**3GPP TSG-RAN2 Meeting #116bis-e R2-2201787**

**Online, January 17 – 25, 2022**

**Agenda Item: 9.1.4**

**Source: Huawei**

**Title: [AT116bis-e][303][NBIOT/eMTC R17] UE Capabilities (Huawei)**

**Document for: Discussion and decision**

# Introduction

This document summarises the following offline discussion:

* [AT116bis-e][303][NBIOT/eMTC R17] UE Capabilities (Huawei)

 **Scope:** Initial discussion to progress UE capabilities discussion.

 **Intended outcome:** Report in R2-22xxxxx (agreements by email if possible – will not be treated online in this meeting)

 **Deadline:** Friday 21 January 1200 UTC

The discussion is based on [1] submitted to AI 9.1.4 and RAN1 LS on UE features list [2].

# Contact information

|  |  |
| --- | --- |
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| Huawei, HiSilicon | Odile Rollinger (odile.rollinger@huawei.com) |
| Qualcomm | Mungal Dhanda (mdhanda@qti.qualcomm.com) |
| Sequans | Noam Cayron (noam.cayron@sequans.com) |
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# Discussion

## 16-QAM for unicast in UL and DL

Below is an extract of RAN1 UE features list:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | **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 | Note | Mandatory/Optional |
| 16-QAM for unicast NPDSCH | 1. Reception of unicast NPDSCH modulated with 16-QAM2. CQI report to support 16-QAM modulation3. Downlink power allocation for 16-QAM | Category NB-2 | Yes | The network cannot schedule a unicast NPDSCH modulated with 16-QAM for the UE | Per UE | [Yes] | It is RAN1 assumption that 16-QAM for unicast in DL is compatible with all other NB-IoT features in connected-mode plus PUR | Optional with capability signaling |
| 16-QAM for unicast NPUSCH | 1. Transmission of unicast NPUSCH modulated with 16-QAM2. New term in the UE’s transmit power control equation. | Category NB-2 | Yes | The network cannot schedule a unicast NPUSCH modulated with 16-QAM for the UE | Per UE | [Yes] | It is RAN1 assumption that 16-QAM for unicast in UL is compatible with all other NB-IoT features in connected-mode plus PUR | Optional with capability signaling |

RAN1 has not yet concluded on the need for FDD/TDD differentiation. However, all physical layer features are currently defined with FDD/TDD differentiation due to TDD having only be introduced in Rel-15.

**Proposal 1**: Introduce FDD/TDD differentiation for 16-QAM for unicast NPDSCH and 16-QAM for unicast NPUSCH. This can be revisited if RAN1 decides otherwise.

**Q1: Do you agree with Proposal 1**

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **TBD** | RAN1 is discussing whether the feature is per UE or per band. If it is per band, there is no need of FDD/TDD differentiation. |
| Huawei, HiSlicon | **Yes** | Working assumption is [Yes] in RAN1. we can follow RAN1 WA in RAN2. Of course, we will change if RAN1 changes. |
| Sequans | Yes | We think we can go with RAN1 WA, but we are also fine to wait if majority prefers |
|  |  |  |

Rapporteur’ summary

Two companies have a preference to wait for RAN1.

**Modified Proposal 1**: For 16-QAM for unicast NPDSCH and 16-QAM for unicast NPUSCH, wait for RAN1 to conclude on the scope of the capability before discussion FDD/TDD differentiation.

16-QAM for unicast NPDSCH and 16-QAM for unicast NPUSCH are pure RAN features and independent of which core network the UE is connected to. Thus there is no need for EPC/5GC differentiation.

**Proposal 2**: Support for 16-QAM for unicast NPDSCH & 16-QAM for unicast NPUSCH are indicated without EPC/5GC differentiation.

**Q2: Do you agree with Proposal 2**

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **Yes** |  |
| Sequans | Yes |  |
| MediaTek | **Yes** |  |

Rapporteur’ summary

All companies agree with the proposal.

