/Sanechips | OK to keep the FG and we have the following comments.Regarding the second component, we are supportive of the candidates {1 ,2 , 3}. Regarding the note, we prefer to keep it for clarification. So the square bracket can be removed.~~[~~The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot~~]~~ |
| Ericsson | Keep 14-1 which includes “Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier” as a basic functionality (i.e. component 2 is not needed). |
| Qualcomm | We think we should keep FG 14-1 together with component 1, which is aligned with the agreements. What we think is still missing in the current structure is that the following UE capability cannot be signaled: * The UE supports CRS in a single LTE CC (i.e. does not support non-overlapping CRS), and
* The UE supports two overlapping CRS within one LTE CC

This UE would have to signal the following: * FG 14-1: Comp\_1= 2; Comp\_2= 2
* FG 14-1a: Supported

But this is more than the capability of the example UE, since the FG description would say that the UE supports two non-overlapping CRS within the NR CC, which is against the above assumption. We are ok with any fix that solves the above.  |

**FL proposal:**

* FG14-1 is kept.
	+ Component 1 is kept with candidate values {2,3,4,5,6}
	+ Component 2 is kept with candidate values {1,2,3}

# **[14-1a]: Multiple LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier**

In [1], FG14-1a is captured with bracket as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | [14-1a] | Multiple LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier | Up to two LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier | 14-1 (Multiple LTE-CRS rate matching patterns),16-2 (mTRP support) | Yes | N/A |  | Per band | N/A | N/A |  | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot]FFS: whether this FG is necessary or not | Optional with capability signaling |

Following views are provided in contributions for the RAN1#100bis-e meeting.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [4] | MediaTek Inc. | Without FG14-1a, it’s difficult for the network to know whether a UE can support 14-2 capability or not. Furthermore, there is no strong linking between multi-TRP and DSS, i.e. supporting multi-TRP doesn’t mean that 14-2 should be supported and supporting DSS doesn’t mean that 14-2 should be supported.For FG14-1 and FG14-1a, clarify that they are for FR1 only in the column of “Need of FR1/FR2 differentiation”.

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| 14-1a | Multiple LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier | 1. Up to two LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier
 | 14-1 (Multiple LTE-CRS rate matching patterns),16-2 (mTRP support) | Yes | N/A |  | Per band | N/A | N/A (FR1 only) |  | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot]FFS: whether this FG is necessary or not | Optional with capability signaling |

 |
| [6] | Ericsson | There is no need for this FG since 14-1 already captured 2 to 6 patterns and at most 3 non-overlapping as captured in the basic functionality (if “Up to 3 LTE-CRS non-overlapping rate matching patterns within a NR carrier” is added in 14-1) |
| [8] | Huawei, HiSilicon | As for the FFS of FG 14-1a, we feel this FG should be kept. Because BS station cannot determine whether the UE supports multiple LTE-CRS rate matching patterns within a LTE carrier or across different LTE carriers only with the help of capability report (14-1).

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| ~~[~~14-1a~~]~~ | Multiple LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier | 1. Up to two LTE-CRS overlapping rate matching patterns within a part of NR carrier overlapping with a LTE carrier
 | 14-1 (Multiple LTE-CRS rate matching patterns),16-2 (mTRP support) | Per band | For DSS[The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot]~~FFS: whether this FG is necessary or not~~ | Optional with capability signaling |

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## 3.1 Discussion 2

**Companies are encouraged to provide views on whether the bracket for FG14-1a is removed or FG14-1a is removed.**

 **Keeping the FG[14-1a] (removing bracket) supported by:**

 **Objected (i.e., support removing FG[14-1a]) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Apple | We prefer to keep the FG subject to MTRP discussion. However, there is no need for overlapping restrictions  |
| Huawei, HiSilicon | Support to keep the FG. |
| OPPO | Support to keep the FG |
| Intel | Need to discuss necessity of this FG in conjunction with component 2 of FG 14-1 |
| Nokia, NSB | It is OK to keep the FG as this one would depend on 16-2. However, the current description does not seem to match the desired functionality. It needs to be rewritten before it can be fully agreed to, and at the same time 14-1 needs to be adjusted as well to ensure there is a clear distinction between the two. |
| ZTE/Sanechips | There is no need to support this FG. From the FG14-1, gNB will get the information of how many overlapping CRS patterns. |
| Ericsson | Ok to keep 14-1a FG. If UE support this FG, it can be configured with * 1 overlapping pattern if component 1 of 14-1 is <=3
* 1 or 2 overlapping patterns if component 1 of 14-1 is <=5
* 1, 2 or 3 overlapping patterns if component 1 of 14-1 is 6
 |
| Qualcomm | We think we should keep FG 14-1aHowever, we think the description should be amended to fix the issue mentioned in Discussion #1, namelyEnable signaling the following UE capability: * The UE supports CRS in a single LTE CC (i.e. no non-overlapping CRS), and
* The UE supports two overlapping CRS within one LTE CC

We are ok with any solution that resolves the above.  |

**FL proposal:**

* FG14-1a is kept.

