**S3GPP TSG-RAN WG2 Meeting #116-e R2-210xxxx**

**Online, November 1-12, 2021**

**Agenda Item: 6.1.4.3**

**Source: Huawei, HiSilicon**

**Title: Summary of [AT116-e][013][NR16] UE capabilities II**

**Document for: Discussion and decision**

# Introduction

This document summarizes the following offline discussion.

* [AT116-e][013][NR16] UE capabilities II (Huawei)

 Scope: Determine agreeable parts in a first phase, for agreeable parts agree on CRs. Treat [R2-2111058](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2111058.zip), [R2-2110777](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110777.zip), [R2-2110483](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110483.zip), [R2-2110484](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110484.zip), [R2-2110780](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110780.zip), [R2-2110627](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110627.zip), [R2-2110628](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110628.zip), [R2-2110629](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110629.zip), [R2-2110973](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110973.zip),

 Intended outcome: Report, Agreed CRs if applicable

 Deadline: Schedule 1

# Contact from companies

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| Ericsson | lian.araujo@ericsson.com |
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# Discussion

## Part 1: Intended to determine agreeable parts

### UL TX Switching (MIMO layer reporting)

[R2-2111058](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2111058.zip) Clarification on UL MIMO layer reporting for 1Tx-2Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.306 16.6.0 0661 - F NR\_RF\_FR1-Core\

[R2-2110777](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110777.zip) Support of UL Tx switching and relation with further enhancements Ericsson discussion

In RAN2#115-e meeting, the following two interpretations about Rel-16 UE capability reporting of UL Tx switching have been discussed. After the discussion during the meeting and post-meeting email discussion, companies agreed to go for interpretation 2, thus Interpretation 2 was adopted in Rel-17 running CR. For Rel-16 spec change, since it was not the scope of Rel-17 discussion, no corresponding CR was agreed and rapporteur suggested companies to bring CRs in later meeting for discussion.

**Interpretation 1**: The UE can signal 2layer-2layer in a feature set row of the band pair. And either band can be used as carrier 2 in 1Tx-2Tx switching.

**Interpretation 2**: The UE should signal only 1layer-2layer in feature set for the band pair to indicate the capability of 1Tx-2Tx. Carrier2 can only be the band with 2layer MIMO. This interpretation means that the UE has to signal two feature set rows for a given band pair if it wants to indicate the 1Tx-2Tx switching can be bi-directional.

**Q1 Which interpretation above do companies support for Rel-16?**

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| **Company** | **Interpretation 1 or 2?** | **Comments** |
| Ericsson |  | While we think interpretation 1 is cleaner, we can accept interpretation 2 if we can clarify that a UE indicating support of Rel-17 2Tx-2Tx should also support Rel-17 2Tx-1Tx case. |
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### UL TX Switching (UL MIMO Coherence)

[R2-2110483](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110483.zip) Adding UE capability of UL MIMO coherence for UL Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.306 16.6.0 0635 - F NR\_RF\_FR1-Core R2-2108618

[R2-2110484](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110484.zip) Adding UE capability of UL MIMO coherence for UL Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.331 16.6.0 2786 - F NR\_RF\_FR1-Core R2-2108619

[R2-2110780](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110780.zip) UL MIMO coherence for Tx switching between two carriers Ericsson discussion

RAN4 sent LS (R4-2107765) on Rel-16 UL Tx switching:

* Introduce UE capability to indicate support of the uplink codebook subset for the carrier capable of two antenna connectors, when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled PUSCH transmission.
* UE capability is defined as per band combination when also for band combinations with a carrier capable of one-port transmission + a carrier capable of two-port transmission are indicated with capability *ULTxSwitchingBandPair-r16*. For band combinations with 2Tx to 2Tx switching, RAN4 will further discuss on how to handle the above new capability in Rel-17.
* If the above capability is absent, the existing per band UE capability *pusch-TransCoherence* is applicable to the scenario when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled transmission.
* If UE indicates the above capability as *nonCoherent* and the existing per band UE capability *pusch-TransCoherence* as *fullCoherent* or *partialCoherent*, when UE is configured with uplink switching with parameter *uplinkTxSwitching-r16* and uplink switching is triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 between last transmitted SRS and scheduled PUSCH transmission, UE is not expected to receive TPMI for coherent codebook subset.

Two ways are given:

**Option 1** (from Huawei): Adding Rel-16 parameter *uplinkTxSwitching-PUSCH-TransCoherence* to indicate the UE capability of UL MIMO coherence for UL Tx switching. Following RAN4 LS, if the above capability is absent, the existing per band UE capability *pusch-TransCoherence* is applicable.

**Option 2** (from Ericsson): The UE indicates support of *pusch-TransCoherence* for UL Tx switching solely based on the *pusch-TransCoherence* field the UE reports for the UL Tx switching BC branch. Inform RAN4 on RAN2 design choice on *pusch-TransCoherence* for UL Tx switching.

**Q2 Which option above do companies support?**

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| **Company** | **Option 1 or 2?** | **Comments** |
| Ericsson | Option 2 | We think this could avoid inter-operability problems in the future and is in line with the RAN2 guidelines on UE capabilities that was sent to RAN1 and RAN4. |
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### Clarification regarding CodebookVariantsList-r16

[R2-2110627](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110627.zip) Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell CR Rel-16 38.331 16.6.0 2841 - F NR\_newRAT-Core, TEI16

[R2-2110628](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110628.zip) Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell CR Rel-16 38.306 16.6.0 0653 - F NR\_newRAT-Core, TEI16

[R2-2110629](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110629.zip) Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_newRAT-Core, TEI16

Proposal 1: Define an IE SupportedCSI-RS-Resource-r16 with exactly the same fields as *SupportedCSI-RS-Resource* but parameter names *maxNumberResourcesPerBand* and *totalNumberTxPortsPerBand* changed to *maxNumberResources* and *totalNumberTxPorts* respectively.

Proposal 2: RAN2 to discuss the backward compatible change in CRs in R2-2110627/R2-2110628 for resolving the misunderstanding in resolving the issue in description of the *supportedCSI-RS-ResourceListAlt-r16* capability.

**Q3 Do companies agree with the proposals and intention of the CRs above?**

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| **Company** | **Yes or No** | **Comments** |
| Ericsson | Yes |  |
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### Miscellaneous corrections for Rel-16 UE capabilities

[R2-2110973](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_116-e%5CDocs%5CR2-2110973.zip) Miscellaneous corrections for Rel-16 UE capabilities Huawei, HiSilicon CR Rel-16 38.306 16.6.0 0659 - F NR\_RF\_FR2\_req\_enh, NR\_eMIMO-Core

1) Remove the prerequisite requirement on *beamCorrespondenceWithoutUL-BeamSweeping* capability for *beamCorrespondenceSSB-based-r16* capability and *beamCorrespondenceCSI-RS-based-r16* capability.

2) Add the missing description of *overlapPDSCHsFullyFreqTime-r16*.

2) Remove the description of absence of *maxTBS-Size-r16*.

**Q4 Do companies agree with the intention of the CRs above?**

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| **Company** | **Yes or No** | **Comments** |
| Ericsson | Yes for 2) and 3) | For 1), it seems what is highlighted on the CR coversheet implies that the capability should be dependent on beamCorrespondenceWithoutUL-BeamSweeping? If yes, then the change would not be needed. |
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# Conclusions

# References

1. R2-2111058 Clarification on UL MIMO layer reporting for 1Tx-2Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.306 16.6.0 0661 - F NR\_RF\_FR1-Core\
2. R2-2110777 Support of UL Tx switching and relation with further enhancements Ericsson discussion
3. R2-2110483 Adding UE capability of UL MIMO coherence for UL Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.306 16.6.0 0635 - F NR\_RF\_FR1-Core R2-2108618
4. R2-2110484 Adding UE capability of UL MIMO coherence for UL Tx switching Huawei, HiSilicon, China Telecom, Apple CR Rel-16 38.331 16.6.0 2786 - F NR\_RF\_FR1-Core R2-2108619
5. R2-2110780 UL MIMO coherence for Tx switching between two carriers Ericsson discussion
6. R2-2110627 Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell CR Rel-16 38.331 16.6.0 2841 - F NR\_newRAT-Core, TEI16
7. R2-2110628 Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell CR Rel-16 38.306 16.6.0 0653 - F NR\_newRAT-Core, TEI16
8. R2-2110629 Clarification regarding CodebookVariantsList-r16 Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_newRAT-Core, TEI16
9. R2-2110973 Miscellaneous corrections for Rel-16 UE capabilities Huawei, HiSilicon CR Rel-16 38.306 16.6.0 0659 - F NR\_RF\_FR2\_req\_enh, NR\_eMIMO-Core