## 14-HARQ processes in DL, for HD-FDD Cat M1 UEs

Below is an extract of RAN1 UE features list:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feature group | Components | Prerequisite feature groups | Need for the eNB to know if the feature is supported | **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 | Note | Mandatory/Optional |
| 14 HARQ processes for PDSCH for HD-FDD Cat. M1 UEs | 1. Support of 14 DL HARQ processes for unicast in HD-FDD in CE mode A in RRC\_CONNECTED2. PDSCH scheduling delay3. HARQ-ACK delay solution with Alt-1 and Alt-2e | 1. Category M12. HD-FDD | Yes | The network cannot enable 14 HARQ processes for the UE | Per UE | FDD only | * PDSCH scheduling delay:
	+ 2 BL/CE DL subframes.
	+ 1 BL/CE DL subframe + 1 subframe + 3 BL/CE UL subframes + 1 subframe + 1 BL/CE DL subframe.
	+ 1 subframe + 3 BL/CE UL subframes + 1 subframe + 2 BL/CE DL subframes.
* HARQ-ACK delay:
	+ Alt-1: The HARQ-ACK delay is determined through an expression consisting of different subframe types (Using a similar principle as the PDSCH scheduling delay).
	+ Alt-2e: The HARQ-ACK delay is determined following the legacy approach. That is, the “HARQ-ACK delay” is kept expressed in terms of “absolute subframes”.

For component 3, UE reports one of {Alt-1, Alt-1 and Alt-2e} | Optional with capability signaling |

RAN2 has not discussed yet capability signalling for 14 HARQ processes for PDSCH. RAN1 has agreed that support of 14 HARQ processes for PDSCH is optional with capability signalling and that UE could report support for HARQ-ACK delay solution with Alt-1 or support of HARQ-ACK delay solution with Alt-1 and Alt-2e.

**Proposal 3**: Introduce a new UE capability ce-14HARQProcesses-r17, conditional to support of ce-ModeA-r13. Signalling of the capability implies support of HARQ-ACK delay solution with Alt-1.

**Q3: Do you agree with Proposal 3**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **Yes** |  |
| Sequans | Yes |  |
|  |  |  |

Rapporteur’ summary

All companies agree with the proposal.

**Proposal 4**: Introduce a new UE capability ce-14HARQProcesses-Alt2-r17, conditional to support of ce-14HARQProcesses-r17, for additional support of HARQ-ACK delay solution with Alt-2e.

**Q4: Do you agree with Proposal 4**

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **Yes** |  |
| Sequans | Yes |  |
|  |  |  |

Rapporteur’ summary

All companies agree with the proposal.

Introduce a new UE capability ce-14HARQProcesses-r17, conditional to support of ce-ModeA-r13. Signalling of the capability implies support of HARQ-ACK delay solution with Alt-1.

14 HARQ processes for PDSCH is a pure RAN feature and independent of which core network the UE is connected to. Thus there is no need for EPC/5GC differentiation.

**Proposal 5**: Support for 14 HARQ processes for PDSCH is indicated without EPC/5GC differentiation.

**Q5: Do you agree with Proposal 5**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Sequans | Yes |  |
|  |  |  |

Rapporteur’ summary

All companies agree with the proposal.

## Connected mode measurements for RLF

Connected mode measurements for RLF introduces signaling to perform measurements when the UE is in connected and corresponding measurement requirements. The feature is independent of which carrier is actually measured which is dependent of the band supported by the UE. Thus there is no need for FDD/TDD differentiation

Connected mode measurements for RLF is a pure RAN feature and is independent of which core network the UE is connected to. Thus there is no need for EPC/5GC differentiation.

**Proposal 6**: Support for connected mode measurements for RLF is indicated without FDD/TDD differentiation.

**Q6: Do you agree with Proposal 6**

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **FFS** | Measurement performance will be defined by RAN4 and they should be consulted whether FDD/TDD differentiation is needed. |
| Huawei, HiSilicon | **Yes** | We are confused with Qualcomm’s comment, the support of a feature is normmaly based on the core requirements not the performance requirements |
| Sequans | Yes | Agree with HW |
| MediaTek | **Yes** |  |

Rapporteur’ summary

Three companies agree. One company thinks RAN4 should be consulted.

Rapporteur proposes to follow the majority. If RAN4 needs differentiation, they should inform RAN2.

**Proposal 6b**: Support for connected mode measurements for RLF is indicated without EPC/5GC differentiation.

**Q6b: Do you agree with Proposal 6b**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **yes** |  |
| Sequans | Yes |  |
| MediaTek | Yes |  |

Rapporteur’ summary

All companies agree with the proposal.

## Coverage based paging carrier selection

Coverage based carrier selection introduces signaling for a new paging carrier selection criteria and is independent of which mode of operation, FDD or TDD, is used. Thus, there is no need for FDD/TDD differentiation

Coverage based carrier selection for RLF is a pure RAN feature and is independent of which core network the UE is connected to. Thus, there is no need for EPC/5GC differentiation.

**Proposal 7**: Support for coverage based paging carrier selection is indicated without FDD/TDD differentiation.

**Q7: Do you agree with Proposal 7**

|  |  |  |
| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **yes** |  |
| Sequans | Yes |  |
| MediaTek | Yes |  |

Rapporteur’ summary

All companies agree with the proposal.

**Proposal 7b**: Support for coverage based paging carrier selection is indicated without EPC/5GC differentiation.

**Q7b: Do you agree with Proposal 7b**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **yes** |  |
| Sequans | Yes |  |
| MediaTek | Yes |  |

Rapporteur’ summary

All companies agree with the proposal.

## Power reduction for PRACH, PUCCH, and full-PRB PUSCH

The feature is a pure RAN4 feature and RAN4 has not provided any information yet.

**Proposal 8**: Wait for RAN4 to decide which capability is needed for power reduction for PRACH, PUCCH, and full-PRB PUSCH.

**Q8: Do you agree with Proposal 8**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **yes** |  |
| Sequans | Yes |  |
|  |  |  |

Rapporteur’ summary

All companies agree with the proposal.

## Maximum DL TBS of 1736 bits for HD-FDD Cat. M1 UEs in CE mode A only

Maximum DL TBS of 1736 bits is a pure RAN feature and is independent of which core network the UE is connected to. Thus, there is no need for EPC/5GC differentiation.

**Proposal 9**: Support for maximum DL TBS of 1736 bits is indicated without EPC/5GC differentiation.

**Q9: Do you agree with Proposal 9**

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| --- | --- | --- |
| **Company** | **yes/no** | **Detailed comments** |
| Qualcomm | **Yes** |  |
| Huawei, HiSilicon | **yes** |  |
| Sequans | Yes |  |
|  |  |  |

Rapporteur’ summary

All companies agree with the proposal.

## Other

Please indicate any aspect missing above

|  |  |
| --- | --- |
| **Company** | **Detailed comments** |
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# Conclusion

Four companies contributed to the offline discussion. Based on the feedback the following proposal are made

**Modified Proposal 1**: For 16-QAM for unicast NPDSCH and 16-QAM for unicast NPUSCH, wait for RAN1 to conclude on the scope of the capability before discussion FDD/TDD differentiation.

**Proposal 2**: Support for 16-QAM for unicast NPDSCH & 16-QAM for unicast NPUSCH are indicated without EPC/5GC differentiation.

**Proposal 3**: Introduce a new UE capability ce-14HARQProcesses-r17, conditional to support of ce-ModeA-r13. Signalling of the capability implies support of HARQ-ACK delay solution with Alt-1.

**Proposal 4**: Introduce a new UE capability ce-14HARQProcesses-Alt2-r17, conditional to support of ce-14HARQProcesses-r17, for additional support of HARQ-ACK delay solution with Alt-2e.

**Proposal 5**: Support for 14 HARQ processes for PDSCH is indicated without EPC/5GC differentiation.

**Proposal 6**: Support for connected mode measurements for RLF is indicated without FDD/TDD differentiation.

**Proposal 6b**: Support for connected mode measurements for RLF is indicated without EPC/5GC differentiation.

**Proposal 7**: Support for coverage based paging carrier selection is indicated without FDD/TDD differentiation.

**Proposal 7b**: Support for coverage based paging carrier selection is indicated without EPC/5GC differentiation.

**Proposal 8**: Wait for RAN4 to decide which capability is needed for power reduction for PRACH, PUCCH, and full-PRB PUSCH.

**Proposal 9**: Support for maximum DL TBS of 1736 bits is indicated without EPC/5GC differentiation.

# References

1. [R2-2201450](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201450.zip%22%20%5Co%20%22C%3A%5CUsersbrian.martinOneDrive%20-%20InterDigital%20Communications%2C%20IncDocumentsRAN2RAN2_116bis_eDocsR2-2201450.zip) UE capabilities and FDD/TDD, EPC/5GC differentiation Huawei, HiSilicon

1. [R2-2200090](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200090.zip) “LS on updated Rel-17 RAN1 UE features list for LTE”, RAN1, RAN2#116bis-e, January 2022