**3GPP TSG RAN WG1 #109-e R1-2205172**

**e-Meeting, May 9th – 20th, 2022**

**Agenda Item: 8.16**

**Source: Moderator (AT&T)**

**Title: Summary of email discussion on incoming LS in R1-2205090**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion/approval [109-e-R17-UE-features] during RAN1 #109-e. According to the Chairman’s Notes:

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| [109-e-R17-UE-features] Email discussion on incoming LS (R1-2205090) on updated Rel-17 RAN1 UE features list for NR by May 13 – Ralf (AT&T)* Relevant tdocs: R1-2205093, R1-2205114
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The following was discussed and/or agreed during RAN1 #109-e within the scope of [109-e-R17-UE-features]. All proposals are based on the latest RAN1 UE features list for Rel-17 NR in [1].

# Summary of Contributions Submitted to RAN1 #109-e

The following is the moderator’s summary of contributions submitted to RAN1 #109-e in this agenda item.

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| 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>42. Report the entry number of the first-listed band with UL in the band combination that affects this DL3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest yComponent 2 candidate values: {1 to 32}Component 3 candidate values: {1 to 32}Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y. | Optional with capability signalling |

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| Company | Summary |
| RAN2 (Intel) [2] | RAN2 understanding is that this feature is an extension of *srs-TxSwitch/srs-TxSwitch-v1610* to support SRS antenna switching xTyR with y>4. However, RAN2 is unclear on how this new capability is populated for a band in a band combination where at least one band in the band combination supports xTyR with y>4 and how it works with the existing *srs-TxSwitch/srs-TxSwitch-v1610*. There are 2 interpretations:(a) the new capabilities is populated for a band in the band combination only if at least one xTyR entry for the band supports y>4(b) the new capabilities is populated for a band in the band combination regardless of whether the band supports y>4If the interpretation is (a), the following note will not occur since the candidate values with xTyR with y>4 are {t2r6, t1r6, t4r8, t2r8, t1r8} where x and y are never equal. For b), the Note can be applicable to, but only in band of the band combination where xTyR supports y ≤ 4, while not applicable in band of the band combination where at least one xTyR entry supports y>4. In addition RAN2 understands component 2 and 3 are not reported if x=y as below, and wonders if there is any other case that component 2 and 3 are not reported.Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y.For both interpretations (a) and (b), should the component 1 be set consistently with the existing *supportedSRS-TxPortSwitch/ supportedSRS-TxPortSwitch-v1610* in *srs-TxSwitch/srs-TxSwitch-v1610* (i.e. the R1 23-8-3 bitmap in component 1 be aligned with the existing *supportedSRS-TxPortSwitch/supportedSRS-TxPortSwitch-v1610* for the xTyR entries where y<=4). Also how are component 2 and 3 being set with respect to the Rel-15/16 capabilities if xTyR entries in component 1 contains the xTyR in the existing Rel-15/16 capabilitiesRAN2 would also like to inform that R1 23-8-3 will be implemented similar to Rel-15/16 *srs-TxSwitch/srs-TxSwitch-v1610* in the BandParameters of a band combination rather than in FeatureSetUplink as components 2 and 3 require setting them to the band entry of a combination. |
| Vivo [3] | **Reply A**: FG 23-8-3 is not an extension of *srs-TxSwitch-v1610*, it should be noted that prerequisite is FG 2-55 which is Rel-15 srs-TxSwitch. An UE may support Rel-17 feature only and does not support Rel-16 feature for SRS antenna switching. In this sense interpretation (a) above is correct. Regarding the note, which indeed seems confusing, since Rel-15 feature is prerequisite, and the UE may also support Rel-16 feature, where the components 2 and 3 are already reported, hence components 2 and 3 reported for the xTyR combinations in Rel-17 capability are duplicated. Components 2 and 3 are valid only for the combinations which are not reported in Rel-15/16 UE capabilities. The note is revised as follows (text in red):Note: Component 2 and component 3 are not valid for the same values of xTyR in component 1 with Rel-15/16 UE capability reporting.RAN1 agrees with RAN2 that component 1 should be set consistently with existing Rel-15/16 capabilities reporting. FG 23-8-3 implemented as band combination is also fine. |
| Nokia/Nokia Shanghai Bell [4] | In our understanding, FG23-8-3 is intended to extend Rel-15/16 functionality and at the same time introduce a coupling with band combinations where the FG is supported. Interpretation (a) implies a coupling of FG23-8-3 and at least one of FG14-4 and FG2-55, in the sense that in some bands of the band combination part of the information would be given by FG23-8-3 and the remaining information would be provided by FG2-55. Given that FG2-55 is pre-requisite to FG23-8-3, this is OK from our perspective. Interpretation (b) would require additional effort in ensuring alignment between values provided in this and Rel-15/16 capabilities, which leaves the system more vulnerable to interpretation errors and ambiguities. Hence, we propose the following:**Proposal: Support interpretation (a), i.e. the new capabilities is populated for a band in the band combination only if at least one xTyR entry for the band supports y>4.** |
| ZTE [12] | For SRS, the UE feature discussion in RAN1 was stable during last meeting. In this meeting, we have one LS from RAN2 [2] about FG 23-8-3 as follows:

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| RAN2 understanding is that this feature is an extension of *srs-TxSwitch/srs-TxSwitch-v1610* to support SRS antenna switching xTyR with y>4. However, RAN2 is unclear on how this new capability is populated for a band in a band combination where at least one band in the band combination supports xTyR with y>4 and how it works with the existing *srs-TxSwitch/srs-TxSwitch-v1610*. There are 2 interpretations:(a) the new capabilities is populated for a band in the band combination only if at least one xTyR entry for the band supports y>4(b) the new capabilities is populated for a band in the band combination regardless of whether the band supports y>4If the interpretation is (a), the following note will not occur since the candidate values with xTyR with y>4 are {t2r6, t1r6, t4r8, t2r8, t1r8} where x and y are never equal. For b), the Note can be applicable to, but only in band of the band combination where xTyR supports y ≤ 4, while not applicable in band of the band combination where at least one xTyR entry supports y>4. In addition RAN2 understands component 2 and 3 are not reported if x=y as below, and wonders if there is any other case that component 2 and 3 are not reported.Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y.For both interpretations (a) and (b), should the component 1 be set consistently with the existing *supportedSRS-TxPortSwitch/ supportedSRS-TxPortSwitch-v1610* in *srs-TxSwitch/srs-TxSwitch-v1610* (i.e. the R1 23-8-3 bitmap in component 1 be aligned with the existing *supportedSRS-TxPortSwitch/supportedSRS-TxPortSwitch-v1610* for the xTyR entries where y<=4). Also how are component 2 and 3 being set with respect to the Rel-15/16 capabilities if xTyR entries in component 1 contains the xTyR in the existing Rel-15/16 capabilitiesRAN2 would also like to inform that R1 23-8-3 will be implemented similar to Rel-15/16 *srs-TxSwitch/srs-TxSwitch-v1610* in the BandParameters of a band combination rather than in FeatureSetUplink as components 2 and 3 require setting them to the band entry of a combination. |

From our perspective, we have the following reply:* The interpretation-b is preferred from above two interpretation. Then, it is confirmed that the Note can be applicable to, but only in band of the band combination where xTyR supports y ≤ 4, while not applicable in band of the band combination where **only** xTyR entry supports y>4 due to the fact that the candidate values with xTyR with y>4 are {t2r6, t1r6, t4r8, t2r8, t1r8} where x and y are never equal.
* Then, we share the same views that regardless of either interpretations, the component 1 should be set consistently with the existing *supportedSRS-TxPortSwitch/supportedSRS-TxPortSwitch-v1610* in *srs-TxSwitch/srs-TxSwitch-v1610* (i.e. the R1 23-8-3 bitmap in component 1 be aligned with the existing *supportedSRS-TxPortSwitch/supportedSRS-TxPortSwitch-v1610* for the xTyR entries where y<=4).
* Finally, it is assumed that the same rule as mentioned in the Note should be applied to component 2 and 3 being set with respect to the Rel-15/16 capabilities if xTyR entries in component 1 contains the xTyR in the existing Rel-15/16 capabilities.
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| Vivo [13] | In FG 23-8-3, a note was added to avoid Tx-switching report, i.e. component 2 and component 3, when component 1 is reported as xTyR with x = y.In [3], LS NR from RAN2, there are two interpretations on possible combinations of the component 1 as below:(a) the new capabilities is populated for a band in the band combination only if at least one xTyR entry for the band supports y>4(b) the new capabilities is populated for a band in the band combination regardless of whether the band supports y>4If the interpretation is (a), it means at least one xTyR with y > 4 should be supported in component 1. And, if the interpretation is (b) assumed, there is no restriction on capability reporting. For interpretation (a), the note will never occur as component 1 always supports at least xTyR with y>4. For interpretation (b), the note can be applicable to component 2 and 3 when component 1 only supports xTyR with x=y. If component 1 supports any of xTyR with y > 4 in interpretation (b), it is very similar with interpretation (a) that the note is useless. And, if component 1 only supports legacy capabilities with x < y, component 2 and component 3 should not be reported as tx-switching capabilities is already reported in Rel-15 entry of 2-55. We, thus, propose to revise the note as below:1. For FG 23-5-3, revise the note as below:
* **Component 2 and component 3 are not valid for the same values of xTyR in component 1 with Rel-15/16 UE capability reporting.**
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| NTT DOCOMO, INC. [14] | In addition, RAN2 has sent an LS [1], asking the following:

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| A) R1 23-8-3RAN2 understanding is that this feature is an extension of *srs-TxSwitch/srs-TxSwitch-v1610* to support SRS antenna switching xTyR with y>4. However, RAN2 is unclear on how this new capability is populated for a band in a band combination where at least one band in the band combination supports xTyR with y>4 and how it works with the existing *srs-TxSwitch/srs-TxSwitch-v1610*. There are 2 interpretations:(a) the new capabilities is populated for a band in the band combination only if at least one xTyR entry for the band supports y>4(b) the new capabilities is populated for a band in the band combination regardless of whether the band supports y>4If the interpretation is (a), the following note will not occur since the candidate values with xTyR with y>4 are {t2r6, t1r6, t4r8, t2r8, t1r8} where x and y are never equal. For b), the Note can be applicable to, but only in band of the band combination where xTyR supports y ≤ 4, while not applicable in band of the band combination where at least one xTyR entry supports y>4. In addition RAN2 understands component 2 and 3 are not reported if x=y as below, and wonders if there is any other case that component 2 and 3 are not reported.Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y.For both interpretations (a) and (b), should the component 1 be set consistently with the existing *supportedSRS-TxPortSwitch/ supportedSRS-TxPortSwitch-v1610* in *srs-TxSwitch/srs-TxSwitch-v1610* (i.e. the R1 23-8-3 bitmap in component 1 be aligned with the existing *supportedSRS-TxPortSwitch/supportedSRS-TxPortSwitch-v1610* for the xTyR entries where y<=4). Also how are component 2 and 3 being set with respect to the Rel-15/16 capabilities if xTyR entries in component 1 contains the xTyR in the existing Rel-15/16 capabilitiesRAN2 would also like to inform that R1 23-8-3 will be implemented similar to Rel-15/16 *srs-TxSwitch/srs-TxSwitch-v1610* in the BandParameters of a band combination rather than in FeatureSetUplink as components 2 and 3 require setting them to the band entry of a combination. |

Our views for each of RAN2 questions above are as follows:* How FG23-8-3 is populated for a band in a BC where at least one band in the BC supports xTyR with y>4, our understanding is interpretation (a), which we believe is aligned with the component description.
* For “Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y”, we think it can be removed since this FG will be used for a band only where the UE supports more than 4 Rx ports, i.e., there would be no case that the UE doesn’t report any combination with more than 4 Rx ports.
* For the consistency of component 1 with the existing *supportedSRS-TxPortSwitch*/*supportedSRS-TxPortSwitch-v1610*, we do not think it should be considered since the targets of this component and *supportedSRS-TxPortSwitch*/*supportedSRS-TxPortSwitch-v1610* are different. FG23-8-3 is for Rel-17 UEs implementing more than 4 Rx ports, while *supportedSRS-TxPortSwitch*/*supportedSRS-TxPortSwitch-v1610* are for Rel-15/16 UE implementing at most 4 Rx ports. Also, FG23-8-3 can report the corresponding capability with finer granularity, which was argued as important by some vendors in our understanding.
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| 27. NR\_pos\_enh | 27-16 | OLPC for positioning SRS in RRC\_INACTIVE state - gNB | Same asRRCOLPC-SRS-Pos-r16 |  | Yes |  | OLPC for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | n/a | n/a |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16a | OLPC for positioning SRS in RRC\_INACTIVE state – location server | Same as LPPOLPC-SRS-Pos-r16 |  | No |  | OLPC for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of OLPC in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state - gNB | Same as*RRC**SpatialRelationsSRS-Pos-r16* |  | Yes |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state – location server | Same as *LPP**SpatialRelationsSRS-Pos-r16* |  | No |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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| Company | Summary |
| RAN2 (Intel) [2] | R1 27-16 and 27-19 have a component description of ‘Same as RRC OLPC-SRS-Pos-r16’ and ‘Same as RRC SpatialRelationsSRS-Pos-r16’ respectively. It is unclear to RAN2 whether the pre-requisite in R1 27-16/27-19 should be *srs-PosResources-r16* as in RRC *OLPC-SRS-Pos-r16/SpatialRelationsSRS-Pos-r16* or should be *“srs-PosResourcesRRC-Inactive-r17”* (i.e. R1 27-15)). RAN2 would like RAN1 to clarify the pre-requisite used in the R1 27-16 and 27-19. |
| Vivo [3],[10] | **Reply B**: From RAN1’s perspective, reuse of ‘OLPC-SRS-Pos-r16/SpatialRelationsSRS-Pos-r16’ doesn’t mean pre-requisite of FGs 13-9 and 13-10. Pre-requisite for both FG 27-16 and 27-19 should be FG 27-15 (Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP).Regarding UE feature, an LS [4] from RAN2 asks the following clarification related to FG 27-16 and 27-19.

