**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 7.10.4

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for RAN4#94e\_#85\_LTE\_eMTC5\_Demod

**Document for:** Information

# Introduction

This email discussion targets to sort out open issues on the UE demodulation/CSI reporting requirements and BS demodulation requirements for Rel-16 eMTC.

This email discussion also targets to agree with the simulation assumption of improved MPDCCH with CRS+DMRS and CSI-RS based CSI reporting test.

Candidate target of email discussion for 1st round and 2nd round:

* 1st round: Collect companies view on the open issues
* 2nd round: Sort out open issues. Agree with the simulation assumption for MPDCCH and CSI-RS based CSI reporting test

File name rule from moderator: RAN4#94e\_#85\_LTE\_eMTC5\_Demod\_<mm><dd><hh>UTC

# Topic #1: Open issues on UE/BS demodulation requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| R4-2000311 | Samsung | **Proposal 1:** No new BS requirement for PUSCH with continuous multi-TB scheduling  **Proposal 2:** No new BS requirement for PUSCH with interlace multi-TB scheduling |
| R4-2001351 | Ericsson | **Proposal 1:** RAN4 does not define new PDSCH demodulation requirements with multi-TB scheduling.  **Proposal 2:** RAN4 does not define new PUSCH demodulation requirements with multi-TB scheduling.  **Proposal 3:** RAN4 does not define new MPDCCH/PDSCH demodulation requirements with the use of LTE control region. |
| R4-2001479 | Huawei, HiSilicon | **Proposal 1:** Define performance requirements for multi-TB scheduling for PUSCH in additional MTC enhancement |
| R4-2001480 | Huawei, HiSilicon | **Proposal1:** Define performance requirements for multi-TB scheduling of PDSCH in additional MTC enhancement  **Proposal2:** Not to define new performance requirements for transmission on LTE control region |
| R4-2001915 | Nokia, Nokia Shanghai Bell | **Proposal 1:** No separate UE / BS demodulation requirements are required for multi-TB scheduling for PDSCH / PUSCH.  **Proposal 2:** RAN4 should liaise with RAN1 to receive guidance on relevant performance evaluation scenarios, i.e. assumptions on the configuration of resources and related PHY layer parameters for MPDCCH and PDSCH, for evaluating the performance gain for the feature ‘use of LTE control region in LTE-M standalone deployment’.  **Proposal 3:** RAN4 should specify demodulation requirements for MPDCCH using DMRS and CRS, for both modes precoder cycling and CSI feedback.  **Proposal 4:** RAN4 should specify CSI reporting requirements for CSI-RS based feedback only for single layer transmission to non-BL UEs in CE mode A. |

## Open issues summary

### Sub-topic 1-1: Whether to define PUSCH demodulation requirements with multi-TB scheduling

**Issue 1-1: Define PUSCH demodulation requirements?**

* Proposals
  + Option 1: No (Samsung, Ericsson, Nokia, Nokia, Shanghai Bell)
  + Option 2: Yes (Huawei, HiSilicon)
* Recommended WF
  + More discussion needed

### Sub-topic 1-2: Whether to define PDSCH demodulation requirements with multi-TB scheduling

**Issue 1-2: Define PDSCH demodulation requirements?**

* Proposals
  + Option 1: No (Ericsson, Nokia, Nokia, Shanghai Bell)
  + Option 2: Yes (Huawei, HiSilicon)
* Recommended WF
  + More discussion needed.

### Sub-topic 1-3: Whether to define MPDCCH/PDSCH demodulation requirements using LTE control region

**Issue 1-3: Define MPDCCH/PDSCH demodulation requirements?**

* Proposals
  + Option 1: No (Ericsson, Huawei, HiSilicon)
  + Option 2: Liaise with RAN1 to receive guidance on relevant performance evaluation scenarios (Nokia, Nokia, Shanghai Bell)
* Recommended WF
  + No new MPDCCH/PDSCH demodulation requirements for the transmission on LTE control region.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | Sub topic 1-1: We prefer option 1. From the PUSCH demodulation we don’t see any difference between the multi-TB allocation and the Rel-13 single TB allocation. Since BS continuously receives the channel from the same UE, BS demodulation algorithm should be same regardless multiple TBs are transmitted with interleaved or not.  Sub topic 1-2: We prefer option 1. Same comment as PUSCH. From the demodulation we don’t see any difference between the multi-TB allocation and the Rel-13 single TB allocation. Since UE continuously receives the channel from the same BS, UE demodulation algorithm should be same regardless multiple TBs are transmitted with interleaved or not.  Sub topic 1-3: We prefer option 1. No new demodulation requirements are needed for MPDCCH/PDSCH using the LTE control region. |

