3GPP TSG-RAN WG2 #110-e R2-200xxxx

Electronic Meeting, 1st – 12th June, 2020

Agenda Item: 5.4.3

Source: ZTE Corporation

Title: Report of [Post109bis-e][924][NR15] unnecessary FRx differentiation

Document for: Discussions, Decision

# 1 Introduction

This document is to kick off the following email discussion:

* [Post109bis-e][924][NR15] unnecessary FRx differentiation (ZTE)

Scope: Continue discussion of R2-2002696. Try to come to common understanding on the meaning of “FDD-TDD DIFF” and “FR1-FR2 DIFF” columns for “per frequency band” capabilities in TS38.306.  
Intended outcome: Report, Agreeable CR, if any change to the specification is deemed necessary  
Deadline: May 20th, 2020

Rapporteur would like to have following schedule for this email discussion to have enough time for preparing the summary report and draft CRs.

* Phase 1 (2020-5-18): Companies are invited to provide inputs and comments for questions.
* Phase 2 (2020-5-20): Rapporteur will provide email discussion summary and draft CRs, companies are invited to provide comments to the summary report and CRs.

# 2 Discussion

Regarding the definiton of UE capability parameters in TS 38.306, the table includes two columns ‘ FDD-TDD DIFF’ and ‘FR1-FR2 DIFF’. During RAN2\_109bis-e meeting, companies discussed whether these columns are applicable to per-band level capabilities based on CR [1] and no consensus was made. In this document, we further discuss this issue.

| **Definitions for parameters** | **Per** | **M** | **FDD-TDD DIFF** | **FR1-FR2**  **DIFF** |
| --- | --- | --- | --- | --- |
| ***accessStratumRelease***  Indicates the access stratum release the UE supports as specified in TS 38.331 [9]. | UE | Yes | No | No |
| ***delayBudgetReporting***  Indicates whether the UE supports delay budget reporting as specified in TS 38.331 [9]. | UE | No | No | No |

The interpretation of these two columns are specified in section 4.2.1 (copied as below).

|  |
| --- |
| 4.2 UE Capability Parameters  4.2.1 Introduction  The following clauses define the UE radio access capability parameters. Only parameters for which there is the possibility for UEs to signal different values are considered as UE radio access capability parameters. Therefore, mandatory features without capability parameters that are the same for all UEs are not listed here.  The network needs to respect the signalled UE radio access capability parameters when configuring the UE and when scheduling the UE.  The UE may support different functionalities between FDD and TDD, and/or between FR1 and FR2. The UE shall indicate the UE capabilities as follows. In the table of UE capability parameter in subsequent clauses, "Yes" in the column by "FDD-TDD DIFF" and "FR1-FR2 DIFF" indicates the UE capability field can have a different value for between FDD and TDD or between FR1 and FR2 and "No" indicates if it cannot. "FD" in the column indicates to refer the associated field description. "FR1 only" or "FR2 only" in the column indicates the associated feature is only supported in FR1 or FR2 and "TDD only" indicates the associated feature is only supported in TDD.  <skip> |

In general, value ‘Yes/No’ indicate whether UE can have different value for FDD/TDD, or FR1/FR2.

* Yes : Indicates the UE **can have** different values for FDD and TDD, or FR1 and FR2 ;
* No : Indicates the UE **cannot have** different values for FDD and TDD, or FR1 and FR2.

So far, TS 38.306 defines the following hierachical structures of UE capability parameters :

* Per UE level ;
* Per Band level ;
* Per band combination (BC) level ;
* Per feature set (FS) level ;
* Per feature set per CC (FSPC) level.

For per-UE level capabilities, it is clear that UE can further differentiate the capability values for FDD/TDD, or FR1/FR2 when column ‘FDD-TDD Diff’ or ‘FR1-FR2 DIFF ’ is marked as ‘Yes’, ‘TDD or FDD only’, ‘FR1 or FR2 only’. While for other cases, the interpretation of the two columns is unclear, so in this document, the rapporteur suggest to discuss them one by one.