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| B). R1 27-16 and 27-19R1 27-16 and 27-19 have a component description of ‘Same as RRC OLPC-SRS-Pos-r16’ and ‘Same as RRC SpatialRelationsSRS-Pos-r16’ respectively. It is unclear to RAN2 whether the pre-requisite in R1 27-16/27-19 should be *srs-PosResources-r16* as in RRC *OLPC-SRS-Pos-r16/SpatialRelationsSRS-Pos-r16* or should be *“srs-PosResourcesRRC-Inactive-r17”* (i.e. R1 27-15)). RAN2 would like RAN1 to clarify the pre-requisite used in the R1 27-16 and 27-19. |

From our point of view, the description of ‘Same as RRC OLPC-SRS-Pos-r16’ in FG27-16 is to reuse the content of FG13-9 series for OLPC support, not the pre-requisite groups of FG13-9 series, which is also applied to FG27-19. Therefore, for the pre-requisite groups for both FG 27-16 and FG 27-19, we think basic feature groups in inactive state can be considered, e.g. FG 27-15, FG 27-15b, and FG 27-6 (for PRS related capability, e.g., OLPC support based on PRS). * ***The pre-requisite groups for both FG 27-16 and FG 27-19 can be FG 27-15, FG 27-15b, and FG 27-6 (only for PRS related capability, e.g.,*** ***OLPC support based on PRS).***
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| Nokia/Nokia Shanghai Bell [4] | Given that both FGs 27-16 and 27-19 are defined in Rel-17 WI, it is a first assumption that FG27-15 could be a pre-requisite. However, we acknowledge RAN1 reference to Rel-16 RRC parameter, and hence it requires further discussion in RAN1 to clarify the exact description of the referred FGs.**Observation: RAN1 discussion needed to clarify the descriptions of FGs 27-16 and 27-19 and potential pre-requisites.** |
| NTT DOCOMO, INC. [9] | * FG 27-16: OLPC for positioning SRS in RRC\_INACTIVE state – gNB
	+ We need to discuss the prerequisite FG since RAN1 received an LS requiring a clarification on FG 27-16 and 27-19 from RAN2 (R2-2204360). Considering the prerequisite of OLPC in RRC\_CONNECTED, we think that FG 27-15 (i.e. Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP) should be added to the prerequisite FG.
* FG 27-16a: OLPC for positioning SRS in RRC\_INACTIVE state – location server
	+ Considering the prerequisite of OLPC in RRC\_CONNECTED, we think that FG 27-15 (i.e. Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP) should be added to the prerequisite FG.
* FG 27-19: Spatial relation for positioning SRS in RRC\_INACTIVE state – gNB
	+ We need to discuss the prerequisite FG since RAN1 received an LS requiring a clarification on FG 27-16 and 27-19 from RAN2 (R2-2204360). Considering the prerequisite of spatial relation in RRC\_CONNECTED, we think that FG 27-15 (i.e. Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP) should be added to the prerequisite FG.
* FG 27-19a: Spatial relation for positioning SRS in RRC\_INACTIVE state – location server
	+ Considering the prerequisite of spatial relation in RRC\_CONNECTED, we think that FG 27-15 (i.e. Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP) should be added to the prerequisite FG.
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| ZTE [11] | FG 27-16 and 27-19 have a component description of ‘Same as RRC OLPC-SRS-Pos-r16’ and ‘Same as RRC SpatialRelationsSRS-Pos-r16’ respectively. Based on RAN2 pre-meeting email discussion, it is unclear to RAN2 whether the pre-requisite of FG 27-16/27-19 should be srs-PosResources-r16 as in RRC OLPC-SRS-Pos-r16/SpatialRelationsSRS-Pos-r16 or should be “srs-PosResourcesRRC-Inactive-r17” (i.e. FG 27-15)). RAN2 would like RAN1 to clarify the pre-requisite used in the FG 27-16 and 27-19.Since the two FGs should be for SRS in RRC\_INACTIVE state, we believe that “srs-PosResourcesRRC-Inactive-r17” (i.e. FG 27-15)) should be the prerequisite. **Proposal 5: For FG 27-16 and 27-19, FG 27-15 should be the prerequisite.** |