### CRs/TPs comments collection

Not applicable

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

Not applicable

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Simulation assumption

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| R4-2001352 | Ericsson | **Proposal 1:** RAN4 specifies two MPDCCH demodulation requirements with CRS+DMRS: - Distributed transmission mode, CE Mode A, 2 CRS ports, AL16, [Rep16], EPA5 - Localized transmission mode, CE Mode B, 2 CRS ports, AL24, [Rep32], ETU1  **Proposal 2:** RAN4 specify the CSI-RS based PMI reporting test with periodic PUCCH 1-1 submode 1.  **Proposal 3:** For the CSI-RS based PMI reporting test, set metric as the throughput ratio of the follow PMI over the random PMI. FFS for the SNR test point. |
| R4-2001481 | Huawei, HiSilicon | **Proposal1:** Use the simulation assumption listed in table 2-1 as an initial simulation assumption for discussion |
| R4-2001482 | Huawei, HiSilicon | **Proposal1:** Propose to use the parameter configurations in table 2-1 as an initial simulation assumption for discussion |

## Open issues summary

### Sub-topic 2-1: MPDCCH demodulation requirements

**Issue 2-1: Simulation assumption**

* Proposals
  + Option 1: Proposal by Ericsson

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1  (CE Mode A) | Test 2  (CE Mode B) |
| OFDM starting symbol (startSymbolLC) | | symbols | 2 | 2 |
| Unused RE-s and PRB-s | |  | OCNG | OCNG |
| Cell ID | |  | 0 | 0 |
| Downlink power allocation |  | dB | -3 | 0 |
|  | dB | -3 | 0 |
| σ | dB | 0 | -3 |
| δ | dB | 3 | 0 |
| at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | |  | Normal | Normal |
| Subframe Configuration | |  | Non-MBSFN | Non-MBSFN |
| Precoder Update Granularity | | PRB | N/A | See TS36.211 6.8B.5 |
| ms | N/A | See TS36.211 6.8B.5 |
| Beamforming Pre-Coder | |  | See TS36.211 6.8B.5 | See TS36.211 6.8B.5 |
| Cell Specific Reference Signal | |  | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set | |  | 4 | 2+4 |
| Transmission type | |  | Distributed | Localized |
| Frequency hopping | |  | Disabled | Enabled |
| Number of frequency hopping narrowbands | |  | N/A | 4 |
| Frequency hopping offset | |  | N/A | 1 |
| Frequency hopping interval | | ms | N/A | 16 |
| Value of G in MPDCCH start subframe (*mpdcch-startSF-UESS*) (Note 3) | |  | 1.5 | 1.5 |
| Maximum number of repetitions (*mPDCCH-NumRepetition*) | |  | [16] | [32] |
| MPDCCH repetition number | |  | [16] | [32] |
| MPDCCH narrowband (*mpdcch-Narrowband*) | |  | 1 | 7 |
| PDSCH TM | |  | TM2 | TM2 |
| DCI Format | |  | 6-1A | 6-1B |
| fdd-DownlinkOrTddSubframeBitmapBR | |  | 1111111111 | 1111111111 |
| mpdcch-crs-config | |  | Configured | Configured |
| Power offset between CRS and DMRS antenna ports of MPDCCH | | dB | 0 | 0 |
| mpdcch-crs-localized-mapping-type | |  | N/A | Not configured (cyclic precoder) |
| Note1: For each test, DC subcarrier puncturing shall be considered.  Note2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.  Note 3: For MPDCCH UE-specific search space the formula for the start subframe k0 is given in TS 36.213 [6] clause 9.1.5.  Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth | Aggregation level | Reference Channel (TS 36.101) | Propagation condition | Antenna configuration | Pm-dsg (%) |
| 1 | 10MHz | 16 ECCE | R.82 FDD | EPA5 | 2x1 low | 1 |
| 2 | 10MHz | 24 ECCE | R.83 FDD | ETU1 | 2x1 low | 1 |