## Per-band level capabilities

For per-band level capabilitites, the capability value is signaled under each supported band, so it is clear which duplex mode/FR mode is referring to. Except the capabilities that are only applicable to a single duplex mode and/or FR mode (i.e. TDD only, FDD only, FR1 only, FR2 only), it is straightforward that a UE can signal different capability values for FDD/TDD or FR1/FR2 cases, the column ‘FDD-TDD Diff’ and ‘FR1-FR2 DIFF’ is actually not applicable in this case.

Notice that in the latest Rel-16 RAN1 UE feature list in [3], for almost all of per-band level features (except some FFS), the two columns are marked as “N/A”.

**Q1: For per-band level capabilities, do companies agree the columns “FDD-TDD Diff” and “FR1-FR2 Diff” are not applicable, unless the feature only applies to single duplex/FR mode (i.e. “TDD only”, “FDD only”, “FR1 only” or “FR2 only”)?**

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Nokia | Agree | We also noticed that there are some which are per band but marked YES as well with xDD/FRx but there is no xADD branch really. So are those also under the email discussion? E.g.   * ***aperiodicTRS*** * ***beamManagementSSB-CSI-RS*** * ***sp-BeamReportPUCCH*** * ***sp-BeamReportPUSCH***   [Rapporteur]: Yes, the 4 capabilities are discussed in Q3. |
| **CATT** | Agree |  |
| Ericsson | Agree |  |
| ZTE | Agree |  |
| OPPO | Agree |  |
| Qualcomm Incorporated | Agree |  |
| Apple | Agree |  |

If answers “Agree” to Q1, companies are invited to show your views on how to capture this in TS 38.306. As mentioned before, the RAN1/4 feature list and TR 38.822 usually use “N/A” to indicate “inapplibility”. However, we rarely use “N/A” in TS 38.306, and so far only ‘voiceOverSCG-BearerEUTRA-5GC’ parameter uses “N/A” in “FR1-FR2 Diff“ column because EUTRA does not have FR2.

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***voiceOverSCG-BearerEUTRA-5GC***  Indicates whether the UE supports IMS voice over SCG bearer of NE-DC. | UE | No | No | N/A |

While for most of per-band UE capabilities, we use ”No“ to indicate the feature does not need FDD-TDD, or FR1-FR2 differentiation. However, it is inconsistent with the definition of “No” in TS 38.306 4.2.1, because “No”implies the UE should have the same capability value between FDD and TDD, or between FR1 and FR2.

Therefore, to avoid the confusion of ”No“ and ”Not applicable“, there are two ways to capture this in specification :

* Option 1 : Follow the spirit of RAN1/4, use “ N/A” to indicate “FDD-TDD DIFF” or “FR1-FR2 DIFF” column is “not applicable“ to a feature ;
* Option 2 : Clarify in TS 38.306 section 4.2.1 that for per-band level capabilites, value “No” in ”FDD-TDD DIFF“ and “FR1-FR2 DIFF” columns represents “not applicable”.
* Option 3 : Remove the columns ‘FDD-TDD DIFF’ and ‘FR1-FR2 DIFF’ in the tables for per-Band, per-BandCombinations, per-FeatureSet capabilities. (the few statements that a features is not applicable for FR1 or not for FR2 should be in the field description itself).

Note that in current TS38.306, most of per-band UE capabilities are marked as “No” in the two columns, but the UE indeed is allowed to signal different capability values for FDD/TDD, or FR1/FR2 bands. So if Option1 is chosen, then all those blocks should be revised into “N/A”. While if Option2 chosen, then except clarification in section 4.2.1, for voiceOverSCG-BearerEUTRA-5GC, the “N/A” in FR1-FR2 DIFF column can be revised into “No” for consistency.