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| 24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for initial access in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for initial access in FR2-2 | 1. Support 480KHz SSB for initial in FR2-2 | 24-2, 24-4, 24-4a | N/A | N/A | 480KHz SSB for initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| 26. NR\_NTN\_solutions | 26-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | 1. UE specific TA calculation based on its GNSS-acquired position and the serving satellite ephemeris.
2. UE calculates common TA according to the parameters provided by the network (UE considers common TA as 0 if the parameter is not provided)
3. For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops
4. UE pre-compensates the calculated TA in its uplink transmissions
5. Support of estimating UE-gNB RTT and delaying the start of RAR window by UE-gNB RTT
6. Support of frequency pre-compensation to counter shift the Doppler experienced on the service link
7. Determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated
8. Determining timing of the UE action and assumption on a downlink configuration carried by MAC CE command by K\_mac if it is indicated and determining the timing of PDCCH monitoring in recovery search space using K-mac during beam failure recovery procedure
9. UE receives cell-specific K\_offset/K\_mac in system information
 |  | No | No | Release 17 NR UE cannot communicate via satellite | per band | No | No | No | An NTN UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the serving satellite ephemeris[Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional with capability signalling For UE supports NR communication via satellite, UE must indicate this FG is supported. |
|  26. NR\_NTN\_solutions | 26-8 | Support of polarization signalling in NR NTN | 1. Support polarization indication reception in SIB indicating DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear
2. Support polarization signalling for target serving cell in handover command message
3. Support polarization signalling for non-serving cell in RRM measurement configuration
 |  | No | No | UE is not able to take the advantage of polarization information to save power | Per band | No | No | No | [For UE supports NR communication via satellite, UE must indicate this FG is supported][Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional with capability signalling  |

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| Company | Summary |
| RAN2 (Intel) [2] | Both of the features have N/A in the column of “Need for the gNB to know if the feature is supported” while indicate in the column of “Mandatory/Optional” as “optional with capability signalling”. From RAN2 perspective, if there is no need for gNB to know whether a feature is supported or not, no capability signalling should be defined. RAN2 also noticed that there are other features in NTN that have such ambiguities (e.g. R1 26-1/26-8 for NTN WI). RAN2 would like to know whether such capabilities are really “optional with capability signalling” |
| Vivo [3] [7] | For FG 24-2 and 24-3, RAN1 has already concluded that they should be supported as “optional with capability signaling” in the column of “Mandatory/Optional”. Besides, gNB needs to know if they are supported since it is beneficial in certain cases, e.g. whether gNB can handover the UE to a serving cell in FR 2-2 with 120K/480K SCS. In general, in RAN1’s understanding, FG 24-2 and 24-3 are optional with capability signalling and gNB needs to know if they are supported. Accordingly, RAN1 revised the column of “Need for the gNB to know if the feature is supported” as “Yes”.FGs 26-1 must be supported for UEs supporting NR communication via satellite, as described in the column of “Mandatory/Optional”. However, it is not mandated for UEs not supporting satellite communication but supporting other NTN scenarios, e.g. HAPS, ATG. In other words, this FG is UE optional with capability signalling and gNB needs to know if the feature is supported. Accordingly, RAN1 revised the column of “Need for the gNB to know if the feature is supported” as “Yes”. As for FGs 26-8, gNB would indicate the polarization for UE with circular polarization to take the advantage of polarization information to save power. For UE with linear polarization, reading the polarization signalling is not necessary however UE can also work well in NTN scenario. In NTN scenarios, various UE types could coexist, e.g. UE with linear polarization, UE with LHCP, UE with RHCP, or with a combination of different polarization types. Thus, gNB could always indicate the polarization but it can be UE optional to support the feature without capability signalling. Hence, RAN1 revised the column “Mandatory/Optional” as “Optional without capability signalling”. RAN2 raised concerns on both of FGs 26-1 and FGs 26-8 which have “N/A” in the column of “Need for the gNB to know if the feature is supported” while indicate in the column of “Mandatory/Optional” as “optional with capability signalling”. From RAN2 perspective, if there is no need for gNB to know whether a feature is supported or not, no capability signalling should be defined. RAN2 would like to know whether such capabilities are really “optional with capability signalling”. FGs 26-1 must be supported for UEs supporting NR communication via satellite, as described in the column of “Mandatory/Optional”. However, it is not mandated for UEs not supporting satellite communication but supporting other NTN scenarios, e.g. HAPS, ATG. In one word, UE can be optional with capability signalling and gNB needs to know if the feature is supported. As for FGs 26-8, gNB would indicate the polarization for UE with circular polarization to take the advantage of polarization information to save power. For UE with linear polarization, reading the polarization signalling may be unnecessary and UE can also work well in NTN even without the polarization signalling. However, in NTN, various UE types could coexist, e.g. UE with linear polarization, UE with LHCP, UE with RHCP, or with a combination of different polarization types. Thus, gNB could always indicate the polarization and UE can optionally support the feature without capability signalling. This should be captured into UE feature list, e.g. according to the text proposal we added in red in following list.

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|  26. NR\_NTN\_solutions | 26-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | 1. UE specific TA calculation based on its GNSS-acquired position and the serving satellite ephemeris.
2. UE calculates common TA according to the parameters provided by the network (UE considers common TA as 0 if the parameter is not provided)
3. For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops
4. UE pre-compensates the calculated TA in its uplink transmissions
5. Support of estimating UE-gNB RTT and delaying the start of RAR window by UE-gNB RTT
6. Support of frequency pre-compensation to counter shift the Doppler experienced on the service link
7. Determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated
8. Determining timing of the UE action and assumption on a downlink configuration carried by MAC CE command by K\_mac if it is indicated and determining the timing of PDCCH monitoring in recovery search space using K-mac during beam failure recovery procedure
9. UE receives cell-specific K\_offset/K\_mac in system information
 |  | ~~No~~Yes | No | Release 17 NR UE cannot communicate via satellite | per band | No | No | No | An NTN UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the serving satellite ephemeris[Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional with capability signalling For UE supports NR communication via satellite, UE must indicate this FG is supported. |
|  26. NR\_NTN\_solutions | 26-8 | Support of polarization signalling in NR NTN | 1. Support polarization indication reception in SIB indicating DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear
2. Support polarization signalling for target serving cell in handover command message
3. Support polarization signalling for non-serving cell in RRM measurement configuration
 |  | No | No | UE is not able to take the advantage of polarization information to save power | Per band | No | No | No | [For UE supports NR communication via satellite, UE must indicate this FG is supported][Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional ~~with~~ without capability signalling  |

According to above, we have following proposal which is also captured in our draft reply LS [3].***Proposal 2: RAN1 should send a reply LS to RAN2, indicating:**** ***FGs 26-1 should be optional with capability signalling and gNB needs to know if the feature is supported.***
* ***FGs 26-8 should be optional without capability signalling.***
 |
| Nokia/Nokia Shanghai Bell [4] | Capabilities FG24-2 and 24-3 are related to initial access, and hence the relationship between the capability signalling and knowledge at gNB is not straightforward. RAN1’s understanding has been that it would be useful for the network to know if there are UEs supporting these functionalities, but at the same time RAN1 acknowledges it is not possible to know beforehand which specific gNB would receive the corresponding random access messages from the UEs supporting the feature. However for HO or sPCell configuration, this information is relevant to the network. This is the reason for the apparent contradiction in how those are defined in [2].**Observation: FG24-2 and 24-3 are related to initial access, and hence it is not possible to know beforehand which specific gNB would receive the corresponding random access messages from the UEs supporting the feature. However the information is relevant for the network, and hence it should be signalled.**For FG26-1, this seems to be just a mistake in filling out the table, as it is clear gNB should be aware of the capability. **Observation: For FG26-1, gNB should be aware of the capability.**For FG26-8, currently the specifications do not define any manner in which the network can utilize the information about this capability, and hence it would be more adequate to set it as optional without capability signaling indeed.**Proposal: For FG26-8, define it as optional without capability signaling, and keep current field on gNB knowledge about the capability as ‘no’.**  |
| ZTE/Sanechips [5] | For FG 24-2 and FG24-3, we can observe from FG list that these two FGs are described as “N/A” in the column “Need for the gNB to know if the feature is supported”, while described as “optional with capability singalling” in the column “Mandatory/Optional”. It is unclear whether the corresponding capabilities should be signalled or not according to the current description. In our view, if the capability is allowed to be signalled, then gNB need to know if this feature/capability is supported. Correspondingly, “N/A” in the column “Need for the gNB to know if the feature is supported” should be updated. However, during initial access, there is no UE capability. From this point of view, it would be better to update “optional with capability singalling” as “optional without capability singalling” in the column “Mandatory/Optional” and keep “N/A” in “N/A” in the column “Need for the gNB to know if the feature is supported”. If the above mentioned issue cannot be handled in RAN1, it can be handed over to RAN2 for decision whether “N/A” in the column “Need for the gNB to know if the feature is supported” need to be updated or “optional with capability singalling” in the column “Mandatory/Optional” need to be updated as “optional without capability singalling”.**Proposal 2: Clarify whether the capability corresponding to FG 24-2 and FG 24-3 should be signalled to gNB from RAN1 point of view, or this issue is left to RAN2 for decision.** |
| NTT DOCOMO, INC. [6] | For FG24-2/3, RAN2 has sent an LS [2] to RAN1 in this e-meeting, in which the following has been asked:

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| C) R1 24-2 and 24-3Both of the features have N/A in the column of “Need for the gNB to know if the feature is supported” while indicate in the column of “Mandatory/Optional” as “optional with capability signalling”. From RAN2 perspective, if there is no need for gNB to know whether a feature is supported or not, no capability signalling should be defined. RAN2 also noticed that there are other features in NTN that have such ambiguities (e.g. R1 26-1/26-8 for NTN WI). RAN2 would like to know whether such capabilities are really “optional with capability signalling” |

In our understanding, these FGs are intended for UE supporting DC and/or SA operation, which requires similar PHY functionalities but potentially different implementations. * When DC is operated for a UE for which RRC connection has been established via another (e.g., lower) band already, NW needs to know whether the UE supports DC in FR2-2 or not. For this purpose, FG24-2/24-3 should be optional with capability signaling.
* When SA is operation for a UE for which no RRC connection has been established, NW does not need to know whether the UE supports SA in FR2-2 (rather these is no way to do so before initial access). For this purpose, “Need for the gNB to know if the feature is supported” can be N/A.

Since we believe the current FG structure captures the intention above well, we do not see the need to have changes in terms of RAN2’s question (though they are clarified for RAN2 in the form of reply LS). Meanwhile, if one argues that the current FG structure is confusing, we are open to consider measures to avoid that. One potential resolution could be to divide each FG into two, one is for DC, and the other is for SA. For DC, depending on the related SCS, FG24-2 or 24-3 can be reused with the change of “Need for the gNB to know if the feature is supported” from N/A to Yes. For SA, a new FG with similar contents to FG24-2 or FG24-3 depending on its relevant SCS can be considered, with the change on “Mandatory/optional” from “Optional with capability signaling” to “Optional without capability signaling”. FG24-2 or FG24-3 can be defined as prerequisite.  |
| Apple [8] | The feature 26-1 was updated or expanded to uplink time and frequency pre-compensation and timing relationship enhancements. This feature is mandatory in supporting NR communication via satellite. In the latest version of this feature, the field of “Need for the gNB to know if the feature is supported” is No. However, we think gNB needs to know if a UE supports this feature to serve it via satellite. Hence, we have the following proposal. ***Proposal 1:*** *It is necessary for the gNB to know if the feature 26-1 is supported.*  |

# Discussion/Approval Items during RAN1 #109-e — First Checkpoint

After review of contributions submitted to RAN1 #109-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #109-e.

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG 23-8-3

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal:**

* **Confirm interpretation (a)**
* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**
* **Send LS reply to RAN2, use R1-2205093 (vivo) as starting point for discussion**

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| 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>42. Report the entry number of the first-listed band with UL in the band combination that affects this DL3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest yComponent 2 candidate values: {1 to 32}Component 3 candidate values: {1 to 32}Note: Component 2 and component 3 ~~is~~ are not ~~reported if component 1 is reported as xTyR with x=y~~ valid for the same values of xTyR in component 1 with Rel-15/16 UE capability reporting. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 2: 27-16, 27-16a, 27-19, 27-19a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal:**

* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**
* **Send LS reply to RAN2, use R1-2205093 (vivo) as starting point for discussion**

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| 27. NR\_pos\_enh | 27-16 | OLPC for positioning SRS in RRC\_INACTIVE state - gNB | Same asRRCOLPC-SRS-Pos-r16 | 27-15 | Yes |  | OLPC for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | n/a | n/a |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16a | OLPC for positioning SRS in RRC\_INACTIVE state – location server | Same as LPPOLPC-SRS-Pos-r16 | 27-15 | No |  | OLPC for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of OLPC in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state - gNB | Same as*RRC**SpatialRelationsSRS-Pos-r16* | 27-15 | Yes |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state – location server | Same as *LPP**SpatialRelationsSRS-Pos-r16* | 27-15 | No |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 3: 24-2, 24-3, 16-1, 26-8

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal:**

* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**
* **Send LS reply to RAN2, use R1-2205093 (vivo) as starting point for discussion**

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| 24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for initial access in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1, 24-1a | ~~N/A~~ Yes | N/A | 120KHz SSB based initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for initial access in FR2-2 | 1. Support 480KHz SSB for initial in FR2-2 | 24-2, 24-4, 24-4a | ~~N/A~~ Yes | N/A | 480KHz SSB for initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| 26. NR\_NTN\_solutions | 26-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | 1. UE specific TA calculation based on its GNSS-acquired position and the serving satellite ephemeris.
2. UE calculates common TA according to the parameters provided by the network (UE considers common TA as 0 if the parameter is not provided)
3. For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops
4. UE pre-compensates the calculated TA in its uplink transmissions
5. Support of estimating UE-gNB RTT and delaying the start of RAR window by UE-gNB RTT
6. Support of frequency pre-compensation to counter shift the Doppler experienced on the service link
7. Determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated
8. Determining timing of the UE action and assumption on a downlink configuration carried by MAC CE command by K\_mac if it is indicated and determining the timing of PDCCH monitoring in recovery search space using K-mac during beam failure recovery procedure
9. UE receives cell-specific K\_offset/K\_mac in system information
 |  | ~~No~~ Yes | No | Release 17 NR UE cannot communicate via satellite | per band | No | No | No | An NTN UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the serving satellite ephemeris[Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional with capability signalling For UE supports NR communication via satellite, UE must indicate this FG is supported. |
|  26. NR\_NTN\_solutions | 26-8 | Support of polarization signalling in NR NTN | 1. Support polarization indication reception in SIB indicating DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear
2. Support polarization signalling for target serving cell in handover command message
3. Support polarization signalling for non-serving cell in RRM measurement configuration
 |  | No | No | UE is not able to take the advantage of polarization information to save power | Per band | No | No | No | [For UE supports NR communication via satellite, UE must indicate this FG is supported][Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported] | Optional without capability signalling  |

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| Company | Comments/Questions/Suggestions |
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# Discussion/Approval Items during RAN1 #109-e — Second Checkpoint

Based on the comments/questions/suggestions received by the first checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 3 will not be considered]***

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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# Discussion/Approval Items during RAN1 #109-e — Third Checkpoint

Based on the comments/questions/suggestions received by the second checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 4 will not be considered]***

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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# Summary of Final Proposals for Agreements

This Section summarizes the final proposals for agreement in RAN1 #109-e by email. There are no tables for comments.

***[All comments must be directly made on the RAN1 email reflector]***

Companies can continue to update their comments in the previous Sections, however, these are no longer monitored by the moderator. Any such comments will be for archival purposes only and will not influence the outcome of this email discussion. Any objection to any of the proposals in this Section must be voiced directly on the RAN1 email reflector.

## Final Proposals for Agreement by the First Check Point

**Possible Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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## Final Proposals for Agreement by the Second Check Point

**Possible Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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# Conclusion

In addition to the agreements in Section 6, that were reached by email during RAN1 #109-e, the following was agreed by GTW during RAN1 #109-e:

# References

1. R1-2202929, Updated RAN1 UE features list for Rel-17 NR after RAN1 #108-e including remaining RAN1 issues, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2205090, Reply LS on updated Rel-17 RAN1 UE features list for NR, RAN2 (Intel)
3. R1-2205093, [Draft] Reply LS on updated Rel-17 RAN1 UE features list for NR, vivo
4. R1-2205114, On RAN2 LS regarding Rel-17 RAN1 UE features list for NR, Nokia/Nokia Shanghai Bell
5. R1-2203295, Rel-17 UE features for 52.6 to 71GHz, ZTE/Sanechips
6. R1-2205111, Views on UE features for supporting NR in FR2-2, NTT DOCOMO, INC.
7. R1-2203532, Remaining issues on UE features for NR NTN, vivo
8. R1-2204221, Views on Rel-17 NR NTN UE features, Apple
9. R1-2204360, Discussion on Rel-17 UE features for NR positioning enhancements, NTT DOCOMO, INC.
10. R1-2203533, Discussion on UE features for NR positioning enhancements, vivo
11. R1-2203621, Discussion on UE features for Rel-17 positioning, ZTE
12. R1-2203262 UE features for feMIMO, ZTE
13. R1-2203529 Discussion on UE features for further enhancements on NR-MIMO, vivo
14. R1-2204356 Discussion on Rel-17 FeMIMO UE features, NTT DOCOMO, INC.