* + Option 2: Proposal by Huawei, HiSilicon

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | CE Mode A (Test 1) | CE Mode B (Test 1) |
| OFDM starting symbol (startSymbolLC) | | symbols | 2 | 2 |
| Unused RE-s and PRB-s | |  | OCNG | OCNG |
| Cell ID | |  | 0 | 0 |
| Downlink power allocation |  | dB | -3 | 0 |
|  | dB | -3 | 0 |
| σ | dB | 0 | -3 |
| δ | dB | 3 | 0 |
| at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | |  | Normal | Normal |
| Subframe Configuration | |  | Non-MBSFN | Non-MBSFN |
| Cell Specific Reference Signal | |  | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set | |  | 4 | 2+4 |
| Transmission type | |  | Distributed | Localized |
| Frequency hopping | |  | Disabled | Enabled |
| Number of frequency hopping narrowbands | |  | N/A | 4 |
| Frequency hopping offset | |  | N/A | 1 |
| Frequency hopping interval | | ms | N/A | 16 |
| Value of G in MPDCCH start subframe (*mpdcch-startSF-UESS*) (Note 3) | |  | 1.5 | 1.5 |
| Maximum number of repetitions (*mPDCCH-NumRepetition*) | |  | 32 | 64 |
| MPDCCH repetition number | |  | 32 | 64 |
| MPDCCH narrowband (*mpdcch-Narrowband*) | |  | 1 | 7 |
| PDSCH TM | |  | TM2 | TM2 |
| DCI Format | |  | 6-1A | 6-1B |
| fdd-DownlinkOrTddSubframeBitmapBR | |  | 1111111111 | 1111111111 |
| CRS | |  | Enable | Enable |
| Rank | |  | 1 | 1 |
| Mapping between CRS and DMRS | |  | Predefined | Predefined/  Based on CSI report |
| Precoder cycling granularity | | PRB | 1 | 1 |
| Precoder cycling pattern | |  | 2Tx: { (0,1), (0,1) }  4Tx: {12,13,14,15} | 2Tx: { (0,1), (0,1) }  4Tx: {12,13,14,15} |
| Note1: For each test, DC subcarrier puncturing shall be considered.  Note2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.  Note 3: For MPDCCH UE-specific search space the formula for the start subframe k0 is given in TS 36.213 [6] clause 9.1.5.  Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. | | | | |