# **14-2: PDSCH Type B mapping of length 9 and 10 OFDM symbols**

In [1], FG14-2 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-2 | PDSCH Type B mapping of length 9 and 10 OFDM symbols | Indicates whether the UE supports PDSCH Type B scheduling of length 9 and 10 OFDM symbols | 5-6a (PDSCH mapping type B) | Yes | N/A |  | FFS: [Per band or Per UE] | [N/A or No] | [N/A or No] |  | For DSS | FFS: [Mandatory with capability signailng or Optional with capability signaling] |

Following views are provided in contributions for the RAN1#100bis-e meeting.

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| [4] | MediaTek Inc. | FG14-2 is mainly for DSS enhancements in FR1 so we don’t see why it should be a mandatory FG when other DSS-related FGs are optional with capability signalling.

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| 14-2 | PDSCH Type B mapping of length 9 and 10 OFDM symbols | 1. Indicates whether the UE supports PDSCH Type B scheduling of length 9 and 10 OFDM symbols
 | 5-6a (PDSCH mapping type B) | Yes | N/A |  | Per band | [N/A or No] | [N/A or No] |  | For DSS |  Optional with capability signaling |

 |
| [6] | Ericsson | * FDD/TDD differentiation should be “No”
	+ Note that the main use case and motivation is for TDD and 30 kHz subcarrier spacing in which case the UE is not aware that DSS is in operation. So FDD/TDD differentiation should be No, and “DSS” in the note should be interpreted as for information only. For example, it must be ensured that the RAN1 interpretation is that this feature is not restricted to be dependent that LTE-CRS rate matching pattern is configured (i.e. FDD,15 kHz).
* The signalling should be per UE
* The feature group should be mandatory with capability signalling
 |
| [8] | Huawei, HiSilicon | For FG 14-2, since it is a separate UE capability for PDSCH mapping type B with 9 and 10 OFDM symbols along with FG 10-8, then FG 14-2 should also be per UE instead of per band. |

## 4.1 Discussion 3

**The proposal is to confirm that FG14-2 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

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| --- | --- |
| Company | Comment |
| Apple | We agree to keep FG14-2 |
| Huawei, HiSilicon | Fine to keep, the FG should be per UE |
| OPPO | Support to keep it. The feature should be optional |
| Intel | Agree |
| Nokia, NSB | We agree to keep it. |
| vZTE/Sanechips | We think Rel-15 principle should be reused, so we suggest:This FG should be per UE. Need of FDD/TDD differentiation: Yes.Need of FR1/FR2 differentiation: Yes |
| Ericsson | Keep it. The FG should be per UE |
| Qualcomm | We think this feature should be kept. FG 14-2 should be per band because it is unlikely that the feature would be introduced at the same time for licensed and unlicensed, while IODT differentiation is necessary. Per band signaling enables deployment in unlicensed without being tested in licensed and vice versa. At the same time, we think that if the UE indicates the support of FG 14-2 only in unlicensed, then the DM-RS pattern shift should not apply. Either this fact should be clearly described, or the DM-RS pattern shift should be a separate row with capability bit.  |

**FL proposal:**

* FG14-2 is kept.

# **14-3: One slot periodic TRS configuration for FR1**

In [1], FG14-3 is captured as below.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-3 | One slot periodic TRS configuration for FR1 | UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated | 2-51 (CSI-RS for tracking) | Yes | N/A |  | Per UE | N/A (TDD only) | N/A (FR1 only) |  | UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated.FFS: relationship with maxBurstLength for FG2-51 | Optional with capability signalling |

Following view is provided in a contribution for the RAN1#100bis-e meeting.

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| [8] | Huawei, HiSilicon | In Rel-15, only two-slot TRS is supported for FR1 considering the tracking performance and general use cases. One-slot TRS and two-slot TRS are both supported in FR2 in Rel-15. Although value 2 indicating both one-slot and two-slot for *maxBurstLength* is mandatory in TS38.306, but as detailed described in TS38.214, only two-slot is available for FR1. So, 2-slot is the exact mandatory feature for TRS in Rel-15. Regarding the relationship with *maxBurstLength* for FG2-51, it is up to RAN2 design. One possible way is to revise *maxBurstLength* for FG2-51 as “Value 1 indicate 1-slot TRS, Value 2 indicate 2-slot TRS, where Value 2 is mandatory”. In Rel-16 TEI for one-slot TRS, due to the new deployment for 4.9GHz band, one-slot TRS also may be used, if the following conditions are met:“***Only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated.***” i.e., one-slot TRS only used for the case that there is no way to implement the two-slot periodic TRS. So, as agreed in the TEI, one-slot periodic TRS is an optional feature and only used for the agreed scenarios.One more comment is that, in the draft version, one-slot periodic TRS is per UE reporting. However, the TRS feature is per Band reporting in Rel-15. To align the capability signaling, the one-slot TRS is also need to be per Band configuration. |

## 5.1 Discussion 4

**The proposal is to confirm that FG14-3 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

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| --- | --- |
| Company | Comment |
| Apple | We agree to keep FG14-3 |
| Huawei, HiSilicon | Support to keep. The FG should be per band. |
| OPPO | Support to keep it.  |
| Intel | Agree |
| Nokia, NSB | We agree to keep it. |
| ZTE/Sanechips | Okay to keep it but regarding the following FFS part, we think RAN2 can handle it. FFS: relationship with maxBurstLength for FG2-51 |
| Ericsson | Keep it |
| Qualcomm | We think FG 14-3 should be keptAgree that FG 14-3 should be per band because it is unlikely that the feature would be introduced at the same time for licensed and unlicensed, while IODT differentiation is necessary. Per band signaling enables deployment in unlicensed without being tested in licensed and vice versa. Separately, would like to get a clarification on the following: when all slots are indicated as flexible, we understand that single slot TRS can be configured (if supported by the UE). This is based on our reading of the condition: “***Only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated.***” Our understanding is that this condition is satisfied when all slots are indicated as flexible.  |

**FL proposal:**

* FG14-3 is kept.

# **14-4: SRS Tx switch with allowing downgrading configuration**

In [1], FG14-4 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch[2) Report whether the uplink Tx switching impact to downlink receiving in a band][3) Report whether the UL Tx is switched together with UL Tx in another band][Define affected DL and UL bands by using txSwitchImpactToRx and txSwitchWithAnotherBand for the new (downgraded) entries] | 2-53 (SRS resource)[2-55] | Yes | N/A |  | FFS: [Per band combination or per FSPC] | N/A | N/A |  | Agreement:•Rel-16 UE capability design for SRS antenna switching in conjunction with the existing Rel-15 UE capability should allow UE to indicate support of one of the following combinations o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}oNote: Detailed signaling design is up to RAN2FFS: whether components 2 and 3 are necessary or not | Optional with capability signallingComponent 1: Candidate value set:{o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}}Component2: Candidate value set: {yes, no}Component 3: Candidate value set: {yes, no} |

Following views are provided in contributions for the RAN1#100bis-e meeting.

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| [3] | OPPO | In Rel-15, the configuration of SRS Tx port switching is signaled per band combination. It is natural to follow the same principle to signal Rel-16 configuration.Moreover, in the last RAN2 meeting, a CR for SRS Tx switch with allowing downgrading configuration was agreed as follows [2]

| ***SRS-TxSwitch***Defines whether UE supports SRS for DL CSI acquisition as defined in clause 6.2.1.2 of TS 38.214 [12]. The capability signalling comprises of the following parameters:- *supportedSRS-TxPortSwitch* indicates SRS Tx port switching pattern supported by the UE, which is mandatory with capability signaling. The indicated UE antenna switching capability of ′xTyR′ corresponds to a UE, capable of SRS transmission on ′x′ antenna ports over total of ′y′ antennas, where ′y′ corresponds to all or subset of UE receive antennas, where 2T4R is two pairs of antennas.*supportedSRS-TxPortSwitch-r16*, which is optional to report, indicates downgrading configuration of SRS Tx port switching pattern. If the UE indicates the support of downgrading configuration of SRS Tx port switching pattern using *supportedSRS-TxPortSwitch-r16*, the UE shall report the values for this as below, based on what is reported in *supportedSRS-TxPortSwitch*.

|  |  |  |
| --- | --- | --- |
| ***supportedSRS-TxPortSwitch*** |  | ***supportedSRS-TxPortSwitch-r16*** |
| *t1r2* |  | *t1r1-t1r2* |
| *t1r4* |  | *t1r1-t1r2-t1r4* |
| *t2r4* |  | *t1r1-t1r2-t2r2-t2r4* |
| *t2r2* |  | *t1r1-t2r2* |
| *t4r4* |  | *t1r1-t2r2-t4r4* |
| *t1r4-t2r4* |  | *t1r1-t1r2-t2r2-t1r4-t2r4* |

- *txSwitchImpactToRx* indicates the entry number of the first-listed band with UL in the band combination that affects this DL, which is mandatory with capability signaling; - *txSwitchWithAnotherBand* indicates the entry number of the first-listed band with UL in the band combination that switches together with this UL, which is mandatory with capability signaling. For *txSwitchImpactToRx* and *txSwitchWithAnotherBand*, value 1 means first entry, value 2 means second entry and so on. All DL and UL that switch together indicate the same entry number.The UE is restricted not to include fallback band combinations for the purpose of indicating different SRS antenna switching capabilities. | BC | FD | No | No |

That is to say, RAN2 has decided the corresponding configured is signaled per band combination. Based on the above discussions, we have the following proposal***Proposal 1: In Rel-16, the configuration of SRS Tx switch with allowing downgrading configuration is signaled per band combination (BC).******~***The current version of Component 2 and component 3 are not clear:* For Rel-15 (TS 38.306), there is a capability *txSwitchImpactToRx* indicates the entry number of the first-listed band with UL in the band combination that affects this DL”. If the value of 2nd components is YES, does it mean the new SRS Tx swiching capability follows *txSwitchImpactToRx* of Rel-15, or the new SRS Tx switching capability has impact on all DL of the band combination? If the value of 2nd component is NO, does it mean the new SRS Tx switching capability has no impact on the DL band indicated by *txSwitchImpactToRx* of Rel-15, or the new capability has on impact on any DL within the band combination?
* Rel-16 new capability contains more than one SRS Tx port switching configuration. Take {t1r1, t1r2, t1r4} as example. Is the 2nd component applicable to the whole set {t1r1, t1r2, t1r4}, or only some of them?