**Q2: For per-band level capabilities, which option is preferred to indicate “not applicable” for “FDD-TDD DIFF” and “FR1-FR2 DIFF” columns in TS 36.306?**

|  |  |  |
| --- | --- | --- |
| Company | Preferred option | Comments |
| Nokia | Option 2 | Better to clarify with just a note to avoid mass changes to the specification. |
| **CATT** | Option 2 | Stage 3 is clear, so simplicity is preferred here. |
| Ericsson | Option 3 | The currently stated „No“ is wrong since says that a UE shall set the same value in all instances of BandNR.  Setting it to „N/A“ as ZTE suggests would be OK. But since the columns of those tables contain then no useful information, we could just as well remove them from those tables.  The few places where it is stated e.g. “FDD only”, “FR1 only”, one could just convey this information into the field description instead since we have there anyway many of such restrictions (e.g. “It is not applicable to FR1 and applicable and mandatory to report for FR2 only”, “If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands”….) |
| ZTE | Option 2 | Option 2 is preferred because it has less spec change. And we prefer to change existing “Yes” blocks for consistency.  Option 3 proposed by Ericsson looks also workable, but after checking those tables, we found some tough cases:  - ***csi-ReportFramework***  ***- csi-RS-IM-ReceptionForFeedback***  - ***csi-RS-ProcFrameworkForSRS***  For above capabilities, the granularity column is per “band or UE”, in 38.331, the parameters are defined within both MIMO-ParametersPerBand (per-band) and Phy-ParametersFRX-Diff (per UE). So for Per-UE case, it do need FR1/FR2 differentiation. Then we are not sure if the two columns can be removed in this case (only this table has problem).  We think the “FR1-FR2 DIFF” column of above 3 capabilities can be changed from “No” to “Yes for per UE”, no matter which option is adopted. |
| OPPO | Option 1 or Option 3 | We think to put “N/A” is clearer to avoid any confusion and contradiction within specification. Option3 is even better. Regarding ZTE’s concern, option2 is also not feasible due to same reason. So for both options some specific clarification in the field description for these 3 fields are needed. |
| Qualcomm Incorporated | Option 1 or option 3 | We are saying xDD-diff and FRx-diff should be naturally “yes” for per band capabilities. It is confusing putting a statement that “no” does not mean yes… |
| Apple | Option 2 is preferred  Option 3 is acceptable | Option 2 is the easiest way to capture.  Option 3 is also fine, as long as we can put the “FR1 only/FR2 only” into the field description. That is also why Option 2 is preferred since more careful check is required. |

In addition, in TS 38.306 v15.9.0, within all Rel-15 per-band UE capabilities, the following capabilities are marked as “Yes” in column “FDD-TDD Diff” or “FR1-FR2 Diff”.

| **Definitions for parameters** | **Per** | **M** | **FDD-TDD**  **DIFF** | **FR1-FR2**  **DIFF** |
| --- | --- | --- | --- | --- |
| ***aperiodicTRS***  Indicates whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. | Band | No | No | Yes |
| ***beamManagementSSB-CSI-RS***  Defines support of SS/PBCH and CSI-RS based RSRP measurements. The capability comprises signalling of  - *maxNumberSSB-CSI-RS-ResourceOneTx* indicates maximum total number of configured one port NZP CSI-RS resources and SS/PBCH blocks that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE). On FR2, it is mandatory to report >=8; On FR1, it is mandatory with capability signalling to report >=8.  - *maxNumberCSI-RS-Resource* indicates maximum total number of configured NZP-CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] across all serving cells (see NOTE). It is mandated to report at least n8 for FR1.  - *maxNumberCSI-RS-ResourceTwoTx* indicates maximum total number of two ports NZP CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE).  - *supportedCSI-RS-Density* indicates density of one RE per PRB for one port NZP CSI-RS resource for RSRP reporting, if supported. On FR2, it is mandatory to report either “three” or “oneAndThree”; On FR1, it is mandatory with capability signalling to report either “three” or “oneAndThree”.  - *maxNumberAperiodicCSI-RS-Resource* indicates maximum number of configured aperiodic CSI-RS resources across all serving cells (see NOTE). For FR1 and FR2, the UE is mandated to report at least n4.  NOTE: If the UE sets a value other than *n0* in an FR1 band, it shall set that same value in all FR1 bands. If the UE sets a value other than *n0* in an FR2 band, it shall set that same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. | Band | Yes | No | Yes |
| ***sp-BeamReportPUCCH***  Indicates support of semi-persistent ‘CRI/RSRP’ or ‘SSBRI/RSRP’ reporting using PUCCH formats 2, 3 and 4 in one slot. | Band | No | No | Yes |
| ***sp-BeamReportPUSCH***  Indicates support of semi-persistent ‘CRI/RSRP’ or ‘SSBRI/RSRP’ reporting on PUSCH. | Band | No | No | Yes |

All of above capabilities are defined within *MIMO-ParametersPerBand*, which is per-band signaled. According to previous discussion, it makes more sense to change “Yes” into “N/A” or “No” (based on the conlcusion of Q2). However, during offline-014 in RAN2\_109bis-e, some companies raised concerns about “beamManagementSSB-CSI-RS”, because the Note in field description includes more restriction information about FR1-FR2 differentiation. So the rapporteur suggests to change this one from “Yes” into “FD” (i.e. refer to associated field description).

**Q3: Do companies agree with the proposed change to “FR1-FR2 DIFF” column?**

---For aperiodicTRS, sp-BeamReportPUCCH, sp-BeamReportPUSCH, change from “Yes” to “N/A” or No” (based on the onclusion of Q2);

---For beamManagementSSB-CSI-RS, change from “Yes” to “FD”.

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Nokia | Agree | For 1st bullet point follow the Note suggestion  For 2nd bullet point changing to FD seems reasonable as well. |
| **CATT** | Agree. |  |
| Ericsson | Agree | „Yes“ should certainly be changed or the entire column should be removed. |
| ZTE | Agree |  |
| OPPO | Agree |  |
| Qualcomm Incorporated | Agree |  |
| Apple | Agree |  |

## Per-BC level capabilities

For per band combination level capabilities, basically, the situation is the same as per-band capabiliites, because each band within a band combination already represents the corresponding duplex mode and FR mode.

For instance, the parameters defined within CA-ParametersNR and MRDC-Parameters, except the ones only applicable to FR1 case (defined as “FR1 only”), from signalling point of view, the capabilies are not defined within ‘–XDD-Diff’, or ‘–FRX-Diff’ structures. So we see no necessity to differentiation FDD-TDD or FR1-FR2.

CA-ParametersNR ::= SEQUENCE {

dummy ENUMERATED {supported} OPTIONAL,

parallelTxSRS-PUCCH-PUSCH ENUMERATED {supported} OPTIONAL,

parallelTxPRACH-SRS-PUCCH-PUSCH ENUMERATED {supported} OPTIONAL,

simultaneousRxTxInterBandCA ENUMERATED {supported} OPTIONAL,

simultaneousRxTxSUL ENUMERATED {supported} OPTIONAL,

diffNumerologyAcrossPUCCH-Group ENUMERATED {supported} OPTIONAL,

diffNumerologyWithinPUCCH-GroupSmallerSCS ENUMERATED {supported} OPTIONAL,

supportedNumberTAG ENUMERATED {n2, n3, n4} OPTIONAL,

…

}

MRDC-Parameters ::= SEQUENCE {

singleUL-Transmission ENUMERATED {supported} OPTIONAL,

dynamicPowerSharingENDC ENUMERATED {supported} OPTIONAL,

tdm-Pattern ENUMERATED {supported} OPTIONAL,

ul-SharingEUTRA-NR ENUMERATED {tdm, fdm, both} OPTIONAL,

ul-SwitchingTimeEUTRA-NR ENUMERATED {type1, type2} OPTIONAL,

simultaneousRxTxInterBandENDC ENUMERATED {supported} OPTIONAL,

asyncIntraBandENDC ENUMERATED {supported} OPTIONAL,

…,

[[

dualPA-Architecture ENUMERATED {supported} OPTIONAL,

intraBandENDC-Support ENUMERATED {non-contiguous, both} OPTIONAL,

ul-TimingAlignmentEUTRA-NR ENUMERATED {required} OPTIONAL

]]

}

Companies are invited to show your views to per-BC level capabilities :

**Q4: For per-BC level capabilities, do companies agree the columns “FDD-TDD Diff” and “FR1-FR2 Diff” are not applicable, unless the feature only applies to single duplex/FR mode (i.e. “TDD only”, “FDD only”, “FR1 only” or “FR2 only”)? And the conclusion of Q2 can also be applied here.**

|  |  |  |
| --- | --- | --- |
| Company | Preferred option | Comments |
| Nokia | Option 2 | Better to clarify with just a note to avoid mass changes to the specification. |
| **CATT** | Option 2 |  |
| Ericsson | Option 3 | (see above) |
| ZTE | Option 2 | See comments in Q2. |
| OPPO | Option1 or option3 | See comments in Q2 |
| Qualcomm Incorporated | Option1 or option3 |  |
| Apple | Option 2 |  |

In addition, in current TS38.306, we have only one capability *tdm-Pattern* marked as “Yes” for “FDD-TDD DIFF” and “FR1-FR2 DIFF ”, this parameter is defined within MRDC-Parameters, parallel to other per MRDC capabilites. Similar to the discussion in Q2 and Q3, we think it can be revised into N/A or No based on the conlusion of Q2.

| **Definitions for parameters** | **Per** | **M** | **FDD-TDD**  **DIFF** | **FR1-FR2**  **DIFF** |
| --- | --- | --- | --- | --- |
| ***tdm-Pattern***  Indicates whether the UE supports the *tdm-PatternConfig* for *single UL-transmission* associated functionality, as specified in TS 36.331 [17]. Support is conditionally mandatory in (NG)EN-DC for UEs that do not support dynamicPowerSharingENDC and for UEs that indicate single UL transmission for any (NG)EN-DC BC. Support is conditionally mandatory in NE-DC for UEs that do not support dynamicPowerSharingNEDC and for UEs that indicate single UL transmission for any NE-DC BC. The feature is optional otherwise. | BC | CY | Yes | Yes |

**Q5: For tdm-Pattern capability, do companies agree to change “Yes” into “N/A” or “No” (Based on the conclusion of Q2) in “FDD-TDD DIFF” and “FR1-FR2 DIFF” columns?**

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Nokia | Option 2 | Better to clarify with just a note to avoid mass changes to the specification. |
| **CATT** | Option 2 |  |
| Ericsson | Option 3 | (see above) |
| ZTE | Agree | In fact, this question intends to ask whether companies are fine to change the current “Yes” marks. ☺  We prefer to remove the unreasonable “Yes” for consistency. And only clarify the interpretation of “No” for per-Band/BC/FS/FSPC in 4.2.1. |
| Option1 or option3 | Option1 or option3 | See comments in Q2 |
| Qualcomm Incorporated | Option1 or option3 |  |
| Apple | See comment | No matter which option is agreed, we suggest to put “FR1 only” into the “FR1-FR2 DIFF” as TDM pattern only applies to LTE+NR FR1 case. In details, if Option 2 is agreed, this description could be captured into the right column of the table, else if Option 3 or Option 1 is agreed, it should be catpured into the field description. |

## Per-FS level and Per-FSPC level capabilities

Regarding per feature set level capabilities, the capabilities parameters are defined within FeatureSetDownlink or FeatureSetUplink IEs, and the featureSetDownlinkID/featureSetUplinkID is associated with each band entry within a band combination. From signalling point of view, a given featureSet ID can be associated with multiple band entries (including FDD,TDD,FR1,FR2). So except the capabilities defined as e.g. “FR1 only, FR2 only”, the UE is able to differentiate FDD-TDD, FR1-FR2 cases by reporting multiple feature sets with different capabilities values. In addition, the current signalling design of featureSetDownlink/featureSetUplink does not include structure with suffix  “-XDD-Diff” or “-TDD-Diff”. So, similar to per-band and per-BC level capabilities, the rapporteur thinks “FDD-TDD Diff” and “FR1-FR2 Diff” column are not applicable unless the feature only applies to a single duplex/FR mode.

Similarly, for per feature set per CC level capabilities, the parameters are defined within FeatureSetDownlinkPerCC or FeatureSetUplinkPerCC, and the featureSetDownlinkPerCC-Id or featureSetUplinkPerCC-Id is associated with each carrier of one band entry of a band combination. Although a given featureSet perCC can be associated with multiple carriers (including FDD,TDD,FR1,FR2), the UE is able to differentiate FDD-TDD, FR1-FR2 cases by reporting multiple feature set per CC structures.

Companies are invited to show your views to per-FS and per-FSPC level capabilities :

**Q6: For per-FS and per-FSPC level capabilities, do companies agree the columns “FDD-TDD Diff” and “FR1-FR2 Diff” are not applicable, unless the feature only applies to single duplex/FR mode (i.e. “TDD only”, “FDD only”, “FR1 only” or “FR2 only”)? And the conclusion of Q2 can also be applied here.**

|  |  |  |
| --- | --- | --- |
| Company | Preferred option | Comments |
| Nokia | Option 2 | Better to clarify with just a note to avoid mass changes to the specification. |
| **CATT** | Option 2 |  |
| Ericsson | Option 3 |  |
| ZTE | Option 2 |  |
| OPPO | Option1 or option3 |  |
| Qualcomm Incorporated | Option1 or option3 |  |
| Apple | Option 2 |  |

In addition, in TS 38.306 v15.9.0, the following per-FS DMRS capabilities are marked as “Yes” for “FR1-FR2 DIFF ”, these parameters are defined within FeatureSetDownlink-v1540, parallel to other per feature set capabilites. Similar to the discussion in Q2 and Q3, we propose to update them based on the conlusion of Q2.

| **Definitions for parameters** | **Per** | **M** | **FDD-TDD**  **DIFF** | **FR1-FR2**  **DIFF** |
| --- | --- | --- | --- | --- |
| ***oneFL-DMRS-ThreeAdditionalDMRS-DL***  Defines whether the UE supports DM-RS pattern for DL transmission with 1 symbol front-loaded DM-RS with three additional DM-RS symbols. | FS | No | No | Yes |
| ***oneFL-DMRS-TwoAdditionalDMRS-DL***  Defines support of DM-RS pattern for DL transmission with 1 symbol front-loaded DM-RS with 2 additional DM-RS symbols and more than 1 antenna ports. | FS | Yes | No | Yes |
| ***twoFL-DMRS-TwoAdditionalDMRS-DL***  Defines whether the UE supports DM-RS pattern for DL transmission with 2 symbols front-loaded DM-RS with one additional 2 symbols DM-RS. | FS | No | No | Yes |

**Q7: For above per-FS DMRS capabilities, do companies agree to change “Yes” into “N/A” or “No” (based on the conclusion of Q2) in “FR1-FR2 DIFF” column?**

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Nokia | Option 2 | Better to clarify with just a note to avoid mass changes to the specification. |
| **CATT** | Option 2 |  |
| Ericsson | Option 3 |  |
| ZTE | Agree | In fact, this question intends to ask whether companies are fine to change the current “Yes” marks. ☺  We prefer to remove the unreasonable “Yes” for consistency. And only clarify the interpretation of “No” for per-Band/BC/FS/FSPC in 4.2.1. |
| OPPO | Optioin1 or option3 |  |
| Qualcomm Incorporated | Option1 or option3 |  |
| Apple | Agree |  |

# 3 Other

Companies are invited to provide any other comment identified regarding this aspect.

**Q8: Any other comments?**

|  |  |
| --- | --- |
| Company | Comments |
|  |  |
|  |  |
|  |  |

# 4 Phase 2- Draft CR

# 5 Conclusion

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

**TBD**

# 6 References

1. R2-2002696 CR on unnecessary FRx differentiation ZTE Corporation, Sanechips CR Rel-15 38.306 15.9.0 0273 - F NR\_newRAT-Core
2. Offline discussion[014] in RAN2\_109bis-e meeting;
3. R1-2003073 Rel16\_RAN1\_UE features NR\_afterR1#100bisE