* Recommended WF
  + Need more discussion based on the consolidated simulation assumption below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1  (CE Mode A) | Test 2  (CE Mode B) |
| OFDM starting symbol (startSymbolLC) | | symbols | 2 | 2 |
| Unused RE-s and PRB-s | |  | OCNG | OCNG |
| Cell ID | |  | 0 | 0 |
| Downlink power allocation |  | dB | -3 | 0 |
|  | dB | -3 | 0 |
| σ | dB | 0 | -3 |
| δ | dB | 3 | 0 |
| at antenna port | | dBm/15kHz | -98 | -98 |
| Cyclic prefix | |  | Normal | Normal |
| Subframe Configuration | |  | Non-MBSFN | Non-MBSFN |
| Precoder Update Granularity | | PRB | N/A | See TS36.211 6.8B.5 |
| ms | N/A | See TS36.211 6.8B.5 |
| Beamforming Pre-Coder | |  | See TS36.211 6.8B.5 | See TS36.211 6.8B.5 |
| Cell Specific Reference Signal | |  | Port 0 and 1 | Port 0 and 1 |
| Number of PRB per MPDCCH Set | |  | 4 | 2+4 |
| Transmission type | |  | Distributed | Localized |
| Frequency hopping | |  | Disabled | Enabled |
| Number of frequency hopping narrowbands | |  | N/A | 4 |
| Frequency hopping offset | |  | N/A | 1 |
| Frequency hopping interval | | ms | N/A | 16 |
| Value of G in MPDCCH start subframe (*mpdcch-startSF-UESS*) (Note 3) | |  | 1.5 | 1.5 |
| Maximum number of repetitions (*mPDCCH-NumRepetition*) | |  | Option 1: 16  Option 2: 32 | Option 1: 32  Option 2: 64 |
| MPDCCH repetition number | |  | Option 1: 32  Option 2: 64 | Option 1: 32  Option 2: 64 |
| MPDCCH narrowband (*mpdcch-Narrowband*) | |  | 1 | 7 |
| PDSCH TM | |  | TM2 | TM2 |
| DCI Format | |  | 6-1A | 6-1B |
| fdd-DownlinkOrTddSubframeBitmapBR | |  | 1111111111 | 1111111111 |
| mpdcch-crs-config | |  | Configured | Configured |
| Power offset between CRS and DMRS antenna ports of MPDCCH | | dB | 0 | 0 |
| mpdcch-crs-localized-mapping-type | |  | N/A | Option 1: Not configured (predefined cyclic precoder)  Option 2: CSI-based |
| Note1: For each test, DC subcarrier puncturing shall be considered.  Note2: Same precoding matrix is used for a PRB across subframes during the frequency hopping interval.  Note 3: For MPDCCH UE-specific search space the formula for the start subframe k0 is given in TS 36.213 [6] clause 9.1.5.  Note 4: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [4] or/and TS 36.213 [6] as appropriate. | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth | Aggregation level | Reference Channel (TS 36.101) | Propagation condition | Antenna configuration | Pm-dsg (%) |
| 1 | 10MHz | 16 ECCE | R.82 FDD | EPA5 | 2x1 low | 1 |
| 2 | 10MHz | 24 ECCE | R.83 FDD | ETU1 | 2x1 low | 1 |

### Sub-topic 2-2: CSI-RS based CSI reporting test

**Issue 2-2: Simulation assumption**

* Proposals
  + Option 1: Proposal by Ericsson

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters | | Unit | Values |
| Bandwidth | | MHz | 10 |
| PDSCH transmission mode | |  | 9 |
| Propagation channel | |  | EPA5 |
| Precoding granularity | | PRB | 6 |
| Downlink power allocation | ρA | dB | 0 |
| ρB | dB | 0 |
| σ | dB | -3 |
| δ | dB | 0 |
| CRS reference signals | |  | Antenna ports 0, 1 |
| CSI reference signals | |  | Antenna ports 15,…,22 |
| CSI-RS periodicity and subframe offset  *T*CSI-RS / *∆*CSI-RS | |  | 5/1 |
| CSI reference signal configuration | |  | 0 |
| Propagation condition and antenna configuration | |  | High XP 8 x 2 |
| Beamforming Model | |  | As specified in TS36.101 B.4.3 |
| CodeBookSubsetRestriction bitmap | |  | TBD |
| SNR | | dB | TBD |
|  | | dB[mW/15kHz] | TBD |
|  | | dB[mW/15kHz] | -98 |
| Max number of HARQ transmissions | |  | 4 |
| Redundancy version coding sequence | |  | {0,1,2,3} |
| Reporting mode | |  | PUCCH 1-1 submode1 |
| Physical channel for CQI/PMI reporting | |  | PUSCH |
| PUCCH Report Type for CQI/second PMI | |  | 2b |
| Reporting periodicity | | ms | 10 |
| PMI delay | | ms | 10 |
| *cqi-pmi-ConfigurationIndex* | |  | 12 |
| ce-csi-rs-feedback-config | |  | Configured |
| Frequency hopping | |  | Disabled |
| Frequency hopping inverval  (interval-FDD) | |  | N/A |
| Starting OFDM symbol (startSymbolBR) | |  | 3 |
| PDSCH repetition level | |  | 1 |
| MPDCCH repetition level | |  | 1 |
| Beamforming Precoder for MPDCCH | |  | No precoding |
| Precoder update granularity for MPDCCH | |  | N/A |
| BL/CE DL subframe comfiguration (fdd-DownlinkOrTddSubframeBitmapBR) | |  | 1111111111 |
| PDSCH PRB size | | PRB | 3 |
| PDSCH MCS | |  | [QPSK 1/2] |