There are two possible ways to avoid the above confusion* Alt.1: Configure { *txSwitchImpactToRx, txSwitchWithAnotherBand*} for each SRS switching configuration supported by the UE capability
* Alt.2: Remove component 2 and component 3

Alt.1 can offer the most flexible at the cost of larger signaling overhead. However, the benefit of additional signaling flexibility is not clear so far for practical UE implementation. In contrast, Alt.2 is a simple solution, which seems sufficient at current stage. Thus we have the following proposal***Proposal 2: Remove component 2 and component 3 from “14-4 SRS Tx switch with allowing downgrading configuration”, and UE follows the Rel-15 configuration of { txSwitchImpactToRx, txSwitchWithAnotherBand} .*** |
| [4] | MediaTek Inc. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch[2) Report whether the uplink Tx switching impact to downlink receiving in a band][3) Report whether the UL Tx is switched together with UL Tx in another band][Define affected DL and UL bands by using txSwitchImpactToRx and txSwitchWithAnotherBand for the new (downgraded) entries] | 2-53 (SRS resource)[2-55] | Yes | N/A |  | Per band combination  | N/A | N/A |  | Agreement:•Rel-16 UE capability design for SRS antenna switching in conjunction with the existing Rel-15 UE capability should allow UE to indicate support of one of the following combinations o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}oNote: Detailed signaling design is up to RAN2FFS: whether components 2 and 3 are necessary or not | Optional with capability signallingComponent 1: Candidate value set:{o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}}Component2: Candidate value set: {yes, no}Component 3: Candidate value set: {yes, no} |

 |
| [5] | Intel Corporation | In Rel-15 UE capability for SRS Tx switching supports signaling of the xTyR as well as indication of the DL and UL bands which are impacted by the corresponding switching. In Rel-16 support of the additional xTyR configurations has been agreed as part of TEI work. The agreed xTyR signaling is a sequence of the all possible xTyR’s including the highest xTyR which should be already indicated using Rel-15 capability signaling for the backward compatibility purpose. Considering that Rel-16 indication includes highest xTyR already indicated in Rel-15 (highlighted in yellow), reporting of the affected DL and UL bands can be reused from Rel-15 capability. On the other hand, it is beneficial to have separate indication of the affected DL and UL for downgraded xTyR configuration (highlighted in green) since in most of the cases (except for t1r1-t1r2-) those configurations doesn’t involve any physical switching of the antennas and can be performed without any interruptions to DL and UL bands.* {t1r1, t1r2}
* {t1r1, t1r2, t1r4}
* {t1r1, t1r2, t2r2, t2r4}
* {t1r1, t2r2}
* {t1r1, t2r2, t4r4}
* {t1r1, t1r2, t2r2, t1r4, t2r4}

Considering the discussion above the following proposal can be made:**Proposal:*** *If signalling of xTyR configurations in Rel-16 supports highest xTyR as in the latest TS 38.306 [2]*
	+ *Affected DL and UL bands are inherited from Rel-15 capability*
* *If signaling of xTyR configuration in Rel-16 only supports downgraded xTyR configurations which are decoupled from highest xTyR reported in Rel-15*
	+ *Affected DL and UL bands are not applicable for downgraded xTyR configuration, except {t1r1, t1r2} entry for which associated Rel-15 capability can be reused*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch | 2-53 (SRS resource)[2-55] | BC | Optional with capability signallingComponent 1: Candidate value set:{o{t1r1 }o{t1r1, t1r2 }o{t1r1, t1r2, t2r2 }o{t1r1}o{t1r1, t1r2, t2r2}}NOTE: Rel-15 capability for the affected DL and UL bands are not applicable for downgraded Rel-16 xTyR capability, except {t1r1, t1r2}. |

 |
| [8] | Huawei, HiSilicon | For SRS antenna switching, it is down-gradation from Rel-15 UE capability. Generally the supporting features in Rel-15 also should be inherited for Rel-16. For the impact between DL and UL Tx switching, the impact reporting on 2-55 is only for the reported specific case, such as 1T4R. However, there are new entries are introduced in Rel-16 UE capability, such as {t1r1, t1r2, t1r4} which is more than 1T4R only, so it is necessary to report the impact between DL and UL antenna switching, i.e., keep Component-2 and 3.One more comment is for reporting granularity, to align with Rel-15, it is better to per Band Combination.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch~~[~~2) Report whether the uplink Tx switching impact to downlink receiving in a band~~]~~~~[~~3) Report whether the UL Tx is switched together with UL Tx in another band~~]~~[Define affected DL and UL bands by using txSwitchImpactToRx and txSwitchWithAnotherBand for the new (downgraded) entries] | 2-53 (SRS resource)[2-55] | ~~FFS: [Per band combination or per FSPC]~~Per Band Combination | Agreement:•Rel-16 UE capability design for SRS antenna switching in conjunction with the existing Rel-15 UE capability should allow UE to indicate support of one of the following combinations o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}oNote: Detailed signaling design is up to RAN2FFS: whether components 2 and 3 are necessary or not | Optional with capability signallingComponent 1: Candidate value set:{o{t1r1, t1r2}o{t1r1, t1r2, t1r4}o{t1r1, t1r2, t2r2, t2r4}o{t1r1, t2r2}o{t1r1, t2r2, t4r4}o{t1r1, t1r2, t2r2, t1r4, t2r4}}Component2: Candidate value set: {yes, no}Component 3: Candidate value set: {yes, no} |

 |

## 6.1 Discussion 5

**The proposal is to confirm that FG14-4 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Apple | We agree to keep FG14-4 |
| Huawei, HiSilicon | Agree to keep. The component 2 and 3 also should be kept due to the two parameters are with the different conditions from Rel-15, e.g., the supported cases are more than before. |
| OPPO | We are open to keep or remove Component 2/3 |
| Intel | Agree with FG14-4, however, the necessity of component 2 and 3 are not clear in current formulation and should be further discussed. Given that downgraded xTyR configurations doesn’t involve physical switching of the antennas except ‘1t2r’ (see Intel reply) why components 2 and 3 are needed? |
| Nokia, NSB | We agree to keep it. It should be enough to have it Per BC.  |
| ZTE/Sanechips | Components 2 and 3 are not needed. For xTxR configurations, e.g. 1T1R, 2T2R, there is no switching impact for DL and UL.For others, switching impact to DL and UL can be inherited from Rel-15 report.  |
| Qualcomm | We think FG 14-4 should be kept. We think that the Rel-15 SRS Tx switching capability should (or should have been) per band per band combination. The same xTyR capability doesn’t seem to work in a band combination that has both a 2Rx and a 4Rx band. Then to be consistent, the Rel-16 downgraded capability should also be per band per band combination (FS). If the section is only between BC and FSPC then it should be FSPC. Agreeing with Intel that component 2 and 3 should be separately signaled from the Rel-15 component 2 and 3, however, this could only provide benefit if the Rel-16 signaling were a ‘list of lists’ of impacted bands, e.g. a separate list for each xRyR case. This seems complicated.  |

**FL proposal:**

* FG14-4 is kept.

# **14-5: Half-duplex UE behaviour in TDD CA**

In [1], FG14-5 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-5 | Half-duplex UE behaviour in TDD CA | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with same SCS

[2] Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS] | 6-5, 6-6, simultaneousRxTxInterBandCA not supported | Yes | N/A |  | FFS: [Per band combination or Per UE] | [N/A or No] (TDD only) | [N/A or Yes or No] |  | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | FFS: [Mandatory with capability signaling for intra-band CA band and for inter-band CA in band combination without RAN4 FG 2-5 capability or Optional with capability signaling] |

Following views are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [4] | MediaTek Inc. | FG14-5 should be optional with capability signalling.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 14-5 | Half-duplex UE behaviour in TDD CA with same SCS | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with same SCS
 | 6-5, 6-6, simultaneousRxTxInterBandCA not supported | Yes | N/A |  | Per band combination  | N/A (TDD only) | N/A |  | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | Optional with capability signaling |

 |
| [6] | Ericsson | If we consider separating the UE capability for same and different SCS, then each capability shall be a “Per UE” capability. If the capability 14-5 applies to “Per Band Combination”, then there’s no need to add 14-5a. |
| [8] | Huawei, HiSilicon | The UE capability on same SCS or different SCS for CA cases are already reported through 6-5/6 and 6-9. So, it is not necessary to split the feature group “Half-duplex UE behaviour in TDD CA” into two cases with the same SCS and different SCS.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 14-5 | Half-duplex UE behaviour in TDD CA | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA ~~with same SCS~~

~~[2] Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS]~~ | 6-5, 6-6, simultaneousRxTxInterBandCA not supported | FFS: [Per band combination or Per UE] | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | FFS: [Mandatory with capability signaling for intra-band CA band and for inter-band CA in band combination without RAN4 FG 2-5 capability or Optional with capability signaling] |

 |

## 7.1 Discussion 6

**The proposal is to confirm that FG14-5 is kept (at least for same SCS case).**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | The FG14-5 can be kept, but the component-2 and 1 should be merged as one, since the UE capability on same SCS or different SCS for CA cases are already reported through 6-5/6 and 6-9. |
| Nokia, NSB | We agree to keep it. |
| Ericsson | FG14-5 shall be kept, with TYPE as “per UE”. Suggest to update the component description as below:1)Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA ~~with same SCS~~~~[2] Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS]~~ |
| Qualcomm | We believe we already agreed in Rel-15 that this feature would be optional, so FG 14-5 should be kept. In any case, that would be our preference even ignoring the Rel-15 agreement. The capability should be per band combination. |

**FL proposal:**

* FG14-5 is kept at least for same SCS case.
	+ If it is agreed to support half-duplex UE behavior in TDD CA with different SCS, it is covered by this FG and existing capability

# **[14-5a]: Half-duplex UE behaviour in TDD CA with different SCS**

In [1], FG14-5a is captured with bracket as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | [14-5a] | Half-duplex UE behaviour in TDD CA with different SCS | Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS | 6-5, 6-6, simultaneousRxTxInterBandCA not supported | Yes | N/A |  | FFS: [Per band combination or Per UE] | [N/A or No] (TDD only) | [N/A or Yes or No] |  | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | FFS: [Mandatory with capability signaling for intra-band CA band and for inter-band CA in band combination without RAN4 FG 2-5 capability or Optional with capability signaling] |

Following views are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [4] | MediaTek Inc. | Remove brackets for FG14-5a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 14-5a | Half-duplex UE behaviour in TDD CA with different SCS | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS
 | 6-5, 6-6, simultaneousRxTxInterBandCA not supported | Yes | N/A |  | Per band combination  | N/A (TDD only) | N/A |  | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | Optional with capability signaling |

 |
| [6] | Ericsson | If we consider separating the UE capability for same and different SCS, then each capability shall be a “Per UE” capability. If the capability 14-5 applies to “Per Band Combination”, then there’s no need to add 14-5a. |
| [8] | Huawei, HiSilicon | The UE capability on same SCS or different SCS for CA cases are already reported through 6-5/6 and 6-9. So, it is not necessary to split the feature group “Half-duplex UE behaviour in TDD CA” into two cases with the same SCS and different SCS. |

## 8.1 Discussion 7

**Companies are encouraged to provide views on whether FG14-5 includes component 2 “Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with different SCS” (i.e., 14-5a is removed) or 14-5a is separately defined (i.e., component 2 for FG14-5 is removed).**

 **Keeping the FG[14-5a] (removing bracket) supported by:**

 **Objected (i.e., support removing FG[14-5a] and adding component 2 for FG14-5) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | Remove FG14-5a, since the UE capability on same SCS or different SCS for CA cases are already reported through 6-5/6 and 6-9 |
| Nokia, NSB | It is beneficial to cover both cases of same and different SCS. If the signaling is per UE then we might need a separate FG for that, otherwise there is no strict need for a different FG.  |
| ZTE/Sanechips | Whether/how to support half-duplex CA with different numerologies is still under discussion in TEI session in this meeting. Without the outcome from TEI session, it is preferred not to introduce a separate UE feature for different numerologies for now. One approach is to postpone the discussion until the discussion in TEI session has been completed. Another approach is to make half-duplex with different numerologies one component of FG14-5. |
| Ericsson | Remove 14-5a. |
| Qualcomm | We believe that different SCS is unlikely for the time being, since half-duplex should only occur between TDD bands within FR1, where SCS 30kHz is the prevalent option.So we think that the feature support in Rel-16 should be decided first. On the other hand, if it is decided that different SCS half-duplex would be supported in Rel-16, than it should have a separate capability indication from same SCS support.  |

**FL proposal:**

* FG14-5a is removed.

# **14-6: New RACH configuration for FR1 TDD**

In [1], FG14-6 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-6 | New RACH configuration for FR1 TDD | new RACH configuration entries with subframe number 2 and/or 7 for RACH periodicity longer than 10 ms |  |  | N/A |  | N/A | N/A | N/A (FR1 only] |  | Agreement:•A new UE capability is not introduced for this TEI, i.e., it is a mandatory UE feature for Rel-16. | Mandatory without capability signalling |

Following view is provided in a contribution for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [8] | Huawei, HiSilicon | For the “Need of FR1/FR2 differentiation” column of FG 14-6, there is a mistake that the bracket in “(FR1 only]” should be replaces as “(FR1 only)”, which means only applicable for FR1. |

## 9.1 Discussion 8

**The proposal is to confirm that FG14-6 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | OK to keep |
| Nokia, NSB | We agree to keep it. |
| Ericsson | Agree to keep it |
| Qualcomm | We think the row should be kept. It should be marked in the xDD differentiation column as TDD only and in the FRx differentiation columns as FR1 only. |

**FL proposal:**

* FG14-6 is kept

# **[14-7]: New capability for beamSwitchTiming values of 224 and 336**

In [1], FG14-7 is captured with bracket as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | [14-7] | New capability for beamSwitchTiming values of 224 and 336 | 1. 48 is used as the beam switching threshold for UEs reporting 224 or 336

When using sym224 and sym336, beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI. | [2-28] | Yes | N/A |  | FFS: [per UE or per band] | [No or N/A] | [No or N/A (FR2 only)] |  | FFS: whether this FG is necessary or notFFS: relationship with beamSwitchTiming for FG2-28Agreements:・48 is used as the beam switching threshold for UEs reporting 224 or 336When using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI. | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | vivo | It can be noticed that the UE behavior is undefined when the reported value is one of the values of {224, 336} in RAN1 spec. Overall, it can be understood that for Rel-15 UE reporting of beamSwitchingTiming equal to 224 or 336 symbols is not supported, although it is included in RAN2 spec. Following UE behavior was agreed in Rel-16 TEI for the UEs reporting beamSwithchingTiming of 224 or 336:*48 is used as the beam switching threshold for UEs reporting 224 or 336. When using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.*In our understanding there are two ways to handle this issue:Option1: define a new UE capability as described in 14-7 Option2: agree in RAN1 that Rel-15 UE shall not report beamSwithchingTiming values of 224 or 336, then Rel-16 UE can reuse those values. In this case the agreement can be captured in section 15 of [1].  |
| [4] | MediaTek Inc. | Remove brackets for FG14-7.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 14-7 | New capability for beamSwitchTiming values of 224 and 336 | 1. 48 is used as the beam switching threshold for UEs reporting 224 or 336
2. When using sym224 and sym336, beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.
 | [2-28] | Yes | N/A |  | per band | N/A | N/A (FR2 only) |  | FFS: whether this FG is necessary or notFFS: relationship with beamSwitchTiming for FG2-28Agreements:・48 is used as the beam switching threshold for UEs reporting 224 or 336When using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI. | Optional with capability signaling |

 |
| [5] | Intel Corporation | It should be noted that in the UE is not aware which functionality is supported by the gNB. Due to such uncertainty UE is unlikely to report 224 or 336 values using Rel-15 capability to ensure backward compatibility for the “old” gNB potentially not supporting UE behaviour for beam switching timing of 224 and 336. Then, the agreed enhancement for aperiodic CSI-RS based on Rel-15 capability indication becomes useless. In order to solve the problem, it is necessarily to introduce Rel-16 capability for (e.g., beamSwitchTiming-r16) indicating new values of {224, 336} while keep supporting Rel-15 capability for the backward compatibility purpose without any changes. New UE behaviour in TS 38.214 defining threshold of 48 symbols for aperiodic CSI-RS can be enabled depending whether UE includes Rel-16 capability or not. It should be also noted that Rel-16 enhancement with beam switching timing of {224, 336} is supported based on UE capability and without explicit RRC configuration from gNB. Such approach was not recommended by RAN2 in the LS [4]. As the result ambiguity may occur on the actually assumed threshold for aperiodic CSI-RS, if UE in Rel-15 indicates *beamSwitchTiming* value other than 48 and also include new *beamSwitchTiming*-*r16* in Rel-16 implying threshold of 48 according to TS 38.214. To avoid ambiguity on the actually assumed threshold for aperiodic CSI-RS without explicit RRC signalling, UE including Rel-16 capability of {224, 336} should be required to include the value of 48 using Rel-15 *beamSwitchTiming* to avoid possible ambiguity between Rel-15 and Rel-16.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ~~[~~14-7~~]~~ | New capability for beamSwitchTiming values of 224 and 336 | ~~1. 48 is used as the beam switching threshold for UEs reporting 224 or 336~~~~2. When using sym224 and sym336, beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.~~1. Indicates the minimum number of required OFDM symbols {224, 336} between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition ‘ON’*.* | ~~[~~2-28~~]~~ | ~~FFS: [per UE or per band]~~Per band | ~~FFS: whether this FG is necessary or not~~~~FFS: relationship with beamSwitchTiming for FG2-28~~Component 1: candidate values {224, 336}NOTE: UE indicating *beamSwitchTiming-16* and *beamSwitchTiming* for the same band shall set *beamSwitchTiming* to 48Agreements:48 is used as the beam switching threshold for UEs reporting 224 or 336When using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI. |

 |
| [6] | Ericsson | * Ericsson is supportive of the new feature.
* The following component should be added

3) Support for scheduling aperiodic CSI-RS for beam management with an offset smaller than the beam switching threshold. |
| [8] | Huawei, HiSilicon | The entry seems a description of large values for the beam switching time, the feature reporting in 2-24 can be reused. In current spec for Rel-16, the agreement on the beam switching is captured in TS 38.306 and TS 38.214, so no new UE feature group need to be introduced. |

## 10.1 Discussion 9

**Companies are encouraged to provide views on whether the bracket for FG14-7 is removed or FG14-7 is removed.**

 **Keeping the FG[14-7] (removing bracket) supported by:**

 **Objected (i.e., support removing FG[14-7] and reusing Rel-15 capability) by:**

|  |  |
| --- | --- |
| Company | Comment |
| Apple | We slightly prefer to remove FG14-7 since 224/336 is already allowed to be indicated as of Rel-15 |
| Huawei, HiSilicon | Prefer to remove it, since 224/336 can be reported in Rel-15. In Rel-16, it is a further restriction on UE behaviour, it is already defined in 214 and 306, so no new signalling need to be introduced. |
| OPPO | Agree with Apple and Huawei |
| Intel | UE doesn’t know capability of gNB. UE will never report 224/336 value using Rel-15 considering it may be connected to old BS. New UE capability is required to make the feature work! |
| Nokia, NSB | We are OK to have the FG to be able to differentiate the UEs that follow the R16 behaviour when supporting this feature. |
| ZTE/Sanechips | Objected (i.e., support removing FG[14-7] and reusing Rel-15 capability reporting, **and meanwhile the description for [2-24] can be updated accordingly**)Reusing Rel-15 capability is sufficient but with the corresponding updates. Also, regarding compatibility, in Rel-15 we do not have a complete UE behavior when UE reports one of {224, 336}, but, instead, in Rel-16 we firstly have the corresponding UE behavior through this TEI. Consequently, it can be assumed that the Rel-15 UE may NOT reports one of {224, 336}, and the Rel-16 UE may report one of {224, 336} for supporting long-term panel switching. |
| Ericsson | To make it possible for the UE to report 224/336, the new capability is required. |
| Qualcomm | We prefer to keep FG 14-7, but we could also accept removing it. If it is kept, it should be per band and FR2 only.  |

**FL proposal:**

* FG14-7 is kept with removing bracket

# **New feature group proposal**

In [7], a new FG14-8 is proposed as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 14. NR TEI | 14-8 | CSI trigger states containing non-active BWP | CSI reporting with CSI trigger states containing non-active BWP |  | Yes | N/A |  | Per UE | No | No |  |  | Optional with capability signaling |

## 11.1 Discussion 10

**Companies are encouraged to provide views on whether new FG for “CSI trigger states containing non-active BWP” is added or not.**

 **Adding the new FG supported by:**

 **Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Apple | The question is unclear. * In term of RRC configuration: For *CSI-ResourceConfig, bwp-Id* is configured, we don’t know how to restrict that *bwp-Id* has to be active considering that there is only one active BWP per CC while up to 4 BWP can be configured for each CC, especially for power saving purpose.
* In term of CSI report triggering: we don’t think UE is expected to measure RS on the inactive BWP.
 |
| Huawei, HiSilicon | Need some clarification on the FG |
| OPPO | We have similar questions as Apple |
| Nokia, NSB | It is OK to have the FG, otherwise it would have to be assumed as mandatory for all Rel-16 UEs. |
| ZTE/Sanechips | We don’t think this FG is needed. We see this TEI item as a correction of a critical error in Rel-15 specification. Further, in the specification support on this TEI item, UE complexity has already been taken into account. The complexity of the specified solution is low from our perspective. Hence we cannot see the need to add this new FG. |
| Ericsson | More explanation is needed for the need for this FG. |
| Qualcomm | We support introducing FG 14-8. The description of the FG means that the \*trigger state\* includes reference to CSI-RS not in current active BWP. It does \*not\* mean that the \*CSI report\* would include CSI referring to any CSI-RS not in currently active BWP. The UE will drop those CSI that are invalid but still report the other CSI that are valid. Our understanding is that this works for the Rel-16 UEs that support FG 14-8. In order to the gNB to know whether it can use a trigger codepoint including invalid CSI (while also including some valid CSI), the gNB needs to know whether this FG is supported by the Rel-16 UE.  |

**FL proposal:**

* A new FG for CSI trigger states containing non-active BWP is not introduced

# **Conclusion**

**FL proposal:**

* FG14-1 is kept.
	+ Component 1 is kept with candidate values {2,3,4,5,6}
	+ Component 2 is kept with candidate values {1,2,3}

**FL proposal:**

* FG14-1a is kept.

**FL proposal:**

* FG14-2 is kept.

**FL proposal:**

* FG14-3 is kept.

**FL proposal:**

* FG14-4 is kept.

**FL proposal:**

* FG14-5 is kept at least for same SCS case.
	+ If it is agreed to support half-duplex UE behavior in TDD CA with different SCS, it is covered by this FG and existing capability for CA with different SCS

**FL proposal:**

* FG14-5a is removed.

**FL proposal:**

* FG14-6 is kept

**FL proposal:**

* FG14-7 is kept with removing bracket

**FL proposal:**

A new FG for CSI trigger states containing non-active BWP is not introduced

TBD

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001724 Discussion on UE TEI feature 14-7 vivo

[3] R1-2001741 Discussion on Rel-16 UE features for TEIs OPPO

[4] R1-2001834 Views on Rel-16 UE features for NR TEIs MediaTek Inc.

[5] R1-2002025 UE features for NR TEI Intel Corporation

[6] R1-2002280 UE features for TEIs Ericsson

[7] R1-2002573 Discussion on UE features for TEI Qualcomm Incorporated

[8] R1-2002597 Rel-16 UE features for TEIs Huawei, HiSilicon