* + Option 2: Proposal by Huawei, HiSilicon

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | |
| Bandwidth | | | MHz | 10 | |
| Transmission Scheme | | |  | TM9 | |
| Downlink power allocation |  | | dB | 0 | |
|  | | dB | 0 | |
| σ | | dB | 0 | |
| δ | | dB | 0 | |
| Propagation condition | | |  | AWGN | |
| Antenna configuration | | |  | 4 Tx, Cross-polarization: +/-45 degrees  2 Rx with X-polarized: 0/+90 degrees | |
|  | | | dB[mW/15kHz] | -93 | -92 |
|  | | | dB[mW/15kHz] | -98 | -98 |
| Max number of HARQ transmissions | | |  | 1 | |
| Reporting periodicity | | | ms | *Npd* = 10 | |
| CQI delay | | | ms | 10 | |
| *cqi-pmi-ConfigurationIndex* | | |  | 12 | |
| Frequency hopping | | |  | Disabled | |
| Frequency hopping inverval  (interval-FDD) | | |  | N/A | |
| Starting OFDM symbol (startSymbolBR) | | |  | 3 | |
| PDSCH repetition level | | |  | 1 | |
| MPDCCH repetition level | | |  | 1 | |
| Beamforming Precoder for MPDCCH | | |  | No precoding | |
| Precoder update granularity for MPDCCH | | |  | N/A | |
| CSI-RS configuration | | CSI-RS resource Type |  | Periodic | |
| Number of CSI-RS ports (*X*) | 8 | |
| RI | 1 | |
| Report mode | 1-1 | |
| Physical channel for CSI report | | |  | PUCCH/PUSCH | |
| Note 1: Table 7.2.4-1 of TS 36.213 is reused for the support of CSI-RS based CSI feedback for non-BL UEs in CE mode A.  Note 2: Assuming RI=1, Table 7.2.2-1E in TS 36.213 is reused without modification for the support of CSI-RS based CSI feedback for non-BL UEs in CE mode A.  Note 3: Assuming RI=1, Table 7.2.2-1D in TS 36.213 is reused without modification for the support of CSI-RS based CSI feedback for non-BL UEs in CE mode A. | | | | | |

* Recommended WF
  + Test metric for CSI-RS based CSI reporting test
    - Option 1: Throughput ratio of the follow PMI over the random PMI
  + Transmission mode
    - Option 1: PUCCH 1-1 submode 1
  + Propagation condition
    - Option 1: EPA5
    - Option 2: AWGN
  + Antenna configuration
    - Option 1: High XP 8 x 2
    - Option 2: 4 Tx, Cross-polarization: +/-45 degrees, 2 Rx with X-polarized: 0/+90 degrees

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | Sub topic 2-1: For mpdcch-crs-localized-mapping-type, we prefer option 1, since it is MPDCCH demodulation requirements, the test should verifiy the demodulation based on CRS+DMRS. Another reason is it is for CE Mode B test, which means the SNR test point is very low. We think the estimated PMI is noisy and not good for codebook selection. For MPDCCH repetition level, we are ok to keep both options in this meeting and decide according to the simulation results.    Sub topic 2-2:  Metric: RAN1 introduced CSI-RS based feedback for TM9 with PUCCH 1-1 submode 1 and 2, which means we should verify PMI feedback. Therefore we propose the metric should be the throughput ratio of the follow PMI over the random PMI.  Transmission mode: We prefer to use PUCCH 1-1 submode 1 rather than submode 2 since the most existing CSI reporting tests in TS36.101 uses submode.  Propagation: Since it is PMI reporting test, we prefer to use EPA5 instead of AWGN.  Antenna configuration: RAN1 agreement is CSI-RS based feedback for non-BL UE is applicable only if the UE is configured with PMI/RI reporting and number of CSI-RS ports=8. This means the number of CRS-RS ports should be 8. So we prefer to set 8x2 XPOL HIGH. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

Note applicable

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

Note applicable

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |