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Contents

| Intelle | ctual Property Rights | 2 |
|--------------------|--|----|
| Legal | Notice | 2 |
| Modal | verbs terminology | 2 |
| Forew | ord | 10 |
| 1 | Scope | 11 |
| 2 | References | 11 |
| 3.1 | Definitions | |
| 3.2 | Symbols | |
| 3.3 | Abbreviations | |
| 4 | General | 13 |
| 4.1 | Relationship between minimum requirements and test requirements | |
| 4.2 | Applicability of minimum requirements | |
| 4.3 | Specification suffix information | |
| 4.4 | Conducted requirements | 14 |
| 4.4.1 | Reference point | 15 |
| 4.4.2 | SNR definition | 15 |
| 4.4.3 | Noc | |
| 4.4.3.1 | Introduction | |
| 4.4.3.2 | 1 · · · · · · · · · · · · · · · · · · · | |
| 4.4.3.2 | | |
| 4.4.4.2 | T | |
| 4.5 | Radiated requirements | |
| 4.5.1 | Reference point | |
| 4.5.2 | SNR definition | |
| 4.5.3 | Noc | |
| 4.5.3.1 | Introduction | |
| 4.5.3.2 4.5.3.3 | | |
| 4.5.3.3 | Angle of arrival | |
| | | |
| | Demodulation performance requirements (Conducted requirements) | |
| 5.1 | General | |
| 5.1.1 | Applicability of requirements | |
| 5.1.1.1 | General | |
| 5.1.1.2 | | |
| 5.1.1.3 | rr | |
| 5.1.1.4 5.2 | Applicability of requirements for mandatory UE features with capability signalling | |
| 5.2.1 | 1RX requirements | |
| 5.2.1 | 2RX requirements | |
| 5.2.2.1 | FDD | |
| 5.2.2.1 | | |
| 5.2.2.1. | | |
| 5.2.2.1. | | |
| 5.2.2.1. | | |
| 5.2.2.2 | | |
| 5.2.2.2 | | |
| 5.2.2.2 | | |
| 5.2.2.2 | | |
| 5.2.3 | 4RX requirements | |
| 5.2.3.1 | FDD | |
| 5.2.3.1 | | |
| 5.2.3.1 | 1 11 0 11 | |
| 5.2.3.1. | | |
| 5.2.3.1. | .4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence | 39 |

| 5.2.3.2 | TDD | 40 |
|----------------------|--|------------|
| 5.2.3.2.1 | Minimum requirements for PDSCH Mapping Type A | 40 |
| 5.2.3.2.2 | Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH | |
| 5.2.3.2.3 | Minimum requirements for PDSCH Mapping Type B | |
| 5.3 | PDCCH demodulation requirements | |
| 5.3.1 | 1RX requirements | |
| 5.3.2 | 2RX requirements | |
| 5.3.2.1 | FDD | |
| 5.3.2.1.1 | 1 Tx Antenna performances | |
| 5.3.2.1.2 | 2 Tx Antenna performances | |
| 5.3.2.2 | TDD | |
| 5.3.2.2.1 | 1 Tx Antenna performances | |
| 5.3.2.2.2 | 2 Tx Antenna performances | |
| 5.3.3 | 4RX requirements | |
| 5.3.3.1 | FDD | |
| 5.3.3.1.1 | 1 Tx Antenna performances | |
| 5.3.3.1.1 | | |
| | 2 Tx Antenna performances | |
| 5.3.3.2 5.3.3.2.1 | TDD | |
| | 1 Tx Antenna performances | |
| 5.3.3.2.2 | 2 Tx Antenna performances | |
| 5.4 | PBCH demodulation requirements | |
| 5.4.1 | 1RX requirements | |
| 5.4.2 | 2RX requirements | |
| 5.4.2.1 | FDD | |
| 5.4.2.2 | TDD | |
| 5.4.3 | 4RX requirements | |
| 5.4.3.1 | FDD | |
| 5.4.3.2 | TDD | |
| 5.5 | Sustained downlink data rate provided by lower layers | |
| 5.5.1 | FR1 single carrier requirements | |
| 5.5A | Sustained downlink data rate provided by lower layers | |
| 5.5A.1 | FR1 CA requirements | 54 |
| 6 CS | I reporting requirements (Conducted requirements) | <i>6</i> 0 |
| | SI reporting requirements (Conducted requirements) | |
| 6.1 | General | |
| 6.1.1 | Applicability of requirements | |
| 6.1.1.1 | General | |
| 6.1.1.2 | Applicability of requirements for different number of RX antenna ports | |
| 6.1.1.3 | Applicability of requirements for optional UE features | 60 |
| 6.1.1.4 | Applicability of requirements for mandatory UE features with capability signalling | |
| 6.1.2 | Common test parameters | |
| 6.2 | Reporting of Channel Quality Indicator (CQI) | |
| 6.2.1 | 1RX requirements | |
| 6.2.2 | 2RX requirements | |
| 6.2.2.1 | FDD | |
| 6.2.2.1.1 | CQI reporting definition under AWGN conditions | 65 |
| 6.2.2.1.2 | CQI reporting under fading conditions | 67 |
| 6.2.2.2 | TDD | 72 |
| 6.2.2.2.1 | CQI reporting definition under AWGN conditions | 72 |
| 6.2.2.2.2 | CQI reporting under fading conditions | |
| 6.2.3 | 4RX requirements | |
| 6.2.3.1 | FDD | 79 |
| 6.2.3.1.1 | CQI reporting definition under AWGN conditions | |
| 6.2.3.1.2 | CQI reporting under fading conditions | |
| 6.2.3.2 | TDD | |
| 6.2.3.2.1 | CQI reporting definition under AWGN | |
| 6.2.3.2.2 | CQI reporting under fading conditions | |
| 6.3 | Reporting of Precoding Matrix Indicator (PMI) | |
| 6.3.1 | 1RX requirements | |
| 6.3.2 | 2RX requirements | |
| 6.3.2.1 | FDD | |
| 0.5.2.1 | Γυν | |
| 6.3.2.1.1 | Single PMI with 4TX TypeI-SinglePanel Codebook | വാ |

| 6.3.2.1.2 | \mathcal{E} | |
|----------------------------|--|------------|
| 6.3.2.2 | TDD | |
| 6.3.2.2.1 | 71 | |
| 6.3.2.2.2 | | |
| 6.3.3 | 4RX requirements | |
| 6.3.3.1 | FDD | |
| 6.3.3.1.1 | Single PMI with 4TX TypeI-SinglePanel Codebook | 105 |
| 6.3.3.1.2 | Single PMI with 8TX TypeI-SinglePanel Codebook | 108 |
| 6.3.3.2 | TDD | |
| 6.3.3.2.1 | Single PMI with 4TX TypeI-SinglePanel Codebook | 111 |
| 6.3.3.2.2 | Single PMI with 8TX TypeI-SinglePanel Codebook | 114 |
| 6.4 | Reporting of Rank Indicator (RI) | 117 |
| 6.4.1 | 1RX requirements | 117 |
| 6.4.2 | 2RX requirements | |
| 6.4.2.1 | FDD | |
| 6.4.2.2 | TDD | |
| 6.4.3 | 4RX requirements | |
| 6.4.3.1 | FDD | |
| 6.4.3.2 | TDD | 125 |
| 7 D | Demodulation performance requirements (Radiated requirements) | 129 |
| 7.1 | General | |
| 7.1 7.1.1 | Applicability of requirements | |
| 7.1.1 7.1.1.1 | General | |
| 7.1.1.1 | Applicability of requirements for different number of RX antenna ports | |
| 7.1.1.2 | Applicability of requirements for optional UE features | |
| 7.1.1.3 7.2 | PDSCH demodulation requirements | |
| 7.2.1 | 1RX requirements | |
| 7.2.1 | 2RX requirements | |
| 7.2.2.1 | FDD | |
| 7.2.2.1 | TDD | |
| 7.2.2.2.1 | | |
| 7.2.2.2.1 | PDCCH demodulation requirements | |
| 7.3.1 | 1RX requirements | |
| 7.3.1 | 2RX requirements | |
| 7.3.2.1 | FDD | |
| 7.3.2.2 | TDD | |
| 7.3.2.2.1 | | |
| 7.3.2.2.2 | 1 | |
| 7.3. 2.2. 2. 7.4 | PBCH demodulation requirements | |
| 7.4.1 | 1RX requirements | |
| 7.4.2 | 2RX requirements | |
| 7.4.2.1 | FDD | |
| 7.4.2.2 | TDD | |
| 7.5 | Sustained downlink data rate provided by lower layers | |
| 7.5.1 | FR2 single carrier requirements | |
| 7.5A | Sustained downlink data rate provided by lower layers | |
| 7.5A.1 | FR2 CA requirements | |
| 0 0 | • | |
| | SI reporting requirements (Radiated requirements) | |
| 8.1 | General | |
| 8.1.1 | Applicability of requirements | |
| 8.1.1.1 | General | |
| 8.1.1.2 | Applicability of requirements for different number of RX antenna ports | |
| 8.1.1.3 | Applicability of requirements for optional UE features | |
| 8.1.1.4 | Applicability of requirements for mandatory UE features with capability signalling | |
| 8.1.2 | Common test parameters | |
| 8.2 | Reporting of Channel Quality Indicator (CQI) | |
| 8.2.1 | 1RX requirements | |
| 8.2.2 | 2RX requirements | |
| 8.2.2.1 | FDD | 151 151 |
| $\alpha / / /$ | 11717 | |

| 8.2.2.2.1 | CQI reporting under AWGN conditions | |
|---------------------------------|--|-----------------|
| 8.2.2.2.2 | CQI reporting under fading conditions | |
| 8.3 | Reporting of Precoding Matrix Indicator (PMI) | |
| 8.3.1 | 1RX requirements | 156 |
| 8.3.2 | 2RX requirements | 156 |
| 8.3.2.1 | FDD | 156 |
| 8.3.2.2 | TDD | 156 |
| 8.3.2.2.1 | Single PMI with 2TX TypeI-SinglePanel Codebook | 15 6 |
| 8.4 | Reporting of Rank Indicator (RI) | |
| 8.4.1 | 1RX requirements | |
| 8.4.2 | 2RX requirements | |
| 8.4.2.1 | FDD. | |
| 8.4.2.2 | TDD | |
| 9 De | emodulation performance requirements for interworking | 163 |
| 9.1 | General | |
| 9.1 9.1.1 | Applicability of requirements | |
| | | |
| 9.1.1.1 | Applicability of requirements for optional UE features | |
| 9.1.1.2 | Applicability of requirements for mandatory UE features with capability signalling | |
| 9.1.2 | E-UTRA Cell setup | |
| 9.1.2.1 | FDD | |
| 9.1.2.2 | TDD | |
| 9.2 | PDSCH Demodulation | 166 |
| 9.2A | PDSCH demodulation for CA | |
| 9.2A.1 | NR CA between FR1 and FR2 | 166 |
| 9.2B | PDSCH demodulation for DC | 167 |
| 9.2B.1 | EN-DC | 167 |
| 9.2B.1.1 | EN-DC within FR1 | 167 |
| 9.2B.1.1. | 1 PDSCH | 167 |
| 9.2B.1.2 | EN-DC including FR2 NR carrier only | |
| 9.2B.1.2. | | |
| 9.2B.1.3 | EN-DC including FR1 and FR2 NR carriers | |
| 9.2B.2 | NR DC between FR1 and FR2. | |
| 9.3 | PDCCH demodulation. | |
| 9.3A | PDCCH demodulation for CA. | |
| 9.3A.1 | NR CA between FR1 and FR2. | |
| 9.3 B .1 | PDCCH demodulation for DC | |
| 9.3 Б 9.3 В .1 | EN-DC | |
| | | |
| 9.3B.1.1 | EN-DC within FR1 | |
| 9.3B.1.1. | | |
| 9.3B.1.2 | EN-DC including FR2 NR carrier only | |
| 9.3B.1.2. | | |
| 9.3B.1.3 | EN-DC including FR1 and FR2 NR carriers | |
| 9.3B.2 | NR DC between FR1 and FR2 | |
| 9.4 | Void | |
| 9.4A | SDR test for CA | |
| 9.4A.1 | NR CA between FR1 and FR2 | 168 |
| 9.4B | SDR test for DC | 169 |
| 9.4B.1 | EN-DC | 169 |
| 9.4B.1.1 | EN-DC within FR1 | 169 |
| 9.4B.1.1. | | |
| 9.4B.1.2 | EN-DC including FR2 NR carrier | |
| 9.4B.1.2. | | |
| 9.4B.1.3 | EN-DC including FR1 and FR2 NR carriers. | |
| 9.4B.2 | NR DC between FR1 and FR2 | |
| | | |
| | SI reporting requirements for interworking | |
| 10.1 | General | |
| 10.1.1 | Applicability of requirements | |
| 10.1.1.1 | Applicability of requirements for optional UE features | |
| 10.1.1.2 | Applicability of requirements for mandatory UE features with capability signalling | 173 |
| 10.2 | Reporting of Channel Quality Indicator (COI) | |

| 10.2A | Reporting of Channel Quality Indicator (CQI) for CA | |
|--|--|-------|
| 10.2B | Reporting of Channel Quality Indicator (CQI) for DC | |
| 10.2B.1 | EN-DC | |
| 10.2B.1.1 | EN-DC within FR1 | |
| 10.2B.1.2 | EN-DC including FR2 NR carrier | |
| 10.2B.1.3 | EN-DC including FR1 and FR2 NR carriers | |
| 10.2B.2 | NR DC between FR1 and FR2 | |
| 10.3 | Reporting of Precoding Matrix Indicator (PMI) | 173 |
| 10.3A | Reporting of Precoding Matrix Indicator (PMI) for CA | |
| 10.3B | Reporting of Precoding Matrix Indicator (PMI) for DC | 174 |
| 10.3B.1 | EN-DC | 174 |
| 10.3B.1.1 | EN-DC within FR1 | 174 |
| 10.3B.1.2 | EN-DC including NR FR2 carrier | 174 |
| 10.3B.1.3 | EN-DC including FR1 and FR2 NR carriers | 174 |
| 10.3B.2 | NR DC between FR1 and FR2 | |
| 10.4 | Reporting of Rank Indicator (RI) | |
| 10.4A | Reporting of Rank Indicator (RI) for CA | |
| 10.4B | Reporting of Rank Indicator (RI) for DC | |
| 10.4B.1 | EN-DC | |
| 10.4B.1.1 | EN-DC within FR1 | |
| 10.4B.1.2 | EN-DC including NR FR2 carrier | |
| 10.4B.1.3 | EN-DC including FR1 and FR2 NR carriers | |
| 10.4B.1.3 | NR DC between FR1 and FR2 | |
| 10.70.2 | TAX De octween TAT and TA2 | 1 / т |
| Annex A | (normative): Measurement channels | 175 |
| | | |
| | neral | |
| A.1.1 | Throughput definition | |
| A.1.2 | TDD UL-DL configurations for FR1 | 175 |
| A.1.3 | TDD UL-DL configuration for FR2 | 179 |
| | | |
| $\lambda 2 \mathcal{M}_{c}$ | :4 | 101 |
| A.2 Vo | id | 181 |
| | | |
| A.3 DI | reference measurement channels | 181 |
| A.3 DI A.3.1 | reference measurement channels | 181 |
| A.3 DI A.3.1 A.3.2 | General | 181 |
| A.3 DI A.3.1 A.3.2 A.3.2.1 | General | |
| A.3 DI A.3.1 A.3.2 A.3.2.1 A.3.2.1.1 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1 A.3.2.1.1 A.3.2.1.2 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 | Reference measurement channels | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.1 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.2 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.2 A.3.2.2.3 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.4 | General Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 120 kHz FR2 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 | General Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 16 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.2.3 | General | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 | General | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 | General | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for E-UTRA Reference measurement channels for PDCCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2 | General | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for E-UTRA Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for FDCCH performance requirements FDD Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2 A.3.3.2.1 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for E-UTRA Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2 A.3.3.2.1 A.3.3.2.1 A.3.3.2.2 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for FDCCH performance requirements FDD Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2 A.3.3.2.1 A.3.3.2.2 A.3.3.2.3 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for E-UTRA Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2.1 A.3.3.2.1 A.3.3.2.1 A.3.3.2.1 A.3.3.2.2 A.3.3.2.3 A.3.3.2.3 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for PDCCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2.2 A.3.3.2.3 A.3.3.2.4 A.3.3.2.3 A.3.3.2.4 A.3.3.2.3 | Reference measurement channels for PDSCH performance requirements FDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for E-UTRA TDD Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 120 kHz FR2 Reference measurement channels for E-UTRA Reference measurement channels for E-UTRA Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 15 kHz FR1 Reference measurement channels for SCS 30 kHz FR1 TDD Reference measurement channels for SCS 30 kHz FR1 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 60 kHz FR2 Reference measurement channels for SCS 60 kHz FR2 | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2.2 A.3.3.2.3 A.3.3.2.1 A.3.3.2.3 A.3.3.2.3 A.3.3.2.4 A.3.3.2.5 A.3.3.2.4 | Reference measurement channels for PDSCH performance requirements FDD | |
| A.3 DI A.3.1 A.3.2 A.3.2.1.1 A.3.2.1.2 A.3.2.1.3 A.3.2.1.4 A.3.2.2 A.3.2.2.1 A.3.2.2.2 A.3.2.2.3 A.3.2.2.4 A.3.2.2.5 A.3.2.2.6 A.3.3 A.3.3.1 A.3.3.1.1 A.3.3.1.2 A.3.3.2.2 A.3.3.2.3 A.3.3.2.4 A.3.3.2.5 A.3.4 A.3.4.1 A.3.4.2 | Reference measurement channels for PDSCH performance requirements FDD | |

| | | 232 |
|---|---|------------|
| | r FDD | |
| | attern 1: Generic OCNG FDD Pattern for all unused REs | |
| | r TDDattern 1: Generic OCNG TDD Pattern for all unused REs | |
| - | | |
| Annex B (normative): | Propagation conditions | |
| | ondition | |
| | 2Rx | |
| B.1.2 UE Receiver with | 4Rx | 234 |
| B.2 Multi-path fading pr | opagation conditions | 235 |
| | | |
| | for FR1 | |
| | for FR2 | |
| | hannel model parametersorrelation Matrices | |
| | tion Matrices using Uniform Linear Array (ULA) | |
| | of MIMO Correlation Matrices | |
| | relation Matrices at High, Medium and Low Level | |
| | tion Matrices using Cross Polarized Antennas (X-pol) | |
| | of MIMO Correlation Matrices using cross polarized antennas | |
| | relation Matrices using cross polarized antennas | |
| | ng approach | |
| B.2.4 Two-tap propagation | on conditions for CQI tests | 249 |
| B.3 High Speed Train So | cenario | 249 |
| B.3.1 Single Tap Channel | el Profile | 249 |
| B.4 Beamforming Mode | 1 | 251 |
| | ing model | |
| | Downlink physical channels | |
| | Hownlink noveled coannois | |
| Annex C (normative): | - • | |
| · · · · · · · · · · · · · · · · · · · | Downink physical chamics | |
| C.1 General | - • | 253 |
| C.1 General | | 253 |
| C.1 GeneralC.2 Setup (Conducted)C.3 Connection (Conducted) | | 253 253 |
| C.1 General | eted)erformance requirements | |
| C.1 General C.2 Setup (Conducted) C.3 Connection (Conducted) Measurement of Performance C.4 Setup (Radiated) | cted)erformance requirements | |
| C.1 General | eted)erformance requirements | |
| C.1 General C.2 Setup (Conducted) C.3 Connection (Conducted) Measurement of Performance C.4 Setup (Radiated) | cted)erformance requirements | |
| C.1 General C.2 Setup (Conducted) C.3 Connection (Conducted) Measurement of Performance C.4 Setup (Radiated) Annex D (informative): Annex E (normative): | vted)erformance requirements | |
| C.1 General | Void Environmental conditions | |
| C.1 General | Void | |
| C.1 General | Void | |
| C.1 General | Void | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void | |
| C.1 General | Void Environmental conditions ducted) | |
| C.1 General | Void | |

| Annex K (informative): | Void | 259 |
|------------------------|----------------|-----|
| Annex L (informative): | Change history | 260 |
| History | | 265 |

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document establishes the minimum performance requirements for NR User Equipment (UE).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.
- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

 [2] 3GPP TS 38.521-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

 [3] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

 [4] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

 [5] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".

 [6] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1
- Standalone".
- [7] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
- [8] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".
- [9] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [11] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [12] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [13] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.
- [14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".
- [15] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

DL BWP: DL bandwidth part as defined in TS 38.213 [11].

EN-DC: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [13].

Enhanced Receiver Type 1: SU-MIMO interference mitigation advanced receiver [14]

- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2 with 2 RX antennas
- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2, 3, and 4 with 4 RX antennas

FR1: Frequency range 1 as defined in clause 5.1 of TS 38.101-3 [8].

FR2: Frequency range 2 as defined in clause 5.1 of TS 38.101-3 [8].

SSB: SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [9].

3.2 Symbols

For the purposes of the present document, the following symbols apply:

E_s The averaged received energy per Hz of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set

of REs used for the transmission of physical, divided transmission bandwidth within the set

μ Subcarrier spacing configuration as defined in clause 4.2 of TS 38.211 [9]

 N_{oc} The power spectral density of a white noise source with average power per Hz as defined in

Section 4.4.3 for conducted requirements and Section 4.5.3 for radiated requirements

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

CA Carrier Aggregation
CC Component Carrier
CCE Control Channel Element
CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information
CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

CQI Channel Quality Indicator CRC Cyclic Redundancy Check CRI CSI-RS Resource Indicator

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DMRS Demodulation Reference Signal EPRE Energy Per Resource Element EN-DC E-UTRA-NR Dual Connectivity

FR Frequency Range

FRC Fixed Reference Channel

HARQ Hybrid Automatic Repeat Request

LI Layer Indicator

MAC Medium Access Control
MCS Modulation and Coding Scheme
MIB Master Information Block

NR New Radio

NSA Non-Standalone Operation Mode OCNG OFDMA Channel Noise Generator

OFDM Orthogonal Frequency Division Multiplexing
OFDMA Orthogonal Frequency Division Multiple Access

PBCH Physical Broadcast Channel

Pcell Primary Cell

PDCCH Physical Downlink Control Channel PDSCH Physical Downlink Shared Channel

PMI Precoding Matrix Indicator
PRB Physical Resource Block
PRG Physical resource block group
PSS Primary Synchronization Signal
PTRS Phase Tracking Reference Signal
PUCCH Physical Uplink Control Channel
PUSCH Physical Uplink Shared Channel

QCL Quasi Co-location
RB Resource Block
RBG Resource Block Group
RE Resource Element
REG Resource Element Group

RI Rank Indicator

RRC Radio Resource Control SA Standalone operation mode

SCS Subcarrier Spacing

SINR Signal-to-Interference-and-Noise Ratio

SNR Signal-to-Noise Ratio
SS Synchronization Signal
SSB Synchronization Signal Block
SSS Secondary Synchronization Signal
TCI Transmission Configuration Indicator

TDM Time division multiplexing TTI Transmission Time Interval

UL Uplink

VRB Virtual Resource Block

4 General

4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT and interwork specification for NR UE, covering minimum performance requirements of both conducted and radiated requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification TS 38.521-4 [2].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-4 [2] defines test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements.

The measurement results returned by the test system are compared – without any modification – against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU-R M.1545 [3].

The applicability of each requirement is described under each sub-clause in 5.1, 6.1, 7.1, 8.1, 9.1 and 10.1.

4.2 Applicability of minimum requirements

The conducted minimum requirements specified in this specification shall be met in all applicable scenarios for FR1. The radiated minimum requirements specified in this specification shall be met in all applicable scenarios for FR2. The minimum requirements for interworking specified in this specification shall be met in all applicable scenarios for NR interworking operation.

All minimum performance requirements defined in Sections 5-8 are applicable to both SA and NSA unless otherwise explicitly stated in Section 9 and 10.

All minimum performance requirements defined in Sections 5-10 are applicable to all UE power classes unless otherwise stated.

For radiated minimum requirements specified in the specification, if maximum achievable SNR in the test system for certain test conditions is less than the defined SNR requirement for those tests, those requirements shall not be tested.

4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level subclause, shown in table 4.3-1.

 Clause suffix
 Variant

 None
 Single Carrier

 A
 Carrier Aggregation (CA)

 B
 Dual-Connectivity (DC)

 C
 Supplement Uplink (SUL)

Table 4.3-1: Definition of suffixes

A terminal which supports the above features needs to meet the requirement defined in the additional subclause (suffix A, B, C) in clauses 5, 6, 7, 8, 9, 10.

4.4 Conducted requirements

4.4.0 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source
 - Wanted signal with power level Es is transmitted.
 - External white noise source with power spectral density Noc is used.
 - Es and Noc levels are selected to achieve target SNR as described in Clause 4.4.2.
- Mode 2: Noise free conditions
 - Wanted signal with power level Es is transmitted.
 - No external noise transmitted.

4.4.1 Reference point

The reference point for SNR, Es and Noc of DL signal is the UE antenna connector or connectors.

4.4.2 SNR definition

For Mode 1 conditions conducted UE demodulation and CSI requirements the SNR is defined as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

Where

- N_{RX} denotes the number of receiver antenna connectors and the superscript receiver antenna connector j.
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in clause C.3.1.

4.4.3 Noc

4.4.3.1 Introduction

This clause describes the Noc power level for Mode 1 conditions conducted testing of demodulation and CSI requirements.

Unless otherwise stated for CA and EN-DC testing, the same Noc level shall be provided on different component carriers.

4.4.3.2 Noc for NR operating bands in FR1

The Noc power spectrum density shall be larger or equal to the minimum Noc power level for each operating band supported by the UE as defined in clause 4.4.3.2.1.

Unless otherwise stated, a fixed Noc power level of -134 dBm/Hz shall be used for all operating bands.

4.4.3.2.1 Derivation of Noc values for NR operating bands in FR1

The minimum Noc power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

 $Noc_{Band_X,\ SCS_Y,\ CBW_Z} = REFSENS_{Band_X,\ SCS_Y,\ CBW_Z} - 10*log10(12*SCS_Y*nPRB) + D - SNR_{REFSENS} + \Delta_{thermal} +$

where

- REFSENS_{Band_X, SCS_Y, CBW_Z} is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]
- D is diversity gain equal to 3 dB

- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{\text{thermal}} = 16$ dB, giving a rise in total noise of 0.1dB, regarded as insignificant.

The calculated Noc value for the baseline of Band n12, 15 kHz SCS, 15 MHz CBW is -135.5 dBm/Hz.

An allowance of 1.5dB is made for CA and for future bands, giving an Noc power level of -134 dBm/Hz.

4.4.4 Es

4.4.4.1 Introduction

This clause describes the Es power level for Mode 2 conditions conducted testing of demodulation and CSI requirements.

Unless otherwise stated for CA and EN-DC testing, the same Es level shall be provided on different component carriers.

4.4.4.2 Es for NR operating bands in FR1

The Es power spectrum density shall be larger or equal to the minimum Es power level for each operating band supported by the UE as defined in Clause 4.4.4.2.1.

Unless otherwise stated, a fixed Es power level of -112 dBm/Hz shall be used for all operating bands.

4.4.4.2.1 Derivation of Es values for NR operating bands in FR1

The minimum Es power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

 $Es_{Band_X,\ SCS_Y,\ CBW_Z} = REFSENS_{Band_X,\ SCS_Y,\ CBW_Z} - 10*log10(12*SCS_Y*nPRB) + D - SNR_{REFSENS} + dB_{EVM} + \Delta_{thermal} \\ where:$

- REFSENS_{Band_X, SCS_Y, CBW_Z} is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]
- D is diversity gain equal to 3 dB
- $SNR_{REFSENS} = -1 dB$ is the SNR used for simulation of REFSENS
- dB_{EVM} is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dB_{EVM} of 30.5dB, derived as 20*log10(1/0.03).
- $\Delta_{thermal}$ is the amount of dB that the impairment due to EVM on the wanted Es is set above UE thermal noise, giving a defined rise in total impairment. $\Delta_{thermal} = 7.6$ dB, giving a rise in total impairment of 0.7dB, regarded as acceptable.

The calculated Es value for the baseline of Band n12, 15kHz SCS, 15MHz CBW is -113.5 dBm/Hz.

An allowance of 1.5dB is made for CA and for future bands, giving an Es power level of -112 dBm/Hz.

4.5 Radiated requirements

4.5.0 Introduction

The requirements are defined for the following modes:

- Mode 1: conditions with external noise source
 - Wanted signal with power level Es is transmitted.
 - External white noise source with power spectral density Noc is used.
 - Es and Noc levels are selected to achieve target SNR as described in Clause 4.5.2.
- Mode 2: Noise free conditions
 - Wanted signal with power level Es is transmitted.
 - No external noise transmitted.

4.5.1 Reference point

The reference point for SNR, Es and Noc of DL signal from the UE perspective is the input of UE antenna array.

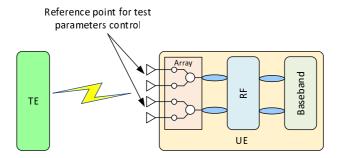


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

4.5.2 SNR definition

For Mode 1 conditions UE demodulation and CSI requirements, the Minimum performance requirement in clause 7, 8, 9 and 10 are defined relative to the baseband SNR level SNR_{BB}. The SNR at the reference point is defined as

$$SNR = SNR_{BB} + \Delta_{BB}$$

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

- N_{RX} denotes the number of receiver reference points, and the super script receiver reference point j.
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in Clause C.3.1.

4.5.3 Noc

4.5.3.1 Introduction

For Mode 1 conditions radiated testing of demodulation and CSI requirements it is not feasible in practice to use signal levels high enough to make the noise contribution of the UE negligible. Demodulation requirements are therefore specified with the applied noise higher than the UE peak EIS level in TS 38.101-2 [7] by a defined amount, so that the impact of UE noise floor is limited to no greater than a value Δ_{BB} at the specified Noc level. As UEs have EIS levels that are dependent on operating band and power class, Noc level is dependent on operating band and power class.

4.5.3.2 Noc for NR operating bands in FR2

Values for Noc according to operating band and power class for single carrier requirements are specified in Table 4.5.3.2-1 for $\Delta_{BB} = 1 dB$.

Table 4.5.3.2-1: Noc power level for different UE power classes and frequency bands

| Operating band | UE Power class | | | | | |
|--|----------------|--------|--------|--------|--|--|
| | 1 | 2 | 3 | 4 | | |
| n257 | -166.8 | -161.3 | -157.6 | -166.3 | | |
| n258 | -166.8 | -161.3 | -157.6 | -166.3 | | |
| n260 | -163.8 | | -155.0 | -164.3 | | |
| n261 | -166.8 | -161.3 | -157.6 | -166.3 | | |
| Note 1: Noc levels are specified in dBm/Hz | | | | | | |

For PC3 multi-band devices, the Noc power level (Noc_{MB}) shall increase by multi-band relaxation defined in Table 6.2.1.3-4 of TS 38.101-2 [7]:

$$Noc_{MB} = Noc_{SB} + \Sigma MB_P$$

- Noc_{SB} is the Noc defined in Table 4.5.3.2-1
- Σ MB_P values are specified in TS 38.101-2 [7].

For CA case, the Noc power level (Noc_{CA}) shall increase by a relaxation factor defined in TS 38.101-2 [7] Table 7.3A.2.1-1:

$$Noc_{CA} = Noc_{SC} + \Delta R_{IB}$$

- Noc_{SC} is derived by assuming UE supports single carrier.
- ΔR_{IB} values are specified in TS 38.101-2 [7].

4.5.3.3 Derivation of Noc values for NR operating bands in FR2

The Noc values in Table 4.5.3.2-1 are based on REFSENS for the operating band and on the UE Power class, and taking a baseline of UE Power class 3 in Band n260.

$$Noc = REFSENS_{PC3, \, n260, \, 50MHz} - 10Log_{10}(SCS_{REFSENS} \, x \, PRB_{REFSENS} \, x \, 12) - SNR_{REFSENS} + \Delta_{thermal} +$$

where:

- REFSENS_{PC3, n260, 50MHz} is the REFSENS value in dBm specified for Power Class 3 UE in Band n260 for 50MHz Channel bandwidth in Table 7.3.2.3-1 of TS 38.101-2 [7].
- SCS_{REFSENS} is a subcarrier spacing associated with N_{RB} for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7], chosen as 120 kHz.
- PRB_{REFSENS} is N_{RB} associated with subcarrier spacing 120 kHz for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7] and is 32.
- 12 is the number of subcarriers in a PRB

- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of Δ_{BB} . $\Delta_{\text{thermal}} = 6 \text{dB}$, giving a rise in total noise of 1 dB.

The calculated Noc value for the baseline of UE Power class 3 in Band n260 is rounded to -155 dBm/Hz.

The following methodology to define the Noc level for UE power class X (PC_X) and operating band Y (Band_Y) is used for the single carrier case and single band devices:

where REFSENS values are specified in TS 38.101-2 [7].

4.5.4 Angle of arrival

Unless otherwise stated, the downlink signal and noise are aligned to arrive in the UE Rx beam peak direction as defined in TS 38.101-2 [7].

4.5.5 Es

For Mode 2 the test system shall transmit the wanted signal with power level Es which is the best achievable power level by the test system.

The test system shall be able to determine achievable Es level and the maximum achievable SNR level

5 Demodulation performance requirements (Conducted requirements)

5.1 General

5.1.1 Applicability of requirements

5.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1[6].

The minimum performance requirements in Clause 5 are mandatory for UE supporting NR operation, except test cases listed in Clauses 5.1.1.3, 5.1.1.4.

5.1.1.2 Applicability of requirements for different number of RX antenna ports

The number of RX antenna ports for different RF operating bands is up to UE declaration.

The UE shall support 2 or 4 RX antenna ports for different RF operating bands. The operating bands, where 4 RX antenna ports shall be the baseline, are defined in Clause 7.2 of TS 38.101-1 [6]. The UE requirements applicability for UEs with different number of RX antenna ports is defined in Table 5.1.1.2-1.

Table 5.1.1.2-1: Requirements applicability

| Supported RX | Test type | Test list | |
|--|-----------|---|--|
| antenna ports | | | |
| UE supports only | PDSCH | All tests in Clause 5.2.2 | |
| 2RX | PDCCH | All tests in Clause 5.3.2 | |
| | PBCH | All tests in Clause 5.4.2 | |
| UE supports only | PDSCH | All tests in Clause 5.2.3 | |
| 4RX or both 2RX | PDCCH | All tests in Clause 5.3.3 | |
| and 4RX | PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note) | |
| Note: Requirements for PBCH with 4Rx is up to UE declaration | | | |

5.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 5.1.1.3-1 shall apply for UEs which support optional UE features only.

Table 5.1.1.3-1: Requirements applicability for optional UE features

| UE feature/capability [14] | Test ty | | Test list | Applicability notes |
|--|-------------|-------|--|--|
| SU-MIMO Interference Mitigation advanced receiver | FR1 FDD | PDSCH | 5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A (Test 3-1) 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A (Test 5-1) | |
| | FR1 TDD | PDSCH | 1) 5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A (Test 3- 1) 5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A (Test 5- 1) | |
| Alternative additional DMRS position for co-existence with LTE CRS (additionalDMRS-DL-Alt) | FR1 FDD | PDSCH | 5.2.2.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence (Test 1-2) 5.2.3.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence (Test 1-2) | |
| Basic DL NR-NR CA operation (supportedBandCombinationList) | NR-NR CA | SDR | 5.5A.1 FR1 CA requirements | 1)Up to 16 DL carriers 2)Same numerology across carrier for data/control channel at a given time |

5.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 5.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

Table 5.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|-----------|--------|--|--|
| 256QAM modulation scheme | FR1 FDD | PDSCH | 5.2.2.1.1 Minimum | |
| for PDSCH for FR1 (pdsch- | | | requirements for PDSCH | |
| 256QAM-FR1) | | | Mapping Type A (Test 1-3) | |
| | | | 5.2.3.1.1 Minimum | |
| | | | requirements for PDSCH | |
| | | | Mapping Type A (Test 1-3) | |
| | FR1 TDD | PDSCH | 5.2.2.2.1 Minimum | |
| | | | requirements for PDSCH Mapping Type A (Test 1-3) | |
| | | | Mapping Type A (Test 1-3) | |
| | | | 5.2.3.2.1 Minimum | |
| | | | requirements for PDSCH | |
| | | | Mapping Type A (Test 1-3) | |
| PDSCH mapping type B | FR1 FDD | PDSCH | 5.2.2.1.3 Minimum | |
| (pdsch-MappingTypeB) | | | requirements for PDSCH Mapping Type B | |
| | | | I wapping Type B | |
| | | | 5.2.3.1.3 Minimum | |
| | | | requirements for PDSCH | |
| | 504 FDD | DD0011 | Mapping Type B | |
| | FR1 TDD | PDSCH | 5.2.2.2.3 Minimum requirements for PDSCH | |
| | | | Mapping Type B | |
| | | | | |
| | | | 5.2.3.2.3 Minimum | |
| | | | requirements for PDSCH | |
| | | | Mapping Type B | |
| Rate-matching around LTE | FR1 FDD | PDSCH | 5.2.2.1.4 Minimum | |
| CRS (rateMatchingLTE-CRS) | I KI I DD | I Boom | requirements for PDSCH | |
| | | | Mapping Type A and LTE-NR | |
| | | | coexistence | |
| | FR1 FDD | PDSCH | 5.2.3.1.4 Minimum | |
| | | | requirements for PDSCH Mapping Type A and LTE-NR | |
| | | | coexistence | |
| Supported max number of | FR1 FDD | PDSCH | 5.2.2.1.4 Minimum | The requirements |
| ports across all configured | and TDD | | requirements for PDSCH | apply only in case |
| NZP-CSI-RS resources per CC | | | Mapping Type A and LTE-NR | the number of NZP- |
| (maxConfigNumberPortsAcros sNZP-CSI-RS-PerCC) | | | coexistence (Test 1-1, 1-2) | CSI-RS ports in the test case does not |
| 61121 661 161 61 61 61 61 | | | 5.2.3.1.1 Minimum | exceed UE maximum |
| | | | requirements for PDSCH | number of NZP-CSI- |
| | | | Mapping Type A (Test 3-1, 4- | RS ports capability |
| | | | 1, 5-1) | |
| | | | 5.2.3.1.4 Minimum | |
| | | | requirements for PDSCH | |
| | | | Mapping Type A and LTE-NR | |
| | | | coexistence (Test 1-1, 1-2) | |
| | | | 5.2.3.2.1 Minimum | |
| | | | requirements for PDSCH | |
| | | | Mapping Type A (Test 3-1, 4- | |
| | | | 1, 5-1) | |
| Supported maximum number of | FR1 FDD | PDSCH | 5 2 3 1 1 Minimum | The requirements |
| Supported maximum number of PDSCH MIMO layers | FRIFUU | FDOCE | 5.2.3.1.1 Minimum requirements for PDSCH | The requirements apply only in case |
| (maxNumberMIMO- | | | Mapping Type A (Test 2-1, 2- | the PDSCH MIMO |
| LayersPDSCH) | | | 2, 3-1, 4-1) | rank in the test case |
| | FR1 TDD | PDSCH | 5.2.3.2.1 Minimum | does not exceed UE |
| | | | requirements for PDSCH | PDSCH MIMO layers capability |
| | | | Mapping Type A (Test 2-1, 2-2, 3-1, 4-1) | σαμαυπιτή |
| | l . | L | , U | <u> </u> |

5.2 PDSCH demodulation requirements

The parameters specified in Table 5.2-1 are valid for all PDSCH tests unless otherwise stated.

Table 5.2-1: Common test parameters

| | Parameter | Unit | Value |
|-------------------------------|--|---------|--|
| PDSCH transmission | | | Transmission scheme 1 |
| Carrier | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 |
| configuration | Subcarrier spacing | kHz | 15 or 30 |
| | Cyclic prefix | | Normal |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Common serving | Physical Cell ID | | 0 |
| cell parameters | SSB position in burst | | First SSB in Slot #0 |
| | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | Symbols | 0, 1 |
| PDCCH | Number of PRBs in CORESET | | Table 5.2-2 for tested channel bandwidth and subcarrier spacing |
| configuration | Number of PDCCH candidates and aggregation levels | | 1/AL8 |
| | CCE-to-REG mapping type | | Non-interleaved |
| | DCI format | | 1_1 |
| | TCI state | | TCI state #1 |
| Cross carrier schedu | | | Not configured |
| | First subcarrier index in the PRB used for CSI-RS | | k ₀ =0 for CSI-RS resource 1,2,3,4 |
| | First OFDM symbol in the PRB used for CSI-RS | | $I_0 = 6$ for CSI-RS resource 1 and 3 $I_0 = 10$ for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |
| | CDM Type | | 'No CDM' for CSI-RS resource 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| | CSI-RS offset | Slots | 15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4 |
| | Frequency Occupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | TCI state #0 |
| | First subcarrier index in the PRB used for CSI-RS | | k ₀ = 0 |
| | First OFDM symbol in the PRB used for CSI-RS | | I ₀ = 12 |
| | Number of CSI-RS ports (X) | | Same as number of transmit antenna |
| NZP CSI-RS for | СДМ Туре | | 'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna |
| CSI acquisition | Density (ρ) | | 1 |
| | CSI-RS periodicity | Slots | 15 kHz SCS: 20 30 kHz SCS: 40 |
| | CSI-RS offset | Slots | 0 |
| | Frequency Occupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | TCI state #1 |
| 7D 001 D0 for 001 | First subcarrier index in the PRB used for CSI-RS | | k ₀ = 4 |
| ZP CSI-RS for CSI acquisition | First OFDM symbol in the PRB used for CSI-RS | | I ₀ = 12 |
| | Number of CSI-RS ports (X) | | 4 |

| | CDM Type | | | 'FD-CDM2' |
|-------------------------------------|--------------------|-------------------------------|--------------|-------------------------------------|
| | Density (ρ) | | | 1 |
| | CSI-RS periodicity | | Slots | 15 kHz SCS: 20 |
| | | | | 30 kHz SCS: 40 |
| | CSI-RS offset | | Slots | 0 |
| | Frequency Occ | cupation | | Start PRB 0 |
| | Troquency Coc | - Apation | | Number of PRB = BWP size |
| | | | | {1000} for Rank 1 tests |
| | Antenna ports | indexes | | {1000, 1001} for Rank 2 tests |
| DD00H DMD0 | • | | | {1000-1002} for Rank 3 tests |
| PDSCH DMRS | Docition of the | first DMRS for PDSCH | | {1000-1003} for Rank 4 tests |
| configuration | mapping type A | | | 2 |
| | | SCH DMRS CDM group(s) | | 1 for Rank 1 and Rank 2 tests |
| | without data | BOTT DIVITED CDIVI group(3) | | 2 for Rank 3 and Rank 4 tests |
| | Type 1 QCL | SSB index | | SSB #0 |
| | information | QCL Type | | Type C |
| TCI state #0 | Type 2 QCL | SSB index | | N/A |
| | information | QCL Type | | N/A |
| | | | | CSI-RS resource 1 from 'CSI-RS for |
| | Type 1 QCL | CSI-RS resource | | tracking' configuration |
| TCI state #1 | information | QCL Type | | Type A |
| | Type 2 QCL | CSI-RS resource | | N/A |
| | information | QCL Type | | N/A |
| PT-RS configuration | | • | | PT-RS is not configured |
| Maximum number of | code block grou | os for ACK/NACK feedback | | 1 |
| Maximum number of HARQ transmission | | | 4 | |
| HARQ ACK/NACK bundling | | | Multiplexed | |
| Redundancy version coding sequence | | | | {0,2,3,1} |
| Precoding configurat | tion | | | SP Type I, Random per slot with PRB |
| | | | | bundling granularity |
| Symbols for all unus | | | L | OCNG Annex A.5 |
| I Note 1. LIE accum | nac that tha TCI c | tata tor the DDSCH is identic | ol to the TC | I state applied for the PDCCH |

UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH Note 1:

transmission.

Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested Note 2: channel bandwidth and subcarrier spacing.

Table 5.2-2: Number of PRBs in CORESET

| SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 100 MHz |
|--------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 216 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 102 | 132 | 162 | 216 | 270 |

5.2.1 1RX requirements

(Void)

5.2.2 2RX requirements

5.2.2.1 **FDD**

5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.2.1.1-3 and Table 5.2.2.1.1-4, with the addition of test parameters in Table 5.2.2.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

| Purpose | Test index |
|---|------------------------------|
| Verify the PDSCH mapping Type A normal performance | 1-1, 1-2, 1-3, 1-5, 2-1, 2-2 |
| under 2 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 2 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 3-1 |
| requirements for Enhanced Receiver Type 1 under 2 | |
| receive antenna conditions. | |

Table 5.2.2.1.1-2: Test parameters

| | Parameter | Unit | Value |
|--|---|-------|--------------------------------------|
| Duplex mode | | | FDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| | PRB bundling type | | Static |
| | DDD hundling size | | 4 for Test 1-1 |
| PDSCH | PRB bundling size | | 2 for other tests |
| configuration | | | Test 1-2: Type 1 with start RB = 23, |
| | Resource allocation type | | $L_{RBs} = 6$ |
| | | | Other tests: Type 0 |
| | RBG size | | Test 1-2: N/A |
| | NDG Size | | Other tests: Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size | | IV/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 2 for Tests 1-1, 1-5 |
| configuration | | | 1 for other tests |
| Comiguration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | | | Test 1-5: |
| | CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| | Col-Ro periodicity | 31013 | Other tests: Table 5.2-1. |
| CSI-RS for tracking | | | Test 1-5: |
| oo. No for tracking | | | 1 for CSI-RS resource 1 and 2 |
| | CSI-RS offset | Slots | 2 for CSI-RS resource 3 and 4. |
| | | Cioto | 2 for our five resource o and fi |
| | | | Other tests: Table 5.2-1. |
| | | | 8 for Test 1-4 |
| Number of HARQ Pro | ocesses | | 4 for other tests |
| The number of slots I ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.2.1.1-3: Minimum performance for Rank 1

| | | Bandwidth | | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | -0.8 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x2, ULA Low | 70 | 0.2 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x2, ULA Low | 70 | 24.6 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 30 | 1.1 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x2 | 70 | 6.2 |

Table 5.2.2.1.1-4: Minimum performance for Rank 2

| | | Bandwidth | | | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|--|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) | |
| 2-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.4 | |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.7 | |

Table 5.2.2.1.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

| | | Bandwidth | | | Correlation Reference value | | alue |
|--------------|----------------------|---|---------------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 3-1 | R.PDSCH.1-2.2 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Medium | 70 | 17.6 |

5.2.2.1.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.2.1.2-3, with the addition of test parameters in table 5.2.2.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.2-1.

Table 5.2.2.1.2-1: Tests purpose

| Purpose | Test index |
|--|------------|
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.2.1.2-2: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|-------|-------------------------------------|
| Duplex mode | | | FDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size | | IN/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | OFDM symbols in the PRB used for CSI- | | |
| NZP CSI-RS for | RS | | $I_0 = 13$ |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| | Subcarrier index in the PRB used for CSI- | | (l. l. l. l.) (2.4.6.0) |
| ZP CSI-RS for CSI acquisition | RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Pr | ocesses | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.2.1.2-3: Minimum performance for Rank 2

| Ī | | | Bandwidth | | | Correlation | Reference value | |
|---|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| | Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| | 1-1 | R.PDSCH.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300- 100 | 2x2, ULA Low | 70 | 14.8 |

5.2.2.1.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.2.1.3-3, with the addition of test parameters in Table 5.2.2.1.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.3-1.

Table 5.2.2.1.3-1: Tests purpose

| Purpose | Test index |
|---|------------|
| Verify PDSCH mapping Type B performance under 2 | 1-1 |
| receive antenna conditions | |

Table 5.2.2.1.3-2: Test parameters

| | Parameter | Unit | Value |
|--|---|------|-----------------|
| Duplex mode | | | FDD |
| Active DL BWP inde | X | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Pr | ocesses | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.2.1.3-3: Minimum performance for Rank 1

| | Bandwidth | | | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.4 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |

5.2.2.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.2.1.4-3, with the addition of test parameters in Table 5.2.2.1.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.4-1.

Table 5.2.2.1.4-1: Tests purpose

| Purpose | Test index |
|---|------------|
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

Table 5.2.2.1.4-2: Test parameters

| Parameter | | | Value |
|--|---|-----|---|
| Duplex mode | | | FDD |
| Active DL BWP index | | | 1 |
| NR UL transmission | with a 7.5 kHz shift to the LTE raster | | true |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 3 |
| | Length (L) | | 9 for Test 1-1 11 for Test 1-2 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| DD0011 D14D0 | Position of the first DM-RS for downlink | | 3 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| CRS for rate | LTE carrier centre subcarrier location | | Same as NR carrier centre subcarrier location |
| 0.10.101 | LTE carrier BW | MHz | 10 |
| matching (Note 1) | Number of antenna ports | | 4 |
| | v-shift | | 0 |
| Number of HARQ Processes | | | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | 2 |
| | N is configured on LTE carrier | I | |

Table 5.2.2.1.4-3: Minimum performance for Rank 1

| | Bandwidth | | | | Reference value | | |
|--------------|----------------------|---|---------------------------------------|-----------------------|---|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-7.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x2, ULA Low | 70 | -1.0 |
| 1-2 | R.PDSCH.1-7.2 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x2, ULA Low | 70 | -1.0 |

5.2.2.2 TDD

5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.2.2.1-3 and Table 5.2.2.2.1-4, with the addition of test parameters in Table 5.2.2.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.1-1.

Table 5.2.2.2.1-1: Tests purpose

| Purpose | Test index |
|---|--|
| Verify the PDSCH mapping Type A normal performance | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 2-1, 2-2 |
| under 2 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 2 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 3-1 |
| requirements for Enhanced Receiver Type 1 under 2 | |
| receive antenna conditions. | |

Table 5.2.2.2.1-2: Test parameters

| Parameter | | | Value |
|--|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | X | | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | Specific to each Reference channel |
| | PDSCH aggregation factor | | 1 |
| | PRB bundling type | | Static |
| PDSCH configuration | PRB bundling size | | 4 for Tests 1-1, 1-8, 1-9 2 for other tests |
| | Resource allocation type | | Test 1-2: Type 1 with start RB = 50, L _{RBs} = 6 Other tests: Type 0 |
| | RBG size | | Test 1-2: N/A Other tests: Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| PDSCH DMRS | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | First OFDM symbol in the PRB used for CSI-RS | | Tests 1-8, 1-9: $l_0 = 4$ for CSI-RS resource 1 and 3 $l_0 = 8$ for CSI-RS resource 2 and 4 |
| | | | Other tests; Table 5.2-1. |
| | CSI-RS periodicity | Slots | Test 1-7: 20 for CSI-RS resource 1,2,3,4. |
| | | | Other tests: Table 5.2-1. |
| CSI-RS for tracking | CSI-RS offset | Slots | Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| | | | Other tests: Table 5.2-1. |
| | Frequency Occupation | | Test 1-7: Start PRB 0 Number of PRB = 52 |
| | | | Other tests: Table 5.2-1. |
| Number of HARQ Processes | | | 16 for Test 1-4 10 for Test 1-9 8 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.2.2.1-3: Minimum performance for Rank 1

| | | Bandwidth | | | | Correlation | Reference | value |
|--------------|------------------------|---|---------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2- 1.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100- 400 | 2x2, ULA Low | 70 | -1.1 |
| 1-2 | R.PDSCH.2- 1.2 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1 | TDLC300- 100 | 2x2, ULA Low | 70 | 0.2 |
| 1-3 | R.PDSCH.2- 4.1 TDD | 40 / 30 | 256QAM, 0.82 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 25.3 |
| 1-4 | R.PDSCH.2- 2.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300- 100 | 2x2, ULA Low | 30 | 1.6 |
| 1-5 | R.PDSCH.2- 5.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-2 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |
| 1-6 | R.PDSCH.2- 6.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-3 | TDLA30-10 | 2x2, ULA Low | 70 | -0.8 |
| 1-7 | R.PDSCH.2- 10.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-1000 | 1x2 | 70 | 6.4 |
| 1-8 | R.PDSCH.2- 11.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-5 | TDLB100- 400 | 2x2, ULA Low | 70 | -1.0 |
| 1-9 | R.PDSCH.2- 12.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-6 | TDLB100- 400 | 2x2, ULA Low | 70 | -1.1 |

Table 5.2.2.2.1-4: Minimum performance for Rank 2

| | | Bandwidth | | | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------|-------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.2- 3.1 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30- 1 | TDLA30-10 | 2x2, ULA Low | 70 | 19.8 |
| 2-2 | R.PDSCH.2- 9.1 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30- 4 | TDLA30-10 | 2x2, ULA Low | 70 | 19.8 |

Table 5.2.2.2.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

| | | Bandwidth | Mandadatian | TDD III | | Correlation | Reference | value |
|--------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 3-1 | R.PDSCH.2- 2.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 2x2, ULA Medium | 70 | 18.0 |

5.2.2.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.2.2.2-3, with the addition of test parameters in Table 5.2.2.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.1.

Table 5.2.2.2-1: Tests purpose

| Purpose | Test index |
|--|------------|
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.2.2-2: Test parameters

| Parameter | | | Value |
|---|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | Specific to each Reference channel |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size | | • |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | I ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | (k ₀ , k ₁ , k ₂ , k ₃)=(2, 4, 6, 8) |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Processes | | | 8 |
| The number of slots between PDSCH and corresponding HARQ- | | | Specific to each TDD UL-DL pattern |
| ACK information | | | and as defined in Annex A.1.2 |

Table 5.2.2.2-3: Minimum performance for Rank 2

| | | Bandwidth | Madulation | TDD III | | Correlation | Reference v | /alue |
|--------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2- 7.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300- 100 | 2x2, ULA Low | 70 | 14.8 |

5.2.2.2.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.2.2.3-3, with the addition of test parameters in Table 5.2.2.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.3-1.

Table 5.2.2.2.3-1: Tests purpose

| Purpose | Test index |
|---|------------|
| Verify PDSCH mapping Type B performance under 2 | 1-1 |
| receive antenna conditions | |

Table 5.2.2.3-2: Test parameters

| Parameter | | Unit | Value |
|--|---|------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Pr | rocesses | | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.2.3-3: Minimum performance for Rank 1

| | | Bandwidth | | | | Correlation matrix and antenna configuration | Reference value | |
|--------------|-----------------------|---|---------------------------------|-------------------------|-----------------------|---|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2- 1.3 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 1 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |

5.2.3 4RX requirements

5.2.3.1 FDD

5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.1.1-3, Table 5.2.3.1.1-4, Table 5.2.3.1.1-5 and Table 5.2.3.1.1-6, with the addition of test parameters in Table 5.2.3.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

| Purpose | Test index |
|---|--|
| Verify the PDSCH mapping Type A normal performance | 1-1, 1-2, 1-3, 1-5, 2-1, 2-2, 3-1, 4-1 |
| under 4 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 4 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 5-1 |
| requirements for Enhanced Receiver Type 1 under 4 | |
| receive antenna conditions. | |

Table 5.2.3.1.1-2: Test parameters

| Parameter | | | Value | |
|--|---|-------|--|--|
| Duplex mode | | | FDD | |
| Active DL BWP index | | | 1 | |
| | Mapping type | | Type A | |
| | k0 | | 0 | |
| | Starting symbol (S) | | 2 | |
| | Length (L) | | 12 | |
| | PDSCH aggregation factor | | 1 | |
| | PRB bundling type | | Static | |
| PDSCH configuration | PRB bundling size | | 4 for Test 1-1 WB for Test 3-1 2 for other tests | |
| | Resource allocation type | | Test 1-2: Type 1 with start RB = 50, $L_{RBs} = 6$ Other test: Type 0 | |
| | RBG size | | Test 1-2: N/A Other tests: Config2 | |
| | VRB-to-PRB mapping type | | Non-interleaved | |
| | VRB-to-PRB mapping interleaver bundle size | | N/A | |
| | DMRS Type | | Type 1 | |
| PDSCH DMRS | Number of additional DMRS | | 2 for Test 1-1, 1-5 1 for other tests | |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 | |
| | CSI-RS periodicity | Slots | Test 1-5: 10 for CSI-RS resource 1,2,3,4. | |
| CSI-RS for tracking | CSI-RS offset | Slots | Other tests: Table 5.2-1. Test 1-5: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1. | |
| Number of HARQ Processes | | | 8 for Test 1-4, 2-1 4 for other tests | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | 2 | |

Table 5.2.3.1.1-3: Minimum performance for Rank 1

| | | Bandwidth | | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x4, ULA Low | 70 | -3.5 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x4, ULA Low | 70 | -2.9 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x4, ULA Low | 70 | 21.0 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 30 | -1.5 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x4 | 70 | 3.3 |

Table 5.2.3.1.1-4: Minimum performance for Rank 2

| | Bandwidth Madulation | | | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.1-3.1 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.5 |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.7 |

Table 5.2.3.1.1-5: Minimum performance for Rank 3

| | | Bandwidth (MHz) / | Modulation | Propagation | Correlation | Reference value | | |
|--------------|----------------------|--------------------------------|---------------------------------------|-------------|--|---|-------------|--|
| Test num. | Reference channel | Subcarrier spacing (kHz) | Modulation format and code rate | | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) | |
| 3-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 11.0 | |

Table 5.2.3.1.1-6: Minimum performance for Rank 4

| | | Bandwidth | Madulation | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 4-1 | R.PDSCH.1-2.4 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 15.6 |

Table 5.2.3.1.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

| | | Bandwidth | Madulation | | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|--|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) | |
| 5-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Medium A | 70 | 22.3 | |

5.2.3.1.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.3.1.2-3, with the addition of test parameters in table 5.2.3.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.2-1.

Table 5.2.3.1.2-1: Tests purpose

| Purpose | Test index |
|--|------------|
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.3.1.2-2: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|-------|-------------------------------------|
| Duplex mode | | | FDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size | | · |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Pr | ocesses | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.3.1.2-3: Minimum performance for Rank 2

| Test | Reference | Bandwidth (MHz) / Subcarrier spacing | Modulation format and | Propagation condition | Correlation matrix and antenna configuration | Reference va | llue |
|------|----------------------|---|-----------------------|-----------------------|---|------------------------------------|-------------|
| num. | channel | (kHz) | code rate | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300- 100 | 4x4, ULA Low | 70 | 9.1 |

5.2.3.1.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.3.1.3-3, with the addition of test parameters in Table 5.2.3.1.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.3-1.

Table 5.2.3.1.3-1: Tests purpose

| Purpose | Test index |
|--|------------|
| PDSCH mapping Type B performance under 4 receive | 1-1 |
| antenna conditions | |

Table 5.2.3.1.3-2: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|------|-----------------|
| Duplex mode | | | FDD |
| Active DL BWP index | | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Pr | ocesses | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.3.1.3-3: Minimum performance for Rank 1

| | | Bandwidth | Madadatian | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.4 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x4, ULA Low | 70 | -3.8 |

5.2.3.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.3.1.4-3, with the addition of test parameters in Table 5.2.3.1.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

| Purpose | Test index |
|---|------------|
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions with CRS rate | 1-1, 1-2 |
| matching configured | |

Table 5.2.3.1.4-2: Test parameters

| | Parameter | Unit | Value | | | | |
|--|---|------|---|--|--|--|--|
| Duplex mode | | | FDD | | | | |
| Active DL BWP index | (| | 1 | | | | |
| NR UL transmission | with a 7.5 kHz shift to the LTE raster | | true | | | | |
| | Mapping type | | Type A | | | | |
| | k0 | | 0 | | | | |
| | Starting symbol (S) | | 3 | | | | |
| | Length (L) | | 9 for Test 1-1 11 for Test 1-2 | | | | |
| DDCCH | PDSCH aggregation factor | | 1 | | | | |
| PDSCH | PRB bundling type | | Static | | | | |
| configuration | PRB bundling size | | 2 | | | | |
| | Resource allocation type | | Type 0 | | | | |
| | RBG size | | Config2 | | | | |
| | VRB-to-PRB mapping type | | Non-interleaved | | | | |
| | VRB-to-PRB mapping interleaver bundle size | | N/A | | | | |
| | DMRS Type | | Type 1 | | | | |
| PDSCH DMRS | Position of the first DM-RS for downlink | | 3 | | | | |
| configuration | Number of additional DMRS | | 1 | | | | |
| Comgulation | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 | | | | |
| 000 for and | LTE carrier centre subcarrier location | | Same as NR carrier centre subcarrier location | | | | |
| CRS for rate | LTE carrier BW | MHz | 10 | | | | |
| matching (Note 1) | Number of antenna ports | | 4 | | | | |
| | v-shift | | 0 | | | | |
| Number of HARQ Pro | | | 4 | | | | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | 2 | | | | |
| Note 1: No MBSFN is configured on LTE carrier | | | | | | | |

Table 5.2.3.1.4-3: Minimum performance for Rank 1

| | | Bandwidth (MHz) / | Modulation | | Correlation | Reference value | |
|--------------|----------------------|--------------------------------|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-7.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x4, ULA Low | 70 | -4.0 |
| 1-2 | R.PDSCH.1-7.2 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x4, ULA Low | 70 | -4.0 |

5.2.3.2 TDD

5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.2.1-3, Table 5.2.3.2.1-4, Table 5.2.3.2.1-5 and Table 5.2.3.2.1-6, with the addition of test parameters in Table 5.2.3.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.1-1.

Table 5.2.3.2.1-1: Tests purpose

| Purpose | Test index |
|--|--|
| Verify the PDSCH mapping Type A normal performance | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 2-1, 2-2, 3-1, 4-1 |
| under4 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 4 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 5-1 |
| requirements for Enhanced Receiver Type 1 under 4 | |
| receive antenna conditions. | |

Table 5.2.3.2.1-2: Test parameters

| | Parameter | Unit | Value |
|---------------------|---|-------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | Specific to each Reference channel |
| | PDSCH aggregation factor | | 1 |
| | PRB bundling type | | Static |
| PDSCH configuration | PRB bundling size | | 4 for Tests 1-1, 1-8, 1-9 WB for Test 3-1 2 for other tests |
| Comiguration | Resource allocation type | | Test 1-2: Type 1 with start RB = 50, L _{RBs} = 6 Other tests: Type 0 |
| | RBG size | | Test 1-2: N/A Other tests: Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | First OFDM symbol in the PRB used for CSI-RS | | Tests 1-8, 1-9: l ₀ = 4 for CSI-RS resource 1 and 3 l ₀ = 8 for CSI-RS resource 2 and 4 Other tests; Table 5.2-1. |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-7: 20 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1. |
| | CSI-RS offset | Slots | Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1. |

| Frequency Occupation | Test 1-7: Start PRB 0 Number of PRB = 52 Other tests: Table 5.2-1. |
|--|--|
| Number of HARQ Processes | 16 for Test 1-4 8 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.3.2.1-3: Minimum performance for Rank 1

| | | Bandwidth | | | | Correlation | Reference | value |
|--------------|------------------------|---|---------------------------------------|-------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2- 1.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 1A | TDLB100- 400 | 2x4, ULA Low | 70 | -4.1 |
| 1-2 | R.PDSCH.2- 1.2 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 1 | TDLC300- 100 | 2x4, ULA Low | 70 | -2.7 |
| 1-3 | R.PDSCH.2- 4.1 TDD | 40 / 30 | 256QAM, 0.82 | FR1.30- 1 | TDLA30-10 | 2x4, ULA Low | 70 | 21.6 |
| 1-4 | R.PDSCH.2- 2.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30- 1 | TDLC300- 100 | 2x4, ULA Low | 30 | -1.2 |
| 1-5 | R.PDSCH.2- 5.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 2 | TDLA30-10 | 2x4, ULA Low | 70 | -3.8 |
| 1-6 | R.PDSCH.2- 6.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 3 | TDLA30-10 | 2x4, ULA Low | 70 | -3.6 |
| 1-7 | R.PDSCH.2- 10.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30- 1 | HST-1000 | 1x4 | 70 | 3.4 |
| 1-8 | R.PDSCH.2- 11.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 5 | TDLB100- 400 | 2x4, ULA Low | 70 | -4.0 |
| 1-9 | R.PDSCH.2- 12.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 6 | TDLB100- 400 | 2x4, ULA Low | 70 | -4.0 |

Table 5.2.3.2.1-4: Minimum performance for Rank 2

| Test | Reference | Bandwidth (MHz) / Subcarrier spacing | Modulation | Propagation condition | Correlation matrix and antenna configuration | Reference va | ilue |
|------|----------------------|---|----------------------|-----------------------|---|---|-------------|
| num. | channel | (kHz) | format and code rate | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300- 100 | 2x4, ULA Low | 70 | 9.1 |

Table 5.2.3.2.1-5: Minimum performance for Rank 3

| | | Bandwidth | | | | | Correlation | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------|-----------------------|-----------------------|----------------------------------|------------------------------------|-------------|-------------|-----------------|--|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) | | | |
| 3-1 | R.PDSCH.2- 2.3 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 11.1 | | | |

Table 5.2.3.2.1-6: Minimum performance for Rank 4

| | | | Bandwidth | | TDD | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|---|------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|---|------------------------------------|-------------|
| | est um. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | | | Fraction of maximum throughput (%) | SNR (dB) |
| 4 | I-1 | R.PDSCH.2- 2.4 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30- 1 | TDLA30-10 | 4x4, ULA Low | 70 | 15.4 |

Table 5.2.3.2.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

| | | Bandwidth | Mandadatian | TDD.!!! | Correlation | Reference | value | |
|--------------|-----------------------|---|---------------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 5-1 | R.PDSCH.2- 2.3 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Medium A | 70 | 22.9 |

5.2.3.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.3.2.2-3, with the addition of test parameters in table 5.2.3.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Tests purpose

| Purpose | Test index |
|--|------------|
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.3.2.2-2: Test parameters

| | Parameter | Unit | Value |
|--|---|-------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Processes | | | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.3.2.2-3: Minimum performance for Rank 2

| | | Bandwidth | Madulation | TDD III | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2- 7.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300- 100 | 2x4, ULA Low | 70 | 9.0 |

5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.3.2.3-3, with the addition of test parameters in Table 5.2.3.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.3-1.

Table 5.2.3.2.3-1: Tests purpose

| Purpose | Test index |
|---|------------|
| PDSCH mapping Type B performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.2.3-2: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|------|---|
| Duplex mode | | | TDD |
| Active DL BWP inde | X | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Pr | rocesses | | 8 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.3.2.3-3: Minimum performance for Rank 1

| | | Bandwidth | | | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH,2- 1.3 TDD | 40 / 30 | QPSK, 0.30 | FR1.30- 1 | TDLA30-10 | 2x4, ULA Low | 70 | -3.9 |

5.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 5.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 5.3-1: Common test Parameters

| | Paramete | Unit | Value | |
|-------------------|------------------------------|---|-------|---|
| Carrier | Offset between | en Point A and the | | 0 |
| configuration | lowest usab | le subcarrier on this | | |
| | carrier (Note | | | |
| DL BWP | Cyclic prefix | | | Normal |
| configuration #1 | RB offset | | RBs | 0 |
| Common | Physical Ce | | | 0 |
| serving cell | SSB position | | | 1 |
| parameters | SSB periodi | | ms | 20 Fach slat |
| | | CCH monitoring PDCCH candidates | | Each slot |
| PDCCH | | | | Start from RB = 0 |
| configuration | | lomain resource r CORESET | | with contiguous RB allocation |
| | TCI state | | | TCI state #1 |
| | First subcari used for CS | rier index in the PRB I-RS (k_0) | | 0 |
| | | | | CSI-RS resource 1: |
| | First OFDM used for CS | symbol in the PRB | | CSI-RS resource 2: 8 CSI-RS resource 3: |
| | used for CS | I-N3 (10) | | CSI-RS resource 3: |
| | Number of C | CSI-RS ports (X) | | 8 1 |
| | CDM Type | oorno porto (x) | | No CDM |
| | Density (ρ) | | | 3 |
| | | 1: -: | 01-4- | 15 kHz SCS: 20 |
| CSI-RS for | CSI-RS peri | odicity | Slots | 30 kHz SCS: 40 |
| tracking | | | | 15 kHz SCS: |
| | | | | 10 for CSI-RS |
| | | | | resource 1 and 2 11 for CSI-RS |
| | | | | resource 3 and 4 |
| | CSI-RS offs | et | Slots | resource 5 and 4 |
| | | • | 0.010 | 30 kHz SCS: |
| | | | | 20 for CSI-RS |
| | | | | resource 1 and 2 |
| | | | | 21 for CSI-RS |
| | | | | resource 3 and 4 |
| | Frequency (| Occupation | | Start PRB 0 Number of PRB = |
| | 1 requeries c | occupation | | BWP size |
| | QCL info | | | TCI state #0 |
| | Type 1 | SSB index | | SSB #0 |
| | QCL | QCL Type | | Type C |
| TCI state #0 | information Type 2 | SSB index | | SSB #0 |
| | QCL | | | |
| | information | QCL Type | | Type D |
| | Type 1 | | | CSI-RS resource 1 from 'CSI-RS for |
| | Type 1 QCL | CSI-RS resource | | tracking' |
| | information | | | configuration |
| TOI -1 1 "1 | | QCL Type | 1 | Type A |
| TCI state #1 | | , | | CSI-RS resource 1 |
| | Type 2 | CSI-RS resource | | from 'CSI-RS for |
| | QCL | COLING TODOGRADO | | tracking' |
| | information | OCL Turns | + | configuration |
| | L | QCL Type | | Type D SP Type I, Random |
| | | | | per slot with REG |
| Precoding config | uration | | | bundling granularity |
| | | | | for number of Tx |
| Owner had to " | | | | larger than 1 |
| Symbols for all u | nused REs | | | OCNG in Annex A.5 |

Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.

5.3.1 1RX requirements

(Void)

5.3.2 2RX requirements

5.3.2.1 FDD

The parameters specified in Table 5.3.2.1-1 are valid for all FDD tests unless otherwise stated.

Table 5.3.2.1-1: Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna |
|-------------------------|------|--------------|--------------|
| CCE to REG mapping type | | nonInter | leaved |
| REG bundle size | | 6 | |
| Shift index | | 0 | |

5.3.2.1.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.1-1: Minimum performance for PDCCH with 15 kHz SCS

| | | CORES | | | Antenna | Reference | value | | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 1x2 Low | 1 | 8.1 |
| 2 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.3 FDD | TDLC300- 100 | 1x2 Low | 1 | 8.2 |
| 3 | 10 | 48 | 2 | 4 | R.PDCCH. 1-2.4 FDD | TDLA30-10 | 1x2 Low | 1 | 5.5 |
| 4 | 10 | 48 | 1 | 4 | R.PDCCH. 1-1.1 FDD | TDLA30-10 | 1x2 Low | 1 | 4.4 |
| 5 | 10 | 48 | 2 | 16 | R.PDCCH. 1-2.6 FDD | TDLA30-10 | 1x2 Low | 1 | -2.1 |

5.3.2.1.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.2-1: Minimum performance for PDCCH with 15 kHz SCS

| | | . CORES | | | Antenna | Reference value | | | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 4 | R.PDCCH. | TDLC300- | 2x2 Low | 1 | 2.0 |
| | | | | | 1-2.2 FDD | 100 | | | |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. | TDLC300- | 2x2 Low | 1 | -1.3 |
| | | | | | 1-2.5 FDD | 100 | | | |
| 3 | 10 | 48 | 1 | 8 | R.PDCCH. | TDLA30-10 | 2x2 Low | 1 | -0.2 |
| | | | | | 1-1.3 FDD | | | | |

5.3.2.2 TDD

The parameters specified in Table 5.3.2.2-1 are valid for all TDD tests unless otherwise stated.

Table 5.3.2.2-1: Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna |
|-------------------------|------|--|--------------|
| TDD UL-DL pattern | | FR1. | 30-1 |
| CCE to REG mapping type | | Test 3: non- interleaved Other tests: interleaved | interleaved |
| Interleaver size | | 3 | |
| REG bundle size | | Test 3: 6 Other tests: 2 | 6 |
| Shift Index | | 0 | |

5.3.2.2.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.1-1: Minimum performance for PDCCH with 30 kHz SCS

| | | | CORES | | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 102 | 1 | 2 | R.PDCCH. 2-1.1 TDD | TDLA30-10 | 1x2 Low | 1 | 7.0 |
| 2 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300- 100 | 1x2 Low | 1 | 3.0 |
| 3 | 40 | 48 | 2 | 16 | R.PDCCH. 2-2.1 TDD | TDLC300- 100 | 1x2 Low | 1 | -3.8 |

5.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.2-1: Minimum performance for PDCCH with 30 kHz SCS

| | | | CORES | CORES | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 TDD | TDLC300- 100 | 2x2 Low | 1 | -1.2 |

5.3.3 4RX requirements

5.3.3.1 FDD

The parameters specified in Table 5.3.3.1-1 are valid for all FDD tests unless otherwise stated.

Table 5.3.3.1-1: Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna |
|-------------------------|------|--------------|--------------|
| CCE to REG mapping type | | nonInter | leaved |
| REG bundle size | | 6 | |
| Shift index | | 0 | |

5.3.3.1.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.1.1-1: Minimum performance for PDCCH with 15 kHz SCS

| | | | CORES | ORFS | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 1x4 Low | 1 | 2.2 |
| 2 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.3 FDD | TDLC300- 100 | 1x4 Low | 1 | 2.7 |
| 3 | 10 | 48 | 2 | 4 | R.PDCCH. 1-2.4 FDD | TDLA30-10 | 1x4 Low | 1 | 0.2 |
| 4 | 10 | 48 | 1 | 4 | R.PDCCH. 1-1.1 FDD | TDLA30-10 | 1x4 Low | 1 | -0.4 |
| 5 | 10 | 48 | 2 | 16 | R.PDCCH. 1-2.6 FDD | TDLA30-10 | 1x4 Medium A | 1 | -3.2 |

5.3.3.1.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.1.2-1: Minimum performance for PDCCH with 15 kHz SCS

| | | | CORES | | | | Antenna | Reference value | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|----------------------|--------------------------|---|-----------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 4 | R.PDCCH. | TDLC300- | 2x4 Low | 1 | -1.9 |
| | | | | | 1-2.2 FDD | 100 | | | |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. | TDLC300- | 2x4 Low | 1 | -4.5 |
| | | | | | 1-2.5 FDD | 100 | | | |
| 3 | 10 | 48 | 1 | 4 | R.PDCCH. | TDLA30-10 | 2x4 Low | 1 | -1.0 |
| | | | | | 1-1.3 FDD | | | | |

5.3.3.2 TDD

The parameters specified in Table 5.3.3.2-1 are valid for all TDD tests unless otherwise stated.

Table 5.3.3.2-1: Common Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna |
|-------------------------|------|--|--------------|
| TDD UL-DL pattern | | FR1. | 30-1 |
| CCE to REG mapping type | | Test 3: Non- interleaved Other tests: interleaved | interleaved |
| Interleaver size | | 3 | |
| REG bundle size | | Test 3: 6 Other tests: 2 | 6 |
| Shift Index | | C | |

5.3.3.2.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.1-1: Minimum performance for PDCCH with 30 kHz SCS

| | | | CORES | | | | Antenna | Reference | Reference value | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-----------------|--|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) | |
| 1 | 40 | 102 | 1 | 2 | R.PDCCH. 2-1.1 TDD | TDLA30-10 | 1x4 Low | 1 | 2.1 | |
| 2 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300- 100 | 1x4 Low | 1 | -0.9 | |
| 3 | 40 | 48 | 2 | 16 | R.PDCCH. 2-2.1 TDD | TDLA30-10 | 1x4 Medium A | 1 | -3.6 | |

5.3.3.2.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.2-1: Minimum performance for PDCCH with 30 kHz SCS

| | | | CORES | | | | Antenna | Reference value | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|----------------------|--------------------------|---|-----------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 | TDLC300- 100 | 2x4 Low | 1 | -4.3 |

5.4 PBCH demodulation requirements

The receiver characteristics of PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$Pm - bch = 1 - \frac{A}{B}$$

Where A is the number of correctly decoded MIB PDUs and B is the number of transmitted MIB PDUs. The Pm-bch is derived with the assumption UE combines the PBCH symbols of the same SS/PBCH block index within the MIB TTI (80ms).

5.4.1 1RX requirements

(Void)

5.4.2 2RX requirements

5.4.2.1 FDD

Table 5.4.2.1-1: Test parameters for PBCH

| Parameter | Unit | Single antenna port |
|---|------|---------------------|
| Physical Cell ID | | 0 |
| Cyclic prefix | | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity | | 1 |
| SS/PBCH block index Note1 | | 0 |
| SS/PBCH block periodicity | ms | 20 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | |

For the parameters specified in Table 5.4.2.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.1-2 in case SS/PBCH block index is not known and below the specifies values in Table.5.4.2.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | | |
|----------------|---|-------------------|-----------------------|--|-----------------|-------------|--|
| | (kHz) | | | | Pm- bch | SNR (dB) | |
| | | | | | (%) | , , | |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -6.7 | |

Table 5.4.2.1-3 Minimum performance PBCH in case SS/PBCH block index is known

| Test | Bandwidth (MHz) / | Reference | Propagation | Antenna configuration | Referen | ce value |
|--------|-----------------------------|-----------|-------------|------------------------|-------------------|-------------|
| number | Subcarrier spacing (kHz) | channel | condition | and correlation matrix | Pm- bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -8.3 |

5.4.2.2 TDD

Table 5.4.2.2-1: Test parameters for PBCH

| Parameter | Unit | Single antenna port |
|---|------|---------------------|
| Physical Cell ID | | 0 |
| Cyclic prefix | | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity | | 1 |
| SS/PBCH block index Note1 | | 0 |
| SS/PBCH block periodicity | ms | 20 |
| TDD UL-DL pattern | | FR1.30-1 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | • | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | |

For the parameters specified in Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

| | Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | ence lue |
|---|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | | (kHz) | | | | Pm- bch (%) | SNR (dB) |
| L | 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -5.3 |

Table 5.4.2.2-3 Minimum performance PBCH in case SS/BPCH block index is known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | |
|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | (kHz) | | | | Pm- bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -6.5 |

5.4.3 4RX requirements

5.4.3.1 FDD

Table 5.4.3.1-1: Test parameters for PBCH

| Parameter | Unit | Single antenna port |
|---|------|---------------------|
| Physical Cell ID | | 0 |
| Cyclic prefix | | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity | | 1 |
| SS/PBCH block index Note1 | | 0 |
| SS/PBCH block periodicity | ms | 20 |
| Note 1: as specified in clause 11.1 of TS 38.213 [11] | | |

For the parameters specified in Table 5.4.3.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.1-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | (kHz) | | | | Pm- bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -8.9 |

Table 5.4.3.1-3 Minimum performance PBCH in case SS/PBCH block index is known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | (kHz) | | | | Pm- bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -10.9 |

5.4.3.2 TDD

Table 5.4.3.2-1: Test parameters for PBCH

| Parameter | Unit | Single antenna port | | |
|---|------|---------------------|--|--|
| Physical Cell ID | | 0 | | |
| Cyclic prefix | | Normal | | |
| Number of SS/PBCH blocks within an SS burst set periodicity | | 1 | | |
| SS/PBCH block index Note1 | | 0 | | |
| SS/PBCH block periodicity | ms | 20 | | |
| TDD UL-DL pattern | | FR1.30-1 | | |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | | | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | | | |

For the parameters specified in Table 5.4.3.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.2-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
|----------------|---|-------------------|-----------------------|--|-----------------|------|
| | (kHz) | | | | Pm- | SNR |
| | | | | | bch | (dB) |
| | | | | | (%) | , , |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -8.6 |

Table 5.4.3.2-3: Minimum performance PBCH in case SS/BPCH block index is known

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
|-------------|---|-------------------|-----------------------|--|-----------------|-------------|
| | (kHz) | | | | Pm- bch | SNR (dB) |
| | | | | | (%) | |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -9.6 |

5.5 Sustained downlink data rate provided by lower layers

5.5.1 FR1 single carrier requirements

The requirements in this clause are applicable to the FR1 single carrier case.

The requirements and procedure defined in Clause 5.5A.1 apply using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

5.5A Sustained downlink data rate provided by lower layers

5.5A.1 FR1 CA requirements

< Editor's note: Open issues to be resolved:

Whether same requirements apply for FR1 DC>

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR1 CA.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Select one CA bandwidth combination among all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate in accordance with clause 4.1.2 of TS 38.306 [14].
 - Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.
- For each CC in CA bandwidth combination, use Table 5.5A-5 to determine MCS based on test parameters and indicated UE capabilities.

The TB success rate shall be higher than 85% when PDSCH is scheduled with MCS defined for the selected CA bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

The TB success rate is defined as $100\%*N_{DL_correct_rx}/(N_{DL_newtx} + N_{DL_retx})$, where N_{DL_newtx} is the number of newly transmitted DL transport blocks, N_{DL_retx} is the number of retransmitted DL transport blocks, and $N_{DL_correct_rx}$ is the number of correctly received DL transport blocks.

The common test parameters are specified in Table 5.5A-1. The parameters specified in Table 5.5A-2 are applicable for tests on FDD CCs and parameters specified in Table 5.5A-3 are applicable for tests on TDD CCs.

Unless otherwise stated, no user data is scheduled on slot #0, 10 and 11 within 20 ms for SCS 15 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 20 and 21 within 20 ms for SCS 30 kHz.

Table 5.5A-1: Common test parameters for FDD and TDD component carriers

| | Parameter | Unit | Value |
|-----------------------------|--|--------|--|
| PDSCH transmission | | - Cinc | Transmission scheme 1 |
| EPRE ratio of PTRS to PDSCH | | | N/A |
| Channel bandwidth | | | Channel bandwidth from selected CA |
| Chariner bandwidth | , | MHz | bandwidth combination |
| | Physical Cell ID | | 0 |
| Common serving | SSB position in burst | | First SSB in Slot #0 |
| cell parameters | SSB periodicity | ms | 20 |
| | First DMRS position for Type A PDSCH mapping | | 2 |
| Cross carrier schedu | | | Not configured |
| Active DL BWP index | | | 1 |
| Actual carrier | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 |
| configuration | Subcarrier spacing | kHz | 15 or 30 |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| | Subcarrier spacing | kHz | 15 or 30 |
| | Cyclic prefix | | Normal |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | | Symbols #0 |
| | Number of PRBs in CORESET | | Table 5.5A-4 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels | | 1/AL 1 for 30 kHz / 5 MHz 1/AL4 for 15 kHz / 5 MHz, 30 kHz / 10 MHz and 30 kHz / 15 MHz 1/AL 8 for other combinations |
| | CCE-to-REG mapping type | | Non-interleaved |
| | DCI format | | 1_1 |
| | TCI State | | TCI state #1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | WB |
| J | Resource allocation type | | Type 0 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 |
| | Length | | 1 |
| PDSCH DMRS configuration | Antenna ports indexes | | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs {1000 – 1003} for 4 Layers CCs |
| | Number of PDSCH DMRS CDM group(s) without data | | 1 for 1 layer and 2 layers CCs 2 for 4 Layers CCs |
| PTRS configuration | without data | | PTRS is not configured |
| . The configuration | Subcarrier indexes in the PRB used for CSI-RS | | $k_0 = 3$ for CSI-RS resource 1,2,3,4 |
| | OFDM symbols in the PRB used for CSI- | | l ₀ = 6 for CSI-RS resource 1 and 3 |
| | RS Number of CSI-RS ports (X) | | l ₀ = 10 for CSI-RS resource 2 and 4 1 for CSI-RS resource 1,2,3,4 |
| CSI_DS for trooking | . , , | | |
| CSI-RS for tracking | CDM Type | | 'No CDM' for CSI-RS resource 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 15 kHz SCS: 20 for CSI-RS resource |
| | CSI-RS periodicity | Slots | 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| | · | | . ;=;=; |

| | T | | _ | |
|-------------------------|-----------------|-------------------------------|-------|--|
| | | | | 15 kHz SCS: 10 for CSI-RS resource 1 and 2 |
| | | | | 11 for CSI-RS resource 3 and 4 |
| | CSI-RS offset | t | Slots | |
| | | | | 30 kHz SCS: |
| | | | | 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4 |
| | | | | Start PRB 0 |
| | Frequency O | ccupation | | Number of PRB = BWP size |
| | QCL info | | | TCI state #0 |
| | CSI-RS | dexes in the PRB used for | | k ₀ = 4 |
| | OFDM symbo | ols in the PRB used for CSI- | | l ₀ = 12 |
| | | SI-RS ports (X) | | Same as number of transmit antenna |
| NZP CSI-RS for | CDM Type | | | 'FD-CDM2' |
| CSI acquisition | Density (ρ) | | | 1 |
| | CSI-RS perio | dicity | | 15 kHz SCS: 20 |
| | CSI-RS offset | - | | 30 kHz SCS: 40 0 |
| | | | | Start PRB 0 |
| | Frequency Od | ccupation | | Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| | Subcarrier inc | dexes in the PRB used for | | $k_0 = 0$ |
| | OFDM symbo | ols in the PRB used for CSI- | | I ₀ = 12 |
| | | SI-RS ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | | | 'FD-CDM2' |
| acquisition | Density (ρ) | | | 1 |
| | CSI-RS perio | dicity | | 15 kHz SCS: 20 30 kHz SCS: 40 |
| | CSI-RS offset | t | | 0 |
| | Frequency Oc | ccupation | | Start PRB 0 Number of PRB = BWP size |
| | Type 1 QCL | SSB index | | SSB #0 |
| TCI state #0 | information | QCL Type | | Type C |
| TOI State #0 | Type 2 QCL | SSB index | | N/A |
| | information | QCL Type | | N/A |
| | Type 1 QCL | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for |
| TCI state #1 | information | QCL Type | | tracking' configuration |
| TOI State #1 | Type 2 QCL | CSI-RS resource | | Type A N/A |
| | information | QCL Type | | N/A |
| Maximum number of | code block grou | ups for ACK/NACK feedback | | 1 |
| Maximum number of | | | | 4 |
| HARQ ACK/NACK bu | | | | Multiplexed |
| Redundancy version | | ce | | {0,2,3,1} |
| Precoding configuration | | | | SP Type I, Random per slot with PRB bundling granularity |
| Symbols for all unuse | ed REs | | | OCNG Annex A.5 |
| Propagation condition | | | | Static propagation condition No external noise sources are applied |
| | 1 layer CCs | | | 1x2 or 1x4 |
| Antenna | 2 layers CCs | | | 2x2 or 2x4 |
| configuration | 4 layers CCs | | | 4x4 |
| Note 1: UE assum | | I state applied for the PDCCH | | |

Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission

Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing

Table 5.5A-2: Additional test parameters for FDD CC

| Parameter | | | Value |
|--------------------------|---------------------|--|-------|
| Duplex mode | | | FDD |
| PDSCH | Starting symbol (S) | | 1 |
| configuration | Length (L) | | 13 |
| Number of HARQ Processes | | | 4 |
| K1 value | | | 2 |

Table 5.5A-3: Additional test parameters for TDD CC

| | Parameter | Unit | Value | |
|--|--------------------------|------|--------------------------------|--|
| Duplex mode | | | TDD | |
| PDSCH | Starting symbol (S) | | 1 | |
| configuration | Length (L) | | 13 | |
| Number of HARQ | Number of HARQ Processes | | 8 | |
| K1 value | | | Specific to each UL-DL pattern | |
| TDD III DI potto | TDD III DI nottorio | | 15 kHz SCS: FR1.15-1 | |
| TDD UL-DL pattern | | | 30 kHz SCS: FR1.30-1 | |
| Note 1: PDSCH is scheduled only on full DL slots | | | | |

Table 5.5A-4: Number of PRBs in CORESET

| SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 100MHz |
|--------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 216 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 102 | 132 | 162 | 216 | 270 |

Table 5.5A-5: MCS indexes for indicated UE capabilities

| 1 8 1 2 1 8 0.8 2 1 8 0.75 2 1 8 0.4 1 1 6 1 2 | 1 0 1 7 |
|--|------------------|
| 1 8 0.75 2 1 8 0.4 1 | 0 1 7 |
| 1 8 0.4 1 | 1 7 |
| | 7 |
| 1 6 1 2 | |
| | 3 |
| 1 6 0.8 2 | • |
| 1 6 0.75 2 | 2 |
| 1 6 0.4 1 | |
| 1 4 1 1 | 6 |
| 1 4 0.8 1 | |
| 1 4 0.75 1 | 6 |
| 1 4 0.4 1 | |
| 1 2 1 9 | |
| 1 2 0.8 9 | |
| 1 2 0.75 9 |) |
| 1 2 0.4 4 | |
| 2 8 1 2 | 6 |
| 2 8 0.8 2 | 1 |
| 2 8 0.75 2 | 0 |
| 2 8 0.4 1 | 1 |
| 2 6 1 2 | 7 |
| 2 6 0.8 2 | 3 |
| 2 6 0.75 2 | 2 |
| 2 6 0.4 1 | 4 |
| 2 4 1 1 | 6 |
| | 6 |
| 2 4 0.75 1 | 6 |
| 2 4 0.75 1 2 4 0.4 1 | |
| 2 2 1 9 |) |
| 2 2 0.8 9 | |
| 2 2 0.75 9 |) |
| 2 2 0.4 4 | |
| 4 8 1 2 | |
| 4 8 0.8 2 | |
| 4 8 0.75 2 | |
| 4 8 0.4 1 | |
| 4 6 1 2 | |
| 4 6 0.8 2 | |
| 4 6 0.75 2 | |
| 4 6 0.4 1 | |
| | 6 |
| | 6 |
| | 6 |
| 4 4 0.4 1 | |
| 4 2 1 9 | |
| 4 2 0.8 9 | |
| 4 2 0.75 9 | |
| 4 2 0.4 5 | |

Note 1: MCS Index for maximum modulation format 2,4 and 6 is based on MCS index table 1 defined in clause 5.1.3.1 of TS 38.214 [12]

Note 2: MCS Index for maximum modulation format 8 is based on MCS index table 2 defined in clause 5.1.3.1 of TS 38.214 [12]

6 CSI reporting requirements (Conducted requirements)

6.1 General

This section includes conducted requirements for the reporting of channel state information (CSI).

6.1.1 Applicability of requirements

6.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1 [6].

The minimum performance requirements in Clause 6 are mandatary for UE supporting NR operation, except test cases listed in Clause 6.1.1.3, 6.1.1.4.

6.1.1.2 Applicability of requirements for different number of RX antenna ports

The number of RX antenna ports for different RF operating bands is up to UE declaration.

The UE shall support 2 or 4 RX antenna ports for different RF operating bands. The operating bands, where 4 RX antenna ports shall be the baseline, are defined in clause 7.2 of TS 38.101-1 [6]. The UE requirements applicability for UEs with different number of RX antenna ports is defined in Table 6.1.1.2-1.

| Supported RX antenna ports | Test type | Test list |
|----------------------------|-----------|---------------------------|
| UE supports only | CQI | All tests in Clause 6.2.2 |
| 2RX | PMI | All tests in Clause 6.3.2 |
| | RI | All tests in Clause 6.4.2 |
| UE supports only | CQI | All tests in Clause 6.2.3 |
| 4RX or both 2RX | PMI | All tests in Clause 6.3.3 |
| and 4RX | RI | All tests in Clause 6.4.3 |

Table 6.1.1.2-1: Requirements applicability

6.1.1.3 Applicability of requirements for optional UE features

6.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 6.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

Table 6.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | type | Test list | Applicability notes |
|---|--------------------|-----------------------|--|--|
| | FR1 FDD | CQI | 6.2.3.1.1 .1 Minimum requirement for CQI periodic reporting | The requirements apply only in case the PDSCH MIMO |
| | | PMI | 6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook | rank in the test case does not exceed UE PDSCH MIMO layers |
| | | RI | 6.4.3.1 (Test 1 - 4) | capability |
| PDSCH MIMO layers (maxNumberMIMO- | FR1 TDD | PDSCH | 6.2.3.2.1.1 Minimum requirement for CQI periodic reporting | |
| LayersPDSCH) | | | 6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook | |
| | | | 6.4.3.2 (Test 1 - 4) | |
| | | PMI | 6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook | |
| | | RI | 6.4.3.2 (Test 1 - 4) | |
| Supported max number of ports across all configured NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros sNZP-CSI-RS-PerCC) | FR1 FDD and TDD | CQI, PMI and RI | All test cases with the max number of ports across all configured NZP-CSI-RS resource per CC larger than 2 | The requirements apply only in case the number of NZP-CSI-RS ports in the test case does not exceed UE maximum number of NZP-CSI-RS ports capability |

6.1.2 Common test parameters

Parameters specified in Table 6.1.2-1 are applied for all test cases in this section unless otherwise stated.

Table 6.1.2-1: Test parameters for CSI test cases

| Parameter | | Unit | Value |
|------------------------------|---|------|--|
| PDSCH transmission scheme | | | Transmission scheme 1 |
| Actual carrier configuration | onfiguration carrier (Note 3) | | 0 |
| | Subcarrier spacing | kHz | 15 or 30 |
| | Cyclic prefix | | Normal |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP in | | | 1 |
| Common | Physical Cell ID | | 0 First CCB in Clot #0 |
| serving cell | SSB position in burst | | First SSB in Slot #0 |
| parameters | SSB periodicity | ms | 20 Each slot |
| | Slots for PDCCH monitoring | | Each slot |
| PDCCH configuration | Symbols with PDCCH Number of PDCCH candidates | | 0,1 1/AL8 |
| Configuration | and aggregation levels DCI format | | 1 1 |
| | TCI state | | TCI state #1 |
| Cross carrier sch | | | Not configured |
| Cross carrier sch | Mapping type | | Type A |
| | k0 | | - '' |
| | 110 | | 0 2 |
| | Starting symbol (S) | | |
| | Length (L) | | 12 |
| PDSCH | PDSCH aggregation factor | | 1 |
| configuration | PRB bundling type | | Static |
| | PRB bundling size | | 2 |
| | Resource allocation type | | type 0 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 |
| | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| PDSCH DMRS configuration | DMRS ports indexes | | {1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,100 3} for Rank4 |
| | Number of PDSCH DMRS CDM group(s) without data | | 2 |
| PTRS | Frequency density (K _{PT-RS}) | | N/A |
| configuration | Time density (<i>L_{PT-RS}</i>) | | N/A |
| <u> </u> | First subcarrier index in the PRB used for CSI-RS (k_0) | | 0 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS (Io) | | 4 for CSI-RS resource 1 and 3 8 for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |

| | | | | 'No CDM' for CSI-RS |
|--|--------------------------|-----------------|--|------------------------------------|
| CDM Type | | | | resource 1,2,3,4 |
| | Danaita (a) | | | 3 for CSI-RS |
| | Density (ρ) | | | resource 1,2,3,4 |
| | | | | 15 kHz SCS: 20 for |
| | | | | CSI-RS resource |
| CSI-RS periodicity | | dicity | slot | 1,2,3,4 |
| | | | | 30 kHz SCS: 40 for CSI-RS resource |
| | | | | 15 kHz SCS: |
| | | | | 10 for CSI-RS |
| | | | | resource 1 and 2 |
| | | | | 11 for CSI-RS |
| | | | | resource 3 and 4 |
| | CSI-RS offset | t . | slot | |
| | | | | 30 kHz SCS: |
| | | | | 20 for CSI-RS resource 1 and 2 |
| | | | | 21 for CSI-RS |
| | | | | resource 3 and 4 |
| | | | | Start PRB 0 |
| | Frequency Od | ccupation | | Number of PRB = |
| | | | | BWP size |
| | QCL info | | | TCI state #0 |
| | | | | Start PRB 0 |
| NZP CSI-RS for | Frequency Od | ccupation | | Number of PRB = |
| CSI acquisition | 001 : (| | | BWP size |
| | QCL info | | | TCI state #1 |
| ZP CSI-RS for | Frequency Oc | acupation | | Start PRB 0 Number of PRB = |
| CSI acquisition | Frequency Oc | Cupation | | BWP size |
| | Type 1 QCL | SSB index | | SSB #0 |
| | information | QCL Type | | Type C |
| TCI state #0 | T 0.00l | | | |
| | Type 2 QCL information | SSB index | | N/A |
| | | QCL Type | | N/A |
| | | | | CSI-RS resource 1 |
| | Type 1 QCL | CSI-RS resource | | from 'CSI-RS for |
| | information | | | tracking' |
| TCI state #1 | | | | configuration |
| | | QCL Type | | Type A |
| | Type 2 QCL information | CSI-RS resource | | N/A |
| | IIIIOIIIIalioii | QCL Type | | N/A |
| Number of HAPC |) Processes | | | 4 For FDD |
| | Number of HARQ Processes | | | 8 for TDD |
| | HARQ ACK/NACK bundling | | | Multiplexed |
| Redundancy version coding sequence | | | | {0,2,3,1} |
| | | | | 2 for FDD |
| | | | For FR1.30-1: 8 if mod(i,10) = 0 | |
| | | | 6 if $mod(i, 10) = 0$ 6 if $mod(i, 10) = 2$ | |
| K1 value (PDSCH-to-HARQ-timing-indicator) | | | | 5 if $mod(i, 10) = 2$ |
| | | | | 5 if $mod(i,10) = 4$ |
| | | | | 4 if $mod(i,10) = 5$ |
| | | | | 3 if mod(i,10) = 6 |
| | | | | Where i is slot index |
| | | | | per radio frame with |
| | | | | 0~19 |
| Symbols for unus | Symbols for unused REs | | | OCNG as specified in A.5 |
| | | | i | Λ.υ |

| Note 1: | PDSCH is not scheduled on slots containing CSI-RS or slots which are not full |
|---------|---|
| | DL. |
| Note 2: | UE assumes that the TCI state for the PDSCH is identical to the TCI state |
| | applied for the PDCCH transmission. |
| Note 3: | Point A coincides with minimum guard band as specified in Table 5.3.3-1 from |
| | TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing. |

6.2 Reporting of Channel Quality Indicator (CQI)

This section includes the requirements for the reporting of channel quality indicator (CQI).

6.2.1 1RX requirements

(Void)

6.2.2 2RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 2 receiver antennas.

6.2.2.1 FDD

6.2.2.1.1 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

6.2.2.1.1.1 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 6.2.2.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.1-1: CQI reporting definition test

| Parameter | | Unit | Test 1 | Test 2 | |
|--|---|----------|--|--------------------|--|
| Bandwidth | | MHz | | 10 | |
| Duplex Mode | | | FDD | | |
| Subcarrier spacing | | kHz | , | 15 | |
| SNR | | dB | 8 9 | 14 15 | |
| Propagation chan | nel | | | /GN | |
| Antenna configura | ation | | 2x2 with static channel specified in Annex B.1 | | |
| Beamforming Mod | del | | | in Annex B.4.1 | |
| | CSI-RS resource Type | | | riodic | |
| | Number of CSI-RS ports (X) | | | 4 | |
| | CDM Type | | FD-CDM2 | | |
| 7D COL DO | Density (ρ) | | 1 | | |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row 5,4 | | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | | 9 | |
| | CSI-RS | | | | |
| | periodicity and offset | slot | 5 | 5/1 | |
| | CSI-RS resource Type | | Per | riodic | |
| | Number of CSI-RS ports (X) | | | 2 | |
| | CDM Type | | | CDM2 | |
| | Density (p) | | , , , | 1 | |
| NZP CSI-RS for | First subcarrier index in the PRB | | | | |
| CSI acquisition | used for CSI-RS (k_0 , k_1) | | Row | 3,(6,-) | |
| | First OFDM symbol in the PRB used | | | | |
| | for CSI-RS (I ₀) | | ' | 13 | |
| | NZP CSI-RS-timeConfig | | _ | | |
| | periodicity and offset | slot | 5 | 5/1 | |
| | CSI-IM resource Type | | Per | riodic | |
| | CSI-IM RE pattern | | 0 | | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4 | , 9) | |
| Comigaration | CSI-IM timeConfig | | | | |
| | periodicity and offset | slot | 5/5 | | |
| ReportConfigType | | | Per | riodic | |
| CQI-table | , | | | ole 2 | |
| reportQuantity | | | | PMI-CQI | |
| | rChannelMeasurements | | | nfigured | |
| | rInterferenceMeasurements | | | nfigured | |
| cgi-FormatIndicate | | | | eband | |
| pmi-FormatIndicat | | | | eband | |
| Sub-band Size | | RB | <u> </u> | 8 | |
| Csi-ReportingBan | d | | | 1111 | |
| CSI-Report periodicity and offset | | slot | | 5/1 | |
| aperiodicTriggeringOffset | | 0.01 | | nfigured | |
| aponodio mggomi | Codebook Type | | | nglePanel | |
| Codebook configuration | Codebook Mode | | iypoi oii | 1 | |
| | (CodebookConfig- N1,CodebookConfig-N2) | | Not co | nfigured | |
| Johngaradon | CodebookSubsetRestriction | | 010 | 0000 | |
| | RI Restriction | <u> </u> | | I/A | |
| Physical channel | | | | CCH | |
| Physical channel for CSI report CQI/RI/PMI delay | | ms | | 8 | |
| Maximum number of HARQ transmission | | 1113 | | 1 | |
| | | | As specified in T | able A.4-2, TBS.2- | |
| Measurement channel | | | - | 2 | |

6.2.2.1.2 CQI reporting under fading conditions

6.2.2.1.2.1 Minimum requirement for wideband CQI reporting

The purpose of the requirements is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.2.1.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 6.2.2.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.2.1.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| Parameter | | Unit | Test 1 | Test 2 |
|-----------------------------------|---|------|---------------------|-------------------|
| Bandwidth | | MHz | 10 |) |
| Subcarrier spacing | | kHz | 15 | |
| Duplex Mode | | | FD | D |
| SNR | | dB | 6 7 | 12 13 |
| Propagation channel | | | TDLA | 30-5 |
| Antenna configura | ation | | 2× | 2 |
| Correlation config | uration | | ULA | high |
| Beamforming Mod | del | | As specified in | Annex B.4.1 |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-C | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| configuration | First subcarrier index in the PRB | | Row | 5 A |
| Comiguration | used for CSI-RS (k ₀) | | NOW | 5,4 |
| | First OFDM symbol in the PRB used | | 9 | 1 |
| | for CSI-RS (I ₀) | | 3 | |
| | CSI-RS | slot | 5/ | 1 |
| | periodicity and offset | 3101 | | |
| | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-C | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB | | Row 3 | 3.(6) |
| | used for CSI-RS (k ₀ , k ₁) | | | ,,(-,) |
| | First OFDM symbol in the PRB used | | 13 | 3 |
| | for CSI-RS (I ₀) NZP CSI-RS-timeConfig | | + | |
| | periodicity and offset | slot | 5/ | 1 |
| | CSI-IM resource Type | | Perio | odic |
| | CSI-IM RE pattern | | 0 | |
| | CSI-IM Resource Mapping | | | |
| CSI-IM | (kcsi-im,lcsi-im) | | (4, | 9) |
| configuration | (************************************** | | (' ' | -, |
| | CSI-IM timeConfig | -1-4 | F./ | _ |
| | periodicity and offset | slot | 5/ | 5 |
| ReportConfigType |) | | Perio | odic |
| CQI-table | | | Tabl | |
| reportQuantity | | | cri-RI-P | |
| | rChannelMeasurements | | Not con | |
| | rInterferenceMeasurements | | Not con | |
| cqi-FormatIndicate | | | Widel | |
| pmi-FormatIndicat | tor | | Widel | |
| Sub-band Size | | RB | 8 | |
| Csi-ReportingBan | | | 1111 | |
| CSI-Report periodicity and offset | | slot | 5/ | |
| aperiodicTriggeringOffset | | | Not con | |
| | Codebook Type | | typel-Sing | |
| | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not con | figured |
| | CodebookSubsetRestriction | | 0000 | 001 |
| | RI Restriction | | N/ | A |
| Physical channel for CSI report | | | PUC | CH |
| CQI/RI/PMI delay | | ms | 8 | |
| | of HARQ transmission | | 1 | |
| Measurement channel | | | As specified in Tal | ble A.4-2, TBS.2- |
| weasurement tha | u ii iGi | | 1 | |

Table 6.2.2.1.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| <i>α</i> [%] | 20 | 20 |
| γ | 1.05 | 1.05 |

6.2.2.1.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

For the parameters specified in Table 6.2.2.1.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.2.1.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD.

Table 6.2.2.1.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|-------------------------------|--|------|---------------------------------------|
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | | KIIZ | FDD |
| SNR | | dB | 8 9 14 15 |
| SIVIX | SNR | | Two tap model specified in Annex |
| Propagation chan | nel | | B.2.4 with $a=1$, $f_D = 5$ Hz, and |
| Propagation charine | | | $T_{d}=0.45 \mu s$ |
| Antenna configura | ation | | 2×2 |
| Correlation config | | | As per Annex B.1 |
| Beamforming Mod | | | As specified in Annex B.4.1 |
| beamlorning woo | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 |
| | . , | | · · |
| | CDM Type | | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 |
| configuration | First subcarrier index in the PRB | | Row 5,4 |
| | used for CSI-RS (k ₀) | | , |
| | First OFDM symbol in the PRB used | | 9 |
| | for CSI-RS (I ₀) | | Ü |
| | CSI-RS | slot | 5/1 |
| | periodicity and offset | 0.01 | |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| NZD CCL DC for | Density (p) | | 1 |
| NZP CSI-RS for | First subcarrier index in the PRB | | Dow 2 (C.) |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used | | 40 |
| | for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig | | |
| | periodicity and offset | slot | 5/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| | CSI-IM Resource Mapping | | |
| CSI-IM | (Kcsi-im, Icsi-im) | | (4, 9) |
| configuration | (NCSI-IIVI, ICSI-IIVI) | | (4, 5) |
| | CSI-IM timeConfig | _ | |
| | periodicity and offset | slot | 5/1 |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | rChannelMeasurements | | Not configured |
| | rInterferenceMeasurements | | Not configured |
| cgi-FormatIndicate | | | Subband |
| pmi-FormatIndicate | | | Wideband |
| Sub-band Size | .01 | RB | 8 8 |
| | 1 | KD | <u> </u> |
| csi-ReportingBand | | -1-4 | 1111111 |
| CSI-Report interva | | slot | Not configured |
| Aperiodic Report | SIOT UTISET | | 5 |
| CSI request | CSI request | | 1 in slots i, where $mod(i, 5) = 1$, |
| • | | | otherwise it is equal to 0 |
| reportTriggerSize | | | 1 |
| | | | One State with one Associated |
| CSI-AperiodicTriggerStateList | | | Report Configuration |
| | | | Associated Report Configuration |
| | | | contains pointers to NZP CSI-RS |
| | | | and CSI-IM |
| aperiodicTriggerin | | | Not configured |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- | | Not configured |
| configuration | N1,CodebookConfig-N2) | | Not configured |
| | CodebookSubsetRestriction | | 000001 |
| RI Restriction | | | N/A |
| Physical channel | Physical channel for CSI report | | PUSCH |
| CQI/RI/PMI delay | · · · · · · · · · · · · · · · · · | ms | 8 |
| Jan. Wir dolay | | 1110 | |

| Maximum number of HARQ transmission | 1 |
|-------------------------------------|--|
| Measurement channel | As specified in Table A.4-2, TBS.2- 5 |

Table 6.2.2.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| a [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.2.2 TDD

6.2.2.2.1 CQI reporting definition under AWGN conditions

6.2.2.2.1.1 Minimum requirement for periodic CQI reporting

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median.

For the parameters specified in Table 6.2.2.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.2.1.1-1: CQI reporting definition test

| | Parameter | | Test 1 | Test 2 |
|---------------------------------|--|------|---------------------|--------------------|
| Bandwidth | | MHz | 40 | |
| Subcarrier spacing | | | 30 | |
| Duplex Mode | | | TD | D |
| TDD UL-DL patter | DD UL-DL pattern FR1.30-1 | | 30-1 | |
| SNR | | dB | 8 9 | 14 15 |
| Propagation chan | nel | | AW | GN |
| Antenna configura | | | 2×2 with static cha | annel specified in |
| Beamforming Mod | del | | As specified in | |
| <u> </u> | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-C | DM2 |
| 7D 001 D0 | Density (ρ) | | 1 | |
| ZP CSI-RS | First subcarrier index in the PRB | | _ | 5 4 |
| configuration | used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | | | |
| | periodicity and offset | slot | 10. | /1 |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-C | DM2 |
| | Density (p) | | 1 | |
| NZP CSI-RS for | First subcarrier index in the PRB | | | (2.) |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3 | 5,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig | | | |
| | periodicity and offset | slot | 10 | /1 |
| | CSI-IM resource Type | | Perio | odic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/9 | |
| ReportConfigType | | | Perio | odic |
| CQI-table | | | Tabl | |
| reportQuantity | | | cri-RI-P | |
| timeRestrictionFor | rChannelMeasurements | | Not con | |
| | rInterferenceMeasurements | | Not con | |
| cgi-FormatIndicate | | | Widel | |
| pmi-FormatIndicat | | | Widel | |
| Sub-band Size | | RB | 16 | 3 |
| Csi-ReportingBan | d | | 1111 | 111 |
| CSI-Report period | | slot | 10 | /1 |
| aperiodicTriggerin | | | Not con | |
| | Codebook Type | | typel-Sing | glePanel |
| | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not configured | |
| J. 2 | CodebookSubsetRestriction | | 0100 | 000 |
| | RI Restriction | | N/ | |
| Physical channel for CSI report | | | PUC | |
| CQI/RI/PMI delay | | ms | 9. | |
| | of HARQ transmission | | 1 | - |
| | | | As specified in Tal | ole A.4-2. TBS.2- |
| Measurement channel | | | 4 | |

6.2.2.2.2 CQI reporting under fading conditions

6.2.2.2.2.1 Minimum requirement for wideband CQI reporting

The purpose of the requirements is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI.

For the parameters specified in Table 6.2.2.2.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 6.2.2.2.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.2.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 | | |
|--|--|------|-----------------------------------|------|--|
| Bandwidth | | MHz | 40 | | |
| Subcarrier spacin | g | kHz | 30 | | |
| Duplex Mode | | | TDD | | |
| TDD UL-DL patte | rn | | FR1.30-1 | | |
| SNR | | dB | 1 - 1 | 13 | |
| Propagation chan | | | TDLA30-5 | | |
| Antenna configura | | | 2×2 | | |
| Correlation config | | | ULA high | | |
| Beamforming Mod | | | As specified in Annex B.4.1 | | |
| | CSI-RS resource Type | | Periodic | | |
| | Number of CSI-RS ports (X) | | 4 | | |
| | CDM Type | | FD-CDM2 | | |
| ZP CSI-RS | Density (ρ) First subcarrier index in the PRB | | 1 | | |
| configuration | used for CSI-RS (k ₀) | | Row 5,4 | | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | | |
| | CSI-RS periodicity and offset | slot | 10/1 | | |
| | CSI-RS resource Type | | Periodic | | |
| | Number of CSI-RS ports (X) | | 2 | | |
| | CDM Type | | FD-CDM2 | | |
| NZP CSI-RS for | Density (ρ) | | 1 | | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) | | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | | |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 | | |
| | CSI-IM resource Type | | Periodic | | |
| | CSI-IM RE pattern | | 0 | | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9) | | |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 | | |
| ReportConfigType | | | Periodic | | |
| CQI-table | | | Table 2 | | |
| reportQuantity | | | cri-RI-PMI-CQI | | |
| timeRestrictionFo | rChannelMeasurements | | Not configured | | |
| | rInterferenceMeasurements | | Not configured | | |
| cqi-FormatIndicate | | | Wideband | | |
| pmi-FormatIndica | tor | | Wideband | | |
| Sub-band Size | | RB | 16 | | |
| Csi-ReportingBan | d E:: | | 1111111 | | |
| CSI-Report period | | slot | 10/9 | | |
| aperiodicTriggerin | | | Not configured | | |
| | Codebook Type | | typel-SinglePanel | | |
| Codebook | Codebook Mode (CodebookConfig- | | 1 | | |
| configuration | N1,CodebookConfig-N2) | | Not configured | | |
| | CodebookSubsetRestriction | | 000001 | | |
| RI Restriction Physical channel for CSI report | | | N/A | | |
| | ior CSI report | | PUCCH | | |
| CQI/RI/PMI delay | of LIADO transmissism | ms | 9.5 | | |
| iviaxirnum numbei | r of HARQ transmission | | 1 | 0.0 | |
| Measurement cha | nnel | | As specified in Table A.4-2, TB 3 | ა.∠- | |

Table 6.2.2.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 20 | 20 |
| γ | 1.05 | 1.05 |

6.2.2.2.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

For the parameters specified in Table 6.2.2.2.2.1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.2.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

Table 6.2.2.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|----------------------|---|----------|---|
| Bandwidth | | MHz | 40 |
| Subcarrier spacin | g | kHz | 30 |
| Duplex Mode | Duplex Mode | | TDD |
| TDD UL-DL patter | rn | | FR1.30-1 |
| SNR | | dB | 8 9 14 15 |
| Propagation chan | nel | | Two tap model specified in Annex B.2.4 with $a=1$, $f_D=5$ Hz, and |
| | | | τ _d =0.1125μs |
| Antenna configura | ation | | 2×2 |
| Correlation config | uration | | As per Annex B.1 |
| Beamforming Mod | del | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 |
| configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 |
| | CSI-RS periodicity and offset | slot | 10/1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| NZP CSI-RS for | First subcarrier index in the PRB | | |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used | | 40 |
| | for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| 001 111 | CSI-IM Resource Mapping | | |
| CSI-IM configuration | (kcsi-im,lcsi-im) | | (4, 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 |
| ReportConfigType | 9 | | Aperiodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | rChannelMeasurements | | Not configured |
| timeRestrictionFo | rInterferenceMeasurements | | Not configured |
| cqi-FormatIndicat | | | Subband |
| pmi-FormatIndica | tor | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBand | | | 1111111 |
| CSI-Report interv | | slot | Not configured |
| Aperiodic Report | Siot Offset | | 9 |
| CSI request | | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| reportTriggerSize | | | 1 |
| | | | One State with one Associated |
| 001 4 : 1: T: | 0 | | Report Configuration |
| CSI-Aperiodic i rig | | | Associated Report Configuration |
| | | | contains pointers to NZP CSI-RS |
| aporiodioTricas | aperiodicTriggeringOffset | | and CSI-IM |
| apenodiciriggerir | | | Not configured |
| | Codebook Type | | typel-SinglePanel |
| Codebook | Codebook Mode (CodebookConfig- | | 1 |
| configuration | N1,CodebookConfig-N2) | | Not configured |
| Johngaration | CodebookSubsetRestriction | | 000001 |
| | RI Restriction | | N/A |
| Physical channel | | | PUSCH |
| . Hydrodi dilamilei | | <u> </u> | 1 00011 |

| CQI/RI/PMI delay | ms | 9.5 |
|-------------------------------------|----|--------------------------------------|
| Maximum number of HARQ transmission | | 1 |
| Measurement channel | | As specified in Table A.4-2, TBS.2-6 |

Table 6.2.2.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| α [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.3 4RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 4 receiver antennas.

6.2.3.1 FDD

6.2.3.1.1 CQI reporting definition under AWGN conditions

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median.

6.2.3.1.1.1 Minimum requirement for period CQI reporting

For the parameters specified in Table 6.2.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90 % of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.1-1: CQI reporting definition test

| | Parameter | Unit | Test 1 | Test 2 |
|----------------------|--|------|---------------------------------|---------|
| Bandwidth | | MHz | 10 | |
| Subcarrier spacing | g | kHz | 1 | 5 |
| Duplex Mode | | | FDD | |
| SNR | | dB | 5 6 | 11 12 |
| Propagation chan | nel | | AW | |
| Antenna configura | ation | | 2x4 with static characters Anne | |
| Beamforming Mod | del | | As specified in | |
| | CSI-RS resource Type | | Peri | odic |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-C | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | g |) |
| | CSI-RS periodicity and offset | slot | 5/ | 1 |
| | CSI-RS resource Type | | Peri | odic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-C | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/1 | |
| | CSI-IM resource Type | | Periodic | |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/ | 5 |
| ReportConfigType | 9 | | Peri | odic |
| CQI-table | | | Tab | |
| reportQuantity | | | cri-RI-P | |
| | rChannelMeasurements | | Not con | |
| timeRestrictionFo | rInterferenceMeasurements | | Not con | |
| cqi-FormatIndicate | | | Wide | |
| pmi-FormatIndicat | tor | | Wide | |
| Sub-band Size | .1 | RB | 8 | |
| csi-ReportingBand | | -1-4 | 1111 | |
| CSI-Report period | | slot | 5/ | |
| aperiodicTriggerin | | | Not con | |
| | Codebook Type Codebook Mode | | typel-Sin | • |
| Codebook | (CodebookConfig- | | ' | |
| configuration | N1,CodebookConfig-N2) | | Not configured | |
| | CodebookSubsetRestriction | | 010000 N/A | |
| RI Restriction | | | | |
| | Physical channel for CSI report | | PUC | |
| | CQI/RI/PMI delay Maximum number of HARQ transmission | | 8 | |
| | MAXIMUM NUMBER OF HARQ (FANSIMISSION | | As specified in Ta | , |
| Measurement channel | | | As specified in Ta | |

6.2.3.1.2 CQI reporting under fading conditions

6.2.3.1.2.1 Minimum requirement for wideband CQI reporting

The purpose of the requirements is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI.

For the parameters specified in Table 6.2.3.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.3.1.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 6.2.3.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.1.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| Bandwidth | | Parameter | Unit | Test 1 | Test 2 |
|--|----------------------|--|------|--------------------|-------------------|
| Subcarrier spacing | Bandwidth | andwidth | | 10 |) |
| Duplex Mode | | | kHz | | |
| SNR | | | | FDD | |
| Propagation channel | | | dB | 3 4 | 9 10 |
| Antenna configuration | Propagation chan | nel | | | 30-5 |
| Correlation configuration | | | | | |
| As specified in Annex B.4.1 | Correlation config | uration | | | |
| CSI-RS resource Type | | | | | |
| Number of CSI-RS ports (X) | | | | | |
| CDM Type | | | | | |
| Density (p) | | | | FD-C | DM2 |
| First subcarrier index in the PRB used for CSI-RS (k ₀) First OFDM symbol in the PRB used for CSI-RS (k ₀) CSI-RS (c) CSI-RS (c) CSI-RS resource Type Number of CSI-RS for CSI-RS for CSI acquisition Number of CSI-RS (k ₀) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀) First subcarrier index in the PRB used for CSI-RS (k ₀) NZP CSI-RS firenconfig periodicity and offset CSI-IM (CSI-RS (k ₀) NZP CSI-RS-timeConfig periodicity and offset CSI-IM Resource Type CSI-IM Resource Type CSI-IM Resource Mapping (kCSI-IM, ICSI-IM) CSI-IM Resource Mapping (kCSI-IM, ICSI-IM) CSI-IM merconfig periodicity and offset CSI-IM resource Mapping (kCSI-IM, ICSI-IM) CSI-IM reconfig periodicity and offset CSI-IM reconfig periodicity and offset ReportConfigType CSI-IM reconfig periodicity and offset CSI-IM reconfig periodicity and offset ReportConfigType CSI-IM reconfig periodicity and offset ReportConfigType CSI-IM reconfig periodicity and offset ReportConfigType CSI-RS (k ₀) SIOT SIOT SIOT SIOT SIOT SIOT SIOT SIOT | 70.001.00 | | | | |
| Used for CSI-RS (k ₀) | | | | | - 4 |
| First OFDM symbol in the PRB used for CSI-RS (b) | configuration | | | Row | 5,4 |
| Tor CSI-RS (lo) SI-RS Slot S | | | | | |
| Periodicity and offset | | | | 9 | |
| Deficion Part Part Part Part | | | -1-4 | F./ | 4 |
| CSI-RS resource Type | | periodicity and offset | SIOT | 5/ | 1 |
| Number of CSI-RS ports (X) 2 CDM Type | | | | Perio | odic |
| NZP CSI-RS for CSI acquisition | | | | 2 | |
| Density (p) | | | | FD-C | DM2 |
| First subcarrier index in the PRB used for CSI-RS (lo, k1) | NZD OOL DO (| | | 1 | |
| Seed to CSI-RS (lo) | | | | 5 | . (0.) |
| First OFDM symbol in the PRB used for CSI-RS (lo) NZP CSI-RS-timeConfig periodicity and offset Slot S/1 | CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3 | 3,(6,-) |
| for CSI-RS (I ₀) NZP CSI-RS-timeConfig periodicity and offset slot 5/1 | | First OFDM symbol in the PRB used | | <u>.</u> | |
| NZP CSI-RS-timeConfig periodicity and offset Slot S/1 | | | | 13 | |
| Deriodicity and offset Slot Slot Slot Slot CSI-IM resource Type Periodic CSI-IM Resource Mapping CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) (4, 9) | | | | 5/1 | |
| CSI-IM resource Type | | | SIOT | | |
| CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table CQI-table Table 2 reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured Totale 2 ReportIngPand ReportIngBand Sub-band Size RB 8 8 8 8 8 8 8 8 8 8 8 8 8 | | | | Periodic | |
| CSI-IM configuration CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured videband wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 8 8 8: 8: 8: 8: 8: 8: 8: 8: 8: 8: | | | | C | |
| CSI-IM timeConfig periodicity and offset Slot S/1 | CCLIM | CSI-IM Resource Mapping | | | |
| CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Mode Codebook configuration CodebookConfig- N1,CodebookConfig- N1,CodebookConfig- N1,CodebookConfig- N1,CodebookSubsetRestriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Periodic Table 2 Periodic Table 2 Reportocle Rable 3 Not configured Slot 5/5 Not configured As specified in Table A.4-2, TBS.2- | | | | (4, 9) | |
| ReportConfigType | Corniguration | | | | |
| ReportConfigType Periodic CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Mode 1 Codebook Mode 1 Codebook Configuration N1,CodebookConfig-N1,CodebookConfig-N1,CodebookConfig-N1,CodebookConfig-N1,CodebookConfig-N2) Codebook SubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel | | | elot | 5/ | 1 |
| CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typeI-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config-N12 Not configured Not configured Not configured V1,CodebookConfig-N2 Not configured Codebook SubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | 3101 | 3/ | I |
| reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured Codebook SubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | |) | | | |
| timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Configuration COdebook Configuration RI Restriction RI Restriction Measurement channel Tode to Angel Content of the Angel Transmission Not configured Not con | CQI-table | | | | |
| timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Configuration Codebook Configuration RI Restriction Physical channel for CSI report Cqi-FormatIndicator Wideband Wideband RB 8 8 8 Slot 5/5 Not configured typel-SinglePanel Codebook Config-N2) CodebookConfig-N2) CodebookSubsetRestriction RI Restriction N/A Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel Not configured As specified in Table A.4-2, TBS.2- | | | | | |
| cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | | | |
| pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | timeRestrictionFor | InterferenceMeasurements | | Not con | figured |
| Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typeI-SinglePanel Codebook Mode 1 Codebook Config- configuration N1,CodebookConfig- N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | cqi-FormatIndicate | or | | | |
| csi-ReportingBand 1111111 CSI-Report periodicity and offset aperiodicTriggeringOffset slot 5/5 Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | or | | Widel | band |
| CSI-Report periodicity and offset slot 5/5 aperiodicTriggeringOffset Not configured Codebook Type typeI-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | RB | | |
| aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,CodebookConfig- N1,CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | | | |
| Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration (CodebookConfig- N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction RI Restriction 000001 N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | slot | | |
| Codebook Configuration Codebook Mode (CodebookConfig-N1, CodebookConfig-N2) Not configured CodebookSubsetRestriction RI Restriction RI Restriction 000001 Physical channel for CSI report CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2- | aperiodicTriggerin | gOffset | | Not con | figured |
| Codebook configuration (CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | Codebook Type | | typel-Sin | glePanel |
| N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | | 1 | |
| Conliguration N1,CodebookConing-N2) 000001 CodebookSubsetRestriction 000001 RI Restriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | | Not con | figured |
| RI Restriction Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel RI Restriction N/A PUCCH ms 8 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2- | configuration | | | | |
| Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel PUCCH ms 8 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2- | | | | | |
| CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | | | | |
| Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2- | | for CSI report | | | |
| Measurement channel As specified in Table A.4-2, TBS.2- | | | ms | 8 | |
| Measurement Channel . | Maximum number | of HARQ transmission | | · | |
| 1 | Measurement cha | nnel | | As specified in Ta | ble A.4-2, TBS.2- |
| | wicasurciniciii Clia | THO | | 1 | |

Table 6.2.3.1.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 5 | 5 |
| γ | 1.05 | 1.05 |

6.2.3.1.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

For the parameters specified in Table 6.2.3.1.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.3.1.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.1.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD.

Table 6.2.3.1.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 | Test 2 |
|---------------------------------|--|------|---|------------------|
| Bandwidth | | MHz | 1(| |
| Subcarrier spacing | Subcarrier spacing | | 1: | 5 |
| Duplex Mode | | | FD |)D |
| SNR | | dB | 5 6 | 11 12 |
| Propagation chan | | | Two tap model specified in Ann B.2.4 with a=1, f _D = 5Hz, and r _d =0.45µs | |
| Antenna configura | ation | | 2× | :4 |
| Correlation config | uration | | As per Ar | |
| Beamforming Mod | | | As specified in | |
| | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-C | |
| ZP CSI-RS | Density (ρ) First subcarrier index in the PRB | | 1 | |
| configuration | used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS periodicity and offset | slot | 5/ | 1 |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-C | |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 1: | 3 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/1 | |
| | CSI-IM resource Type | | Perio | odic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/ | 1 |
| ReportConfigType |) | | Aperi | |
| CQI-table | | | Tab | |
| reportQuantity | | | cri-RI-P | |
| | rChannelMeasurements | | Not con | |
| | rInterferenceMeasurements | | Not con | |
| cqi-FormatIndicate | | | Subb Widel | |
| pmi-FormatIndical Sub-band Size | loi | RB | vvidei 8 | |
| csi-ReportingBand | 1 | IND. | 1111 | |
| CSI-Report interva | | slot | Not con | |
| Aperiodic Report | | 0.01 | 5 | • |
| CSI request | | | 1 in slots i, wher otherwise it i | e mod(i, 5) = 1, |
| reportTriggerSize | | | 1 | <u> </u> |
| CSI-AperiodicTrig | | | One State with on Report Configurat Associated Repo | ion |
| 22. 1501130101119 | g 1010 - 101 | | contains pointers | to NZP CSI-RS |
| aperiodicTriggeringOffset | | | Not con | |
| | Codebook Type | - | typel-Sin | glePanel |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- | | Not con | figured |
| configuration | N1,CodebookConfig-N2) | | | |
| | CodebookSubsetRestriction RI Restriction | | 0000 N/ | |
| Physical channel | | | PUS | |
| CQI/RI/PMI delay | | ms | 8 | |
| OQI/NI/FIVII UEIAY | | | | |

| Maximum number of HARQ transmission | 1 |
|-------------------------------------|--------------------------------------|
| Measurement channel | As specified in Table A.4-2, TBS.2-5 |

Table 6.2.3.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| α [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.3.2 TDD

6.2.3.2.1 CQI reporting definition under AWGN

6.2.3.2.1.1 Minimum requirement for CQI periodic reporting

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median.

For the parameters specified in Table 6.2.3.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.2.1.1-1: CQI reporting definition test

| Parameter | | Unit | Test 1 | Test 2 |
|---------------------------------|--|------|---------------------|-----------------|
| Bandwidth | | MHz | 40 |) |
| Subcarrier spacing | | kHz | 30 | |
| Duplex Mode | Duplex Mode | | TD | D |
| TDD UL-DL patter | n | | FR1.3 | 30-1 |
| SNR | | dB | 5 6 | 11 12 |
| Propagation chann | nel | | AWO | 3N |
| Antenna configura | tion | | 2x4 with static cha | |
| Beamforming Mod | el | | As specified in | |
| J | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CI | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| | First subcarrier index in the PRB | | Dow | F 1 |
| configuration | used for CSI-RS (k ₀) | | Row | 5, 4 |
| | First OFDM symbol in the PRB used | | 9 | |
| | for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | slot | 10/ | /1 |
| | periodicity and offset | SIOL | 10/ | ı |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CI | DM2 |
| | Density (ρ) | | 1 | |
| NZP CSI-RS for | | | | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | ,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | 3 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/ | 1 |
| | CSI-IM resource Type | | Perio | odic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| J. J. W. | CSI-IM timeConfig | slot | 10/ | <u>'</u> 1 |
| D 10 " T | periodicity and offset | | 5 . | ı· |
| ReportConfigType | | | Perio | |
| CQI-table | | | Table | |
| reportQuantity | | | cri-RI-PI | |
| | ChannelMeasurements | | Not conf | 0 |
| | InterferenceMeasurements | | Not conf | |
| cqi-FormatIndicato | | | Widek | |
| pmi-FormatIndicate | or | | Widek | |
| Sub-band Size | | RB | 16 | |
| csi-ReportingBand | | slot | 1111 | |
| | CSI-Report periodicity and offset | | 10/ | |
| aperiodicTriggering | | | Not conf | |
| | Codebook Type | | typel-Sing | glePanel |
| | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig-N1,CodebookConfig-N2) | | Not conf | |
| | CodebookSubsetRestriction | | 0100 | |
| RI Restriction | | | N/A | |
| Physical channel for CSI report | | | PUC | CH |
| CQI/RI/PMI delay | | ms | 9.5 | 5 |
| Maximum number | of HARQ transmission | | 1 | |
| Measurement char | nnel | | As specified in Tab | |

6.2.3.2.2 CQI reporting under fading conditions

6.2.3.2.2.1 Minimum requirement for wideband CQI reporting

The purpose of the requirements is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI.

For the parameters specified in Table 6.2.3.2.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.3.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.2.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|---------------------------------------|--|------|-------------------------------------|
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD UL-DL patte | rn | | FR1.30-1 |
| SNR | | dB | 3 4 9 10 |
| Propagation chan | | | TDLA30-5 |
| Antenna configura | | | 2×4 |
| Correlation config | | | XP High |
| Beamforming Mod | | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 FD 0DM0 |
| | CDM Type Density (ρ) | | FD-CDM2 |
| ZP CSI-RS | First subcarrier index in the PRB | | I I |
| configuration | used for CSI-RS (k ₀) | | Row 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 |
| | CSI-RS periodicity and offset | slot | 10/1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| NZP CSI-RS for | Density (ρ) | | 1 |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 |
| ReportConfigType | | | Periodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | rChannelMeasurements | | Not configured |
| | rInterferenceMeasurements | | Not configured |
| cqi-FormatIndicat | | | Wideband |
| pmi-FormatIndica | tor | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBan | | -l-+ | 111111 |
| CSI-Report period aperiodicTriggering | | slot | 10/9 |
| apenodicinggenr | GOTISET Codebook Type | | Not configured typel-SinglePanel |
| | Codebook Type Codebook Mode | | typei-SinglePanei |
| Codebook | (Codebook Config- | | · |
| configuration | N1,CodebookConfig-N2) | | Not configured |
| . J | CodebookSubsetRestriction | | 000001 |
| RI Restriction | | | N/A |
| Physical channel for CSI report | | | PUCCH |
| CQI/RI/PMI delay | • | ms | 9.5 |
| Maximum number | r of HARQ transmission | | 1 |
| Measurement cha | annel | | As specified in Table A.4-2, TBS.2- |

Table 6.2.3.2.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 5 | 5 |
| γ | 1.05 | 1.05 |

6.2.3.2.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

For the parameters specified in Table 6.2.3.2.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.3.2.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

Table 6.2.3.2.2.1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 | Test 2 |
|---------------------------------|--|-------------|----------------------------|----------------|
| Bandwidth | | | 40 | |
| Subcarrier spacing | | kHz | 30 | |
| Duplex Mode | _ | | TDD | |
| TDD UL-DL patter | rn | | FR1.30-1 | |
| SNR | | dB | | 1 12 |
| | | | Two tap model specifi | |
| Propagation chan | nel | | B.2.4 with $a=1$, $f_D =$ | |
| | | | т _d =0.1125µ | S |
| Antenna configura | | | 2×4 | |
| Correlation config | | | As per Annex | |
| Beamforming Mod | | | As specified in Ann | nex B.4.1 |
| | CSI-RS resource Type | | Periodic | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CDM2 | |
| ZP CSI-RS | Density (ρ) | | 1 | |
| configuration | First subcarrier index in the PRB | | Row 5,4 | |
| | used for CSI-RS (k ₀) | | , | |
| | First OFDM symbol in the PRB used | | 9 | |
| | for CSI-RS (I ₀) CSI-RS | | | |
| | periodicity and offset | slot | 10/1 | |
| | CSI-RS resource Type | | Periodic | |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CDM2 | |
| | Density (ρ) | | 1 D-CDIVIZ | |
| NZP CSI-RS for | First subcarrier index in the PRB | | I | |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,- |) |
| | First OFDM symbol in the PRB used | | | |
| | for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig | | 10/1 | |
| | periodicity and offset | slot | 10/1 | |
| | CSI-IM resource Type | | Periodic | |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM | CSI-IM Resource Mapping | | | |
| configuration | (kcsi-im,lcsi-im) | | (4, 9) | |
| Comigaration | | | | |
| | CSI-IM timeConfig | slot | 10/1 | |
| D 10 " T | periodicity and offset | | A | |
| ReportConfigType | 9 | | Aperiodic | |
| CQI-table | | | Table 2 | -01 |
| reportQuantity | 01 114 | | cri-RI-PMI-C | |
| | rChannelMeasurements | | Not configur | |
| | rInterferenceMeasurements | | Not configur | ea |
| cqi-FormatIndicat | | | Subband Wideband | 1 |
| pmi-FormatIndica | lOI | DD | | |
| Sub-band Size csi-ReportingBand | <u> </u> | RB | 16 1111111 | |
| CSI-Report interv | | slot | Not configur | ed. |
| Aperiodic Report | | 3101 | 9 | c u |
| | GIOL OTIGEL | | 1 in slots i, where mo | d(i 10) – 1 |
| CSI request | | | otherwise it is eq | |
| reportTriggerSize | | | 1 | |
| . opontriiggoroize | | | One State with one As | sociated |
| | | | Report Configuration | |
| CSI-AperiodicTrig | gerStateList | | Associated Report Co | onfiguration |
| | | | contains pointers to N | IZP CSI-RS |
| | | | and CSI-IN | Λ |
| aperiodicTriggeringOffset | | | 0 | |
| | Codebook Type | | typel-SinglePa | anel |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- | Not configu | | ed |
| configuration | N1,CodebookConfig-N2) | | | |
| | CodebookSubsetRestriction | | 000001 | |
| Dhariasi | RI Restriction | | N/A | |
| Physical channel for CSI report | | | PUSCH | |

| CQI/RI/PMI delay | ms | 9.5 |
|-------------------------------------|----|--------------------------------------|
| Maximum number of HARQ transmission | | 1 |
| Measurement channel | | As specified in Table A.4-2, TBS.2-6 |

Table 6.2.2.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| α [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.3 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 1 with higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio:

$$\gamma = \frac{t_{ue, follow 1, follow 2}}{t_{rnd1, rnd2}}$$

In the definition of γ , for 4TX and 8TX PMI requirements, $t_{follow1,follow2}$ is 90 % of the maximum throughput obtained at $SNR_{follow1,follow2}$ using the precoders configured according to the UE reports, and $t_{rnd1,rnd2}$ is the throughput measured at $SNR_{follow1,follow2}$ with random precoding.

6.3.1 1RX requirements

(Void)

6.3.2 2RX requirements

6.3.2.1 FDD

6.3.2.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.1-2.

Table 6.3.2.1.1-1: Test parameters (single layer)

| Bandwidth | Pai | rameter | Unit | Test 1 |
|---|------------------------------------|---------------------|------|-----------------------------|
| Duplex Mode | | | | |
| Propagation channel | | | kHz | |
| Antenna configuration | | | | |
| Beamforming Mode | Propagation cha | annei | | |
| Beamforming Model | Antenna configu | uration | | |
| CSI-RS resource | Beamforming M | lodel | | As specified in Annex B.4.1 |
| Number of CSI- RS ports (X) | 3 | | | |
| RS ports (X) | | | | Aperiodic |
| CDM Type | | | | 4 |
| Density (p) | | | | FD-CDM2 |
| First subcarrier index in the PRB used for CSI-RS (ko, kr) | | | | 1 1 3 3 5 W 2 |
| used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS interval and offset zP CSI-RS trice and offset zero index in the PRB used for CSI-RS (l ₀ , l ₁) NZP CSI-RS resource Type Aperiodic NZP CSI-RS for CSI S acquisition NZP CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS interval and offset sinterval and offset interval and offset of CSI-MR (k ₀ , l ₁) CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern Patten 0 CSI-IM RE pattern CSI-IM (k ₀ , l ₁) CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (k ₀) (k ₀ | | | | |
| Line | 7P CSI-RS | | | Row 5 (4 -) |
| | | | | 10W 3, (4,-) |
| Symbol in the PRB used for CSI-RS (0, 1) CSI-RS (0, 1) CSI-RS (0, 1) CSI-RS (0, 1) CSI-RS (0, 1) (0 | 3 | | | |
| Used for CSI-RS (lo, ln) CSI-RS interval and offset In slots i, where mod(i, 5) = 1, otherwise it is equal to 0 | | | | |
| CSI-RS Interval and offset Slot Not configured | | | | (9,-) |
| Interval and offset Slot Not configured | | | | |
| Title Val alt 0 bitset ZP CSI-RS trigger | | | slot | Not configured |
| CSI-RS resource Type | | interval and offset | Olot | |
| Type | | | | |
| RS ports (X) | | | | Aperiodic |
| NZP CSI-RS for CSI acquisition | | | | 4 |
| Density (p) | | | | - |
| NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS (l ₀ , l ₁) CSI-RS interval and offset O O | | | | |
| for CSI acquisition Index in the PRB used for CSI-RS (ko, kr) First OFDM symbol in the PRB used for CSI-RS (lo, lr) | | - 11 1 | | 1 |
| acquisition CSI-IM CSI-IM CSI-IM | | | | 5 4 (2) |
| | | used for CSI-RS | | Row 4, (0,-) |
| Symbol in the PRB used for CSI-RS (lo, l₁) CSI-RS interval and offset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource Mapping (4,9) CSI-IM Sibil Silvi Silvi Not configured interval and offset CSI-IM TimeConfig interval and offset CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas timeRestrictionForInterferenceMeas trements Qi-FormatIndicator Wideband | acquisition | | | |
| Used for CSI-RS | | | | |
| CSI-RS | | | | (13,-) |
| interval and offset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource Mapping CSI-IM Resource Mapping CSI-IM Resource Mapping CSI-IM Resource Mapping CSI-IM Resource CSI-IM Resource Mapping CSI-IM R | | | | |
| CSI-IM resource Type Aperiodic CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) (KcSI-IM,ICSI-IM) CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) (CSI-IM RE pattern Patten 0 CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset Slot 5/1 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | | Not configured |
| CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (KcSI-IM,ICSI-IM) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (KCSI-IM RE pattern CSI-IM RE pattern CSI-IM RE pattern CSI-IM Resource Mapping (CSI-IM Resource Mapping (KCSI-IM,ICSI-IM) CSI-IM Resource Mapping (KCSI-IM,ICSI-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table Table 1 reportQuantity Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | interval and offset | | <u> </u> |
| CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM Resource Mapping (4,9) CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset Slot S/1 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | CSI-IM resource | | |
| CSI-IM Resource Mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (kcsi-iM,lcsi-iM) CSI-IM Resource Mapping CSI-IM Resource Mapping CSI-IM Resource Mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Wideband | | | | Aperiodic |
| configuration Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig interval and offset CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | | Patten 0 |
| CSI-IM timeConfig interval and offset Slot Not configured | | | | |
| CSI-IM timeConfig interval and offset CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) CSI-IM TimeConfig interval and offset SIot SIot SIot SIot SIot SIot SIot SIo | configuration | | | (4,9) |
| interval and offset Slot Not configured CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset Slot S/1 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Value (4,9) (4,9) (4,9) (4,9) (4,9) (Aperiodic Table 1 Table 1 Not configured Not configured Wideband | | | | |
| CSI-IM RE pattern Patten 0 CSI-IM Resource Mapping (4,9) Configuration SI-IM timeConfig interval and offset Patten 0 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | slot | Not configured |
| CSI-IM mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig interval and offset slot 5/1 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | 1 | | Patten 0 |
| configuration (kcsl-IM, lcsl-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator (kcsl-IM, lcsl-IM) Slot 5/1 Aperiodic Cri-RI-PMI-CQI Not configured Not configured Wideband Wideband | | CSI-IM Resource | | |
| CSI-IM timeConfig interval and offset slot 5/1 ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | | (4,9) |
| Interval and offset Slot Slot Slot ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure Not configured timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Slot Slot CQI-table Table 1 ReportConfigType Aperiodic Table 1 Not configured Not configured Wideband Wideband PromatIndicator Wideband CQI-table Table 1 CQI-table Tabl | configuration | | | |
| ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | slot | 5/1 |
| CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | | Aperiodic |
| timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Wideband Wideband | CQI-table | | | Table 1 |
| ments Not configured timeRestrictionForInterferenceMeas urements Not configured viewents Not configured | | | | cri-RI-PMI-CQI |
| timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | | | | Not configured |
| cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband | timeRestrictionForInterferenceMeas | | | Not configured |
| pmi-FormatIndicator Wideband | | | | Wideband |
| | | | | |
| | | | RB | |

| csi-ReportingBa | ind | | 1111111 |
|-------------------------------------|---|------|---|
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Repoi | rt Slot Offset | | 4 |
| CSI request | | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSiz | <u>re</u> | | 1 |
| CSI-AperiodicTr | riggerStateList | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Cadabaak | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) |
| Codebook configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 6 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.1-6.1 FDD |
| | | • | · |

- Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).
- Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the eNB downlink before slot#(n+3).
- Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.1.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.2-2.

Table 6.3.2.1.2-1: Test parameters (dual-layer)

| Pa | rameter | Unit | Test 1 |
|---|--|------|--|
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | | | FDD |
| Propagation channel | | | TDLA30-5 |
| Antenna configi | uration | | High XP 8 x 2 |
| | | | (N1,N2) = (4,1) |
| Beamforming M | | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | · |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| | First subcarrier | | |
| ZP CSI-RS | index in the PRB | | Row 5, (4,-) |
| configuration | used for CSI-RS | | |
| | (k ₀ , k ₁) First OFDM | | |
| | symbol in the PRB | | |
| | used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | | |
| | interval and offset | slot | Not configured |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| | CSI-RS resource | | Aperiodic |
| | Type Number of CSI- | | |
| | RS ports (X) | | 8 |
| | CDM Type | | CDM4 (FD2, TD2) |
| | Density (ρ) | | 1 |
| NZP CSI-RS | First subcarrier | | |
| for CSI | index in the PRB | | Row 8, (4,6) |
| acquisition | used for CSI-RS | | 11011 0, (1,0) |
| | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB used for CSI-RS | | (5,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | | |
| | interval and offset | slot | Not configured |
| | | | 0 |
| | CSI-IM resource | | Aperiodic |
| | Type CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | 1 attern 0 |
| configuration | Mapping | | (4,9) |
| garamen | (kcsi-im,lcsi-im) | | (1,0) |
| | CSI-IM timeConfig | alat | Not configured |
| | interval and offset | slot | Not configured |
| ReportConfigTy | /pe | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasure ments | | | Not configured |
| timeRestrictionForInterferenceMeas urements | | | Not configured |
| | cqi-FormatIndicator | | Wideband |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | | | 1111111 |
| CSI-Report interval and offset | | slot | 5/1 |
| Aperiodic Report Slot Offset | | | 5 |
| | | | 1 in slots i, where $mod(i, 5) = 1$, |
| CSI request | CSI request | | otherwise it is equal to 0 |

| reportTriggerSize | | | 1 |
|-------------------------------------|---|----|---|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) |
| | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.1-6.2 |

For random precoder selection, the precoder shall be updated in each Note 1:

slot (1 ms granularity).

If the UE reports in an available uplink reporting instance at slot#n Note 2: based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the eNB downlink before

slot#(n+4).Randomization of the principle beam direction shall be used as

Note 3: specified in Annex B.2.3.2.3.

Table 6.3.2.1.2-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.3.2.2 **TDD**

Single PMI with 4TX TypeI-SinglePanel Codebook 6.3.2.2.1

For the parameters specified in Table 6.3.2.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.1-2.

Table 6.3.2.2.1-1: Test parameters (single layer)

| Parameter | | Unit | Test 1 |
|--|--|------|--|
| Bandwidth | | MHz | 40 |
| Subcarrier spacing Duplex Mode | | kHz | 30 TDD |
| • | | | FR1.30-1 as specified in |
| TDD DL-UI | L configuration | | Annex A |
| Propaga | Propagation channel | | TDLA30-5 |
| Antenna configuration | | | High XP 4 x 2 (N1,N2) = (2,1) |
| Beamforming Model | | | As specified in Annex B.4.1 |
| | CSI-RS resource | | Aperiodic |
| | Type Number of CSI- | | 1,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |
| | RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| | First subcarrier | | |
| ZP CSI-RS | index in the PRB used for CSI-RS | | Row 5, (4,-) |
| configuration | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB | | (9,-) |
| | used for CSI-RS (l ₀ , l ₁) | | (, , |
| | CSI-RS | | |
| | interval and offset | slot | Not configured |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| NZP CSI-RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (0,-) |
| acquisilion | First OFDM symbol in the PRB used for CSI-RS (lo, l1) | | (13,-) |
| | CSI-RS interval and offset | slot | Not configured |
| | aperiodicTriggerin gOffset | | 0 |
| | CSI-IM resource Type | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4,9) |
| | CSI-IM timeConfig interval and offset | slot | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity timeRestrictionForChannelMeasure | | | cri-RI-PMI-CQI |
| ments | | | Not configured |
| timeRestrictionForInterferenceMeas urements | | | Not configured |
| cqi-FormatIndicator | | | Wideband |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBand CSI-Report interval and offset | | slot | 1111111 Not configured |
| Aperiodic Report Slot Offset | | 0.00 | 8 |

| | | | 4.1 1 . 1 . 1 . 1/1 / 2) |
|---------------------------------|-------------------------------------|----|----------------------------------|
| CSI request | | | 1 in slots i, where mod(i, 10) = |
| ' | | | 1, otherwise it is equal to 0 |
| reportTriggerSiz | ze | | 1 |
| | | | One State with one Associated |
| | | | Report Configuration |
| CSI-AperiodicT | riggerStateList | | Associated Report |
| | | | Configuration contains pointers |
| | | | to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| | (CodebookConfig- N1,CodebookConf | | (2,1) |
| Codebook | ig-N2) | | (=, .) |
| configuration | (CodebookConfig- O1,CodebookCon | | (4,1) |
| | fig-O2) | | (', ') |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 5.5 |
| Maximum number of HARQ | | | 4 |
| transmission | | | 4 |
| Measurement channel | | | R.PDSCH.2-8.1 TDD |
| | | | · |

- Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity).
- Note 2: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the eNB downlink before slot#(n+4).
- Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.2.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.2.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.2-2.

Table 6.3.2.2.2-1: Test parameters (dual-layer)

| Parameter | | Unit | Test 1 |
|--|--|------|--|
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | | | TDD FR1.30-1 as specified in |
| TDD DL-UL configurations | | | Annex A |
| Propaga | tion channel | | TDLA30-5 |
| Antenna configuration | | | High XP 8 x 2 |
| Beamforming Model | | | (N1,N2) = (4,1) As specified in Annex B.4.1 |
| Беаппо | CSI-RS resource | | |
| | Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | • |
| | CDM Type Density (ρ) | | FD-CDM2 |
| | First subcarrier | | <u> </u> |
| ZP CSI-RS | index in the PRB | | Dow F (4.) |
| configuration | used for CSI-RS | | Row 5, (4,-) |
| Coringaration | (k ₀ , k ₁) | | |
| | First OFDM symbol in the PRB | | |
| | used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | Not configured |
| | interval and offset | 0.01 | - |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- RS ports (X) | | 8 |
| | CDM Type | | CDM4 (FD2, TD2) |
| | Density (ρ) | | 1 |
| NZP CSI-RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 8, (4,6) |
| acquicition | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (5,-) |
| | CSI-RS interval and offset | slot | Not configured |
| | aperiodicTriggerin gOffset | | 0 |
| | CSI-IM resource Type | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4,9) |
| | CSI-IM timeConfig interval and offset | slot | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForlChannelMeasur ements | | | Not configured |
| timeRestrictionForInterferenceMeas urements | | | Not configured |
| cqi-FormatIndicator | | | Wideband |
| pmi-FormatIndicator | | רכ | Wideband |
| Sub-band Size | | RB | 16 1111111 |
| csi-ReportingBand CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | | | 8 |

| CSI request | | | 1 in slots i, where mod(i, 10) = |
|-------------------------------------|---|----|--|
| reportTriggerSize | | | 1, otherwise it is equal to 0 |
| reportringgeron | 26 | | One State with one Associated |
| CSI-AperiodicTriggerStateList | | | Report Configuration Associated Report |
| | | | Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConf ig-N2) | | (4,1) |
| | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 6.5 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.2-8.2 TDD |

Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity).

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the eNB downlink before slot#(n+6).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.2.2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.1-2.

Table 6.3.3.1.1-1: Test parameters (single layer)

| Parameter | | Unit | Test 1 |
|---|--|------|--|
| Bandwidth | | MHz | 10 |
| Subcarrier space | eing | kHz | 15 |
| Duplex Mode Propagation channel | | | FDD TDLA30-5 |
| | | | High XP 4 x 4 |
| Antenna configuration | | | (N1,N2) = (2,1) |
| Beamforming M | | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | _ |
| | RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| | First subcarrier index in the PRB | | |
| ZP CSI-RS | used for CSI-RS | | Row 5, (4,-) |
| configuration | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | alat | Net configured |
| | interval and offset | slot | Not configured |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | FD-CDM2 |
| | CDM Type Density (p) | | 1 |
| | First subcarrier | | ' |
| NZP CSI-RS | index in the PRB | | Row 4, (0,-) |
| for CSI | used for CSI-RS | | 1.0w 4, (0,-) |
| acquisition | (k ₀ , k ₁) First OFDM | | |
| | symbol in the PRB | | (40.) |
| | used for CSI-RS | | (13,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS interval and offset | slot | Not configured |
| | aperiodicTriggerin | | |
| | gOffset | | 0 |
| | CSI-IM resource | | Aperiodic |
| | Type CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | 1 attern 0 |
| configuration | Mapping | | (4,9) |
| | (kcsi-im,lcsi-im) | | |
| | CSI-IM timeConfig interval and offset | slot | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasure ments | | | Not configured |
| timeRestrictionForInterferenceMeas | | | Not configured |
| urements cgi-FormatIndicator | | | |
| cqi-FormatIndicator pmi-FormatIndicator | | | Wideband Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | | | 1111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | | | 4 1 in slots i, where mod(i, 5) = 1, |
| CSI request | | | otherwise it is equal to 0 |

| reportTriggerSize | | | 1 | |
|--|---|--------------|---|--|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | |
| | Codebook Type | | typel-SinglePanel | |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) | |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) | |
| | CodebookSubset Restriction | | 11111111 | |
| | RI Restriction | | 0000001 | |
| Physical chann | nel for CSI report | | PUSCH | |
| CQI/RI/PMI de | , | ms | 6 | |
| Maximum num transmission | ber of HARQ | | 4 | |
| Measurement | channel | | R.PDSCH.1-6.1 FDD | |
| | | ction, the p | recoder shall be updated in each | |
| | | | k reporting instance at slot#n nk slot not later than slot#(n-3), | |
| this reported PMI cannot be applied slot#(n+3). | | e applied a | at the eNB downlink before | |
| Note 3: Randomization of the princ specified in Annex B.2.3.2. | | | unection shall be used as | |
| Parameter | | Unit | Test 1 | |

Table 6.3.3.1.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.2-2.

Table 6.3.3.1.2-1: Test parameters (dual-layer)

| Parameter | | Unit | Test 1 | |
|--|------------------------------------|------|--|--|
| Bandwidth | | MHz | 10 | |
| Subcarrier spacing | | kHz | 15 | |
| Duplex Mode | | | FDD | |
| Propagation channel | | | TDLA30-5 | |
| Antenna configuration | | | High XP 8 x 4 (N1,N2) = (4,1) | |
| Beamforming M | Beamforming Model | | As specified in Annex B.4.1 | |
| | CSI-RS resource | | | |
| | Type | | Aperiodic | |
| | Number of CSI- | | 4 | |
| | RS ports (X) | | · | |
| | CDM Type | | FD-CDM2 | |
| | Density (ρ) First subcarrier | | 1 | |
| | index in the PRB | | | |
| ZP CSI-RS | used for CSI-RS | | Row 5, (4,-) | |
| configuration | (k ₀ , k ₁) | | | |
| | First OFDM | | | |
| | symbol in the PRB | | (0.) | |
| | used for CSI-RS | | (9,-) | |
| | (l ₀ , l ₁) | | | |
| | CSI-RS | slot | Not configured | |
| | interval and offset | | | |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 | |
| | CSI-RS resource | | Aperiodic | |
| | Type Number of CSI- | | · | |
| | RS ports (X) | | 8 | |
| | CDM Type | | CDM4 (FD2, TD2) | |
| | Density (ρ) | | 1 | |
| | First subcarrier | | | |
| NZP CSI-RS | index in the PRB | | Row 8, (4,6) | |
| for CSI | used for CSI-RS | | 1100 0, (1,0) | |
| acquisition | (k ₀ , k ₁) | | | |
| | First OFDM symbol in the PRB | | | |
| | used for CSI-RS | | (5,-) | |
| | (l ₀ , l ₁) | | | |
| | CSI-RS | alat | Not configured | |
| | interval and offset | slot | Not configured | |
| | aperiodicTriggerin | | 0 | |
| | gOffset CSI-IM resource | | | |
| | Type | | Aperiodic | |
| | CSI-IM RE pattern | | Pattern 0 | |
| CSI-IM | CSI-IM Resource | | | |
| configuration | Mapping | | (4,9) | |
| | (kcsi-im,lcsi-im) | | () | |
| | CSI-IM timeConfig | slot | Not configured | |
| ReportConfigTy | interval and offset | | Aperiodic | |
| ReportConfigType CQI-table | | | Table 1 | |
| reportQuantity | | | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasure | | | Not configured | |
| ments timeRestrictionForInterferenceMeas | | | - | |
| urements | | | Not configured | |
| cqi-FormatIndicator | | | Wideband | |
| pmi-FormatIndicator | | | Wideband | |
| Sub-band Size | | RB | 8 | |
| csi-ReportingBand | | | 1111111 | |
| CSI-Report interval and offset | | slot | Not configured | |
| Aperiodic Report Slot Offset | | | 5 | |
| CSI request | | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 | |

| reportTriggerSiz | ze | | 1 | |
|-------------------------------------|---|----|---|--|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | |
| | Codebook Type | | typel-SinglePanel | |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) | |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) | |
| | CodebookSubset Restriction | | 0x FFFF | |
| | RI Restriction | | 0000010 | |
| Physical channel for CSI report | | | PUSCH | |
| CQI/RI/PMI delay | | ms | 8 | |
| Maximum number of HARQ transmission | | | 4 | |
| Measurement channel | | | R.PDSCH.1-6.2 FDD | |

Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).

If the UE reports in an available uplink reporting instance at slot#n Note 2: based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the eNB downlink before slot#(n+4).

Randomization of the principle beam direction shall be used as Note 3: specified in Annex B.2.3.2.3.

Table 6.3.3.1.2-2: Minimum requirement

| Parameter | Test 1 | |
|-----------|--------|--|
| γ | 1.5 | |

6.3.3.2 **TDD**

Single PMI with 4TX TypeI-SinglePanel Codebook 6.3.3.2.1

For the parameters specified in Table 6.3.3.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.1-2.

Table 6.3.3.2.1-1: Test parameters (single layer)

| Parameter | | Unit | Test 1 | |
|---|--|------|--|--|
| Bandwidth | | MHz | 40 | |
| | Subcarrier spacing | | 30 | |
| Duplex Mode | | | TDD | |
| TDD DL-UL configuration | | | FR1.30-1 as specified in Annex A | |
| Propagation cha | annel | | TDLA30-5 | |
| Antenna configu | uration | | High XP 4 x 4 | |
| | | | (N1,N2) = (2,1) | |
| Beamforming M | CSI-RS resource | | As specified in Annex B.4.1 | |
| | Type | | Aperiodic | |
| | Number of CSI- | | _ | |
| | RS ports (X) | | 4 | |
| | CDM Type | | FD-CDM2 | |
| | Density (ρ) | | 1 | |
| | First subcarrier | | | |
| ZP CSI-RS | index in the PRB | | Row 5, (4,-) | |
| configuration | used for CSI-RS | | / / / / | |
| | (k ₀ , k ₁) First OFDM | | | |
| | symbol in the PRB | | | |
| | used for CSI-RS | | (9,-) | |
| | (l ₀ , l ₁) | | | |
| | CSI-RS | -1-4 | Niet eerfierend | |
| | interval and offset | slot | Not configured | |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 | |
| | CSI-RS resource Type | | Aperiodic | |
| | Number of CSI- | | _ | |
| | RS ports (X) | | 4 | |
| | CDM Type | | FD-CDM2 | |
| | Density (ρ) | | 1 | |
| NZP CSI-RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (0,-) | |
| | First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) | | (13,-) | |
| | CSI-RS interval and offset | | Not configured | |
| | aperiodicTriggerin gOffset | | 0 | |
| | CSI-IM resource Type | | Aperiodic | |
| | CSI-IM RE pattern | | Pattern 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping | | (4,9) | |
| | (kcsi-im,lcsi-im) CSI-IM timeConfig | slot | Not configured | |
| interval and offset ReportConfigType | | | Aperiodic | |
| CQI-table | | | Table 1 | |
| reportQuantity | | | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasure | | | | |
| ments | | | Not configured | |
| timeRestrictionForInterferenceMeas urements | | | Not configured | |
| cqi-FormatIndicator | | | Wideband | |
| pmi-FormatIndicator | | | Wideband | |
| Sub-band Size | | RB | 16 | |
| csi-ReportingBand | | | 1111111 | |
| CSI-Report inte | | slot | Not configured | |
| Aperiodic Report Slot Offset | | | 8 | |

| CSI request | | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 | |
|-------------------------------------|---|----|---|--|
| reportTriggerSize | | | 1 | |
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | |
| | Codebook Type | | typel-SinglePanel | |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) | |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) | |
| | CodebookSubset Restriction | | 11111111 | |
| RI Restriction | | | 0000001 | |
| Physical channel for CSI report | | | PUSCH | |
| CQI/RI/PMI delay | | ms | 5.5 | |
| Maximum number of HARQ transmission | | | 4 | |
| Measurement channel | | | R.PDSCH.2-8.1 TDD | |

Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity).

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the eNB downlink before slot#(n+4).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.3.2.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.2-2.

Table 6.3.3.2.2-1: Test parameters (dual-layer)

| Parameter | | Unit | Test 1 | |
|---|--|------|--|--|
| Bandwidth | | MHz | 40 | |
| Subcarrier spacing | | kHz | 30 | |
| Duplex Mode | | | TDD | |
| TDD DL-UL configurations | | | FR1.30-1 as specified in Annex A | |
| Propagation cha | annel | | TDLA30-5 | |
| Antenna configu | ıration | | High XP 8 x 4 | |
| • | | | (N1,N2) = (4,1) | |
| Beamforming M | CSI-RS resource | | As specified in Annex B.4.1 | |
| | Type | | Aperiodic | |
| | Number of CSI- | | 4 | |
| | RS ports (X) | | | |
| | CDM Type | | FD-CDM2 | |
| | Density (ρ) First subcarrier | | 1 | |
| | index in the PRB | | | |
| ZP CSI-RS | used for CSI-RS | | Row 5, (4,-) | |
| configuration | (k_0, k_1) | | | |
| | First OFDM | | | |
| | symbol in the PRB | | (9,-) | |
| | used for CSI-RS | | (6,) | |
| | (l ₀ , l ₁) CSI-RS | | | |
| | interval and offset | slot | Not configured | |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 | |
| | CSI-RS resource | | Aperiodic | |
| | Туре | | Aperiodic | |
| | Number of CSI- RS ports (X) | | 8 | |
| | CDM Type | | CDM4 (FD2, TD2) | |
| | Density (ρ) | | 1 | |
| | First subcarrier | | | |
| NZP CSI-RS | index in the PRB | | Row 8, (4,6) | |
| for CSI | used for CSI-RS | | 1.0w 0, (4,0) | |
| acquisition | (k ₀ , k ₁) First OFDM | | | |
| | symbol in the PRB | | | |
| | used for CSI-RS | | (5,-) | |
| | (l ₀ , l ₁) | | | |
| | CSI-RS | slot | Not configured | |
| | interval and offset | 0.01 | Tret cormigui ca | |
| | aperiodicTriggerin gOffset | | 0 | |
| | CSI-IM resource | | | |
| | Туре | | Aperiodic | |
| | CSI-IM RE pattern | | Pattern 0 | |
| CSI-IM | CSI-IM Resource | | | |
| configuration | Mapping | | (4,9) | |
| | (k _{CSI-IM} , l _{CSI-IM}) | | | |
| CSI-IM timeConfig interval and offset | | slot | Not configured | |
| ReportConfigType | | | Aperiodic | |
| CQI-table CQI-table | | | Table 1 | |
| reportQuantity | | | cri-RI-PMI-CQI | |
| timeRestrictionForChannnelMeasur ements | | | Not configured | |
| timeRestrictionForInterferenceMeas | | | Not configured | |
| urements | | | _ | |
| cqi-FormatIndicator | | | Wideband Wideband | |
| pmi-FormatIndicator Sub-band Size | | RB | 16 | |
| csi-ReportingBand | | 1.0 | 1111111 | |
| CSI-Report inte | rval and offset | slot | Not configured | |
| Aperiodic Repo | | | 8 | |

| | | | 4.1. 1. 1. 1. 1/1.40 | |
|---------------------------------|------------------|----|----------------------------------|--|
| CSI request | | | 1 in slots i, where mod(i, 10) = | |
| ' | | | 1, otherwise it is equal to 0 | |
| reportTriggerSiz | ze | | 1 | |
| | | | One State with one Associated | |
| | | | Report Configuration | |
| CSI-AperiodicT | riggerStateList | | Associated Report | |
| | | | Configuration contains pointers | |
| | | | to NZP CSI-RS and CSI-IM | |
| | Codebook Type | | typel-SinglePanel | |
| | Codebook Mode | | 1 | |
| | (CodebookConfig- | | | |
| | N1,CodebookConf | | (4,1) | |
| Codebook | ig-N2) | | | |
| configuration | (CodebookConfig- | | | |
| Corniguration | O1,CodebookCon | | (4,1) | |
| | fig-O2) | | | |
| | CodebookSubset | | 0x FFFF | |
| | Restriction | | UX FFFF | |
| | RI Restriction | | 0000010 | |
| Physical channel for CSI report | | | PUSCH | |
| CQI/RI/PMI delay | | ms | 6.5 | |
| Maximum number of HARQ | | | 4 | |
| transmission | | | 4 | |
| Measurement channel | | | R.PDSCH.2-8.2 TDD | |
| | | | | |

For random precoder selection, the precoder shall be updated in each Note 1:

slot (0.5 ms granularity).

If the UE reports in an available uplink reporting instance at slot#n Note 2: based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the eNB downlink before slot#(n+6).

Note 3: Randomization of the principle beam direction shall be used as

specified in Annex B.2.3.2.3.

Table 6.3.3.2.2-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.4 Reporting of Rank Indicator (RI)

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

1RX requirements 6.4.1

(Void)

6.4.2 2RX requirements

6.4.2.1 **FDD**

The minimum performance requirement in Table 6.4.2.1-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.1-2.

Table 6.4.2.1-1: RI Test (FDD)

| Parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---------------------------------|---|------|----------------|-------------------|-------------------|
| Bandwidth | | MHz | 10 | 10 | 10 |
| | Subcarrier spacing | | 15 | 15 | 15 |
| Duplex Mode | | | FDD | FDD | FDD |
| SNR | | dB | 0 | 20 | 20 |
| Propagation of | | | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | guration | | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| Beamforming | Model | | As defined in | As defined in | As defined in |
| | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| ZP CSI-RS | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| | Density (p) First subcarrier index in the | | 1 | 1 | 1 |
| configuratio n | PRB used for CSI-RS (k ₀ , k ₁) | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| '' | First OFDM symbol in the PRB | | | | |
| | used for CSI-RS (I ₀ , I ₁) | | (9,-) | (9,-) | (9,-) |
| | CSI-RS | | | | _,, |
| | periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 |
| NZD OOL | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- RS for CSI | Density (ρ) | | 1 | 1 | 1 |
| acquisition | First subcarrier index in the | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| | PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB | | - (-,) | - (-, / | - (-, / |
| | used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig | | | | |
| | periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| 001.154 | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM configuratio | CSI-IM Resource Mapping | | (4.0) | (4.0) | |
| n | (kcsi-im,lcsi-im) | | (4,9) | (4,9) | (4,9) |
| " | CSI-IM timeConfig periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| ReportConfig | | | Periodic | Periodic | Periodic |
| CQI-table | .,,,,, | | Table 2 | Table 2 | Table 2 |
| | | | | cri-RI-PMI- | cri-RI-PMI- |
| reportQuantity | / | | cri-RI-PMI-CQI | CQI | CQI |
| timeRestrictio | nForChannelMeasurements | | not configured | not configured | not configured |
| | | | | not | not |
| timeRestrictio | nForInterferenceMeasurements | | not configured | configured | configured |
| cqi-FormatInd | licator | | Wideband | Wideband | Wideband |
| pmi-FormatIn | | | Wideband | Wideband | Wideband |
| Sub-band Siz | e | RB | 8 | 8 | 8 |
| csi-Reportingl | Band | | 1111111 | 1111111 | 1111111 |
| CSI-Report pe | eriodicity and offset | slot | 5/5 | 5/5 | 5/5 |
| | Codebook Type | | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| Codobools | (CodebookConfig- | | N/A | N/A | N/A |
| Codebook configuration | N1,CodebookConfig-N2) CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for |
| Comiguration | CodebookSubsetRestriction | | fixed rank 2, | fixed rank 1, | fixed rank 1, |
| | | | 010011 for | 010011 for | 010011 for |
| | | | following rank | following rank | following rank |
| | RI Restriction | | N/A | N/A | N/A |
| Physical channel for CSI report | | | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI de | | ms | 8 | 8 | 8 |
| | Maximum number of HARQ transmission | | 1 | 1 | 1 |
| RI Configurati | on | | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 |
| 7.1 Johngurati | <u></u> | | and follow RI | and follow RI | and follow RI |

Table 6.4.2.1-2: Minimum requirement (FDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 71 | N/A | 1.05 | 0.9 |
| 72 | 1.0 | N/A | N/A |

6.4.2.2 TDD

The minimum performance requirement in Table 6.4.2.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.2-2.

Table 6.4.2.2-1: RI Test (TDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 |
|---------------------|--|------|----------------|-------------------|-------------------|
| Bandwidth | r dramotor | MHz | 40 | 40 | 40 |
| Subcarrier sp | acing | kHz | 30 | 30 | 30 |
| Duplex Mode | <u>J</u> | | TDD | TDD | TDD |
| TDD Slot Cor | figuration | | FR1.30-1 | FR1.30-1 | FR1.30-1 |
| SNR | • | dB | 0 | 20 | 20 |
| Propagation of | hannel | | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna conf | guration | | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| Doomforming | Madal | | As defined in | As defined in | As defined in |
| Beamforming | Model | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 |
| configuratio n | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| | First OFDM symbol in the PRB | | (9,-) | (9,-) | (9,-) |
| | used for CSI-RS (I ₀ , I ₁) | | (0,) | (0,) | (0,) |
| | CSI-RS | slot | 10/1 | 10/1 | 10/1 |
| | periodicity and offset | | Daviadia | Daviadia | Daviadia |
| | CSI-RS resource Type Number of CSI-RS ports (X) | | Periodic 2 | Periodic 2 | Periodic 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- | Density (ρ) | | 1 | 1 | 1 |
| RS for CSI | First subcarrier index in the | | I I | ı | • |
| acquisition | PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 | 10/1 | 10/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| 001.114 | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM configuratio | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4,9) | (4,9) | (4,9) |
| n | CSI-IM timeConfig periodicity and offset | slot | 10/9 | 10/9 | 10/9 |
| ReportConfig | | | Periodic | Periodic | Periodic |
| CQI-table | -71 | | Table 2 | Table 2 | Table 2 |
| | | | : DI DI II 001 | cri-RI-PMI- | cri-RI-PMI- |
| reportQuantity | / | | cri-RI-PMI-CQI | CQI | CQI |
| timeRestrictio | nForChannelMeasurements | | not configured | not configured | not configured |
| timeRestrictio | nForInterferenceMeasurements | | not configured | not configured | not configured |
| cqi-FormatInd | licator | | Wideband | Wideband | Wideband |
| pmi-Formatin | | | Wideband | Wideband | Wideband |
| Sub-band Siz | | RB | 16 | 16 | 16 |
| csi-Reporting | | | 1111111 | 1111111 | 1111111 |
| | eriodicity and offset | slot | 10/1 | 10/1 | 10/1 |
| 22 | Codebook Type | | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | N/A | N/A | N/A |
| configuration | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for |
| | | | fixed rank 2, | fixed rank 1, | fixed rank 1, |
| | | | 010011 for | 010011 for | 010011 for |
| | | | following rank | following rank | following rank |
| | RI Restriction | | N/A | N/A | N/A |
| | nel for CSI report | | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI d | | ms | 9.5 | 9.5 | 9.5 |
| Maximum nur | nber of HARQ transmission | | 1 | 1 | 1 |
| RI Configurati | ion | | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 |
| 13 Comiguration | | | and follow RI | and follow RI | and follow RI |

Table 6.4.2.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 21 | N/A | 1.05 | 0.9 |
| 72 | 1.0 | N/A | N/A |

6.4.3 4RX requirements

6.4.3.1 FDD

The minimum performance requirement in Table 6.4.3.1-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.3.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.1-2.

Table 6.4.3.1-1: RI Test (FDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|-----------------|--|---------|----------------|------------------------|------------------------|---------------------------------------|
| Bandwidth | | MHz | 10 | 10 | 10 | 10 |
| Subcarrier spa | acing | kHz | 15 | 15 | 15 | 15 |
| Duplex Mode | | | FDD | FDD | FDD | FDD |
| SNR | | dB | -2 | 16 | 16 | 22 |
| Propagation c | | | TDLA30-5 | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | guration | | ULA Low 2x4 | ULA Low 2x4 | ULA High 2x4 | ULA Low 4x4 |
| Beamforming | Model | | As defined in | As defined in | As defined in | As defined in |
| Deamlonning | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 | 1 |
| configuratio | First subcarrier index in the | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| n | PRB used for CSI-RS (k ₀ , k ₁) | | 110W 3, (+,-) | 110W 3, (+,-) | 110W 3, (+,-) | 110W 3, (+,-) |
| | First OFDM symbol in the PRB | | (9,-) | (9,-) | (9,-) | (9,-) |
| ļ | used for CSI-RS (I ₀ , I ₁) | | (0,) | (0,) | (0,) | (0,) |
| | CSI-RS | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| | periodicity and offset | 0.01 | | | | |
| - | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 | 4 |
| NZP CSI- | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| RS for CSI | Density (ρ) | | 1 | 1 | 1 | 1 |
| acquisition | First subcarrier index in the | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) | Row 4 (0,-) |
| aoquiomon | PRB used for CSI-RS (k ₀ , k ₁) | | 11011 0 (0,) | 11011 0 (0,) | 11011 0 (0,) | 11011 1 (0,) |
| | First OFDM symbol in the PRB | | (13,-) | (13,-) | (13,-) | (13,-) |
| - | used for CSI-RS (I ₀ , I ₁) | | (10,) | (10,) | (10,) | (10,) |
| | NZP CSI-RS-timeConfig | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| | periodicity and offset | | | | | |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic | Periodic |
| CSI-IM | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 | Pattern 0 |
| configuratio | CSI-IM Resource Mapping | | (4,9) | (4,9) | (4,9) | (4,9) |
| n Š | (KCSI-IM, ICSI-IM) | | (, , | (, , | (, , | |
| | CSI-IM timeConfig | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| DanartCartin | periodicity and offset | | Daviadia | Periodic | Daviadia | Daviadia |
| ReportConfig | туре | | Periodic | | Periodic | Periodic |
| CQI-table | | | Table 2 | Table 2 cri-RI-PMI- | Table 2 cri-RI-PMI- | Table 2 cri-RI-PMI- |
| reportQuantity | <i>'</i> | | cri-RI-PMI-CQI | CQI | CII-RI-PIVII- CQI | CII-RI-PIVII- CQI |
| | | | | not | not | not |
| timeRestriction | nForChannelMeasurements | | not configured | configured | configured | configured |
| | | | | not | not | not |
| timeRestriction | nForInterferenceMeasurements | | not configured | configured | configured | configured |
| cqi-FormatInd | icator | | Wideband | Wideband | Wideband | Wideband |
| pmi-FormatIng | | | Wideband | Wideband | Wideband | Wideband |
| Sub-band Size | | RB | 8 | 8 | 8 | 8 |
| csi-Reporting | | | 1111111 | 1111111 | 1111111 | 1111111 |
| | eriodicity and offset | slot | 5/5 | 5/5 | 5/5 | 5/5 |
| 23. Hoport pe | Codebook Type | 3.00 | typel- | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 | 1 |
| | (CodebookConfig- | | | | | · · · · · · · · · · · · · · · · · · · |
| | N1,CodebookConfig-N2) | | N/A | N/A | N/A | (2,1) |
| | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for | |
| Codebook | | | fixed rank 2, | fixed rank 1, | fixed rank 1, | 11111111 |
| configuration | | | 010011 for | 010011 for | 010011 for | 111111111 |
| | | <u></u> | following rank | following rank | following rank | |
| | RI Restriction | | | | | 00000010 for |
| | | | | | | fixed Rank 2 |
| | | | N/A | N/A | N/A | and |
| | | | | | | 00001111 for |
| | | | | | _,, | follow RI |
| | nel for CSI report | | PUCCH | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI de | | ms | 8 | 8 | 8 | 8 |
| Maximum nun | nber of HARQ transmission | | 1 | 1 | 1 | 1 |

| DI Configuration | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 | Fixed RI = 2 |
|------------------|---------------|---------------|---------------|---------------|
| RI Configuration | and follow RI | and follow RI | and follow RI | and follow RI |

Table 6.4.3.1-2: Minimum requirement (FDD)

| | Test 1 | Test 2 | Test 3 | Test 4 |
|------------|--------|--------|--------|--------|
| <i>7</i> 1 | N/A | 1.05 | 0.9 | N/A |
| 72 | 0.9 | N/A | N/A | 0.9 |

6.4.3.2 TDD

The minimum performance requirement in Table 6.4.3.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.3.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.2-2.

Table 6.4.3.2-1: RI Test (TDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|---------------------|--|------|-------------------|-------------------|-------------------|-------------------|
| Bandwidth | | MHz | 40 | 40 | 40 | 40 |
| Subcarrier sp | acing | kHz | 30 | 30 | 30 | 30 |
| Duplex Mode | | | TDD | TDD | TDD | TDD |
| TDD Slot Con | figuration | | FR1.30-1 | FR1.30-1 | FR1.30-1 | FR1.30-1 |
| SNR | | dB | -2 | 16 | 16 | 22 |
| Propagation of | | | TDLA30-5 | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | iguration | | ULA Low 2x4 | ULA Low 2x4 | ULA High 2x4 | ULA Low 4x4 |
| Beamforming | Model | | As defined in | As defined in | As defined in | As defined in |
| Dearmonning | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 | 1 |
| configuratio | First subcarrier index in the | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| n | PRB used for CSI-RS (k ₀ , k ₁) | | 11011 0, (1,) | 110W 0, (1,) | 1100 0, (1,) | 11011 0, (1,) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (9,-) | (9,-) | (9,-) | (9,-) |
| | CSI-RS | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| | periodicity and offset CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 | 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- | Density (ρ) | | 1 | 1 | 1 D-0DIVIZ | 1 0-001012 |
| RS for CSI | First subcarrier index in the | | ' | ' | ' | ' |
| acquisition | PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) | Row 4 (0,-) |
| a o qui o i i o i i | First OFDM symbol in the PRB | | | | | |
| | used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig | | 10/1 | 10/1 | 10/1 | 10/1 |
| | periodicity and offset | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic | Periodic |
| CSI-IM | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 | Pattern 0 |
| configuratio n | CSI-IM Resource Mapping (k _{CSI-IM} , l _{CSI-IM}) | | (4,9) | (4,9) | (4,9) | (4,9) |
| 11 | CSI-IM timeConfig periodicity and offset | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| ReportConfig | Type | | Periodic | Periodic | Periodic | Periodic |
| CQI-table | | | Table 2 | Table 2 | Table 2 | Table 2 |
| reportQuantity | V | | cri-RI-PMI-CQI | cri-RI-PMI- | cri-RI-PMI- | cri-RI-PMI- |
| roportadantit | , | | 011 TU 1 TU 1 GQ1 | CQI | CQI | CQI |
| timeRestrictio | nForChannelMeasurements | | not configured | not configured | not configured | not configured |
| timeRestrictio | nForInterferenceMeasurements | | not configured | not configured | not configured | not configured |
| cqi-FormatInd | | | Wideband | Wideband | Wideband | Wideband |
| pmi-FormatIn | | | Wideband | Wideband | Wideband | Wideband |
| Sub-band Siz | | RB | 16 | 16 | 16 | 16 |
| csi-Reporting | | | 1111111 | 1111111 | 1111111 | 1111111 |
| CSI-Report pe | eriodicity and offset | slot | 10/9 | 10/9 | 10/9 | 10/9 |
| | Codebook Type | | typel- | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 | 1 |
| | (CodebookConfig- N1,CodebookConfig-N2) | | N/A | N/A | N/A | (2,1) |
| | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for | |
| Codebook | 2 3 4 3 5 CH CONTROL C | | fixed rank 2, | fixed rank 1, | fixed rank 1, | |
| configuration | | | 010011 for | 010011 for | 010011 for | 11111111 |
| g: | | | following rank | following rank | following rank | |
| | RI Restriction | | <u> </u> | <u> </u> | <u> </u> | 00000010 for |
| | | | | | | fixed Rank 2 |
| | | | N/A | N/A | N/A | and |
| | | | | | | 00001111 for |
| | | | | | | follow RI |
| | nnel for CSI report | | PUCCH | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI d | | ms | 9.5 | 9.5 | 9.5 | 9.5 |
| Maximum nur | nber of HARQ transmission | 1 | 1 1 | 1 | 1 1 | 1 |

| DI Configuration | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 | Fixed RI = 2 |
|------------------|---------------|---------------|---------------|---------------|
| RI Configuration | and follow RI | and follow RI | and follow RI | and follow RI |

Table 6.4.3.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 | Test 4 |
|----|--------|--------|--------|--------|
| 21 | N/A | 1.05 | 0.9 | N/A |
| 12 | 0.9 | N/A | N/A | 0.9 |

7 Demodulation performance requirements (Radiated requirements)

7.1 General

7.1.1 Applicability of requirements

7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with F_{DL_high} not exceeding 40000 MHz.

The minimum performance requirements in Clause 7 are mandatary for UE supporting NR operation, except test cases listed in Clause 7.1.1.3, 7.1.1.4.

7.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 7.1.1.2-1.

Table 7.1.1.2-1: Requirements applicability

| Supported RX antenna ports | Test type | Test list |
|----------------------------|-----------|---------------------------|
| UE supports 2RX | PDSCH | All tests in Clause 7.2.2 |
| antenna ports | PDCCH | All tests in Clause 7.3.2 |
| | PBCH | All tests in Clause 7.4.2 |

7.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 7.1.1.3-1 shall apply for UEs which support optional UE features only...

Table 7.1.1.3-1: Requirements applicability for optional UE features

| UE feature/capability [14] | Test type | | eature/capability [14] Test type Test list | | Applicability notes | |
|--|-------------|-------|--|--|---------------------|--|
| SU-MIMO Interference Mitigation advanced receiver | FR2 TDD | PDSCH | 7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A (Test 3- 1) | | | |
| Basic DL NR-NR CA operation (supportedBandCombinationList) | NR-NR CA | SDR | 7.5A.1 FR2 CA requirements | 1)Up to 16 DL carriers 2)Same numerology across carrier for data/control channel at a given time | | |

7.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 7.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

.

Table 7.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|---------|-------|--|--|
| Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH) | FR2 TDD | PDSCH | 7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A (Test 2-1 to 2-6) | |
| Support of PT-RS with one antenna port for DL reception (onePortsPTRS) | FR2 TDD | PDSCH | All test cases in Clause 7.2 All test cases in Clause 7.5 | |
| PCell operation | FR2 TDD | SDR | All SDR CA test cases in section 7.5A.1 with PCell on FR2 | PCell operation on FR2 (pCell-FR2) |
| Supported max number of ports across all configured NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros sNZP-CSI-RS-PerCC) | FR2 TDD | SDR | All SDR test cases with max number of ports across all configured NZP-CSI-RS resources per CC larger than 2. | The requirements apply only in case the number of NZP- CSI-RS ports in the test case does not exceed UE maximum number of NZP-CSI- RS ports capability |

7.2 PDSCH demodulation requirements

The parameters specified in Table 7.2-1 are valid for all PDSCH demodulation tests unless otherwise stated.

Table 7.2-1: Common Test Parameters

| | Parameter | Unit | Value |
|----------------------------|---|-------|--|
| PDSCH transmission | scheme | | Transmission scheme 1 |
| PTRS epre-Ratio | T | | 0 |
| Actual carrier | Offset between Point A and the lowest usable | RBs | 0 |
| configuration | subcarrier on this carrier (Note 2) | kHz | 60 or 120 |
| | Subcarrier spacing | KHZ | Normal |
| | Cyclic prefix RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Common serving | Physical Cell ID | | 0 |
| cell parameters | SSB position in burst | | 1 |
| celi parameters | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | | 0 |
| PDCCH | Number of PRBs in CORESET | | Table 7.2-2 for tested channel bandwidth and subcarrier spacing |
| configuration | Number of PDCCH candidates and aggregation levels | | 1/AL8 |
| | CCE-to-REG mapping type | | Non-interleaved |
| | DCI format | | 1_1 |
| | TCI state | | TCI state #1 |
| Cross carrier schedul | | | Not configured |
| | First subcarrier index in the PRB used for CSI-RS (<i>k</i> ₀) | | 0 for CSI-RS resource 1,2,3,4 |
| | First OFDM symbol in the PRB used for CSI-RS (Io) | | 6 for CSI-RS resource 1 and 3 10 for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |
| | CDM Type | | 'No CDM' for CSI-RS resource 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 60 kHz SCS: 80 for CSI- RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| | CSI-RS offset | Slots | 60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource |
| | Frequency Occupation | | 3 and 4 Start PRB 0 Number of PRB = BWP size |
| | QCL info | | TCI state #0 |
| NZP CSI-RS for | First subcarrier index in the PRB used for CSIRS (k_0) | | 0 |
| CSI acquisition | First OFDM symbol in the PRB used for CSI-RS (Io) | | 12 |
| | Number of CSI-RS ports (X) | | 2 |

| | CDM Type | | | FD-CDM2 |
|--------------------------|---------------------------------------|---------------------------------|-------|---|
| | CDM Type Density (ρ) | | | 1 1 |
| | CSI-RS periodi | icity | Slots | 60 kHz SCS: 80 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occ | cupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| | First subcarrier RS (k ₀) | index in the PRB used for CSI- | | 4 |
| | First OFDM syl | mbol in the PRB used for CSI-RS | | 12 |
| | Number of CSI | -RS ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | | | FD-CDM2 |
| acquisition | Density (ρ) | | | 1 |
| | CSI-RS period | icity | Slots | 60 kHz SCS: 80 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occ | - | | Start PRB 0 Number of PRB = BWP size |
| | | index in the PRB used for CSI- | | k ₀ =0 for CSI-RS |
| | RS | | | resource 1,2 I ₀ = 8 for CSI-RS |
| | | | | resource 1 |
| | First OFDM sy | mbol in the PRB used for CSI-RS | | l ₀ = 9 for CSI-RS |
| | | | | resource 2 |
| | Number of CSI | -RS ports (X) | | 1 for CSI-RS resource 1.2 |
| | CDM Type | | | 'No CDM' for CSI-RS |
| CSI-RS for beam | CDW Type | | | resource 1,2 |
| refinement | Density (ρ) | | | 3 for CSI-RS resource 1.2 |
| | CSI-RS period | icity | Slots | 60 kHz SCS: 80 for CSI- RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 |
| | CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| | Repetition | | | ON |
| | QCL info | | | TCI state #1 |
| | Antenna ports | indexes | | {1000} for Rank 1 tests {1000, 1001} for Rank 2 tests |
| PDSCH DMRS configuration | Position of the type A | first DMRS for PDSCH mapping | | 2 |
| | Number of PDS | SCH DMRS CDM group(s) without | | 1 |
| | Type 1 QCL | SSB index | | SSB #0 |
| TOLetete #0 | information | QCL Type | | Type C |
| TCI state #0 | Type 2 QCL | SSB index | | SSB #0 |
| | information | QCL Type | | Type D |
| | Type 1 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| TCI state #1 | | QCL Type | | Type A |
| | Type 2 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' |
| | | | | configuration |

| | QCL Type | | Type D | | | |
|------------------------------------|---|---------------|------------------------|--|--|--|
| | Frequency density (K _{PT-RS}) | | 2 | | | |
| PTRS configuratio | Time density (<i>L_{PT-RS}</i>) | | 1 | | | |
| | Resource Element Offset | | 2 | | | |
| Maximum number | of code block groups for ACK/NACK feedback | | 1 | | | |
| Maximum number | of HARQ transmission | | 4 | | | |
| HARQ ACK/NACK | bundling | | Multiplexed | | | |
| Redundancy version coding sequence | | | {0,2,3,1} | | | |
| | | | SP Type I, Random per | | | |
| Precoding configu | ation | | slot with PRB bundling | | | |
| | | | granularity | | | |
| Symbols for all un | ised REs | | OCNG in Annex A.5 | | | |
| Note 1: UE assi | imes that the TCI state for the PDSCH is identical to th | e TCI state a | pplied for the PDCCH | | | |
| transmi | ssion. | | | | | |
| | Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. | | | | | |

Table 7.2-2: Number of PRBs in CORESET

| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
|-----------|--------|---------|---------|---------|
| 60 | 66 | 132 | 264 | N.A |
| 120 | 30 | 66 | 132 | 264 |

7.2.1 1RX requirements

(Void)

7.2.2 2RX requirements

7.2.2.1 FDD

(Void)

7.2.2.2 TDD

7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A

For PDSCH Type-A scheduling, the requirements are specified in Table 7.2.2.2.1-3, 7.2.2.2.1-4 and 7.2.2.2.1-5, with the addition of the parameters in Table 7.2.2.2.1-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type-A scheduling.

The test purposes are specified in Table 7.2.2.1.1-1.

Table 7.2.2.1.1-1: Tests purpose

| Purpose | Test index |
|---|--|
| Verify the PDSCH mapping Type A normal performance | 1-1, 1-3, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6 |
| under 2 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-2 |
| performance under 2 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 3-1 |
| requirements for Enhanced Receiver Type 1 under 2 | |
| receive antenna conditions. | |

Table 7.2.2.2.1-2: Test Parameters

| Parameter | | | Value |
|---|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | | | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | For Test 1-1 and 1-2: 3 for CSI-RS resource 1 and 3 7 for CSI-RS resource 2 and 4 |
| | CSI-RS offset | Slots | For Test 1-2: 82 for CSI-RS resource 1 and 2 83 for CSI-RS resource 3 and 4 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels | | 1/AL4 for Test 2-3 1/AL8 for other tests |
| | Mapping type k0 Starting symbol (S) Length (L) PDSCH aggregation factor PRB bundling type PRB bundling size | | Type A 0 1 Specific to each Reference channel as defined in A.3.2.2 1 Static WB for Test 1-1, 2 for other tests |
| PDSCH configuration | Resource allocation type RBG size | | Test 2-1: Type 1 with start RB = 30, L _{RBs} = 6 Other tests: Type 0 Test 2-1: N/A Other tests: Config2 |
| | VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle size | | Non-interleaved N/A |
| PDSCH DMRS configuration | DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS | | Type 1 1 1 |
| Number of HARQ Process | ses | | 8 for Test 1-1, 1-3, 2-2, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2 |
| The number of slots between information | een PDSCH and corresponding HARQ-ACK | | As defined in Annex A.1.3 |

Table 7.2.2.2.1-3: Minimum performance for Rank 1 (FRC)

| | | | | | | | | Correlation | Reference | value |
|-------------|--------------------------|---|---------------------------------|--------------------------|---------------------------|--|-------------------------------------|------------------------------------|-----------|-------|
| Test num | Referenc e channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL- DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughpu t (%) | SNR _B _B (dB) | | |
| 1-1 | R.PDSCH .5-1.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.120- 1A | TDLC60- 300 | 2x2 ULA Low | 70 | -0.4 | | |
| 1-2 | R.PDSCH .5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120- 1 | TDLA30- 300 | 2x2 ULA Low | 30 | 1.7 | | |
| 1-3 | R.PDSCH .5-3.1 TDD | 100 / 120 | 64QAM, 0.46 | FR2.120- 1 | TDLA30- 300 | 2x2 XPL Medium-A | 70 | 12.4 | | |

Table 7.2.2.2.1-4: Minimum performance for Rank 2 (FRC)

| | | Bandwidth | | | | Correlation | Reference value | |
|-------------|-----------------------|---|---------------------------------|-------------------------|------------------------------|--|---|------------------------|
| Test num | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL-DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughp ut (%) | SNR _{BB} (dB) |
| 2-1 | R.PDSCH. 5-4.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 4.1 |
| 2-2 | R.PDSCH. 5-2.2 TDD | 100 / 120 | 16QAM, 0.48 | FR2.12 0-1 | TDLA30- 300 | 2x2 ULA Low | 70 | 14.4 |
| 2-3 | R.PDSCH. 5-5.2 TDD | 50 / 120 | 16QAM,0.4 8 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 14.0 |
| 2-4 | R.PDSCH. 5-2.3 TDD | 200 / 120 | 16QAM, 0.48 | FR2.12 0-1 | TDLA30- 300 | 2x2 ULA Low | 70 | 14.2 |
| 2-5 | R.PDSCH. 4-1.1 TDD | 50 / 60 | 16QAM, 0.48 | FR2.60- 1 | TDLA30-75 | 2x2 ULA Low | 70 | 14.3 |
| 2-6 | R.PDSCH. 5-6.1 TDD | 100 / 120 | 64QAM, 0.43 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 18.6 |

Table 7.2.2.2.1-5: Minimum performance for Rank 2 (FRC) for Enhanced Receiver Type 1

| | | Bandwidt | | | | Correlation | Reference | value |
|-------------|-----------------------|---|---------------------------------|--------------------------|---------------------------|--|-------------------------------------|---------------------------------------|
| Test num | Reference channel | h (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL- DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughpu t (%) | SNR _B _B (dB) |
| 3-1 | R.PDSCH.5 -5.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120 -2 | TDLA30-75 | 2x2 ULA Medium | 70 | 19.0 |

7.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 7.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 7.3-1: Common test Parameters

| | Parameter | | Unit | Value |
|-------------------------|-------------------------------|--------------------------------|----------|---|
| Carrier | | en Point A and the | | 0 |
| configuration | | subcarrier on this | | |
| DI DIVID | carrier (Note | 1) | | |
| DL BWP configuration #1 | Cyclic prefix | | | Normal |
| Common | Physical Cell | ID | | 0 |
| serving cell | SSB position | | | 1 |
| parameters | SSB periodici | ty | ms | 20 |
| | | CH monitoring | | Each slot |
| | Number of PD | OCCH candidates | | 1 |
| PDCCH configuration | Frequency do allocation for | omain resource CORESET | | Start from RB = 0 with contiguous RB allocation |
| | TCI state | | | TCI state #1 |
| | First subcarrie used for CSI- | er index in the PRB RS (k0) | | 0 |
| | | | | CSI-RS resource 1: |
| | | | | 4 CSI-RS resource 2: |
| | First OFDM s | ymbol in the PRB | | 8 |
| | used for CSI- | | | CSI-RS resource 3: |
| | | | | CSI-RS resource 4: |
| | | | | 8 |
| CSI-RS for | | SI-RS ports (X) | | 1 |
| tracking | CDM Type | | | No CDM |
| | Density (ρ) | P 16 | 01.4 | 3 |
| | CSI-RS perio | aicity | Slots | 160 80 for CSI-RS |
| | | | | resource 1 and 2 |
| | CSI-RS offset | ţ | Slots | 81 for CSI-RS |
| | | | | resource 3 and 4 |
| | | | | Start PRB 0 |
| | Frequency O | ccupation | | Number of PRB = |
| | 001 : (| | | BWP size |
| | QCL info | er index in the PRB | | TCI state #0 |
| | used for CSI- | | | 0 |
| | | | | CSI-RS resource 1: |
| | | ymbol in the PRB | | 8 |
| | used for CSI- | RS (I0) | | CSI-RS resource 2: |
| | Nivershau of CC | OLDC marks (V) | | 9 |
| NZP CSI-RS for | CDM Type | SI-RS ports (X) | | No CDM |
| beam | Density (ρ) | | | 3 |
| management | Boriotty (p) | | | 120 kHz SCS: 160 |
| | CSI-RS perio | dicity | Slots | for CSI-RS resource |
| | | · | | 1,2 |
| | CSI-RS offset | t | Slots | 0 for CSI-RS |
| | | | | resource 1,2 |
| | Repetition QCL info | | - | ON TCI state #1 |
| | QUE IIIIO | | | SP Type I, Random |
| | | | | per slot with REG |
| Precoding configu | ıration | | | bundling granularity |
| | | | | for number of Tx |
| | Tupo 1 001 | CCD indov | 1 | larger than 1 |
| | Type 1 QCL information | SSB index QCL Type | - | SSB #0 Type C |
| TCI state #0 | Type 2 QCL | SSB index | | SSB #0 |
| | information | QCL Type | <u> </u> | Type D |
| | | | 1 | CSI-RS resource 1 |
| | Type 1 001 | CSI-RS resource | | from 'CSI-RS for |
| TCI state #1 | Type 1 QCL information | COI-IVO TESOUICE | | tracking' |
| | | 001.7 | 1 | configuration |
| | | QCL Type | | Type A |

| | Type 2 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
|---|------------------------|-----------------|--|---|
| | | QCL Type | | Type D |
| Symbols for all unused REs | | | | OCNG in Annex A.5 |
| Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 | | | | |

Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.

7.3.1 1RX requirements

(Void)

7.3.2 2RX requirements

7.3.2.1 FDD

(Void)

7.3.2.2 TDD

The parameters specified in Table 7.3.2.2-1 are valid for all TDD tests unless otherwise stated.

Table 7.3.2.2-1: Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna |
|-------------------------|------|----------------|--------------|
| TDD UL-DL pattern | | FR2.1: | 20-1 |
| CCE to REG mapping type | | Interleaved | |
| REG bundle size | | 2 for test 1-1 | 2 |
| REG bullule size | | 6 for test 1-2 | 2 |
| Interleaver size | | 3 for test 1-1 | 2 |
| interieaver size | | 2 for test 1-2 | 3 |
| Shift index | | 0 | |

7.3.2.2.1 1 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.1-1: Minimum performance requirements with 120 kHz SCS

| Ī | Test | Bandwidth | CORES ET RB | CORESET duration | Aggregation level | Reference Channel | Bronogotion | Antenna configuration and correlation Matrix | Reference value | |
|---|------------|-----------|----------------|------------------|-------------------|-----------------------|--------------------------|--|-------------------|------------------------|
| | num ber | (MHz) | | | | | Propagation Condition | | Pm- dsg (%) | SNR _{BB} (dB) |
| Ī | 1-1 | 100 | 60 | 1 | 2 | R.PDCCH. 5-1.1 TDD | TDLA30-75 | 1x2 Low | 1 | 6.4 |
| | 1-2 | 100 | 60 | 1 | 4 | R.PDCCH. 5-1.2 TDD | TDLA30-300 | 1x2 Low | 1 | 3.0 |

7.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.2-1. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.2-1: Minimum performance requirements with 120 kHz SCS

| Test | Bandwidth | CORESE T RB | CORESET duration | Aggregation level | Reference Channel | Dronogotion | Antenna configuration | Reference value | |
|------------|-----------|----------------|------------------|-------------------|-----------------------|--------------------------|------------------------------|-------------------|------------------------|
| num ber | (MHz) | | | | | Propagation Condition | and correlation Matrix | Pm- dsg (%) | SNR _{BB} (dB) |
| 2-1 | 100 | 60 | 1 | 8 | R.PDCCH. 5-1.3 TDD | TDLA30-75 | 2x2 Low | 1 | 0.1 |
| 2-2 | 100 | 60 | 2 | 16 | R.PDCCH. 5-2.1 TDD | TDLA30-75 | 2x2 Low | 1 | -3.0 |

7.4 PBCH demodulation requirements

The receiver characteristics of PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$Pm - bch = 1 - \frac{A}{R}$$

Where A is the number of correctly decoded MIB PDUs and B is the number of transmitted MIB PDUs. The Pm-bch is derived with the assumption UE combines the PBCH symbols of the same SS/PBCH block index within the MIB TTI (80ms).

7.4.1 1RX requirements

(Void)

7.4.2 2RX requirements

7.4.2.1 FDD

(Void)

7.4.2.2 TDD

Table 7.4.2.2-1: Test parameters for PBCH

| Parameter | Unit | Single antenna port | | | | |
|---|------|---------------------|--|--|--|--|
| Physical Cell ID | | 0 | | | | |
| Cyclic prefix | | Normal | | | | |
| Number of SS/PBCH blocks within an SS burst set periodicity | | 1 | | | | |
| SS/PBCH block index Note1 | | 0 | | | | |
| SS/PBCH block periodicity | ms | 20 | | | | |
| TDD UL-DL pattern | | FR2.120-1 | | | | |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | | | | | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | | | | | |

For the parameters specified in Table 7.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 7.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.7.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.4.2.2-2: Minimum performance PBCH in case SS/PBCH block index is not known

| Test Bandwidth (MHz) / | | Reference | Propagation | Propagation Antenna configuration | | | |
|------------------------|-----------------------------|-----------|-------------|-----------------------------------|-------------------|---------------------------|--|
| number | Subcarrier spacing (kHz) | channel | condition | and correlation matrix | Pm- bch (%) | SNR _{BB} (dB) | |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -6.3 | |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -6.1 | |

Table 7.4.2.2-3 Minimum performance PBCH in case SS/PBCH block index is known

| Test Bandwidth (MHz) / | | Reference | Propagation | | | | |
|------------------------|--------------------------|-----------|-------------|------------------------|------------|-------------|--|
| number | Subcarrier spacing (kHz) | channel | condition | and correlation matrix | Pm- bch | PBCH SNR | |
| | | | | | (%) | (dB) | |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -7.9 | |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -7.6 | |

7.5 Sustained downlink data rate provided by lower layers

7.5.1 FR2 single carrier requirements

The requirements in this clause are applicable to the FR2 single carrier case.

The requirements and procedure defined in Clause 7.5A.1 apply using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

7.5A Sustained downlink data rate provided by lower layers

7.5A.1 FR2 CA requirements

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR2 CA.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the date rate for all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities:
 - Use Table 7.5A.1-3 to determine the MCS (=MCS1) achieving the largest data rate [clause 4.1.2 of TS 38.306 [14]] based on UE capabilities.
 - Use Table 7.5A.1-4 to determine the largest MCS (=MCS2) requiring SNR below test equipment maximum achievable SNR for that CA configuration.
 - Compute the data rate for CA configuration using the MCS = min(MCS1,MCS2) and the following equation for each CC in CA bandwidth combination.

$$DataRate = 10^{-3} \sum_{j=1}^{J} TBS_j 2^{\mu_j}$$

where

J is the number of aggregated component carriers in CA bandwidth combination

TBS_j is the total number of DL-SCH transport block bits calculated based on methodology in Clause 5.1.3.2 of TS 38.214 [12] and using parameters from Table 7.5A.1-1

μ_i is provided in Clause 4.2 of TS 38.211 for different subcarrier spacing values

- Step 2: Choose the CA bandwidth combination among all supported CA configurations that achieves maximum data rate in step 1 among all UE capabilities.
 - Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same data rate, select one among sets with the smallest aggregated channel bandwidth.
- Step 3: For each CC in chosen CA bandwidth combination, use determined MCS for each CC in step 1 for that CA configuration based on test parameters and indicated UE capabilities.

The TB success rate shall be higher than 85% when PDSCH is scheduled with MCS defined for the selected CA bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

The TB success rate is defined as 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and NDL_correct_rx is the number of correctly received DL transport blocks.

The test parameters are specified in Table 7.5A.1-1.

Unless otherwise stated, no user data is scheduled on slot #0, 40 and 41 within 20 ms for SCS 60 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 80 and 81 within 20 ms for SCS 120 kHz.

Table 7.5A.1-1: Test parameters for FR2 TDD

| | Parameter | Unit | Value |
|------------------------------|--|-------|--|
| PDSCH transmission | n scheme | | Transmission scheme 1 |
| PTRS epre-Ratio | | | 0 |
| Channel bandwidth | | MHz | Channel bandwidth from selected CA bandwidth combination |
| | Physical Cell ID | | 0 |
| Common serving | SSB position in burst | | First SSB in Slot #0 |
| cell parameters | SSB periodicity First DMRS position for Type A PDSCH | ms | 20 |
| | mapping | | 2 |
| Cross carrier schedu | | | Not configured |
| Active DL BWP inde | | | 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 |
| Configuration | Subcarrier spacing | kHz | 60 or 120 |
| | RB Offset | | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| | Subcarrier spacing | kHz | 60 or 120 |
| | Cyclic prefix | | Normal |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | | Symbols #0 |
| PDCCH | Number of PRBs in CORESET | | Table 7.5A.1-2 |
| configuration | Number of PDCCH candidates and aggregation levels | | 1/8 |
| | CCE-to-REG mapping type | | Non-interleaved |
| | DCI format | | 1-1 |
| | TCI State | | TCI state #1 |
| | Mapping type | | Type A |
| | k0 PDSCH aggregation factor | | 0 |
| | PRB bundling type | | Static |
| | PRB bundling size | | WB |
| PDSCH | Resource allocation type | | Type 0 |
| configuration | RBG size | | Config2 |
| oormgaration | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size Starting symbol (S) | | 1 |
| | Length (L) | | 13 |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 |
| DD0011 D14D0 | Length | | 1 |
| PDSCH DMRS configuration | Antenna ports indexes | | {1000} for 1 Layer CCs |
| | Number of PDSCH DMRS CDM group(s) without data | | {1000, 1001} for 2 Layers CCs |
| PTRS | Frequency density (K _{PT-RS}) | | 2 |
| configuration | Time density (Lpt-Rs) | | 1 |
| | Subcarrier indexes in the PRB used for CSI-RS | | k ₀ = 3 for CSI-RS resource 1,2,3,4 |
| | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 6 for CSI-RS resource 1 and 3 l ₀ = 10 for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | CDM Type | | 'No CDM' for CSI-RS resource |
| | 7. | | 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 60 kHz SCS: 80 for CSI-RS resource |
| | CSI-RS periodicity | Slots | 1,2,3,4 120 kHz SCS: 160 for CSI-RS |
| | | | resource 1,2,3,4 |

| | CCL DC 2#2 24 | | Slots | 60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 |
|--|--------------------------|------------------------|----------|---|
| | CSI-RS offset | | 51015 | 120 kHz SCS: 80 for CSI-RS resource 1 and 2 |
| | Fraguesey Occupa | tion | | 81 for CSI-RS resource 3 and 4 Start PRB 0 |
| | Frequency Occupation | | | Number of PRB = BWP size |
| | QCL info | in the PRB used for | | TCI state #0 |
| | CSI-RS | | | $k_0 = 4$ |
| | OFDM symbols in t | he PRB used for CSI- | | I ₀ = 13 |
| | Number of CSI-RS | ports (X) | | Same as number of transmit antenna |
| NZP CSI-RS for | CDM Type | | | 'FD-CDM2' |
| CSI acquisition | Density (ρ) | | | 1 60 kHz SCS: 80 |
| | CSI-RS periodicity | | Slots | 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occupa | tion | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| | CSI-RS | in the PRB used for | | $k_0 = 0$ |
| | OFDM symbols in t | he PRB used for CSI- | | I ₀ = 12 |
| | Number of CSI-RS | ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | | | 'FD-CDM2' |
| acquisition | Density (ρ) | | | 1 |
| | CSI-RS periodicity | | Slots | 60 kHz SCS: 80 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occupation | | | Start PRB 0 Number of PRB = BWP size |
| | CSI-RS | ex in the PRB used for | | k ₀ =0 for CSI-RS resource 1,2 |
| | First OFDM symbol CSI-RS | in the PRB used for | | $I_0 = 8$ for CSI-RS resource 1 $I_0 = 9$ for CSI-RS resource 2 |
| | Number of CSI-RS | ports (X) | | 1 for CSI-RS resource 1,2 |
| 001 00 (| CDM Type | | | 'No CDM' for CSI-RS resource 1,2 |
| CSI-RS for beam refinement | Density (ρ) | | | 3 for CSI-RS resource 1,2 60 kHz SCS: 80 for CSI-RS resource |
| Telliferiterit | | | . | 1,2 |
| | CSI-RS periodicity | | Slots | 120 kHz SCS: 160 for CSI-RS resource 1,2 |
| | CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| | Repetition | | | ON |
| | QCL info | 1 00D : 1 | | TCI state #1 |
| | Tyoe 1 QCL | SSB index | | SSB #0 |
| TCI state #0 | information Tyoe 2 QCL | QCL Type SSB index | | Type C SSB #0 |
| | information | QCL Type | | Type D |
| | Tyoe 1 QCL | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for |
| | information | | | tracking' configuration |
| TCI state #1 | | QCL Type | | Type A CSI-RS resource 1 from 'CSI-RS for |
| | Tyoe 2 QCL information | CSI-RS resource | | tracking' configuration |
| Maximum number of | code block groups for | QCL Type | | Type D |
| feedback | | DI ACIVINACIA | | 1 |
| Number of HARQ Processes | | | | 10 for FR2.60-1 and 8 for FR2.120-1 |
| K1 value | | | | Specific to each UL-DL pattern |
| Maximum number of HARQ transmission HARQ ACK/NACK bundling | | | | 4 Multiplexed |
| Redundancy version | | | | {0,2,3,1} |
| | | | | |

| TDD UL-DL pattern | | 60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1 | | |
|---|-------------|--|--|--|
| Precoding configuration | | SP Type I, Random per slot with PRB bundling granularity | | |
| Symbols for all unused REs | | OCNG Annex A.5 | | |
| Propagation condition | | Static propagation condition No external noise sources are applied | | |
| Antenna | 1 layer CCs | 1x2 or 1x4 | | |
| configuration 2 layers CCs | | 2x2 or 2x4 | | |
| Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS. | | | | |

Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH

transmission.

Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. Note 3:

Table 7.5A.1-2: Number of PRBs in CORESET

| SCS (kHz) | 50 MHz | 100 MHz 200 MHz | | 400 MHz |
|-----------|--------|-----------------|-----|---------|
| 60 | 66 | 132 | 264 | N.A |
| 120 | 30 | 66 | 132 | 264 |

Table 7.5A.1-3: MCS indexes for indicated UE capabilities

| Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS |
|-------------------------------------|---------------------------|----------------|-----|
| 1 | 6 | 1 | 27 |
| 1 | 6 | 0.8 | 23 |
| 1 | 6 | 0.75 | 22 |
| 1 | 6 | 0.4 | 14 |
| 1 | 4 | 1 | 16 |
| 1 | 4 | 0.8 | 16 |
| 1 | 4 | 0.75 | 16 |
| 1 | 4 | 0.4 | 10 |
| 1 | 2 | 1 | 9 |
| 1 | 2 | 0.8 | 9 |
| 1 | 2 | 0.75 | 9 |
| 1 | 2 | 0.4 | 4 |
| 2 | 6 | 1 | 27 |
| 2 | 6 | 0.8 | 23 |
| 2 | 6 | 0.75 | 22 |
| 2 | 6 | 0.4 | 14 |
| 2 | 4 | 1 | 16 |
| 2 | 4 | 0.8 | 16 |
| 2 | 4 | 0.75 | 16 |
| 2 | 4 | 0.4 | 10 |
| 2 | 2 | 1 | 9 |
| 2 | 2 | 0.8 | 9 |
| 2 | 2 | 0.75 | 9 |
| 2 | 2 | 0.4 | 4 |

Table 7.5A.1-4: SNR required to achieve 85% of peak throughput under AWGN conditions

| MCS Index (Note 1) | SNR _{BB} (dB) for maximum number of PDSCH MIMO | SNR _{BB} (dB) for maximum number of PDSCH MIMO |
|--------------------|---|---|
| 13 | Layers = 1 | Layers = 2 |
| | 6.2 | 9.0 |
| 14 | 7.2 | 9.9 |
| 15 | 8.2 | 10.9 |
| 16 | 8.7 | 11.6 |
| 17 | 10.1 | 13.2 |
| 18 | 10.7 | 13.7 |
| 19 | 11.7 | 14.7 |
| 20 | 12.7 | 15.6 |
| 21 | 13.6 | 16.5 |
| 22 | 14.8 | 17.6 |
| 23 | 15.6 | 18.6 |
| 24 | 16.9 | 19.7 |
| 25 | 18.3 | 21.2 |
| 26 | 19.3 | 22.3 |
| 27 | 20.5 | 23.3 |

Note 1: MCS Index is based on MCS Table defined in clause 5.1.3 of TS 38.214 [12] when 256QAM is not enabled.

8 CSI reporting requirements (Radiated requirements)

8.1 General

This section includes radiated requirements for the reporting of channel state information (CSI).

8.1.1 Applicability of requirements

8.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with F_{DL_high} not exceeding 40000 MHz.

The minimum performance requirements in Clause 8 are mandatory for UE supporting NR operation, except test cases listed in Clause 8.1.1.3, 8.1.1.4.

8.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 8.1.1.2-1.

Table 8.1.1.2-1: Requirements applicability

| Supported RX antenna ports | Test type | Test list |
|----------------------------|-----------|---------------------------|
| UE supports 2RX | CQI | All tests in Clause 8.2.2 |
| antenna | PMI | All tests in Clause 8.3.2 |
| | RI | All tests in Clause 8.4.2 |

8.1.1.3 Applicability of requirements for optional UE features

8.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 8.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

.

Table 8.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|---------|-----------------------|--|---|
| Supported maximum number of PDSCH MIMO layers (maxNumberMIMO- | FR2 TDD | CQI | 8.2.2.2.1.1 Minimum requirement for periodic CQI reporting | The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE |
| LayersPDSCH) | | RI | 8.4.2.2 (Test 1 – 3) | PDSCH MIMO layers capability |
| Support of 1 port PTRS (onePortsPTRS) | FR2 TDD | CQI, PMI and RI | All test cases | |
| Supported max number of configured NZP-CSI-RS resources per CC (maxConfigNumberNZP-CSI-RS-PerCC) | FR2 TDD | CQI, PMI and RI | All test cases with max number of configured NZP- CSI-RS resource per CC larger than 1 | The requirements apply only in case the max number of configured NZP-CSI-RS resource per CC in the test case does not exceed UE maximum number of NZP-CSI-RS resource per CC capability |
| Supported max number of ports across all configured NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros sNZP-CSI-RS-PerCC) | FR2 TDD | CQI, PMI and RI | All test cases with max number of ports across all configured NZP-CSI-RS resource per CC larger than 2 | The requirements apply only in case the number of NZP-CSI-RS ports in the test case does not exceed UE maximum number of NZP-CSI-RS ports capability |

8.1.2 Common test parameters

Parameters specified in Table 8.1.2-1 are applied for all test cases in this section unless otherwise stated.

Table 8.1.2-1: Test parameters for CSI test cases

| | Parameter | Unit | Value |
|-------------------------------|--|------|--|
| PDSCH transmis | sion scheme | | Transmission |
| | STOTI SCHEITIE | | scheme 1 |
| Duplex Mode | | | TDD |
| PTRS epre-Ratio | | | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 |
| | Subcarrier spacing | kHz | 120 |
| | Cyclic prefix | | Normal |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP in | | | 1 |
| Common | Physical Cell ID | | 0 First 00D is 01st #0 |
| serving cell | SSB position in burst | | First SSB in Slot #0 |
| parameters | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| DD 0011 | Symbols with PDCCH | | 0,1 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels | | 1/AL8 |
| | DCI format | | 1_1 |
| | TCI state | | TCI state #1 |
| Cross carrier sch | | | Not configured |
| | Mapping type | | Type A |
| | <u>k0</u> | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| DDOOLL | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle size | | N/A |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |
| PDSCH DMRS | DMRS ports indexes | | {1000} for Rank1 {1000,1001} for Rank2 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | Number of PDSCH DMRS CDM group(s) without data | | 2 |
| PTRS | Frequency density (K _{PT-RS}) | | 2 |
| configuration | Time density (L _{PT-RS}) | | 1 |
| Comiguration | Resource Element Offset | | 2 |
| | First subcarrier index in the PRB used for CSI-RS (k_0) | | 0 for CSI-RS resource 1,2,3,4 |
| CSI-RS for | First OFDM symbol in the PRB | | 4 for CSI-RS resource 1 and 3 |
| tracking | used for CSI-RS (lo) | | 8 for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |

| CDM Type | | T | | 1 | |
|--|-----------------|-----------------|-----------------|-------|-------------------|
| Density (ρ) | | CDM Type | | | No CDM for CSI-RS |
| Density (p) | | - 71 - | | | |
| CSI-RS periodicity Slot CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1,2,1,2,4 1,2,4,4 | | Density (ρ) | | | |
| CSI-RS periodicity | | , , , | | | |
| CSI-RS offset | | CCL DC maria | ر ما ا ما الم | alat | |
| CSI-RS offset | | CSI-RS perio | odicity | SIO | |
| CSI-RS offset | | | | | |
| CSI-RS offset | | | | | |
| Repetition CSI-RS periodicity Slots Fresource 1,2 | | CSI-RS offer | t . | slot | |
| Prequency Occupation | | 0011001130 | | 3101 | |
| Frequency Occupation | | | | | |
| Frequency Occupation | | | | | |
| NZP CSI-RS for CSI acquisition | | Frequency O | ccupation | | |
| NZP CSI-RS for CSI acquisition | | | | | |
| NZP CSI-RS for CSI acquisition | | QCL info | | | |
| Frequency Occupation | NZD COL DO | | | | |
| CSI-RS for LSI-RS f | | Frequency O | ccupation | | Number of PRB = |
| ZP CSI-RS for CSI acquisition | | | • | | BWP size |
| Frequency Occupation | acquisition | QCL info | | | TCI state #1 |
| CSI acquisition | 7D CSI DS for | | | | Start PRB 0 |
| First subcarrier index in the PRB | | Frequency O | ccupation | | Number of PRB = |
| Used for CSI-RS | COI acquisition | | | | |
| CSI-RS for beam refinement CSI-RS periodicity CSI-RS periodicity CSI-RS resource 1 lo = 8 for CSI-RS resource 2 | | | | | |
| First OFDM symbol in the PRB resource 1 lo = 9 for CSI-RS resource 2 | | used for CSI- | ·RS | | |
| Used for CSI-RS | | E: . OED14 | | | |
| CSI-RS for beam refinement CDM Type To CSI-RS resource 1,2 1 for CSI-RS resource 1 for CSI-RS resource 1 for CSI-RS resource 1 for CSI-RS for tracking configuration CSI-RS resource 1 for CSI-RS for tracking configuration CSI-RS resource 1 for CSI-RS for tracking configuration CSI-RS for tracking co | | | | | |
| Number of CSI-RS ports (X) | | used for CSI-RS | | | • |
| Number of CSI-RS ports (X) resource 1,2 | | | | | |
| CSI-RS for beam refinement CDM Type 'No CDM' for CSI-RS resource 1,2 Density (ρ) 3 for CSI-RS resource 1,2 CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots 0 for CSI-RS resource 1,2 Repetition ON QCL info TCI state #1 Type 1 SSB index SSB #0 TCI state #0 Type 1 QCL Type Type C Type C TType 2 QCL information QCL Type Type D CSI-RS resource 1 from 'CSI-RS for tracking' configuration TCI state #1 Type 2 QCL Type CSI-RS resource 1 from 'CSI-RS for tracking' configuration TYpe 2 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type 2 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type D Number of HARQ Processes 8 HARQ ACK/NACK bundling | | Number of C | SI-RS ports (X) | | |
| Density (ρ) Tesource 1,2 3 for CSI-RS resource 1,2 3 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 | CCI DC for | | | | |
| Density (ρ) 3 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 1,2 O for CSI-RS resource 1,2 O for CSI-RS for tracking O for CSI-RS for tracking C for CSI-RS for tracking | | CDM Type | | | |
| Density (p) resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 1,2 O for CSI-RS resource 1,2 O for CSI-RS #0 O for CSI-RS for tracking configuration O for CSI | | | | | |
| CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 | Tomomone | Density (ρ) | | | |
| CSI-RS periodicity | | | | | |
| 1,2 | | CSI-RS perio | dicity | Slots | |
| CSI-RS offset | | | , | | |
| Repetition | | 001 00 -# | | 01-4- | 0 for CSI-RS |
| TCI state #1 Type 1 SSB index SSB #0 QCL information Type C Type C Type C Type C QCL information Type 2 SSB index SSB #0 QCL Type Type D Type D Type D Type D Type D Type D Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Type D Type D Number of HARQ Processes 8 HARQ ACK/NACK bundling Multiplexed Multiplexed Multiplexed Multiplexed Type D Type D | | CSI-RS offse | T | Siots | resource 1,2 |
| Type 1 | | Repetition | | | ON |
| TCI state #0 QCL Type Type C | | QCL info | | | TCI state #1 |
| TCI state #0 Information Type 2 SSB index SSB #0 | | | SSB index | | SSB #0 |
| TCI state #0 Type 2 QCL Information Type 2 QCL Information QCL Type Type D | | | QCL Type | | Type C |
| CCL Information QCL Type Type D | TCI state #0 | | | | |
| Information QCL Type Type D | | | SSB index | | SSB #0 |
| Type 1 CSI-RS resource CSI-RS resource 1 from 'CSI-RS for tracking' configuration | | | QCL Type | | Type D |
| Type 1 CSI-RS resource from 'CSI-RS for tracking' configuration | | IIIIOIIIIalioii | | | CSI-RS resource 1 |
| TCI state #1 CSI-RS resource tracking' configuration QCL Type Type A | | Type 1 | | | |
| TCI state #1 CSI-RS resource CSI-RS resource 1 Type 2 CSI-RS resource Tracking' Configuration | | | CSI-RS resource | | |
| TCI state #1 QCL Type Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type D Number of HARQ Processes HARQ ACK/NACK bundling QCL Type Type D Multiplexed | | | | | |
| Type 2 QCL information CSI-RS resource Type 2 QCL QCL information QCL Type Number of HARQ Processes HARQ ACK/NACK bundling CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Multiplexed | | | QCL Type | | |
| Type 2 QCL information CSI-RS resource information CSI-RS resource tracking' configuration QCL Type Type D Number of HARQ Processes HARQ ACK/NACK bundling Multiplexed | TCI state #1 | | | | |
| QCL information CSI-RS resource tracking' configuration QCL Type Type D Number of HARQ Processes 8 HARQ ACK/NACK bundling Multiplexed | | Type 2 | 001.00 | | |
| information Configuration QCL Type Type D Number of HARQ Processes 8 HARQ ACK/NACK bundling Multiplexed | | | CSI-RS resource | | |
| QCL Type Type D Number of HARQ Processes 8 HARQ ACK/NACK bundling Multiplexed | | information | | | |
| Number of HARQ Processes 8 HARQ ACK/NACK bundling Multiplexed | | | QCL Type | | |
| | Number of HARO | | | | |
| Redundancy version coding sequence {0,2,3,1} | | | | | |
| | Redundancy vers | sion coding sed | quence | | {0,2,3,1} |

| | For FR2.120-1: | | | | |
|---|----------------------------------|--|--|--|--|
| | 3 if mod $(i.5) = 0$, | | | | |
| | 6 if $mod(i,5) = 2$ | | | | |
| | For FR2.120-2: | | | | |
| K1 value | 11 if $mod(i,8) = 0$, | | | | |
| (PDSCH-to-HARQ-timing-indicator) | 7]if $mod(i,8) = 4$, | | | | |
| | 6]if $mod(i,8) = 5$, | | | | |
| | where i is slot index | | | | |
| | per radio fame with | | | | |
| | values 0-79. | | | | |
| Symbols for unused REs | OCNG as specified | | | | |
| Symbols for unused KES | in A.5 | | | | |
| Note 1: PDSCH is not scheduled on slots containing | ng CSI-RS or slots which are not | | | | |
| full DL. | | | | | |
| - O. T. I. F TOL -t-t- f db - DDOOLL's identical to the TOL -t-t- | | | | | |

Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.

Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing.

8.2 Reporting of Channel Quality Indicator (CQI)

8.2.1 1RX requirements

(Void)

8.2.2 2RX requirements

8.2.2.1 FDD

(Void)

8.2.2.2 TDD

8.2.2.2.1 CQI reporting under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

8.2.2.2.1.1 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 8.2.2.2.1.1-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

- a) the reported CQI value shall be in the range of ± 1 of the reported median more than 90% of the time;
- b) if the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI 1) shall be less than or equal to 0.1.

Table 8.2.2.2.1.1-1 Test parameters

| | Parameter | Unit | Test 1 | Test 2 |
|------------------------|--|------|--------------|-----------------------------|
| Bandwidth | Bandwidth | | | 00 |
| Subcarrier sp | | kHz | 120 | |
| Duplex Mode | | | | DD |
| TDD Slot Cor | figuration | | FR2.120-2 | Annex A.1.3 |
| SNR _{BB} | | dB | 8 9 | 14 15 |
| Propagation of | channel | | | /GN |
| Antenna conf | iguration | | specified in | atic channel n Annex B.1 |
| Beamforming | - | | В. | ed in Annex 4.1 |
| | CSI-RS resource Type | | | riodic |
| | Number of CSI-RS ports (X) | | | 4 |
| | CDM Type | | | CDM2 |
| ZP CSI-RS | Density (p) | | | 1 |
| configuratio n | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | 8 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | 1 | 13 |
| | CSI-RS periodicity and offset | slot | 8 | 3/1 |
| | CSI-RS resource Type | | Per | riodic |
| | Number of CSI-RS ports (X) | | | 2 |
| | CDM Type | | fd-C | DM2 |
| NZP CSI- | Density (ρ) | | | 1 |
| RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | 6 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | 1 | 13 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 8 | 3/1 |
| | CSI-IM resource Type | | Per | iodic |
| | CSI-IM RE pattern | | 1 01 | 1 |
| CSI-IM | CSI-IM Resource Mapping | | | |
| configuratio | (Kcsi-im,Icsi-im) | | (8, | 13) |
| n | CSI-IM timeConfig | slot | G | 3/1 |
| | periodicity and offset | SIOL | | |
| ReportConfig | Type | | | riodic |
| CQI-table | | | | ole 1 |
| reportQuantit | | | | PMI-CQI |
| | nForChannelMeasurements | | | nfigured |
| | nForInterferenceMeasurements | | | nfigured |
| cqi-FormatInd | | | | eband |
| pmi-FormatIn | | | | eband |
| Sub-band Siz | | RB | | 8 |
| csi-Reporting | | | | 11111 |
| CSI-Report po | eriodicity and offset | slot | | /35 |
| aperiodicTrig | | | | nfigured |
| | Codebook Type | 1 | | nglePanel |
| 0-4-1 | Codebook Mode | | | 1 |
| Codebook | (CodebookConfig- | | Not co | nfigured |
| configuration | N1,CodebookConfig-N2) | | | |
| | CodebookSubsetRestriction | 1 | | 0000 |
| Dhysiaal shee | RI Restriction | | | I/A |
| Friysical char | nnel for CSI report CQI/RI/PMI delay | me | | CCH 375 |
| Maximum nur | mber of HARQ transmission | ms | | 375 1 |
| | | 1 | | ed in Table |
| Measurement channel | | | | TBS.1-2 |

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

The purpose of the requirements is to verify that the UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the CQI reporting under frequency non-selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 8.2.2.2.2.1-1 and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

- a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time, where α % is specified in Table 8.2.2.2.2.1-2;
- b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 8.2.2.2.1-2;
- c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.01.

Table 8.2.2.2.1-1 Test parameters

| | Parameter | Unit | Test 1 | Test 2 |
|------------------------------|--|------|-------------------------|-------------|
| Bandwidth | | | | 00 |
| Subcarrier sp | | kHz | 120 | |
| Duplex Mode | | | FR2.120- | |
| TDD Slot Cor | nfiguration | | A.1 | |
| SNR _{BB} | | dB | 6 7 | 12 13 |
| Propagation of | channel | | TDLA | 30-35 |
| Antenna conf | iguration | | 2> | |
| | | | ULA As specifie | |
| Beamforming | Model | | B.4 | |
| | CSI-RS resource Type | | Aper | iodic |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type Density (ρ) | | FD-C | |
| | First subcarrier index in the | | l | |
| ZP CSI-RS | PRB used for CSI-RS (k ₀ , k ₁) | | 3 | 3 |
| configuratio | First OFDM symbol in the PRB | | 1: | 3 |
| n | used for CSI-RS (I ₀ , I ₁) | | | |
| | CSI-RS interval and offset | slot | Not con | figured |
| | | | 1 in slots | |
| | ZP CSI-RS trigger | | mod(i, | 8) = 1, |
| | 331 | | otherwise it | |
| | CSI-RS resource Type | | Aper | |
| | Number of CSI-RS ports (X) | | 2 | <u>)</u> |
| | CDM Type | | fd-C | |
| NZP CSI- | Density (ρ) | | 1 | |
| RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | 6 | 5 |
| acquisition | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | 1: | 3 |
| | NZP CSI-RS-timeConfig interval and offset | slot | Not con | figured |
| | aperiodicTriggeringOffset | | (|) |
| | CSI-IM resource Type | | Aper | iodic |
| CSI-IM | CSI-IM RE pattern | | 1 | |
| configuratio | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (8, | 13) |
| n | CSI-IM timeConfig | | NI i | <i>r</i> |
| | interval and offset | slot | Not con | |
| ReportConfig | Type | | Aper | |
| CQI-table reportQuantit | | | Tab cri-RI-P | |
| | y nForChannelMeasurements | | | figured |
| | onForInterferenceMeasurements | | | nfigured |
| cqi-FormatInd | | | | band |
| pmi-FormatIn | | | | band |
| Sub-band Siz csi-Reporting | | RB | 11111 | |
| | eriodicity and offset | slot | Not con | |
| Aperiodic Report Slot Offset | | 0.01 | 7 | 7 |
| | | | 1 in slots | |
| CSI request | | | mod(i, | |
| | | | otherwise it | |
| reportTrigger | Size | | 1 | |
| | | | One State v | |
| | | | Associated | |
| CSI-Aperiodic | cTriggerStateList | | Configuration Associate | |
| 22. / (portour | | | Configuration | on contains |
| | | | pointers to | NZP CSI- |
| | | | RS and | CSI-IM |

| | Codebook Type | | typel-SinglePanel |
|------------------------|---------------------------------------|----|---|
| | Codebook Mode | | 1 |
| Codebook configuration | (CodebookConfig-N1,CodebookConfig-N2) | | Not configured |
| | CodebookSubsetRestriction | | 000001 |
| | RI Restriction | | N/A |
| Physical chan | nel for CSI report | | PUSCH |
| CQI/RI/PMI delay | | ms | 1.375 |
| Maximum num | ber of HARQ transmission | | 1 |
| Measurement | channel | | As specified in Table A.4-1, TBS.1-1 |

Table 8.2.2.2.1-2 Minimum requirements

| | Test 1 | Test 2 |
|------|--------|--------|
| α[%] | 2 | 2 |
| γ | 1.05 | 1.05 |

8.3 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 1 with 2TX and higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio

$$\gamma = \frac{t_{ue}}{t_{rnd}}$$

In the definition of γ , for 2TX PMI requirements, t_{ue} is 90 % of the maximum throughput obtained at SNR_{ue} using the precoders configured according to the UE reports, and t_{rnd} is the throughput measured at SNR_{ue} with random precoding.

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX Typel-SinglePanel Codebook

For the parameters specified in Table 8.3.2.2.1-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified in Table 8.3.2.2.1-2.

Table 8.3.2.2.1-1: Test parameters (single layer)

| Pa | rameter | Unit | Test 1 | Test 2 |
|--------------------------------------|--|------|--|--|
| Bandwidth | | MHz | 100 | 100 |
| Subcarrier spacia | Subcarrier spacing | | 120 | 120 |
| | | | FR2.120-2 as | FR2.120-1 as |
| TDD DL-UL conf | TDD DL-UL configuration | | specified in | specified in |
| Propagation cha | nnol | | Annex A.1.3 TDLA30-35 | Annex A.1.3 TDLA30-35 |
| Propagation cha | | | 2 x 2 ULA Low | 2 x 2 ULA Low |
| Ť | | | As specified in | As specified in |
| Beamforming Mo | _ | | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Aperiodic | Aperiodic |
| | Number of CSI-RS ports (X) | | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 | 1 |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (8,-) | Row 4, (8,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) |
| | CSI-RS interval and offset | slot | Not configured | Not configured |
| | ZP CSI-RS trigger | | 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| | CSI-RS resource | | Aperiodic | Aperiodic |
| | Type Number of CSI-RS | | 2 | 2 |
| | ports (X) CDM Type | | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 | 1 |
| NZP CSI-RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3, (6,-) | Row 3, (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) |
| | CSI-RS interval and offset | slot | Not configured | Not configured |
| | aperiodicTriggering Offset | | 0 | 0 |
| | CSI-IM resource Type | | Aperiodic | Aperiodic |
| | CSI-IM RE pattern | | Pattern 1 | Pattern 1 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (8,13) | (8,13) |
| | CSI-IM timeConfig interval and offset | slot | Not configured | Not configured |
| ReportConfigTyp | | | Aperiodic | Aperiodic |
| CQI-table | | | Table 1 | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| | orChannelMeasureme | | Not configured | Not configured |
| nts | | | 3 | |

| - | | | | |
|---|---|------|---|---|
| timeRestrictionForInterferenceMeasur ements | | | Not configured | Not configured |
| cqi-FormatIndicator | | | Wideband | Wideband |
| pmi-FormatIndica | ator | | Wideband | Wideband |
| Sub-band Size | | RB | 8 | 8 |
| csi-ReportingBar | nd | | 111111111 | 111111111 |
| CSI-Report interv | val and offset | slot | Not configured | Not configured |
| Aperiodic Report | Slot Offset | | 7 | 9 |
| CSI request | | | 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSize | 9 | | 1 | 1 |
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel- SinglePanel | typel- SinglePanel |
| | Codebook Mode | | 1 | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConfi g-N2) | | N/A | N/A |
| | CodebookSubsetR estriction | | 001111 | 001111 |
| | RI Restriction | | N/A | N/A |
| Physical channel for CSI report | | | PUSCH | PUSCH |
| CQI/RI/PMI delay | | ms | 1.375 | 1.75 |
| Maximum number of HARQ transmission | | | 4 | 4 |
| Measurement channel | | | R.PDSCH.5-8.1 TDD | R.PDSCH.5- 7.1 TDD |
| Note 1: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity). | | | | |

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4)], this reported PMI cannot be applied at the eNB downlink before slot#(n+4)].

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 8.3.2.2.1-2: Minimum requirement

| Parameter | Test 1 | Test 2 |
|-----------|--------|--------|
| γ | 1.05 | 1.05 |

8.4 Reporting of Rank Indicator (RI)

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

8.4.1 1RX requirements

(Void)

8.4.2 2RX requirements

8.4.2.1 FDD

(Void)

8.4.2.2 TDD

The minimum performance requirement in Table 8.4.2.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 8.4.2.2-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified in Table 8.4.2.2-2.

Table 8.4.2.2-1: RI Test (TDD)

| Parameter | | Unit | Test 1 | Test 2 | Test 3 |
|---|--|------------|-----------------|-----------------|-----------------|
| Bandwidth | | | 100 | 100 | 100 |
| Subcarrier sp | acing | MHz kHz | 120 | 120 | 120 |
| Duplex Mode | | | TDD | TDD | TDD |
| TDD Slot Cor | | | FR1.120-2 | FR1.120-2 | FR1.120-2 |
| SNR | inguration | dB | 0 | 16 | 16 |
| Propagation (| channel | u.b | TDLA30-35 | TDLA30-35 | TDLA30-35 |
| Antenna conf | | | ULA Low 2x2 | ULA Low 2x2 | XP High 2x2 |
| | | | As defined in | As defined in | As defined in |
| Beamforming | Model | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Aperiodic | Aperiodic | Aperiodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 | 1 D-0DIVIZ | 1 0-001012 |
| | First subcarrier index in the | | ı | ı | ı |
| | PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (8,-) | Row 4, (8,-) | Row 4, (8,-) |
| ZP CSI-RS | First OFDM symbol in the PRB | | | | |
| configuratio | used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| n | CSI-RS | | Not configured | Not | Not |
| | interval and offset | slot | Not configured | configured | configured |
| | intervar and onset | | 1 in slots i, | 1 in slots i, | 1 in slots i, |
| | | | where mod(i, | where mod(i, | where mod(i, |
| | ZP CSI-RS trigger | | 8) = 1, | 8) = 1, | 8) = 1, |
| | ZF CSI-KS trigger | | otherwise it is | otherwise it is | otherwise it is |
| | | | equal to 0 | equal to 0 | equal to 0 |
| | CSI-RS resource Type | | Aperiodic | Aperiodic | Aperiodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 D-0DIVIZ | 1 D-0DIVIZ | 1 |
| NZP CSI- | First subcarrier index in the | | <u>'</u> | | |
| RS for CSI | PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| acquisition | First OFDM symbol in the PRB | | | | |
| | used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig | | Not configured | Not | Not |
| | interval and offset | slot | Not configured | configured | configured |
| | aperiodicTriggeringOffset | | 0 | 0 | 0 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| | CSI-IM RE pattern | | Pattern 1 | Pattern 1 | Pattern 1 |
| CSI-IM | CSI-IM Resource Mapping | | T attern i | i alleiii i | i alleiii i |
| configuratio | (ксы-ім, Ісы-ім) | | (8,13) | (8,13) | (8,13) |
| n | CSI-IM timeConfig | | Not configured | Not | Not |
| | interval and offset | slot | 140t configured | configured | configured |
| ReportConfig | | | Aperiodic | Aperiodic | Aperiodic |
| CQI-table | туре | | Table 1 | Table 1 | Table 1 |
| | | | | cri-RI-PMI- | cri-RI-PMI- |
| reportQuantit | у | | cri-RI-PMI-CQI | CQI | CQI |
| | | | | not | not |
| timeRestriction | onForChannelMeasurements | | not configured | configured | configured |
| | | | | not | not |
| timeRestriction | onForInterferenceMeasurements | | not configured | configured | configured |
| cgi-FormatIng | dicator | | Wideband | Wideband | Wideband |
| cqi-FormatIndicator pmi-FormatIndicator | | | Wideband | Wideband | Wideband |
| Sub-band Size | | RB | 8 | 8 | 8 8 |
| csi-ReportingBand | | ייט | 111111111 | 111111111] | 111111111 |
| | | | | Not | Not |
| CSI-Report interval and offset | | slot | Not configured | configured | configured |
| Aperiodic Pa | Aperiodic Report Slot Offset | | 7 | 7 | 7 |
| Aponodic Ne | COR CIOC CIISEL | | 1 in slots i, | 1 in slots i, | 1 in slots i, |
| | | | where mod(i, | where mod(i, | where mod(i, |
| CSI request | | | 8) = 1, | 8) = 1, | 8) = 1, |
| 33.1044031 | | | otherwise it is | otherwise it is | otherwise it is |
| | | | equal to 0 | equal to 0 | equal to 0 |
| reportTrigger | Size | | 1 | 1 | 1 |
| . opolitingger | | 1 | ' | ' | ' |

| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|---------------------------------|---|----|---|---|---|
| | Codebook Type | | typel- SinglePanel | typel- SinglePanel | typel- SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | N/A | N/A | N/A |
| configuration | CodebookSubsetRestriction | | 010000 for fixed rank 2, 010011 for following rank | 000011 for fixed rank 1, 010011 for following rank | 000011 for fixed rank 1, 010011 for following rank |
| | RI Restriction | | N/A | N/A | N/A |
| Physical channel for CSI report | | | PUSCH | PUSCH | PUSCH |
| CQI/RI/PMI delay | | ms | 1.375 | 1.375 | 1.375 |
| Maximum num | Maximum number of HARQ transmission | | 1 | 1 | 1 |
| RI Configuration | | | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |

Table 8.4.2.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 71 | N/A | 1.05 | 1.05 |
| 72 | 1.0 | N/A | N/A |

9 Demodulation performance requirements for interworking

9.1 General

This clause covers the UE demodulation performance requirements for EN-DC, NE-DC, inter-band NR-DC between FR1 and FR2, and inter-band NR CA between FR1 and FR2.

9.1.1 Applicability of requirements

The following applicability rules are specified for demodulation performance requirements for interworking:

- For UEs supporting both SA and NSA,
 - The performance requirements specified in Section 5 will be verified only for SA except for the sustained downlink data rate test specified in Section 5.5 and 5.5A.
 - The performance requirements specified in Section 7 will be verified only for SA except for the sustained downlink data rate test specified in Section 7.5 and 7.5A.
 - The sustained downlink data rate tests specified in Sections 5.5, 5.5A and 7.5, 7.5A for SA and in Section 9.4B for NSA are verified separately.

- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR FR1 CA and NR CA including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-1.

Table 9.1.1-1: Requirements applicability for UEs supporting NR FR2 CA and NR CA including FR1 and FR2

| Supported scenarios | Requirements |
|--|----------------|
| NR FR2 CA | Section 7.5A |
| NR CA including FR1 and FR2 | Section 9.4A.1 |
| Both NR FR2 CA and NR CA including FR1 and FR2 | Section 7.5A |

For UEs supporting EN-DC including FR2 and EN-DC including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-2.

Table 9.1.1-2: Requirements applicability for UEs supporting EN-DC including FR2 and EN-DC including FR1 and FR2

| Supported scenarios | Requirements |
|--|------------------|
| EN-DC including FR2 | Section 9.4B.1.2 |
| EN-DC including FR1 and FR2 | Section 9.4B.1.3 |
| Both EN-DC including FR2 and EN-DC including FR1 | Section 9.4B.1.2 |
| and FR2 | |

9.1.1.1 Applicability of requirements for optional UE features

For UE which supports optional UE features the additional performance requirements from Table 9.1.1.1-1 should be applied.

Table 9.1.1.1-1: Requirements applicability for optional UE features

| UE feature/capability [14] | Test | type | Test list | Applicability notes |
|--|---------|-------|--|---------------------|
| DDGGU MIMO Issues | FR1 FDD | PDSCH | 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A (Test 2-1, 2-2, 3-1, 4-1) | EN-DC |
| PDSCH MIMO layers (maxNumberMIMO- LayersPDSCH) | FR1 TDD | PDSCH | 5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A (Test 2-1, 2-2, 3-1, 4-1) | EN-DC |
| | FR2 TDD | PDSCH | 7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A (Test 2-1 to 2-6) | EN-DC |

9.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

9.1.2 E-UTRA Cell setup

This sub-clause provides the parameters for E-UTRA cell during the demodulation performance test for EN-DC unless otherwise stated. For EN-DC with multiple E-UTRA carriers or bands, randomly selected one carrier or band can be used as E-UTRA Pcell for the connection setup unless otherwise stated.

9.1.2.1 FDD

The parameters specified in Table 9.1.2.1-1 and Table 9.1.2.1-2 are used to setup E-UTRA cell. One of test setup in Table 9.1.2.1-2 will be selected for the E-UTRA Cell depending on the maximum bandwidth of an E-UTRA carrier for all the EN-DC band combinations supported by the UE.

The measurement channels in Table 9.1.2.1-2 and OCNG pattern OP.1 FDD are specified in TS 36.101 [4]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.101 [4].

Table 9.1.2.1-1: Common Test Parameters (FDD)

| Parameter | Unit | Value | |
|--|-----------|---|--|
| Cyclic prefix | | Normal | |
| Physical Cell ID | | 0 | |
| Number of PDCCH symbols | symbols | 1 | |
| PHICH Ng (Note 1) | | 1 | |
| PHICH duration | | Normal | |
| Number of HARQ processes per component carrier | Processes | 8 | |
| Maximum number of HARQ transmission | | 4 | |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM | |
| Propagation condition | | Static propagation condition No external noise sources are applied | |
| Transmission mode | | 1 | |
| Transmission time difference between E- UTRA cell and NR cell(s) | μs | 0 | |
| Antenna configuration | | All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx ^{Note 1} | |
| Codebook subset restriction | | 10 | |
| Symbols for all unused REs | | OCNG in Annex A.5 | |
| Note 1: As the link can be provided over the air, the UE Rx antenna configuration is not | | | |

relevant for the test configuration and has no impact on the test implementation.

Table 9.1.2.1-2: Specific Test Parameters (FDD [64QAM])

| Test setup | Bandwidth (MHz) | Downlink power allocation (dB) | | | |
|---------------|--------------------|--------------------------------------|------------------------------|---|--|
| | (| $ ho_{\scriptscriptstyle A}$ | $ ho_{\scriptscriptstyle B}$ | σ | |
| 1 | 5 | 0 | 0 | 0 | |
| 2 | 10 | 0 | 0 | 0 | |
| 3 | 15 | 0 | 0 | 0 | |
| 4 | 20 | 0 | 0 | 0 | |

9.1.2.2 TDD

The parameters specified in Table 9.1.2.2-1 and Table 9.1.2.2-2 are used to setup an E-UTRA cell. One of test setup in Table 9.1.2.2-2 will be selected for the E-UTRA Cell depending on the maximum bandwidth of an E-UTRA carrier for all the EN-DC band combinations supported by the UE.

The measurement channels in Table 9.1.2.2-2 and OCNG pattern OP.1 TDD are specified in TS 36.101 [4]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.101 [4].

Table 9.1.2.2-1: Common Test Parameters (TDD)

| Parameter | Unit | Value | |
|---|---------|---|--|
| UL DL configuration | | 2 (Note1) | |
| Special subframe configuration | | 7 | |
| Number of PDCCH symbols | symbols | 1 | |
| PHICH Ng (Note 3) | | 1 | |
| PHICH duration | | Normal | |
| Cyclic prefix | | Normal | |
| Cell ID | | 0 | |
| Maximum number of HARQ transmission | | 4 | |
| Redundancy version coding sequence | | {0,0,1,2} for 64QAM | |
| Propagation condition | | Static propagation condition No external noise sources are applied | |
| Transmission mode | | 1 | |
| Transmission time difference between E- UTRA cell and NR cell(s) | μs | 0 | |
| Antenna configuration | | All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx ^{Note 2} | |
| Codebook subset restriction | | 10 | |
| Symbols for all unused REs | | OCNG in Annex A.5 | |

NOTE 1: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame when TDD-TDD EN-DC configuration is configured during the test.

NOTE 2: As the link can be provided over the air, the UE Rx antenna configuration is not relevant for the test configuration and has no impact on the test implementation.

Table 9.1.2.2-2: Specific Test Parameters (FDD 64QAM)

| Test | Bandwidth | Downlink power allocation (dB) | | | |
|-------|-----------|--------------------------------|------------------------------|---|--|
| setup | tup (MHz) | | $ ho_{\scriptscriptstyle B}$ | σ | |
| 1 | 10 | 0 | 0 | 0 | |
| 2 | 15 | 0 | 0 | 0 | |
| 3 | 20 | 0 | 0 | 0 | |

9.2 PDSCH Demodulation

9.2A PDSCH demodulation for CA

9.2A.1 NR CA between FR1 and FR2

(Void)

9.2B PDSCH demodulation for DC

- 9.2B.1 EN-DC
- 9.2B.1.1 EN-DC within FR1
- 9.2B.1.1.1 PDSCH

The test setup for E-UTRA PCell is specified in Section 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Section 5.2. During the test, only the PDSCH performance on the NR cell(s) shall be verified.

- 9.2B.1.2 EN-DC including FR2 NR carrier only
- 9.2B.1.2.1 PDSCH

The test setup for E-UTRA PCell is specified in Section 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Section 7.2. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers shall be verified.

9.2B.1.3 EN-DC including FR1 and FR2 NR carriers

(Void)

- 9.2B.2 NR DC between FR1 and FR2
- 9.3 PDCCH demodulation
- 9.3A PDCCH demodulation for CA
- 9.3A.1 NR CA between FR1 and FR2

(Void)

- 9.3B PDCCH demodulation for DC
- 9.3B.1 EN-DC
- 9.3B.1.1 EN-DC within FR1
- 9.3B.1.1.1 PDCCH

The test setup for E-UTRA PCell is specified in Section 9.1.2. The NR PDCCH demodulation performance requirements for NR are specified in Section 5.3. During the test, only the PDCCH performance on the single NR cell shall be verified.

9.3B.1.2 EN-DC including FR2 NR carrier only

9.3B.1.2.1 PDCCH

The test setup for E-UTRA PCell is specified in Section 9.1.2. The NR PDCCH demodulation performance requirements are specified in Section 7.3. During the test, only the PDCCH performance on the single NR cell shall be verified.

9.3B.1.3 EN-DC including FR1 and FR2 NR carriers

(Void)

9.3B.2 NR DC between FR1 and FR2

9.4 Void

9.4A SDR test for CA

9.4A.1 NR CA between FR1 and FR2

The Sustained Data Rate (SDR) requirements in this clause are applicable to the NR CA between FR1 and FR2 NR carriers.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the NR FR1 data rate for CA bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported CA configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for CA bandwidth combinations, using a procedure from Clause 7.5A, for all supported CA configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Select the CA bandwidth combination among all supported CA configurations that achieves maximum total data rate in steps 1 and 2 among all UE capabilities:
 - When there are multiple sets of CA bandwidth combinations and UE capabilities with the same largest data rate, select a single set with the smallest aggregated channel bandwidth.
- Step 4: For each NR FR2 CC in the selected CA bandwidth combination, use MCS determined in step 2 for that CA bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for NR FR1 PCell is specified in Section 5.5A. The NR FR2 SDR tests setup is specified in Section 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified and only NR FR1 PCell is activated from all FR1 CCs for the tested CA bandwidth combination.

The TB success rate shall be higher than 85% when NR FR2 PDSCH is scheduled with MCS defined for the selected CA bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

9.4B SDR test for DC

9.4B.1 EN-DC

< Editor note: which NR SDR test case(s) will be selected for EN-DC test need FFS.>

9.4B.1.1 EN-DC within FR1

9.4B.1.1.1 SDR test

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC within FR1.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Select one EN-DC bandwidth combination among all supported EN-DC configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate [in accordance with clause 4.1.2 of TS 38.306 [14]].
 - Set of per NR CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - Set of per E-UTRA CC UE capabilities includes channel bandwidth, number of PDSCH MIMO layers and modulation format in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.
- For each NR FR1 CC in EN-DC bandwidth combination, use Table 5.5A-5 in Section 5.5A to determine MCS based on test parameters and indicated UE capabilities.
- For each E-UTRA CC in EN-DC bandwidth combination, use Table 9.4B.1.1.1-2 and Table 9.4B.1.1.1-3 to determine FRC based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Section 9.1.2 and Table 9.4B.1.1.1-1. The NR SDR tests setup is specified in Section 5.5A. During the test, the PDSCH performance on both the NR cell(s) and LTE cell(s) shall be verified.

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1 and when E-UTRA PDSCH is scheduled with FRC defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.2 from TS 36.101 [4].

 $\rho_A = -3dB$, $\rho_B = -3dB$, $\sigma = 0dB$

 $\rho_A = -6 \text{dB}, \ \rho_B = -6 \text{dB}, \ \sigma = 3 \text{dB}$

Downlink power allocation

Parameter Unit Value Inter-TTI Distance Number of OFDM symbols for PDCCH per OFDM symbols component carrier Cross carrier scheduling Not configured Static propagation condition Propagation condition No external noise sources are applied dBm/15kHz at antenna port -85 2 layer CC 2x2 or 2x4 Antenna configuration 4 layer CC 4x4 Codebook subset 2 layer CC 10 restriction 4 layer CC 1000

Table 9.4B.1.1.1-1: Additional test setup for E-UTRA CC

Table 9.4B.1.1.1-2: E-UTRA FRC for SDR test (FDD)

2 layer CC

4 layer CC

| MIMO layer | Bandwidth | Reference channel | | | | | |
|------------|-----------|-------------------|-------------------|-------------------|--|--|--|
| | Danuwium | 64QAM | 256QAM | 1024QAM | | | |
| | 5 | R.PDSCH.4-1.1 FDD | R.PDSCH.4-3.1 FDD | R.PDSCH.4-5.1 FDD | | | |
| 2 layer | 10 | R.PDSCH.4-1.2 FDD | R.PDSCH.4-3.2 FDD | R.PDSCH.4-5.2 FDD | | | |
| | 15 | R.PDSCH.4-1.3 FDD | R.PDSCH.4-3.3 FDD | R.PDSCH.4-5.3 FDD | | | |
| | 20 | R.PDSCH.4-1.4 FDD | R.PDSCH.4-3.4 FDD | R.PDSCH.4-5.4 FDD | | | |
| | 5 | R.PDSCH.4-2.1 FDD | R.PDSCH.4-4.1 FDD | R.PDSCH.4-6.1 FDD | | | |
| 4 lover | 10 | R.PDSCH.4-2.2 FDD | R.PDSCH.4-4.2 FDD | R.PDSCH.4-6.2 FDD | | | |
| 4 layer | 15 | R.PDSCH.4-2.3 FDD | R.PDSCH.4-4.3 FDD | R.PDSCH.4-6.3 FDD | | | |
| | 20 | R.PDSCH.4-2.4 FDD | R.PDSCH.4-4.4 FDD | R.PDSCH.4-6.4 FDD | | | |

Table 9.4B.1.1.1-3: E-UTRA FRC for SDR test (TDD)

| MIMO layer | Bandwidth | Reference channel | | | | | |
|---------------|-----------|-------------------|-------------------|-------------------|--|--|--|
| Willwio layer | Danuwium | 64QAM | 256QAM | 1024QAM | | | |
| | 10 | R.PDSCH.6-1.1 TDD | R.PDSCH.6-3.1 TDD | R.PDSCH.6-5.1 TDD | | | |
| 2 layer | 15 | R.PDSCH.6-1.2 TDD | R.PDSCH.6-3.2 TDD | R.PDSCH.6-5.2 TDD | | | |
| | 20 | R.PDSCH.6-1.3 TDD | R.PDSCH.6-3.3 TDD | R.PDSCH.6-5.3 TDD | | | |
| | 10 | R.PDSCH.6-2.1 TDD | R.PDSCH.6-4.1 TDD | R.PDSCH.6-6.1 TDD | | | |
| 4 layer | 15 | R.PDSCH.6-2.2 TDD | R.PDSCH.6-4.2 TDD | R.PDSCH.6-6.2 TDD | | | |
| | 20 | R.PDSCH.6-2.3 TDD | R.PDSCH.6-4.3 TDD | R.PDSCH.6-6.3 TDD | | | |

9.4B.1.2 EN-DC including FR2 NR carrier

9.4B.1.2.1 SDR test

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC including FR2 NR carrier.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:

- Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves maximum total data rate in steps 1 and 2 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set with the smallest aggregated channel bandwidth.
- Step 4: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 1 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Section 9.1.2 and Table 9.4B.1.1.1-1. The NR PDSCH SDR tests setup is specified in Section 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified.

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

9.4B.1.3 EN-DC including FR1 and FR2 NR carriers

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC including both FR1 and FR2 NR carriers.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the NR FR1 data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].
- Step 4: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves the maximum total data rate in steps 1, 2 and 3 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set among sets with the smallest aggregated channel bandwidth.

- Step 5: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 2 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Section 9.1.2 and Table 9.4B.1.1.1-1. The NR FR2 PDSCH SDR tests setup is specified in Section 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified.

The TB success rate shall be higher than 85% when NR FR2 PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

9.4B.2 NR DC between FR1 and FR2

10 CSI reporting requirements for interworking

10.1 General

This clause specifies CSI performance requirements for EN-DC, NE-DC, inter-band NR-DC between FR1 and FR2, and inter-band NR CA between FR1 and FR2.

The definition of frequency ranges (FR1 and FR2) are specified in table 5.1-1 of TS 38.101-3 [8].

10.1.1 Applicability of requirements

The following applicability rules are specified for demodulation performance requirements for interworking:

- For UEs supporting both SA and NSA,
 - The performance requirements specified in Clause 6 will be verified only for SA.
 - The performance requirements specified in Clause 8 will be verified only for SA.
- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.

10.1.1.1 Applicability of requirements for optional UE features

For UE which supports optional UE features the additional performance requirements from Table 10.1.1.1-1 should be applied.

Table 10.1.1.1-1: Requirements applicability for optional UE features

| UE feature/capability [14] | Test | type | Test list | Applicability notes |
|--------------------------------------|---------|-------|---|---------------------|
| PDSCH MIMO layers (maxNumberMIMO- | FR1 FDD | PDSCH | 6.2.3.1.1 .1 Minimum requirement for CQI periodic reporting 6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook 6.4.3.1 (Test 1 - 4) | EN-DC |
| LayersPDSCH) | FR1 TDD | PDSCH | 6.2.3.2.1.1 Minimum requirement for CQI periodic reporting 6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook | EN-DC |

| | | 6.4.3.2 (Test 1 - 4) | |
|---------|-------|--|-------|
| FR2 TDD | PDSCH | 8.2.2.2.1.1 Minimum requirement for periodic CQI reporting | EN-DC |
| | | 8.4.2.2 (Test 1 – 3) | |

- 10.1.1.2 Applicability of requirements for mandatory UE features with capability signalling
- 10.2 Reporting of Channel Quality Indicator (CQI)
- 10.2A Reporting of Channel Quality Indicator (CQI) for CA
- 10.2B Reporting of Channel Quality Indicator (CQI) for DC
- 10.2B.1 EN-DC
- 10.2B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR CQI reporting requirements are specified in Clause 6.2. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.2B.1.2 EN-DC including FR2 NR carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR CQI reporting requirements are specified in Clause 8.2. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.2B.1.3 EN-DC including FR1 and FR2 NR carriers

(Void)

- 10.2B.2 NR DC between FR1 and FR2
- 10.3 Reporting of Precoding Matrix Indicator (PMI)
- 10.3A Reporting of Precoding Matrix Indicator (PMI) for CA

(Void)

10.3B Reporting of Precoding Matrix Indicator (PMI) for DC

10.3B.1 EN-DC

10.3B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 6.3. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.3B.1.2 EN-DC including NR FR2 carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 8.3. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.3B.1.3 EN-DC including FR1 and FR2 NR carriers

(Void)

10.3B.2 NR DC between FR1 and FR2

10.4 Reporting of Rank Indicator (RI)

10.4A Reporting of Rank Indicator (RI) for CA

10.4B Reporting of Rank Indicator (RI) for DC

10.4B.1 EN-DC

10.4B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR RI reporting requirements are specified in Clause 6.4. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.4B.1.2 EN-DC including NR FR2 carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR RI reporting requirements are specified in Clause 8.4. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.4B.1.3 EN-DC including FR1 and FR2 NR carriers

(Void)

10.4B.2 NR DC between FR1 and FR2

Annex A (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per codeword. For multi-codeword transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all codewords.

A.1.2 TDD UL-DL configurations for FR1

TDD UL-DL configurations for performance requirements are provided in Tables A.1.2-1, A.1.2-2, and A.1.2-3.

Table A.1.2-1: TDD UL-DL configuration for SCS 15 kHz

| - | Unit | UL-DL pattern | |
|---------------------------|-------------------------------|---------------------|---------------------|
| Parameter | | | FR1.15-1 |
| TDD Slot Configuration p | pattern (Note 1) | | DDDSU |
| Special Slot Configuratio | n (Note 2) | | 10D+2G+2U |
| referenceSubcarrierSpace | cing | kHz | 15 |
| UL-DL configuration | dl-UL-TransmissionPeriodicity | ms | 5 |
| (tdd-UL-DL- | nrofDownlinkSlots | | 3 |
| ConfigurationCommon) | nrofDownlinkSymbols | | 10 |
| | nrofUplinkSlot | | 1 |
| | nrofUplinkSymbols | | 2 |
| The number of slots bety | veen PDSCH and corresponding | | 4 if $mod(i,5) = 0$ |
| HARQ-ACK information | | 3 if $mod(i,5) = 1$ | |
| | | 2 if $mod(i,5) = 2$ | |
| | | | 6 if $mod(i,5) = 3$ |

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.

Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.

Note 3: i is the slot index per frame; $i = \{0,...,9\}$.

Table A.1.2-2: TDD UL-DL configuration for SCS 30 kHz

| Parameter | | | UL-DL pattern | | | | | |
|--|-----------------------------------|------|---|--|---|--|--|--|
| Param | neter | Unit | FR1.30-1 | FR1.30-2 | FR1.30-3 | FR1.30-4 | FR1.30-5 | FR1.30-6 |
| TDD Slot Configuration pattern | (Note 1) | | 7DS2U | DDDSU | DDDSUDDSUU | DDDSUUDDDD | DSUU | DS ₁ S ₂ U |
| Special Slot Configuration (Note 2) | | | 6D+4G+4U | 10D+2G+2U | 10D+2G+2U | 6D+4G+4U | 12D+2G | \$1: 10D+2G+2U \$2: 12D+2G+0U |
| referenceSubcarrierSpacing | | kHz | 30 | 30 | 30 | 30 | 30 | 30 |
| pattern1 | | | | | | | | |
| | dl-UL- TransmissionPeriodicity | ms | 5 | 2.5 | 2.5 | 3 | 2 | 1 |
| | nrofDownlinkSlots | | 7 | 3 | 3 | 3 | 1 | 1 |
| | nrofDownlinkSymbols | | 6 | 10 | 10 | 6 | 12 | 10 |
| | nrofUplinkSlot | | 2 | 1 | 1 | 2 | 2 | 0 |
| | nrofUplinkSymbols | | 4 | 2 | 2 | 4 | 0 | 2 |
| patterb2 | dl-UL- TransmissionPeriodicity | ms | N/A | N/A | 2.5 | 2 | N/A | 1 |
| | nrofDownlinkSlots | | N/A | N/A | 2 | 4 | N/A | 0 |
| | nrofDownlinkSymbols | | N/A | N/A | 10 | 0 | N/A | 12 |
| | nrofUplinkSlot | | N/A | N/A | 2 | 0 | N/A | 1 |
| | nrofUplinkSymbols | | N/A | N/A | 2 | 0 | N/A | 0 |
| The number of slots between P HARQ-ACK information (Note 3 | | | 8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7 | 4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3 | 4 if mod(i,10) = 0 3 if mod(i,10) = 1 2 if mod(i,10) = 2 5 if mod(i,10) = 3 3 if mod(i,10) = 5 3 if mod(i,10) = 7 | 5 if mod(i,10) = 0 4 if mod(i,10) = 1 3 if mod(i,10) = 2 2 if mod(i,10) = 6 7 if mod(i,10) = 7 6 if mod(i,10) = 8 5 if mod(i,10) = 9 | 3 if mod(i,4) = 0 2 if mod(i,4) = 1 | 3 if mod(i,4) = 0 2 if mod(i,4) = 1 3 if mod(i,4) = 2 |

- Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.
- Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; $i = \{0,...,19\}$

Table A.1.2-2a: TDD UL-DL configuration for SCS 30 kHz for DCI-based dynamic UL/DL detection

| Parame | ator | Unit | UL-DL pattern | | | | |
|---|--|----------|----------------------|--|--|--|--|
| | | Oilit | FR1.30-1A | | | | |
| TDD Slot Configuration pattern (N | | | 7DS2U | | | | |
| Special Slot Configuration (Note 2 | | 6D+4G+4U | | | | | |
| referenceSubcarrierSpacing | kHz | N/A | | | | | |
| pattern (Note 4) | | | | | | | |
| | dl-UL- TransmissionPeriodicity | ms | N/A | | | | |
| | nrofDownlinkSlots | | N/A | | | | |
| | nrofDownlinkSymbols | | N/A | | | | |
| | nrofUplinkSlot | | N/A | | | | |
| | nrofUplinkSymbols | | N/A | | | | |
| Dettern 2 (Note 4) | HIOLOPHINKSYMBOIS | | IN/A | | | | |
| Pattern2 (Note 4) | -11.1.11 | | | | | | |
| | dl-UL- TransmissionPeriodicity | ms | N/A | | | | |
| | nrofDownlinkSlots | | N/A | | | | |
| | nrofDownlinkSymbols | | N/A | | | | |
| | nrofUplinkSlot | | N/A | | | | |
| | nrofUplinkSymbols | | N/A | | | | |
| PDCCH DCI Configuration | DCI Format | | 1-1 for slot | | | | |
| | | | indices with | | | | |
| | | | mod(i,10) = | | | | |
| | | | 0,1,2,3,4,5,6,7 | | | | |
| | Scheduled Grant | | Symbol 2-13 for | | | | |
| | | | slot indices with | | | | |
| | | | mod(i,10) = | | | | |
| | | | 0,1,2,3,4,5,6 and | | | | |
| | | | Symbol 2-5 for | | | | |
| | | | slot indices with | | | | |
| | | | mod(i,10) = 7 | | | | |
| The number of slots between PD | SCH and corresponding | | 8 if $mod(i,10) = 0$ | | | | |
| HARQ-ACK information (Note 3) | | | 7 if $mod(i,10) = 1$ | | | | |
| (PDSCH-to-HARQ-timing-indicate | or) | | 6 if $mod(i,10) = 2$ | | | | |
| | | | 5 if $mod(i,10) = 3$ | | | | |
| | | | 5 if $mod(i,10) = 4$ | | | | |
| | | | 4 if $mod(i,10) = 5$ | | | | |
| | | | 3 if $mod(i,10) = 6$ | | | | |
| Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL a | | | | | | | |
| | | | | | | | |
| guard symbols; U denotes a slot with all UL symbols. The field is for | | | | | | | |
| information. | | | | | | | |
| * | Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for | | | | | | |
| information. Note 3: i is the slot index per frame; $i = \{0,,19\}$ | | | | | | | |
| | | Coopfi | ruration | | | | |
| Note 4: Do not configure <i>tdd-UL-DL</i> -semi-statically using RRC configuration. | | | | | | | |

A.1.3 TDD UL-DL configuration for FR2

TDD UL-DL patterns configurations for performance requirements are provided in Tables A.1.3-1, A.1.3-2.

Table A.1.3-1: TDD UL-DL pattern for SCS 60 kHz

| Poro | Parameter | | UL-DL pattern |
|--------------------------------|-------------------------|------|----------------------|
| | | Unit | FR2.60-1 |
| TDD Slot Configuration pattern | n (Note 1) | | DDSU |
| Special Slot Configuration (No | te 2) | | 11D+3G+0U |
| referenceSubcarrierSpacing | | kHz | 60 |
| pattern1 | pattern1 dl-UL- | | 1 |
| | TransmissionPeriodicity | | 1 |
| | nrofDownlinkSlots | | 2 |
| | nrofDownlinkSymbols | | 11 |
| | nrofUplinkSlot | | 1 |
| | nrofUplinkSymbols | | 0 |
| The number of slots between | PDSCH and corresponding | | 3 if $mod(i,4) = 0$ |
| HARQ-ACK information (Note | 3) | | 2 if $mod(i,4) = 1$ |
| | | | 5] if $mod(i,4) = 2$ |

D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 1:

D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 2:

Note 3: i is the slot index per frame; $i = \{0,...,39\}$

Table A.1.3-2: TDD UL-DL configuration for SCS 120 kHz

| Parameter | | Unit | UL-DL pattern | | |
|---------------------------------|-----------------------------------|------|---------------------|---------------------|--|
| | | Onit | FR2.120-1 | FR2.120-2 | |
| TDD Slot Configuration pattern | (Note 1) | | DDDSU | DDSU | |
| Special Slot Configuration (Not | e 2) | | 10D+2G+2U | 11D+3G+0U | |
| referenceSubcarrierSpacing | | kHz | 120 | 120 | |
| pattern1 | dl-UL- TransmissionPeriodicity | ms | 0.625 | 0.5 | |
| | nrofDownlinkSlots | | 3 | 2 | |
| | nrofDownlinkSymbols | | 10 | 11 | |
| | nrofUplinkSlot | | 1 | 1 | |
| | nrofUplinkSymbols | | 2 | 0 | |
| The number of slots between P | DSCH and corresponding | | 4 if $mod(i,5) = 0$ | 3 if $mod(i,4) = 0$ | |
| HARQ-ACK information(Note 3) | | | 3 if $mod(i,5) = 1$ | 2 if $mod(i,4) = 1$ | |
| | | | 2 if mod(i,5) = 2 | 5 if $mod(i,4) = 2$ | |
| | | | 6 if $mod(i,5) = 3$ | | |

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.

D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 2:

i is the slot index per frame; $i = \{0,...,79\}$ Note 3:

Table A.1.3-2a: TDD UL-DL configuration for SCS 120 kHz for DCI-based dynamic UL/DL detection

| | Parameter | | | UL-DL pattern | | |
|-----------|---|---------------------------------|-----------|------------------------------------|--|--|
| | | | Unit | FR2.120-1A | | |
| TDD Slot | Configuration pattern (N | | DDDSU | | | |
| Special S | Slot Configuration (Note: | | 10D+2G+2U | | | |
| | eSubcarrierSpacing | | kHz | N/A | | |
| pattern1 | (Note 4) | dI-UL- | ms | N/A | | |
| | | TransmissionPeriodicity | | | | |
| | | nrofDownlinkSlots | | N/A | | |
| | | nrofDownlinkSymbols | | N/A | | |
| | | nrofUplinkSlot | | N/A | | |
| | | nrofUplinkSymbols | | N/A | | |
| Pattern2 | (Note 4) | | | | | |
| | | dI-UL- | ms | N/A | | |
| | | TransmissionPeriodicity | | | | |
| | | nrofDownlinkSlots | | N/A | | |
| | | nrofDownlinkSymbols | | N/A | | |
| | | nrofUplinkSlot | | N/A | | |
| | | nrofUplinkSymbols | | N/A | | |
| PDCCH | DCI Configuration | DCI Format | | 1-1 for slot | | |
| | | | | indices with | | |
| | | | | mod(i,5) = | | |
| | | | | 0,1,2,3 | | |
| | | Scheduled Grant | | Symbol 1-13 for | | |
| | | | | slot indices with | | |
| | | | | mod(i,5) = 0,1,2 and Symbol 1-9 | | |
| | | | | for slot indices | | |
| | | | | with mod(i,5) = | | |
| | | | | 3 | | |
| The num | ber of slots between PD | SCH and corresponding | 1 | 4 if $mod(i,5) = 0$ | | |
| | CK information(Note 3) | | | 3 if $mod(i,5) = 1$ | | |
| | | | | 2 if $mod(i,5) = 2$ | | |
| | | | | 6 if $mod(i,5) = 3$ | | |
| Note 1: | D denotes a slot with a | all DL symbols; S denotes a slo | ot with a | | | |
| | and guard symbols; U denotes a slot with all UL symbols. The field is for | | | | | |
| | information. | | | | | |
| Note 2: | | | | | | |
| l | information. | | | | | |
| Note 3: | i is the slot index per fi | | | 550 | | |
| Note 4: | | nfigurationCommon semi-station | ally usir | ng RRC | | |
| | configuration. | | | | | |

A.2 Void

< Editor's note: Clause A.2 is a placeholder for UL Measurement channels>

A.3 DL reference measurement channels

A.3.1 General

The transport block size (TBS) determination procedure is described in clause 5.1.3.2 of TS 38.214 [12].

Unless otherwise stated, no user data is scheduled on slot #0 within 20 ms in order to avoid SSB and PDSCH transmissions in one slot and simplify test configuration.

Reference measurement channels for PDSCH performance A.3.2 requirements

For PDSCH reference channels if more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2.1.1-1: PDSCH Reference Channel for FDD (QPSK)

| Parameter | Unit | | | Value | | |
|--|--|-----------------------|-----------------------|-----------------------|--|--|
| Reference channel | | R.PDSCH.1- 1.1 FDD | R.PDSCH.1- 1.2 FDD | R.PDSCH.1- 1.3 FDD | | |
| Channel bandwidth | MHz | 10 | 1.2 FDD | 10 | | |
| Subcarrier spacing | kHz | 15 | 15 | 15 | | |
| Number of allocated resource | | | | | | |
| blocks | PRBs | 52 | 6 | 52 | | |
| Number of consecutive PDSCH symbols | | 12 | 12 | 7 | | |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | | |
| MCS table | | 64QAM | 64QAM | 64QAM | | |
| MCS index | | 4 | 4 | 4 | | |
| Modulation | | QPSK | QPSK | QPSK | | |
| Target Coding Rate | | 0.30 | 0.30 | 0.30 | | |
| Number of MIMO layers | | 1 | 1 | 1 | | |
| Number of DMRS REs | | 18 | 12 | 12 | | |
| Overhead for TBS determination | | 0 | 0 | 0 | | |
| Information Bit Payload per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | | |
| For Slots i = 1,, 19 | Bits | 3904 | 480 | 2280 | | |
| Transport block CRC per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | | |
| For Slots i = 1,, 19 | Bits | 24 | 16 | 16 | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slot $i = 0$ | CBs | N/A | N/A | N/A | | |
| For Slots i = 1,, 19 | CBs | 1 | 1 | 1 | | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | | |
| For Slots i = 10, 11 | Bits | 12480 | 1512 | 6864 | | |
| For Slots i =1,, 9, 12,, 19 | Bits | 13104 | 1584 | 7488 | | |
| Max. Throughput averaged over 2 frames | Mbps | 3.709 | 0.456 | 2.166 | | |
| Note 1: SS/PBCH block is transmi | Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | |

Table A.3.2.1.1-2: PDSCH Reference Channel for FDD (16QAM)

| Parameter | Unit | Value | | | | |
|--|-------|------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.1- | R.PDSCH.1- | R.PDSCH.1- | R.PDSCH.1- | |
| Reference channel | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD | |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | |
| Number of allocated resource blocks | PRBs | 52 | 52 | 52 | 52 | |
| Number of consecutive PDSCH symbols | | 12 | 12 | 12 | 12 | |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | 19 | |
| MCS table | | 64QAM | 64QAM | 64QAM | 64QAM | |
| MCS index | | 13 | 13 | 13 | 13 | |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM | |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | 0.48 | |
| Number of MIMO layers | | 1 | 2 | 3 | 4 | |
| Number of DMRSREs | | 12 | 12 | 24 | 24 | |
| Overhead for TBS determination | | 0 | 0 | 0 | 0 | |
| Information Bit Payload per Slot | | | | | | |
| For Slot $i = 0$ | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 13064 | 26120 | 35856 | 48168 | |
| Transport block CRC per Slot | | | | | | |
| For Slot $i = 0$ | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | 24 | 24 | 24 | |
| Number of Code Blocks per Slot | | | | | | |
| For Slot $i = 0$ | CBs | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | CBs | 2 | 4 | 5 | 6 | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 10, 11 | Bits | 26208 | 52416 | 71136 | 94848 | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 27456 | 54912 | 74880 | 99840 | |
| Max. Throughput averaged over 2 frames | Mbps | 12.411 | 24.814 | 34.063 | 45.760 | |

Table A.3.2.1.1-3: PDSCH Reference Channel for FDD (64QAM)

| Parameter | Unit | | Value | |
|-------------------------------------|-------|------------|-------|--|
| Reference channel | | R.PDSCH.1- | | |
| Reference channel | | 3.1 FDD | | |
| Channel bandwidth | MHz | 10 | | |
| Subcarrier spacing | kHz | 15 | | |
| Number of allocated resource blocks | PRBs | 52 | | |
| Number of consecutive PDSCH | | 12 | | |
| symbols | | 12 | | |
| Allocated slots per 2 frames | Slots | 19 | | |
| MCS table | | 64QAM | | |
| MCS index | | 19 | | |
| Modulation | | 64QAM | | |
| Target Coding Rate | | 0.51 | | |
| Number of MIMO layers | | 2 | | |
| Number of DMRS REs | | 12 | | |
| Overhead for TBS determination | | 0 | | |
| Information Bit Payload per Slot | | | | |
| For Slot i = 0 | Bits | N/A | | |
| For Slots i = 1,, 19 | Bits | 42016 | | |
| Transport block CRC per Slot | | | | |
| For Slot i = 0 | Bits | N/A | | |
| For Slots i = 1,, 19 | Bits | 24 | | |
| Number of Code Blocks per Slot | | | | |
| For Slot i = 0 | CBs | N/A | | |
| For Slots i = 1,, 19 | CBs | 5 | | |
| Binary Channel Bits Per Slot | | | | |
| For Slot i = 0 | Bits | N/A | | |
| For Slots i = 10, 11 | Bits | 78624 | | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 82368 | | |
| Max. Throughput averaged over 2 | Mhnc | 20.015 | | |
| frames | Mbps | 39.915 | | |

Table A.3.2.1.1-4: PDSCH Reference Channel for FDD (256QAM)

| Parameter | Unit | | Value |
|-------------------------------------|--------|------------|-------|
| Reference channel | | R.PDSCH.1- | |
| Reference channel | | 4.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 256QAM | |
| MCS index | | 24 | |
| Modulation | | 256QAM | |
| Target Coding Rate | | 0.82 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 45096 | |
| Transport block CRC per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot $i = 0$ | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 6 | |
| Binary Channel Bits Per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 10, 11 | Bits | 52416 | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 54912 | |
| Max. Throughput averaged over 2 | Mbps | 42.841 | |
| frames | INIDH2 | 42.041 | |

Table A.3.2.1.1-5: PDSCH Reference Channel for FDD and CSI-RS overlapped with PDSCH

| Parameter | Unit | | Value |
|-------------------------------------|-------|------------|-------|
| Deference showned | | R.PDSCH.1- | |
| Reference channel | | 5.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 26120 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 4 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 5, 15 | Bits | 50752 | |
| For Slots i = 10 | Bits | 48256 | |
| For Slots i = 11 | Bits | 52416 | |
| For Slots $i = 1,,4,6,,$ | Bits | 54912 | |
| 9,12,14,16,,19 | טונס | J4312 | |
| Max. Throughput averaged over 2 | Mbps | 24.814 | |
| frames | | | |

Table A.3.2.1.1-6: PDSCH Reference Channel for FDD PMI reporting requirements

| Parameter | Unit | | | Value | |
|---------------------------------------|-------|------------|------------|-------|--|
| Reference channel | | R.PDSCH.1- | R.PDSCH.1- | | |
| | | 6.1 FDD | 6.2 FDD | | |
| Channel bandwidth | MHz | 10 | 10 | | |
| Subcarrier spacing | kHz | 15 | 15 | | |
| Number of allocated resource blocks | PRBs | 52 | 52 | | |
| Number of consecutive PDSCH | | 12 | 12 | | |
| symbols | | 12 | 12 | | |
| Allocated slots per 2 frames | Slots | 15 | 15 | | |
| MCS table | | 64QAM | 64QAM | | |
| MCS index | | 13 | 13 | | |
| Modulation | | 16QAM | 16QAM | | |
| Target Coding Rate | | 0.48 | 0.48 | | |
| Number of MIMO layer | | 1 | 2 | | |
| Number of DMRS REs (Note 3) | | 24 | 24 | | |
| Overhead for TBS determination | | 0 | 0 | | |
| Information Bit Payload per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | IN/A | IN/A | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 12040 | 24072 | | |
| ={0,2,3,4}, i={1,19} | סונס | 12040 | 24072 | | |
| Transport block CRC per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | IN/A | IN/A | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 24 | 24 | | |
| $=\{0,2,3,4\}, i=\{1,19\}$ | סונס | 24 | 24 | | |
| Number of Code Blocks per Slot | | | | | |
| For Slot i = 0 | CBs | N/A | N/A | | |
| For CSI Slots i, if mod $(i,5) = 1$, | | N/A | N/A | | |
| i={0,,19} | | IN//A | IN//A | | |
| For Non CSI-RS Slot i, if mod (i,5) | CBs | 2 | 3 | | |
| ={0,2,3,4}, i={1,,19} | ODS | | ŭ | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | | · | | |
| For Slots i = 10 | Bits | 23712 | 47424 | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 24960 | 49920 | | |
| ={0,2,3,4}, i={1,9,11,,19} | טוט | 2-300 | 70020 | | |
| Max. Throughput averaged over 2 | Mbps | 9.030 | 18.054 | | |
| frames | · | | 10.004 | | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.1.1-7: PDSCH Reference Channel for FDD LTE-NR coexistence scenario

| Parameter | Unit | | | Value | |
|---|-------|------------|------------|-------|--|
| Reference channel | | R.PDSCH.1- | R.PDSCH.1- | | |
| Reference charmer | | 7.1 FDD | 7.2 FDD | | |
| Channel bandwidth | MHz | 10 | 10 | | |
| Subcarrier spacing | kHz | 15 | 15 | | |
| Number of allocated resource blocks | PRBs | 52 | 52 | | |
| Number of consecutive PDSCH symbols | | 9 | 11 | | |
| Allocated slots per 2 frames | Slots | 19 | 19 | | |
| MCS table | | 64QAM | 64QAM | | |
| MCS index | | 4 | 4 | | |
| Modulation | | QPSK | QPSK | | |
| Target Coding Rate | | 0.30 | 0.30 | | |
| Number of MIMO layers | | 1 | 1 | | |
| Number of DMRS REs | | 12 | 12 | | |
| Overhead for TBS determination | | 18 | 18 | | |
| Information Bit Payload per Slot | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | Bits | 2472 | 3240 | | |
| Transport block CRC per Slot | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | Bits | 16 | 16 | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots i = 0,5,10,15 | CBs | N/A | N/A | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | CBs | 1 | 1 | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | |
| For Slots i = 11 | Bits | 7760 | 10256 | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{1,, 9, 12,, 19\}$ | Bits | 8384 | 10880 | | |
| Max. Throughput averaged over 2 frames | Mbps | 1.978 | 2.592 | | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
No user data is scheduled on slots with LTE PBCH/PSS/SSS Note 3:

Table A.3.2.1.1-8: PDSCH Reference Channel for FDD HST scenario

| Parameter | Unit | | Value |
|--|-------|------------|-------|
| Reference channel | | R.PDSCH.1- | |
| Reference channel | | 8.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs | | 18 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 12552 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,2,11,12 | Bits | 24960 | |
| For Slots i = 3,, 10, 13,, 19 | Bits | 26208 | |
| Max. Throughput averaged over 2 frames | Mbps | 11.924 | |

A.3.2.1.2 Reference measurement channels for SCS 30 kHz FR1

Table A.3.2.1.2-1: PDSCH Reference Channel for FDD (64QAM)

| Parameter | Unit | | Value |
|--|------------|-------------------|-----------|
| Deference showed | | R.PDSCH.2- | |
| Reference channel | | 1.1 FDD | |
| Channel bandwidth | MHz | 20 | |
| Subcarrier spacing | kHz | 30 | |
| Number of allocated resource blocks | PRBs | 51 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 39 | |
| MCS table | | 64QAM | |
| MCS index | | 19 | |
| Modulation | | 64QAM | |
| Target Coding Rate | | 0.51 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 39 | Bits | 40976 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 30 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 39 | CBs | 5 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 20, 21 | Bits | 77112 | |
| For Slots i = 1,, 19, 22,, 39 | Bits | 80784 | |
| Max. Throughput averaged over 2 frames | Mbps | 79.903 | |
| Note 1: SS/PBCH block is transmitte | ed in slot | #0 with periodici | ity 20 ms |

A.3.2.1.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.1.4 Reference measurement channels for E-UTRA

Table A.3.2.1.4-1: PDSCH Reference Channel for sustained data-rate test (64QAM, 2 MIMO layers)

| Parameter | Unit | | lue | | |
|--|------|------------|------------|------------|------------|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- |
| | | 1.1 FDD | 1.2 FDD | 1.3 FDD | 1.4 FDD |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 |
| Allocated subframes per Radio Frame | | 9 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9, | | 0.85 | 0.85 | 0.85 | 0.88 |
| For Sub-Frame 5 | | N/A | 0.89 | 0.91 | 0.87 |
| For Sub-Frame 0 | | 0.83 | 0.90 | 0.88 | 0.90 |
| Information Bit Payload (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 18336 | 36696 | 55056 | 75376 |
| For Sub-Frame 5 | Bits | N/A | 35160 | 52752 | 71112 |
| For Sub-Frame 0 | Bits | 15840 | 36696 | 55056 | 75376 |
| Number of Code Blocks | | | | | |
| (Notes 3 and 4) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 3 | 6 | 9 | 13 |
| For Sub-Frame 5 | Bits | N/A | 6 | 9 | 12 |
| For Sub-Frame 0 | Bits | 3 | 6 | 9 | 13 |
| Binary Channel Bits (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 21600 | 43200 | 64800 | 86400 |
| For Sub-Frame 5 | Bits | N/A | 39744 | 60480 | 82080 |
| For Sub-Frame 0 | Bits | 19152 | 40752 | 62352 | 83952 |
| Number of layers | | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 17.837 | 36.542 | 54.826 | 74.950 |

Note 1: 1 symbol allocated to PDCCH for all tests.

Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].

Note 3: Given per component carrier per codeword.

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.

Note 6: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.

Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.

Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.

Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-2: PDSCH Reference Channel for sustained data-rate test (64QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | | |
|--|------|------------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | | |
| | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | | |
| Allocated subframes per Radio Frame | | 9 | 10 | 10 | 10 | | |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM | | |
| Coding Rate | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9, | | 0.78 | 0.78 | 0.77 | 0.79 | | |
| For Sub-Frame 5 | | N/A | 0.80 | 0.79 | 0.81 | | |
| For Sub-Frame 0 | | 0.85 | 0.83 | 0.8 | 0.81 | | |
| Information Bit Payload (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 31704 | 63776 | 93800 | 128496 | | |
| For Sub-Frame 5 | Bits | N/A | 59256 | 90816 | 124464 | | |
| For Sub-Frame 0 | Bits | 30576 | 63776 | 93800 | 128496 | | |
| Number of Code Blocks | | | | | | | |
| (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 6 | 11 | 16 | 21 | | |
| For Sub-Frame 5 | Bits | N/A | 10 | 15 | 21 | | |
| For Sub-Frame 0 | Bits | 5 | 11 | 16 | 21 | | |
| Binary Channel Bits (Note 3) | | | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 40800 | 81600 | 122400 | 163200 | | |
| For Sub-Frame 5 | Bits | N/A | 74976 | 114144 | 154944 | | |
| For Sub-Frame 0 | Bits | 36192 | 76992 | 117792 | 158592 | | |
| Number of layers | | 4 | 4 | 4 | 4 | | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 28.421 | 63.324 | 93.502 | 128.093 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-3: PDSCH Reference Channel for sustained data-rate test (256QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | | |
|--|------|------------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | | |
| | | 3.1 FDD | 3.2 FDD | 3.3 FDD | 3.4 FDD | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | | |
| Coding Rate | | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.85 | 0.88 | 0.85 | | |
| For Sub-Frames 1,2,6,7 | | 0.77 | 0.74 | 0.74 | 0.74 | | |
| For Sub-Frame 5 | | 0.79 | 0.77 | 0.77 | 0.75 | | |
| For Sub-Frame 0 | | 0.84 | 0.78 | 0.77 | 0.76 | | |
| Information Bit Payload (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 24496 | 48936 | 75376 | 97896 | | |
| For Sub-Frames 1,2,6,7 | Bits | 21384 | 42368 | 63776 | 84760 | | |
| For Sub-Frame 5 | Bits | 19848 | 40576 | 61664 | 81176 | | |
| For Sub-Frame 0 | Bits | 21384 | 42368 | 63776 | 84760 | | |
| Number of Code Blocks | | | | | | | |
| (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 4 | 8 | 13 | 16 | | |
| For Sub-Frames 1,2,6,7 | Bits | 4 | 7 | 11 | 14 | | |
| For Sub-Frame 5 | Bits | 4 | 7 | 11 | 14 | | |
| For Sub-Frame 0 | Bits | 4 | 7 | 11 | 14 | | |
| Binary Channel Bits (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 28800 | 57600 | 86400 | 115200 | | |
| For Sub-Frames 1,2,6,7 | Bits | 28800 | 57600 | 86400 | 115200 | | |
| For Sub-Frame 5 | Bits | 25344 | 52992 | 80640 | 109440 | | |
| For Sub-Frame 0 | Bits | 25536 | 54336 | 83136 | 111936 | | |
| Number of layers | | 2 | 2 | 2 | 2 | | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 22.475 | 44.816 | 68.205 | 89.656 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-4: PDSCH Reference Channel for sustained data-rate test (256QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | | |
|--|------|------------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | | |
| | | 4.1 FDD | 4.2 FDD | 4.3 FDD | 4.4 FDD | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | | |
| Coding Rate | | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.78 | 0.79 | 0.78 | | |
| For Sub-Frames 1,2,6,7 | | 0.77 | 0.78 | 0.79 | 0.78 | | |
| For Sub-Frame 5 | | 0.79 | 0.82 | 0.82 | 0.786 | | |
| For Sub-Frame 0 | | 0.84 | 0.83 | 0.82 | 0.80 | | |
| Information Bit Payload (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 42368 | 84760 | 128496 | 169544 | | |
| For Sub-Frames 1,2,6,7 | Bits | 42368 | 84760 | 128496 | 169544 | | |
| For Sub-Frame 5 | Bits | 39232 | 81176 | 124464 | 161760 | | |
| For Sub-Frame 0 | Bits | 39232 | 84760 | 128496 | 169544 | | |
| Number of Code Blocks | | | | | | | |
| (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 7 | 14 | 21 | 28 | | |
| For Sub-Frames 1,2,6,7 | Bits | 7 | 14 | 21 | 28 | | |
| For Sub-Frame 5 | Bits | 7 | 14 | 21 | 27 | | |
| For Sub-Frame 0 | Bits | 7 | 14 | 21 | 28 | | |
| Binary Channel Bits (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 54400 | 108800 | 163200 | 217600 | | |
| For Sub-Frames 1,2,6,7 | Bits | 54400 | 108800 | 163200 | 217600 | | |
| For Sub-Frame 5 | Bits | 47744 | 99968 | 152192 | 206592 | | |
| For Sub-Frame 0 | Bits | 48256 | 102656 | 157056 | 211456 | | |
| Number of layers | | 4 | 4 | 4 | 4 | | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 41.741 | 84.4016 | 128.093 | 168.766 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-5: PDSCH Reference Channel for sustained data-rate test (1024QAM, 2 MIMO layers)

| Parameter | Unit | | Va | lue | |
|--|------|------------|------------|------------|------------|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- |
| | | 5.1 FDD | 5.2 FDD | 5.3 FDD | 5.4 FDD |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | 1024QAM |
| Coding Rate | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.76 | 0.73 | 0.75 | 0.76 |
| For Sub-Frames 1,2,6,7 | | 0.76 | 0.73 | 0.75 | 0.76 |
| For Sub-Frame 5 | | 0.80 | 0.77 | 0.78 | 0.77 |
| For Sub-Frame 0 | | 0.86 | 0.78 | 0.78 | 0.79 |
| Information Bit Payload (Note 3) | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 27376 | 52752 | 81176 | 110136 |
| For Sub-Frames 1,2,6,7 | Bits | 27376 | 52752 | 81176 | 110136 |
| For Sub-Frame 5 | Bits | 25456 | 51024 | 78704 | 105528 |
| For Sub-Frame 0 | Bits | 27376 | 52752 | 81176 | 110136 |
| Number of Code Blocks | | | | | |
| (Notes 3 and 4) | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 5 | 9 | 14 | 18 |
| For Sub-Frames 1,2,6,7 | Bits | 5 | 9 | 14 | 18 |
| For Sub-Frame 5 | Bits | 5 | 9 | 13 | 18 |
| For Sub-Frame 0 | Bits | 5 | 9 | 14 | 18 |
| Binary Channel Bits (Note 3) | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 36000 | 72000 | 108000 | 144000 |
| For Sub-Frames 1,2,6,7 | Bits | 36000 | 72000 | 108000 | 144000 |
| For Sub-Frame 5 | Bits | 31680 | 66240 | 100800 | 136800 |
| For Sub-Frame 0 | Bits | 31920 | 67920 | 103920 | 139920 |
| Number of layers | | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 27.18 | 52.58 | 80.93 | 109.68 |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-6: PDSCH Reference Channel for sustained data-rate test (1024QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | | |
|--|------|------------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | | |
| | | 6.1 FDD | 6.2 FDD | 6.3 FDD | 6.4 FDD | | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | 1024QAM | | |
| Coding Rate | | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.78 | 0.81 | 0.79 | 0.81 | | |
| For Sub-Frames 1,2,6,7 | | 0.78 | 0.81 | 0.79 | 0.81 | | |
| For Sub-Frame 5 | | 0.82 | 0.81 | 0.83 | 0.82 | | |
| For Sub-Frame 0 | | 0.87 | 0.86 | 0.82 | 0.83 | | |
| Information Bit Payload (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 52752 | 110136 | 161760 | 220296 | | |
| For Sub-Frames 1,2,6,7 | Bits | 52752 | 110136 | 161760 | 220296 | | |
| For Sub-Frame 5 | Bits | 48936 | 101840 | 157432 | 211936 | | |
| For Sub-Frame 0 | Bits | 52752 | 110136 | 161760 | 220296 | | |
| Number of Code Blocks | | | | | | | |
| (Notes 3 and 4) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 9 | 18 | 27 | 36 | | |
| For Sub-Frames 1,2,6,7 | Bits | 9 | 18 | 27 | 36 | | |
| For Sub-Frame 5 | Bits | 8 | 17 | 26 | 35 | | |
| For Sub-Frame 0 | Bits | 9 | 18 | 27 | 36 | | |
| Binary Channel Bits (Note 3) | | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 68000 | 136000 | 204000 | 272000 | | |
| For Sub-Frames 1,2,6,7 | Bits | 68000 | 136000 | 204000 | 272000 | | |
| For Sub-Frame 5 | Bits | 59680 | 124960 | 190240 | 258240 | | |
| For Sub-Frame 0 | Bits | 60320 | 128320 | 196320 | 264320 | | |
| Number of layers | | 4 | 4 | 4 | 4 | | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 52.37 | 109.31 | 161.33 | 219.46 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

A.3.2.2 TDD

- A.3.2.2.1 Reference measurement channels for SCS 15 kHz FR1
- A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1

Table A.3.2.2.2-1: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and FR1.30-1A (QPSK)

| Parameter | Unit | | | Value | |
|--|------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- | |
| | | 1.1 TDD | 1.2 TDD | 1.3 TDD | |
| Channel bandwidth | MHz | 40 | 40 | 40 | |
| Subcarrier spacing | kHz | 30 | 30 | 30 | |
| Allocated resource blocks | PRBs | 106 | 6 | 106 | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | 4 | 4 | N/A | |
| {0,,39} | | • | · | . 4,7.1 | |
| For Slot i, if mod(i, 10) = | | 12 | 12 | 7 | |
| {0,1,2,3,4,5,6} for i from {1,,39} | | 24 | 24 | 07 | |
| Allocated slots per 2 frames | | 31 | 31 | 27 | |
| MCS table | | 64QAM | 64QAM | 64QAM | |
| MCS index | | 4 | 4 | 4 | |
| Modulation | | QPSK | QPSK | QPSK | |
| Target Coding Rate | | 0.30 | 0.30 | 0.30 | |
| Number of MIMO layers | | 1 | 1 | 1 | |
| Number of DMRS REs | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | 6 | 6 | N/A | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = | | | | | |
| | | 18 | 12 | 12 | |
| {0,1,2,3,4,5,6})for i from {1,,39} Overhead for TBS determination | | 0 | 0 | 0 | |
| Information Bit Payload per Slot | | U | U | 0 | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| $\{8,9\}$ for i from $\{0,,39\}$ | Bits | N/A | N/A | N/A | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | |
| $\{0,,39\}$ | Bits | 2664 | 144 | N/A | |
| For Slot i, if mod(i, 10) = | | | | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 8064 | 480 | 4608 | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | |
| {0,,39} | Bits | 16 | 16 | N/A | |
| For Slot i, if mod(i, 10) = | D., | 0.4 | 40 | 0.4 | |
| {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 24 | 16 | 24 | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | CBs | N/A | N/A | N/A | |
| {8,9} for i from {0,,39} | CDS | IN/A | IN/A | IN/A | |
| For Slot i, if mod(i, 10) = 7 for i from | CBs | 1 | 1 | N/A | |
| {0,,39} | CDS | ı | ı | IN/A | |
| For Slot i, if mod(i, 10) = | CBs | 1 | 1 | 1 | |
| {0,1,2,3,4,5,6} for i from {1,,39} | ODS | ' | ' | ' | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | N/A | |
| {8,9} for i from {0,,39} | | | | | |
| For Slots i = 20, 21 | Bits | 25440 | 1512 | 13992 | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 8904 | 504 | N/A | |
| {0,,39} | | 555. | | | |
| For Slot i, if mod(i, 10) = | | | | | |
| {0,1,2,3,4,5,6} for i from | Bits | 26712 | 1584 | 15264 | |
| {1,,19,22,,39} | | | | | |
| Max. Throughput averaged over 2 | Mbps | 11.419 | 0.677 | 6.221 | |
| frames Note 1: SS/PBCH block is transmitted | · | | | | |

Table A.3.2.2.2: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (16QAM)

| Parameter | Unit | | | Value | |
|--|------|------------------|------------|------------|------------|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- |
| | | 2.1 TDD | 2.2 TDD | 2.3 TDD | 2.4 TDD |
| Channel bandwidth | MHz | 40 | 40 | 40 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 106 | 106 | 106 |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | | 4 | 4 | 4 | 4 |
| For Slot i, if mod(i, 10) = | | | | | |
| {0,1,2,3,4,5,6})for i from {1,,39} | | 12 | 12 | 12 | 12 |
| Allocated slots per 2 frames | | 31 | 31 | 31 | 31 |
| MCS table | | 64QAM | 64QAM | 64QAM | 64QAM |
| MCS index | | 13 | 13 | 13 | 13 |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | 0.48 |
| Number of MIMO layers | | 1 | 2 | 3 | 4 |
| Number of DMRS REs | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | 6 | 6 | 12 | 12 |
| {0,,39} | | O | O | 12 | 12 |
| For Slot i, if mod(i, 10) = | | 12 | 12 | 24 | 24 |
| {0,1,2,3,4,5,6} for i from {1,,39} | | | | | |
| Overhead for TBS determination | | 0 | 0 | 0 | 0 |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | N/A | N/A |
| {8,9} for i from {0,,39} | | - | - | - | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 8456 | 16896 | 22032 | 29192 |
| {0,,39} For Slot i, if mod(i, 10) = | | | | | |
| $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | Bits | 26632 | 53288 | 73776 | 98376 |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | 5 | 21/2 | 21/2 | 21/2 | A1/A |
| {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 24 | 24 | 24 | 24 |
| {0,,39} | DIIS | 24 | 24 | 24 | 24 |
| For Slot i, if mod(i, 10) = | Bits | 24 | 24 | 24 | 24 |
| {0,1,2,3,4,5,6}for i from {1,,39} | Dito | 24 | 24 | 27 | 27 |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | CBs | N/A | N/A | N/A | N/A |
| {8,9} for i from {0,,39} | | - | | - | |
| For Slot i, if $mod(i, 10) = 7$ for i from | CBs | 2 | 3 | 3 | 4 |
| {0,,39} For Slot i, if mod(i, 10) = | | | | | |
| $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | CBs | 4 | 7 | 9 | 12 |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | N/A |
| For Slots i = 20, 21 | Bits | 53424 | 106848 | 144008 | 193344 |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | |
| {0,,39} | Bits | 17808 | 35616 | 45792 | 61056 |
| For Slot i, if mod(i, 10) = | | | | | |
| {0,1,2,3,4,5,6} for i from | Bits | 55968 | 111936 | 152640 | 203520 |
| {1,,19,22,,39} | | | | | |
| Max. Throughput averaged over 2 | Mbps | 37.644 | 75.318 | 104.719 | 138.646 |
| frames | | | | | |
| Note 1: SS/PBCH block is transmitte | | #U with periodic | city 20 ms | | |
| Note 2: Slot i is slot index per 2 fram | es | | | | |

Table A.3.2.2.2-3: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (64QAM)

| Parameter | Unit | | Value |
|---|-------------|-----------------------|-------|
| Reference channel | | R.PDSCH.2- 3.1 TDD | |
| Channel bandwidth | MHz | 40 | |
| Subcarrier spacing | kHz | 30 | |
| Allocated resource blocks | PRBs | 106 | |
| Number of consecutive PDSCH | | | |
| symbols | | | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | | 4 | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | | 12 | |
| Allocated slots per 2 frames | | 31 | |
| MCS table | | 64QAM | |
| MCS index | | 19 | |
| Modulation | | 64QAM | |
| Target Coding Rate | | 0.51 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | | 6 | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} | Bits | N/A | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | Bits | 27144 | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | Bits | 83976 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | |
| {8,9} for i from {0,,39} | Bits | N/A | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | Bits | 24 | |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 10) = \{8,9\}$ for i from $\{0,,39\}$ | CBs | N/A | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | CBs | 4 | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | CBs | 10 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | |
| {8,9} for i from {0,,39} For Slots i = 20, 21 | Bits | 160272 | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 53424 | |
| {0,,39} | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$ | Bits | 167904 | |
| Max. Throughput averaged over 2 frames | Mbps | 118.796 | |
| Note 1: SS/PBCH block is transmitted i | n slot #0 v | vith periodicity 20 | 0 ms |
| Note 2: Slot i is slot index per 2 frames | | - | |

Table A.3.2.2.4: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (256QAM)

| Parameter | Unit | | | Value | | |
|---|------|---------------------|--------|-------|---|----------|
| Reference channel | | R.PDSCH.2- | | | | |
| | | 4.1 TDD | | | | |
| Channel bandwidth | MHz | 40 | | | | |
| Subcarrier spacing | kHz | 30 | | | | |
| Allocated resource blocks | PRBs | 106 | | | | |
| Number of consecutive PDSCH symbols | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | | | | | |
| $\{0,,39\}$ | | 4 | | | | |
| For Slot i, if mod(i, 10) = | | | | | | |
| {0,1,2,3,4,5,6}for i from {1,,39} | | 12 | | | | |
| Allocated slots per 2 frames | | 31 | | | | |
| MCS table | | 256QAM | | | | |
| MCS index | | 24 | | | | |
| Modulation | | 256QAM | | | | |
| Target Coding Rate | | 0.82 | | | | |
| Number of MIMO layers | | 1 | | | | |
| Number of DMRS REs | | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | 6 | | | | |
| {0,,39} | | Ů | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 12 | | | | |
| for i from {1,,39} | | | | | | |
| Overhead for TBS determination | | 0 | | | | |
| Maximum number of HARQ | | 4 | | | | |
| transmissions Information Bit Payload per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | | |
| {0,,39} | Bits | 29192 | | | | |
| For Slot i, if mod(i, 10) = | 5 | 22222 | | | | |
| {0,1,2,3,4,5,6}for i from {1,,39} | Bits | 92200 | | | | |
| Transport block CRC per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {8,9} for i from {0,,39} | Dita | IN/A | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 24 | | | | |
| {0,,39} | Dito | 21 | | | | |
| For Slot i, if mod(i, 10) = | Bits | 24 | | | | |
| {0,1,2,3,4,5,6}for i from {1,,39} | | | | | | |
| Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = | | | | | | |
| $\{8,9\}$ for i from $\{0,,39\}$ | CBs | N/A | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | | |
| $\{0,,39\}$ | CBs | 4 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | | | | | |
| for i from {1,,39} | CBs | 11 | | | | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:4- | NI/A | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | <u> </u> |
| For Slots i = 20, 21 | Bits | 106848 | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 35616 | | | | |
| {0,,39} | סווט | 33010 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$ | Bits | 111936 | | | | |
| Max. Throughput averaged over 2 frames | Mbps | 130.308 | | | | |
| Note 1: SS/PBCH block is transmitted i | - | |) ms | | 1 | 1 |
| Note 2: Slot i is slot index per 2 frames | | viti periodicity 20 | 7 1110 | | | |

Table A.3.2.2.5: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-2

| Parameter | Unit | | Value | |
|--|-------------|--------------------|--|--|
| Reference channel | | R.PDSCH.2- | | |
| | | 5.1 TDD | | |
| Channel bandwidth | MHz | 40 | | |
| Subcarrier spacing | kHz | 30 | | |
| Allocated resource blocks | PRBs | 106 | | |
| Number of consecutive PDSCH | | | | |
| symbols | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 8 | | |
| {0,,39} | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | 12 | | |
| from {1,,39} Allocated slots per 2 frames | | 31 | | |
| MCS table | | 64QAM | | |
| MCS table MCS index | | 4 | | |
| Modulation | | QPSK | | |
| Target Coding Rate | | 0.30 | | |
| Number of MIMO layers | | 1 | | |
| Number of DMRS REs | | ' | | |
| | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 12 | | |
| $\{0,,39\}$ For Slot i, if mod(i, 5) = $\{0,1,\}$) for i from | | | | |
| $\{1,,39\}$ | | 12 | | |
| Overhead for TBS determination | | 0 | | |
| Information Bit Payload per Slot | | 0 | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | | | | |
| i from {0,,39} | Bits | N/A | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | | | |
| {0,,39} | Bits | 5376 | | |
| For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i | D., | 0.450 | | |
| from {1,,39} | Bits | 8456 | | |
| Transport block CRC per Slot | | | | |
| For Slot 0 and Slot i, if mod(i, 5) = 4 for | Dito | N/A | | |
| i from {0,,39} | Bits | IN/A | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 24 | | |
| {0,,39} | DIIS | 24 | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Bits | 24 | | |
| from {1,,39} | Dita | 27 | | |
| Number of Code Blocks per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | CBs | N/A | | |
| i from {0,,39} | | 1 47 1 | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 1 | | |
| {0,,39} | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | CBs | 2 | | |
| from {1,,39} | | | | |
| Binary Channel Bits Per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | Bits | N/A | | |
| i from {0,,39} | Bits | 26712 | | |
| For Slot $i = 20, 21$ For Slot i, if $mod(i, 5) = 3$ for i from | DIIS | 20/12 | | |
| | Bits | 17808 | | |
| $\{0,,39\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | 1 | + | |
| For Slot 1, if find(1, 5) = $\{0, 1, 2\}$ for 1 from $\{1,, 19, 22,, 39\}$ | Bits | 27984 | | |
| Max. Throughput averaged over 2 | | 1 | | |
| frames | Mbps | 11.875 | | |
| Note 1: SS/PBCH block is transmitted i | n slot #0 w | ith periodicity 20 | 20 ms | |
| Note 2: Slot i is slot index per 2 frames | 5.5t // W | poliodioley 20 | | |
| | | | | |

Table A.3.2.2.6: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-3

| Parameter | Unit | | | Value | | |
|--|--------------|-----------------------|-------------|-------|---|---|
| Reference channel | | R.PDSCH.2- 6.1 TDD | | | | |
| Channel bandwidth | MHz | 40 | | | | |
| Subcarrier spacing | kHz | 30 | | | | |
| Allocated resource blocks | PRBs | 106 | | | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | 0 | | | | |
| {0,,39} | | 8 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | | 40 | | | | |
| i from {1,,39} | | 12 | | | | |
| Allocated slots per 2 frames | | 27 | | | | |
| MCS table | | 64QAM | | | | |
| MCS index | | 4 | | | | |
| Modulation | | QPSK | | | | |
| Target Coding Rate | | 0.30 | | | | |
| Number of MIMO layers | | 1 | | | | |
| Number of DMRS REs | | | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | 40 | | | | |
| {0,,39} | | 12 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | | 12 | | | | |
| i from {1,,39} | | 12 | | | | |
| Overhead for TBS determination | | 0 | | | | |
| Maximum number of HARQ | | 4 | | | | |
| transmissions | | 4 | | | | |
| Information Bit Payload per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {4,8,9} for i from {0,,39} | סונס | IN/A | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | Bits | 5376 | | | | |
| {0,,39} | Dita | 3370 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | Bits | 8456 | | | | |
| i from {1,,39} | Dito | 0400 | | | | |
| Transport block CRC per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {4,8,9} for i from {0,,39} | D.KO | 1071 | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | Bits | 24 | | | | |
| {0,,39} | | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | Bits | 24 | | | | |
| i from {1,,39} | | | | | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | CBs | N/A | | | | |
| {4,8,9} for i from {0,,39} | | | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | CBs | 1 | | | | |
| {0,,39} | | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | CBs | 2 | | | | |
| i from {1,,39} Binary Channel Bits Per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | | | | | | |
| $\{4,8,9\}$ for i from $\{0,,39\}$ | Bits | N/A | | | | |
| For Slot i = 20, 21 | Bits | 26712 | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | | | | | |
| $\{0,,39\}$ | Bits | 17808 | | | | |
| For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for | | | | | | |
| i from $\{1,,19,22,,39\}$ | Bits | 27984 | | | | |
| Max. Throughput averaged over 2 | | | | | | |
| frames | Mbps | 10.184 | | | | |
| Note 1: SS/PBCH block is transmitted i | n slot #0 v | vith periodicity 20 | | | 1 | L |
| Note 2: Slot i is slot index per 2 frames | 11 3101 #U V | viai periodicity 20 | , 1113 | | | |

Table A.3.2.2.7: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and CSI-RS overlapped with PDSCH

| Parameter | Unit | | Value | | | | |
|--|-------------|-------------|-------|--|--|--|--|
| Reference channel | | R.PDSCH.2- | | | | | |
| | | 7.1 TDD | | | | | |
| Channel bandwidth | MHz | 40 | | | | | |
| Subcarrier spacing Allocated resource blocks | kHz PRBs | 30 106 | | | | | |
| Number of consecutive PDSCH | FKD5 | 100 | | | | | |
| symbols | | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | 4 | | | | | |
| {0,,39} | | 4 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 12 | | | | | |
| for i from {1,,39} | | | | | | | |
| Allocated slots per 2 frames MCS table | | 31 | | | | | |
| MCS table MCS index | | 64QAM 13 | | | | | |
| Modulation | | 16QAM | | | | | |
| Target Coding Rate | | 0.48 | | | | | |
| Number of MIMO layers | | 2 | | | | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | 6 | | | | | |
| {0,,39} | | 0 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 12 | | | | | |
| for i from {1,,39} Overhead for TBS determination | | 0 | | | | | |
| Information Bit Payload per Slot | | U | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 16896 | | | | | |
| {0,,39} | Dito | 10030 | | | | | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ | Bits | 53288 | | | | | |
| for i from {1,,39} Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 24 | | | | | |
| {0,,39} | DIIS | 24 | | | | | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ | Bits | 24 | | | | | |
| for i from {1,,39} Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| {8,9} for i from {0,,39} | CBs | N/A | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | CD- | 2 | | | | | |
| {0,,39} | CBs | 3 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | CBs | 7 | | | | | |
| for i from {1,,39} | | - | | | | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = $\{8,9\}$ for i from $\{0,,39\}$ | Bits | N/A | | | | | |
| For Slot i, if $mod(i, 10) = \{0,5\}$ for i from | D., | 100150 | | | | | |
| {1,,19,22,,39} | Bits | 103456 | | | | | |
| For Slots i = 20 | Bits | 98368 | | | | | |
| For Slots i = 21 | Bits | 106848 | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 35616 | | | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{1,2,3,4,6\}$ for | | | | | | | |
| For Slot 1, if $mod(1, 10) = \{1, 2, 3, 4, 6\}$ for i from $\{1,, 19, 22,, 39\}$ | Bits | 111936 | | | | | |
| Max. Throughput averaged over 2 | N AL | 75.040 | | | | | |
| frames | Mbps | 75.318 | | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | | |

Table A.3.2.2.2-8: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR1.30-1 (16QAM)

| Parameter | Unit | | | Value | |
|---|--------------|------------------|-----------------|-------|---|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | | |
| Reference channel | | 8.1 TDD | 8.2 TDD | | |
| Channel bandwidth | MHz | 40 | 40 | | |
| Subcarrier spacing | kHz | 30 | 30 | | |
| Allocated resource blocks | PRBs | 106 | 106 | | |
| Number of consecutive PDSCH | | 12 | 12 | | |
| symbols | | 12 | 12 | | |
| Allocated slots per 2 frames | | 23 | 23 | | |
| MCS table | | 64QAM | 64QAM | | |
| MCS index | | 13 | 13 | | |
| Modulation | | 16QAM | 16QAM | | |
| Target Coding Rate | | 0.48 | 0.48 | | |
| Number of MIMO layers | | 1 | 2 | | |
| Number of DMRS REs (Note 3) | | 24 | 24 | | |
| Overhead for TBS determination | | 0 | 0 | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | 5 | 21/2 | 21/4 | | |
| {7,8,9} for i from {0,,39} | Bits | N/A | N/A | | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | | | | | |
| from {0,,39} | Bits | N/A | N/A | | |
| For Slot i = 20 | Bits | 24576 | 49176 | | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | Dito | | | | |
| for i from {1,,19,22,,39} | | 24576 | 49176 | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {7,8,9} for i from {0,,39} | Bits | N/A | N/A | | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | | 2.14 | | | |
| from {0,,39} | | N/A | N/A | | |
| For Slot i = 20 | Bits | 24 | 24 | | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | | | | | |
| for i from {1,,19,22,,39} | Bits | 24 | 24 | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {7,8,9} for i from {0,,39} | CBs | N/A | N/A | | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | | 2.14 | | | |
| from {0,,39} | | N/A | N/A | | |
| For Slot i = 20 | CBs | 3 | 6 | | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | | | | | |
| for i from {1,,19,22,,39} | CBs | 3 | 6 | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {7,8,9} for i from {0,,39} | Bits | N/A | N/A | | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | 5 | | A.//2 | | |
| from {0,,39} | Bits | N/A | N/A | | |
| For Slot i = 20 | Bits | 48336 | 96672 | | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | | | | | |
| for i from {1,,19,22,,39} | Bits | 50880 | 101760 | | |
| Max. Throughput averaged over 2 | | 00.555 | 50 555 : | | |
| frames | Mbps | 28.2624 | 56.5524 | | |
| Note 1: SS/PRCH block is transmitted | in clot #0 v | with pariadicity | 20 mc | - L | 1 |

Note 1:

Note 2:

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms
Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.2.9: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-4 (64QAM)

| Reference channel | Parameter | Unit | | Value | | | | |
|---|---|--------------|-------------------|-------|--|--|--|--|
| Subcarrier spacing | Reference channel | | | | | | | |
| Allocated resource blocks For Slot i, if mod(i, 10) = 3 for i from (Jo39) For Slot i, if mod(i, 10) = 4 (Jo39) For Slot i, if mod(i, 10) = 4 (Jo39) For Slot i, if mod(i, 10) = 4 (Jo39) Allocated slots per 2 frames MCS table 640AM MCS index MCS index MCS table 640AM MCS index MCS table 640AM MCS index MCS table 640AM MCS index Modulation 640AM Modulation 640AM Modulation 640AM Modulatio | | | 20 | | | | | |
| Number of consecutive PDSCH Symbols | Subcarrier spacing | | | | | | | |
| symbols For Sloti, if mod(i, 10) = 3 for i from {0,,39} 4 For Sloti, if mod(i, 10) = {0,1,2,6,7,8,9} 12 for i from {1,,39} 31 Allocated slots per 2 frames 31 MCS table 64QAM MCS index 19 Mcdulation 64QAM Target Coding Rate 0.51 Number of MIMO layers 2 Number of DMRS REs 5 For Sloti, if mod(i, 10) = 3 for i from {6, (0,,39)} 6 (0,,39) 12 For Sloti, if mod(i, 10) = {0,1,2,6,7,8,9} 12 for i from {1,,39} 0verhead for TBS determination {6, (0,,39)} for i slots 0 and Sloti, if mod(i, 10) = {4,4,5} for i from {0,,39} Bits {13064} {0,,39} For Sloti, if mod(i, 10) = 3 for i from {0,,39} {0,,39} For Sloti, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Bits {13064} {0,,39} Bits {13064} <td>Allocated resource blocks</td> <td>PRBs</td> <td>51</td> <td></td> | Allocated resource blocks | PRBs | 51 | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from (Jo | | | | | | | | |
| (0,39) | | | | | | | | |
| for i from {1,,39} | {0,,39} | | 4 | | | | | |
| Allocated slots per 2 frames | | | 12 | | | | | |
| MCS index | Allocated slots per 2 frames | | 31 | | | | | |
| Modulation 64QAM Target Coding Rate 0.51 Number of MIMO layers 2 Number of DMRS REs | MCS table | | 64QAM | | | | | |
| Target Coding Rate Number of MIMO layers Number of DMRS REs For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,, 39} Nowhead for TBS determination Information Bit Payload per Slot For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,, 39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,, 39} Number of Code Blocks per Slot For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = 3 for i from {0,, 39} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i, if mod(i, 10) = {0, 1, 2, 6, 7, 8, 9} For Slot i | MCS index | | 19 | | | | | |
| Number of MIMO Jayers 2 | Modulation | | 64QAM | | | | | |
| Number of DMRS RES | | | 0.51 | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from {0,,39} | | | 2 | | | | | |
| For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} | | | | | | | | |
| (1,,39) | For Slot i, if mod(i, 10) = 3 for i from | | 6 | | | | | |
| Tor i from {1,,38} | | | 0 | | | | | |
| Not inform (1,,99) | For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ | | 12 | | | | | |
| Information Bit Payload per Slot | | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from Bits N/A 4,5} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 3 for i from {0,,39} Number of Code Blocks per Slot For Slot 0 and Slot i, if mod(i, 10) = CBs Abstraction (Bits of i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 8 Bits For Slot i, if mod(i, 10) = 8 Bits For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from Bits For Slot i, if mod(i, 10) = 3 for i from Bits For Slot i, if mod(i, 10) = 8 Bits For Slot i, if mod(i, 10) = 10,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 10,1,2,6,7, | | | 0 | | | | | |
| 44,5} for i from {0,,39} | | | | | | | | |
| (4,0) for liftom (1,,39) For Slot i, if mod(i, 10) = 3 for i from (0,,39) For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For i from {1,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 3 for i from (0,,39) For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 3 for i from (CBs Q,39) For Slot i, if mod(i, 10) = 3 for i from (CBs Q,39) For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 8 Bits N/A [4,5) for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = 8 Bits N/A [4,5] for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from Bits Der Slot i, if mod(i, 10) = 8 Bits N/A [4,5] for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits N/A [5,7,930] Max. Throughput averaged over 2 Mbps S7,930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Rits | N/A | | | | | |
| {0,,39} Bits 13004 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 40976 for i from {1,,39} Bits 40976 For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 24 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 24 Number of Code Blocks per Slot CBs N/A For Slots 0 and Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} CBs 5 for i from {1,,39} Bits N/A Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} | {4,5} for i from {0,,39} | Dito | 14/71 | | | | | |
| (1,,39) For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {CBs} Q,,39} For Slot i, if mod(i, 10) = 3 for i from {CBs} Q,,39} For Slot i, if mod(i, 10) = 3 for i from {CBs} Q,,39} For Slot i, if mod(i, 10) = 3 for i from {CBs} Q,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i = 20, 21 Bits For Slot i = 20, 21 Bits For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {1,,39} Binary Channel Bits Per Slot For Slot i = 20, 21 Bits For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) | | Bits | 13064 | | | | | |
| for i from {1,,39} Bits 40976 Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 24 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 24 Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = CBs N/A {4,5} for i from {0,,39} CBs N/A For Slot i, if mod(i, 10) = 3 for i from CBs 2 {0,,39} CBs 5 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} CBs 5 for i from {1,,39} Bits N/A Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits | {0,,39} | | | | | | | |
| Transport block CRC per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 24 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Bits 24 Number of Code Blocks per Slot CBs N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 5 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} CBs 5 For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = \$0,1,2,6,7,8,9} Bits 80784 For Slot i, if mod(i, 10) = \$0,1,2,6,7,8,9} Bits 80784 | | Bits | 40976 | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {4,5) for i from {0,,39}} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| 4,5) for i from {0,,39} | | | | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,4,5} for i from {0,,39} For Slots 0 and Slot i, if mod(i, 10) = {0,4,5} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,4,5} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Bits | N/A | | | | | |
| {0,,39} Bits 24 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Bits 24 Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} CBs N/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} CBs 5 Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {1,,39} Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Bits | 24 | | | | | |
| for i from {1,,39} Bits 24 Number of Code Blocks per Slot CBs N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 5 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} CBs 5 Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 For i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| Number of Code Blocks per Slot CBs N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} CBs N/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBs 2 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} CBs 5 Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Bits | 24 | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slots i = 20, 21 For Slots i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| {4,5} for i from {0,,39} CBS IN/A For Slot i, if mod(i, 10) = 3 for i from {0,,39} CBS 2 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} CBS 5 for i from {1,,39} Bits N/A Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits 77112 For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | 0.0 | N1/A | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | CBS | IN/A | | | | | |
| For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | CDo | 2 | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = Bits N/A | | CDS | 2 | | | | | |
| Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | CBs | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} Bits 80784 Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | OD9 | J | | | | | |
| {4,5} for i from {0,,39} Bits IN/A For Slots i = 20, 21 Bits 77112 For Slot i, if mod(i, 10) = 3 for i from {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| For Slots i = 20, 21 For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Rite | Ν/Δ | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | | |
| {0,,39} Bits 25704 For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,,19,22,,39} Bits 80784 Max. Throughput averaged over 2 frames Mbps 57.930 Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Bits | 77112 | | | | | |
| for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | {0,,39} | Bits | 25704 | | | | | |
| Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | Bits | 80784 | | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | Max. Throughput averaged over 2 | Mbps | 57.930 | | | | | |
| | irames | | | | | | | |
| | Note 2: Slot i is slot index per 2 frames | ii siul #U W | nui penodicity 20 | o nio | | | | |

Table A.3.2.2.2-10: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and HST scenario

| Parameter | Unit | | Value | | | |
|---|-------------|--------------------|-------|--|--|--|
| Deference channel | | R.PDSCH.2- | | | | |
| Reference channel | | 10.1 TDD | | | | |
| Channel bandwidth | MHz | 40 | | | | |
| Subcarrier spacing | kHz | 30 | | | | |
| Allocated resource blocks | PRBs | 106 | | | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | 4 | | | | |
| {0,,39} | | 4 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 40 | | | | |
| for i from {1,,39} | | 12 | | | | |
| Allocated slots per 2 frames | | 31 | | | | |
| MCS table | | 64QAM | | | | |
| MCS index | | 13 | | | | |
| Modulation | | 16QAM | | | | |
| Target Coding Rate | | 0.48 | | | | |
| Number of MIMO layers | | 1 | | | | |
| Number of DMRS REs | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | _ | | | | |
| {0,,39} | | 6 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 40 | | | | |
| for i from {1,,39} | | 18 | | | | |
| Overhead for TBS determination | | 0 | | | | |
| Information Bit Payload per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:: | N1/A | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | ċ | 0.450 | | | | |
| {0,,39} | Bits | 8456 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | D:: | 05000 | | | | |
| for i from {1,,39} | Bits | 25608 | | | | |
| Transport block CRC per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:1- | NI/A | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | D:4- | 0.4 | | | | |
| {0,,39} | Bits | 24 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | Dito | 24 | | | | |
| for i from {1,,39} | Bits | 24 | | | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | CDo | NI/A | | | | |
| {8,9} for i from {0,,39} | CBs | N/A | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | CBs | 2 | | | | |
| {0,,39} | 0 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | CBs | 4 | | | | |
| for i from {1,,39} | 0 | 4 | | | | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {8,9} for i from {0,,39} | | | | | | |
| For Slots i = 1,2,21,22 | Bits | 52176 | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 17808 | | | | |
| {0,,39} | סווט | 17000 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | Bits | 53424 | | | | |
| for i from {3,,20,23,,39} | סונס | JJ424 | | | | |
| Max. Throughput averaged over 2 | Mbps | 36.262 | | | | |
| frames | | | | | | |
| Note 1: SS/PBCH block is transmitted i | n slot #0 w | ith periodicity 20 | 0 ms | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | |

Table A.3.2.2.2-11: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-5

| Parameter | Unit | | Valu | е | |
|--|--------------|--------------------|---------------|---|--|
| Reference channel | | R.PDSCH.2- | | | |
| | N 41 1 | 11.1 TDD | | | |
| Channel bandwidth | MHz | 40 | | | |
| Subcarrier spacing | kHz | 30 | | | |
| Allocated resource blocks | PRBs | 106 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols For Slot i, if mod(i, 4) = 0 for i from | | | | | |
| For Slot 1, if $mod(1, 4) = 0$ for 1 from $\{1,, 39\}$ | | 12 | | | |
| For Slot i, if mod(i, 4) = 1 for i from | | | | | |
| {0,,39} | | 10 | | | |
| Allocated slots per 2 frames | | 31 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 4 | | | |
| Modulation | | QPSK | | | |
| Target Coding Rate | | 0.30 | | | |
| Number of MIMO layers | | 1 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if mod(i, 4) = 0 for i from | | | | | |
| {1,,39} | | 18 | | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | | 4.0 | | | |
| {0,,39} | | 18 | | | |
| Overhead for TBS determination | | 0 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ | Dito | NI/A | | | |
| for i from {0,,39} | Bits | N/A | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | Bits | 8064 | | | |
| {1,,39} | Dita | 0004 | | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | Bits | 6528 | | | |
| {0,,39} | 5.1.0 | 0020 | | | |
| Transport block CRC per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ | Bits | N/A | | | |
| for i from {0,,39} | | | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | Bits | 24 | | | |
| $\{1,,39\}$ For Slot i, if mod(i, 4) = 1 for i from | | | | | |
| {0,,39} | Bits | 24 | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ | | | | | |
| for i from {0,,39} | CBs | N/A | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | OD- | 4 | | | |
| {1,,39} | CBs | 1 | | | |
| For Slot i, if mod(i, 4) = 1 for i from | CBs | 1 | | | |
| {0,,39} | CDS | ı | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ | Bits | N/A | | | |
| for i from {0,,39} | | | | | |
| For Slot i = 20 | Bits | 25440 | | | |
| For Slot i = 21 | Bits | 20352 | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | Bits | 26712 | | | |
| {1,,19,22,,39} | | | <u> </u> | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | Bits | 21624 | | | |
| {0,,19,22,,39} | | | | | |
| Max. Throughput averaged over 2 frames | Mbps | 6.893 | | | |
| Note 1: SS/PBCH block is transmitted i | n slot #0 u | ith periodicity 20 | | I | |
| Note 2: Slot i is slot index per 2 frames | 11 3101 #U W | nur periodicity 20 | <i>J</i> 1113 | | |

Table A.3.2.2.2-12: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-6

| Reference channel | Parameter | Unit | | Value | | |
|--|--|------|--------------|-------|----------|--|
| Channel bandwidth MHz 40 MHz 30 Allocated resource blocks PRBs 106 MINING FOR CONSISTENCY PRBs 107 MINING FOR CONSISTENCY PRBs 107 MINING FOR CONSISTENCY MINI | Reference channel | | | | | |
| Subcarrier spacing | Channel handwidth | МНэ | | | | |
| Allocated resource blocks PRBs 106 Number of consecutive PDSCH symbols For Slot i, if mod(i, 4) = 0 for i from 12 (1,39) For Slot i, if mod(i, 4) = 1 for i from (0,39) 10 (0,39) | | | | | | |
| Number of consecutive PDSCH symbols For Slot I, if mod(i, 4) = 0 for i from (1,38) For Slot I, if mod(i, 4) = 1 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 1 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 2 for i from (0,39) For Slot I, if mod(i, 4) = 3 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 for i from (0,39) For Slot I, if mod(i, 4) = 0 f | Allocated resource blocks | | | | | |
| For Slot i, if mod(i, 4) = 0 for i from (1,39) For Slot i, if mod(i, 4) = 1 for i from (0,39) For Slot i, if mod(i, 4) = 2 for i from (0,39) For Slot i, if mod(i, 4) = 2 for i from (0,39) For Slot i, if mod(i, 4) = 2 for i from (0,39) For Slot i, if mod(i, 4) = 0 for i from (0,39) For Slot i, if mod(i, 4) = 3 for i from (0,39) For Slot i, if mod(i, 4) = 1 for i from (1,39) For Slot i, if mod(i, 4) = 2 for i from (1,39) For Slot i, if mod(i, 4) = 1 for i from (1,39) Bits (0,39) Bits (0, | | | ,,,,, | | | |
| 1139 12 17 18 17 18 17 18 19 19 19 19 19 19 19 | symbols | | | | | |
| Company Comp | | | 12 | | | |
| (i)39 5 | {1,,39} | | 12 | | | |
| For Slot I, if mod(i, 4) = 2 for i from (0,39) | , , , | | 8 | | | |
| 10 | {0,,39} | | | | | |
| Allocated slots per 2 frames | | | 10 | | | |
| MCS table 640AM MCS index 4 MCS index 4 Modulation QPSK Target Coding Rate 0.30 Number of MIMO layers 1 Number of DMRS REs FOR Slot i, if mod(i, 4) = 0 for i from (139) For Slot i, if mod(i, 4) = 1 for i from (039) 18 For Slot i, if mod(i, 4) = 2 for i from (039) 18 For Slot i, if mod(i, 4) = 3 for i from (139) Bits For Slot i, if mod(i, 4) = 0 for i from (139) Bits For Slot i, if mod(i, 4) = 1 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (139) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) CBs | | | 31 | | | |
| MCS index 4 Modulation QPSK Target Coding Rate 0.30 Number of MIMD layers 1 Number of DMRS REs 1 For Slot i, if mod(i, 4) = 0 for i from (039) 18 For Slot i, if mod(i, 4) = 2 for i from (039) 18 For Slot i, if mod(i, 4) = 2 for i from (039) 18 Overhead for TBS determination 0 Information Bit Payload per Slot Bits For Slot and Slot i, if mod(i, 4) = 3 for ifrom (039) Bits For Slot i, if mod(i, 4) = 0 for i from (139) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (039) Bits For Slot i, if mod(i, 4) = 0 for i from (139) Bits For Slot i, if mod(i, 4) = 0 for i from (139) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) Bits For Slot i, if mod(i, 4) = 2 for i from (039) CBs | | | | | | |
| Target Coding Rate 0.30 Number of MIMO layers 1 Number of DMRS REs For Slot i, if mod(i, 4) = 0 for i from (1,39) 18 (1,39) For Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 0 for i from (0,39) Tor Slot i, if mod(i, 4) = 1 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 1 for i from (0,39) Tor Slot i, if mod(i, 4) = 1 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 2 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = 3 for i from (0,39) Tor Slot i, if mod(i, 4) = | | | | | | |
| Number of MIMO layers | Modulation | | QPSK | | | |
| Number of DMRS RES | | | 0.30 | | | |
| For Slot i, if mod(i, 4) = 0 for i from (1,39) | | | 1 | | _ | |
| 1139 For Slot i, if mod(i, 4) = 1 for i from (0,39) 18 18 (0,39) 18 (0,39) 18 (0,39) 18 (0,39) 18 (0,39) (1,39 | | | <u> </u> | | 1 | |
| For Slot i, if mod(i, 4) = 1 for i from (0,,39) For Slot i, if mod(i, 4) = 2 for i from (0,,39) To Slot i, if mod(i, 4) = 3 for i from (0,,39) Slot i, if mod(i, 4) = 3 for i from (0,,39) For Slot i, if mod(i, 4) = 0 for i from (1,,39) For Slot i, if mod(i, 4) = 1 for i from (0,,39) Slot i, if mod(i, 4) = 2 for i from (0,,39) Slot i, if mod(i, 4) = 2 for i from (0,,39) Slot i, if mod(i, 4) = 2 for i from (0,,39) Slot i, if mod(i, 4) = 2 for i from (0,,39) Slot i, if mod(i, 4) = 3 for i from (0,,39) Slot i, if mod(i, 4) = 3 for i from (0,,39) Slot i, if mod(i, 4) = 1 for i from (1,,39) Slot i, if mod(i, 4) = 1 for i from (1,,39) Slot i, if mod(i, 4) = 1 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 2 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i, 4) = 3 for i from (1,,39) Slot i, if mod(i | , , , | | 18 | | | |
| (0,39) 18 | {1,,39} For Slot i, if mod/i, 4) = 1 for i from | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from (0,,39) | · · · · · · · · · · · · · · · · · · · | | 18 | | | |
| (0,,39) | For Slot i, if $mod(i, 4) = 2$ for i from | | 4.0 | | 1 | |
| Information Bit Payload per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from (0,,39) Bits 8064 (1,,39) For Slot i, if mod(i, 4) = 1 for i from (0,,39) Bits 4992 (0,,39) For Slot i, if mod(i, 4) = 2 for i from (0,,39) Bits 6528 (1,,39) CBs (1,,39) CBs (1,,39) CBs (1,,39) CBs (1,,39) For Slot i, if mod(i, 4) = 0 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 2 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 2 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 2 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 2 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) (1,,39) For Slot i, if mod(i, 4) = 3 for i from CBs 1 (1,,39) (1,,39) Each Eac | {0,,39} | | 18 | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | Overhead for TBS determination | | 0 | | | |
| i from {0,,39} | | | | | | |
| For Slot i, if mod(i, 4) = 0 for i from {1,,39} For Slot i, if mod(i, 4) = 1 for i from {1,,39} Bits 4992 {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} Bits 4992 {0,,39} For Slot i, if mod(i, 4) = 3 for i from {0,,39} Bits 4992 {0,,39} For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} Bits 4992 {0,,39} For Slot i, if mod(i, 4) = 0 for i from {1,,39} Bits 24 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} Bits 24 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} Bits 24 {1,,39} For Slot i, if mod(i, 4) = 0 for i from {0,,39} Bits 24 {1,,39} For Slot i, if mod(i, 4) = 0 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 1 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 2 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 3 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 3 for i from {1,,39} CBs 1 {1,,39} For Slot i, if mod(i, 4) = 3 for i from {1,,39} CBs 1 {1,,39} Bits 1 {2,,39} For Slot i, if mod(i, 4) = 3 for i from {1,,39} CBs 1 {2,,39} Bits 1 {3,,39} For Slot i = 20 Bits 1 {3,,39} Bits 1 {3,,39} For Slot i i if mod(i, 4) = 0 for i from {1,,49} Bits 1 {3,,40} Bits 1 {4,,49} Bits 1 {4 | | Bits | N/A | | | |
| {1,,39} Bits 8064 For Slot i, if mod(i, 4) = 1 for i from {0,,39} Bits 4992 For Slot i, if mod(i, 4) = 2 for i from {0,,39} Bits 6528 Transport block CRC per Slot Bits N/A For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} Bits 24 For Slot i, if mod(i, 4) = 1 for i from {0,,39} Bits 24 For Slot i, if mod(i, 4) = 2 for i from {0,,39} Bits 24 Number of Code Blocks per Slot CBs N/A For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} CBs 1 For Slot i, if mod(i, 4) = 0 for i from {0,,39} CBs 1 For Slot i, if mod(i, 4) = 2 for i from {0,,39} CBs 1 For Slot i, if mod(i, 4) = 2 for i from {0,,39} CBs 1 For Slot i, if mod(i, 4) = 3 for i from {0,,39} CBs 1 For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if mod(i, 4) = 0 for i from {1,,19,22,,39} Bits 26712 | I from {0,,39} | | | | | |
| | | Bits | 8064 | | | |
| {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} Transport block CRC per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 0 for i from {1,,39} For Slot i, if mod(i, 4) = 1 for i from {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} Number of Code Blocks per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 1 for i from {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} For Slot i, if mod(i, 4) = 2 for i from {0,,39} For Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 3 for i from {0,,39} Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i = 20 Bits 25440 For Slot i = 20 Bits 25440 For Slot i = 10 Bits 25440 For Slot i i fmod(i, 4) = 0 for i from {1,,39} Bits 15264 For Slot i i fom fod(i, 4) = 0 for i from {1,,39} Bits 15264 For Slot i i fom fod(i, 4) = 0 for i from {1,,39} Bits 15264 For Slot i i fom fod(i, 4) = 0 for i from {1,,39} Bits 15264 For Slot i i fom fod(i, 4) = 0 for i from {1,,39} Bits 15264 | For Slot i, if $mod(i, 4) = 1$ for i from | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{0,, 39\}$ Transport block CRC per Slot For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 4) = 0$ for i from $\{1,, 39\}$ For Slot i, if $mod(i, 4) = 1$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 4) = 1$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{0,, 39\}$ For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 4) = 0$ for i from $\{1,, 39\}$ For Slot i, if $mod(i, 4) = 1$ for i from $\{1,, 39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 39\}$ For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{1,, 39\}$ For Slot i i if $mod(i, 4) = 2$ for i from $\{1,, 39\}$ For Slot i i if $mod(i, 4) = 3$ for i from $\{1,, 39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{1,, 39\}$ For Slot i i = 20 For Slot i i = 20 For Slot i i if $mod(i, 4) = 0$ for i from $\{1,, 39\}$ Bits $\{1,, 39\}$ | {0,,39} | Bits | 4992 | | | |
| Transport block CRC per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 1 for i from Bits 24 {1,,39} For Slot i, if mod(i, 4) = 2 for i from Bits 24 [0,,39] For Slot i, if mod(i, 4) = 2 for i from Bits 24 Number of Code Blocks per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i, if mod(i, 4) = 0 for i from CBs 1 {1,,39} For Slot i, if mod(i, 4) = 1 for i from CBs 1 {1,,39} For Slot i, if mod(i, 4) = 1 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 2 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 2 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 3 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 3 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 3 for i from CBs 1 [0,,39] For Slot i, if mod(i, 4) = 3 for i from CBs 1 [0,,39] Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if mod(i, 4) = 0 for i from Bits 26712 [1,,19,22,,39] | For Slot i, if mod(i, 4) = 2 for i from | Dito | 6529 | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | סווט | 0320 | | | |
| I from {0,,39} | | | | | | |
| | | Bits | N/A | | | |
| | For Slot i, if $mod(i, A) = 0$ for i from | | | | | |
| | | Bits | 24 | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{0,,39\}$ Number of Code Blocks per Slot For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{0,,39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot $mod(i, 4) = 3$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot $mod(i, 4) = 3$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot $mod(i, 4) = 3$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot $mod(i, 4) = 0$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 0$ for i from $\{0,,39\}$ Bits $mod(i, 4) = 0$ for i from $\{0,,39\}$ | For Slot i, if $mod(i, 4) = 1$ for i from | D:1- | 0.4 | | | |
| Number of Code Blocks per Slot | {0,,39} | Bits | 24 | | | |
| Number of Code Blocks per Slot | , , , | Rits | 24 | | | |
| | [{0,,39} | 20 | | | 1 | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | | + | |
| | | CBs | N/A | | | |
| | For Slot i, if mod(i. 4) = 0 for i from | 65 | | | 1 | |
| | {1,,39} | CBs | 1 | | <u> </u> | |
| For Slot i, if mod(i, 4) = 2 for i from $\{0,,39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from $\{0,,39\}$ Bits N/A For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if mod(i, 4) = 0 for i from $\{1,,19,22,,39\}$ | For Slot i, if $mod(i, 4) = 1$ for i from | CRc | 1 | | | |
| {0,,39} CBS 1 Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} Bits N/A For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if mod(i, 4) = 0 for i from {1,,19,22,,39} Bits 26712 | {0,,39} | 000 | <u>'</u> | | 1 | |
| Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,,39} Bits | | CBs | 1 | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,39\}$ For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,19,22,,39\}$ | | | + | | 1 | |
| i from {0,,39} For Slot i = 20 Bits 25440 For Slot i = 21 Bits 15264 For Slot i, if mod(i, 4) = 0 for i from {1,,19,22,,39} Bits 26712 | | | | | 1 | |
| For Slot i = 20 For Slot i = 21 For Slot i, if mod(i, 4) = 0 for i from {1,,19,22,,39} Bits 25440 Bits 25440 Bits 26712 | | Bits | N/A | | | |
| For Slot i, if mod(i, 4) = 0 for i from {1,,19,22,,39} | | Bits | 25440 | | | |
| {1,,19,22,,39} | | Bits | 15264 | | | |
| {1,,19,22,,39} | | Bits | 26712 | | | |
| | [{1,,19,22,,39} | 20 | | | 1 | |
| For Slot i, if mod(i, 4) = 1 for i from {1,,19,22,,39} | | Bits | 16536 | | | |
| For Slot i, if $mod(i, A) = 2$ for i from | For Slot i, if mod(i. 4) = 2 for i from | | 6.55 | | | |
| 1 of Slot 1, if Mod (i, 4) = 2 lol 1 mol ii {0,,39} Bits 21624 | | Bits | 21624 | | | |

| Max. Thro | oughput averaged over 2 | Mbps | 9.389 | | | | |
|-----------|---|------|-------|--|--|--|--|
| Note 1: | 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | |
| Note 2: | Slot i is slot index per 2 frames | | | | | | |

A.3.2.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.2.4 Reference measurement channels for SCS 60 kHz FR2

Table A.3.2.2.4-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.60-1 (16QAM)

| Parameter | Unit | | Value | | |
|---|----------|--|-------|---|--|
| Reference channel | | R.PDSCH.4- | | | |
| Channel bandwidth | MHz | 1.1 TDD 50 | | | |
| Subcarrier spacing | kHz | 60 | | | |
| Allocated resource blocks | PRBs | 66 | | | |
| Number of consecutive PDSCH | TINDS | 00 | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | | |
| | | 10 | | | |
| $\{1,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | | + | |
| | | 13 | | | |
| {1,,79} Allocated slots per 2 frames | | 59 | | + | |
| | | | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 13 | | | |
| Modulation | | 16QAM | | | |
| Target Coding Rate | | 0.48 | | | |
| Number of MIMO layers | | 2 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 12 | | | |
| {1,, 79} | | 12 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 12 | | | |
| {1,,79} | | 12 | | | |
| Overhead for TBS determination | | 6 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | Bits | N/A | | | |
| for i from {0,,79} | DIIS | IN/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 25600 | | | |
| {1,, 79} | DIIS | 25608 | | | |
| For Slot i, if $mod(i, 4) = \{0,\}$) for i from | D:4a | 24040 | | | |
| {1,,79} | Bits | 34816 | | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 4) = 3 | D:1- | N1/A | | | |
| for i from {0,,79} | Bits | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | D:: | 0.4 | | | |
| {1,, 79} | Bits | 24 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | D., | 0.4 | | | |
| {1,,79} | Bits | 24 | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | | |
| for i from {0,,79} | CBs | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | | |
| {1,, 79} | CBs | 4 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | | | | |
| {1,,79} | CBs | 5 | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | | |
| for i from $\{0,,79\}$ | Bits | N/A | | | |
| For Slot i = 40, 41 | Bits | 69960 | | | |
| For Slot i, if mod(i, 4) = 2 for i from | סווט | | | | |
| | Bits | 54912 | | | |
| $\{4,,79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | + | | | |
| | Bits | 73128 | | | |
| {1,,39,42,,79} | | + | | | |
| Max. Throughput averaged over 2 | Mbps | 93.499 | | | |
| frames | | | | | |
| Note 1: SS/PBCH block is transmitted | -1-1 110 | | | | |

ETSI

A.3.2.2.5 Reference measurement channels for SCS 120 kHz FR2

Table A.3.2.2.5-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 and FR2.120-1A (QPSK)

| Parameter | Unit | | Value | | | | |
|--|------|------------|-------|--|--|--|--|
| Deference channel | | R.PDSCH.5- | | | | | |
| Reference channel | | 1.1 TDD | | | | | |
| Channel bandwidth | MHz | 100 | | | | | |
| Subcarrier spacing | kHz | 120 | | | | | |
| Allocated resource blocks | PRBs | 66 | | | | | |
| Number of consecutive PDSCH | | | | | | | |
| symbols | | | | | | | |
| For Slot i, if mod(i, 5) = 3 for i from | | 0 | | | | | |
| {0,, 159} | | 9 | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 40 | | | | | |
| from {1,,159} | | 13 | | | | | |
| Allocated slots per 2 frames | | 127 | | | | | |
| MCS table | | 64QAM | | | | | |
| MCS index | | 4 | | | | | |
| Modulation | | QPSK | | | | | |
| Target Coding Rate | | 0.30 | | | | | |
| Number of MIMO layers | | 1 | | | | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 4.0 | | | | | |
| {0,, 159} | | 12 | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 4.0 | | | | | |
| from {1,,159} | | 12 | | | | | |
| Overhead for TBS determination | | 6 | | | | | |
| Information Bit Payload per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | 5 | 21/2 | | | | | |
| for i from {0,,159} | Bits | N/A | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | 5 | 2224 | | | | | |
| {0,, 159} | Bits | 3624 | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | D:: | 5504 | | | | | |
| from {1,,159} | Bits | 5504 | | | | | |
| Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 5) = 4 | D:: | N1/A | | | | | |
| for i from {0,,159} | Bits | N/A | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | D:4- | 40 | | | | | |
| {0,, 159} | Bits | 16 | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Dita | 0.4 | | | | | |
| from {1,,159} | Bits | 24 | | | | | |
| Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 5) = 4 | CDo | NI/A | | | | | |
| for i from {0,,159} | CBs | N/A | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 1 | | | | | |
| {0,, 159} | CDS | ı | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | CBs | 1 | | | | | |
| from {1,,159} | CDS | ! | | | | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 5) = 4 | Bits | N/A | | | | | |
| for i from {0,,159} | | | | | | | |
| For Slots i = 80, 81 | Bits | 17490 | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 12210 | | | | | |
| {0,, 159} | סונס | 12210 | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Bits | 18282 | | | | | |
| from {1,,79,82,,159} | טונס | 10202 | | | | | |
| Max. Throughput averaged over 2 | Mbps | 31.942 | | | | | |
| frames | · | | | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | |

Table A.3.2.2.5-2: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (16QAM)

| Parameter Unit Value | | | | | | | |
|---|------|------------------------|------------|------------|--|--|--|
| | | R.PDSCH.5- | R.PDSCH.5- | R.PDSCH.5- | | | |
| Reference channel | | 2.1 TDD | 2.2 TDD | 2.3 TDD | | | |
| Channel bandwidth | MHz | 100 | 100 | 200 | | | |
| Subcarrier spacing | kHz | 120 | 120 | 120 | | | |
| Allocated resource blocks | PRBs | 66 | 66 | 132 | | | |
| Number of consecutive PDSCH | | | | | | | |
| symbols | | | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | | 9 | 9 | 9 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$ | | 13 | 13 | 13 | | | |
| Allocated slots per 2 frames | | 127 | 127 | 127 | | | |
| MCS table | | 64QAM | 64QAM | 64QAM | | | |
| MCS index | | 13 | 13 | 13 | | | |
| Modulation | | 16QAM | 16QAM | 16QAM | | | |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | | | |
| Number of MIMO layers | | 1 | 2 | 2 | | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | | 12 | 12 | 12 | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$ | | 12 | 12 | 12 | | | |
| Overhead for TBS determination | | 6 | 6 | 6 | | | |
| Information Bit Payload per Slot | | 0 | - | - | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | D:: | N1/A | N1/0 | N1/A | | | |
| for i from {0159} | Bits | N/A | N/A | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | Bits | 11272 | 22536 | 45096 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from $\{1,,159\}$ | Bits | 17424 | 34816 | 69672 | | | |
| Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | | | | | | | |
| for i from {0,,159} | Bits | N/A | N/A | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | Bits | 24 | 24 | 24 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from $\{1,,159\}$ | Bits | 24 | 24 | 24 | | | |
| Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$ | CBs | N/A | N/A | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | CBs | 2 | 3 | 6 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | CBs | 3 | 5 | 9 | | | |
| from {1,,159} Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | 1 | | | | | | |
| for i from {0,,159} | Bits | N/A | N/A | N/A | | | |
| For Slots i = 80, 81 | Bits | 36564 | 69960 | 139920 | | | |
| For Slots i = 82, 83 | Bits | 34980 | 73128 | 146256 | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | Bits | 24420 | 48840 | 97680 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,79,84,,159\}$ | Bits | 36564 | 73128 | 146256 | | | |
| Max. Throughput averaged over 2 frames | Mbps | 100.799 | 201.434 | 403.096 | | | |
| | - | with periodicity | / 20 me | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames | | | | | | | |

Table A.3.2.2.5-3: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (64QAM)

| Parameter | Unit | | Valu | ue | |
|---|------|--------------------|----------|----|--|
| Reference channel | | R.PDSCH.5- | | | |
| | | 3.1 TDD | | | |
| Channel bandwidth | MHz | 100 | | | |
| Subcarrier spacing | kHz | 120 | | | |
| Allocated resource blocks | PRBs | 66 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 9 | | | |
| $\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | | | | |
| from $\{1,,159\}$ | | 13 | | | |
| Allocated slots per 2 frames | | 127 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 18 | | | |
| Modulation | | 64QAM | | | |
| Target Coding Rate | | 0.46 | | | |
| Number of MIMO layers | | 1 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if mod(i, 5) = 3 for i from | | 40 | | | |
| {0,, 159} | | 12 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 12 | | | |
| from {1,,159} | | | | | |
| Overhead for TBS determination | | 6 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | | | |
| for i from {0,,159} | Bito | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 16136 | | | |
| {0,, 159} | | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | Bits | 25104 | | | |
| from {1,,159} | | | | | |
| Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 5) = 4 | | N/A | | + | |
| for i from $\{0,,159\}$ | Bits | IN/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | | | | |
| {0,, 159} | Bits | 24 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Dit- | 0.4 | | | |
| from {1,,159} | Bits | 24 | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | CBs | N/A | | | |
| for i from {0,,159} | ODS | IN/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 2 | | | |
| {0,, 159} | | _ | | | |
| For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i | CBs | 3 | | | |
| from {1,,159} | | | | | |
| Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 5) = 4 | | N/A | | | |
| for i from $\{0,,159\}$ | Bits | IN/A | | | |
| For Slots i = 80, 81 | Bits | 52470 | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | | | | |
| {0,, 159} | Bits | 36630 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | D:4- | E4040 | | | |
| from {1,,79,82,,159} | Bits | 54846 | <u> </u> | | |
| Max. Throughput averaged over 2 | Mbps | 145.062 | | | |
| frames | - | | | | |
| Note 1: SS/PBCH block is transmitted | | ith periodicity 20 | 0 ms | | |
| Note 2: Slot i is slot index per 2 frames | ; | | | | |

Table A.3.2.2.5-4: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (QPSK)

| Parameter | Unit | | Value |
|---|--------------|--------------------|---|
| Reference channel | | R.PDSCH.5- | |
| Reference charmer | | 4.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 6 | |
| Number of consecutive PDSCH | | | |
| symbols | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 10 | |
| {1,, 159} | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 13 | |
| {1,,159} | | 440 | |
| Allocated slots per 2 frames | | 119 | |
| MCS table | | 64QAM | |
| MCS index | | 4 | |
| Modulation Torget Coding Rate | | QPSK | |
| Target Coding Rate | | 0.30 | |
| Number of MIMO layers Number of DMRS REs | | 2 | |
| | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 12 | |
| $\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | |
| $\{1,,159\}$ | | 12 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | 0 | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | |
| for i from {0,,159} | Bits | N/A | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | |
| {1,, 159} | Bits | 736 | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | 5.4 | 4000 | |
| {1,,159} | Bits | 1032 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 4) = 3 | Bits | N/A | |
| for i from {0,,159} | DIIS | IN/A | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 16 | |
| {1,, 159} | Dita | 10 | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Bits | 16 | |
| {1,,159} | Dito | 10 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | CBs | N/A | |
| for i from {0,,159} | | • | |
| For Slot i, if $mod(i, 4) = 2$ for i from | CBs | 1 | |
| $\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | |
| For Slot 1, if flod(1, 4) = $\{0, 1\}$ for 1 from $\{1,, 159\}$ | CBs | 1 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | |
| for i from $\{0,,159\}$ | Bits | N/A | |
| For Slot i = 80, 81 | Bits | 3180 | + |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | + |
| {4,, 159} | Bits | 2496 | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | | |
| {1,,79,82,,159} | Bits | 3324 | |
| Max. Throughput averaged over 2 | N 41- :: | F 540 | |
| frames | Mbps | 5.548 | |
| Note 1: SS/PBCH block is transmitted | in slot #0 w | ith periodicity 20 | 20 ms |
| Note 2: Slot i is slot index per 2 frames | | | |

Table A.3.2.2.5-5: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (16QAM)

| Parameter | Unit | | | Value | |
|---|------|--------------------|------------|----------|--|
| Reference channel | | R.PDSCH.5- | R.PDSCH.5- | | |
| Treference charmer | | 5.1 TDD | 5.2 TDD | | |
| Channel bandwidth | MHz | 100 | 50 | | |
| Subcarrier spacing | kHz | 120 | 120 | | |
| Allocated resource blocks | PRBs | 66 | 32 | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 10 | 10 | | |
| $\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | | | |
| {1,,159} | | 13 | 13 | | |
| Allocated slots per 2 frames | | 119 | 119 | | |
| MCS table | | 64QAM | 64QAM | | |
| MCS index | | 13 | 13 | | |
| Modulation | | 16QAM | 16QAM | | |
| Target Coding Rate | | 0.48 | 0.48 | | |
| Number of MIMO layers | | 2 | 2 | | |
| Number of DMRS REs | | _ | _ | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | | |
| {1,, 159} | | 12 | 12 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 40 | 40 | | |
| {1,,159} | | 12 | 12 | | |
| Overhead for TBS determination | | 6 | 6 | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 4) = 3 | Dito | NI/A | NI/A | | |
| for i from {0,,159} | Bits | N/A | N/A | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 25608 | 12552 | | |
| {1,, 159} | סוט | 25000 | 12002 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Bits | 34816 | 16896 | | |
| {1,,159} | 5.10 | 01010 | 10000 | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | Bits | N/A | N/A | | |
| for i from {0,,159} | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 24 | 24 | | |
| $\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | | | |
| $ \begin{cases} 701 & \text{Siot 1, if mod(1, 4)} = \{0, 1\} & \text{for 1 from} \\ \{1,, 159\} \end{cases} $ | Bits | 24 | 24 | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | | |
| for i from {0,,159} | CBs | N/A | N/A | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | 0.0 | | | | |
| {1,, 159} | CBs | 4 | 2 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | 0.0 | _ | | | |
| {1,,159} | CBs | 5 | 3 | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 4) = 3 | D:±- | NI/A | N1/A | | |
| for i from {0,,159} | Bits | N/A | N/A | | |
| For Slot i = 80, 81 | Bits | 69960 | 33920 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 54912 | 26624 | T | |
| {4,, 159} | טונט | 0-012 | 20024 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Bits | 73128 | 35456 | | |
| {1,,79,82,,159} | 210 | 70120 | 00 100 | | |
| Max. Throughput averaged over 2 | Mbps | 188.739 | 91.843 | | |
| frames | - | | | | |
| Note 1: SS/PBCH block is transmitted | | with periodicity 2 | ∠∪ ms | | |
| Note 2: Slot i is slot index per 2 frames |) | | | | |

Table A.3.2.2.5-6: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (64QAM)

| Parameter | Unit | | Value |) | |
|---|--------------|-----------------------|---------------|---|---|
| Reference channel | | R.PDSCH.5- 6.1 TDD | | | |
| Channel bandwidth | MHz | 100 | | | |
| Subcarrier spacing | kHz | 120 | | | |
| Allocated resource blocks | PRBs | 66 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$ | | 10 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | | 13 | | | |
| Allocated slots per 2 frames | | 119 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 17 | | | |
| Modulation | | 64QAM | | | |
| Target Coding Rate | | 0.43 | | | |
| Number of MIMO layers | | 2 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$ | | 12 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | | 12 | | | |
| Overhead for TBS determination | | 6 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$ | Bits | 34816 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | Bits | 47112 | | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$ | Bits | 24 | | | |
| For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$ | Bits | 24 | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | CBs | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$ | CBs | 5 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | CBs | 6 | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | |
| For Slot i = 80, 81 | Bits | 114940 | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{4,, 159\}$ | Bits | 82368 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,79,82,,159\}$ | Bits | 109692 | | | |
| Max. Throughput averaged over 2 frames | Mbps | 255.724 | | | |
| Note 1: SS/PBCH block is transmitted | in slot #0 w | ith periodicity 20 | 0 ms | ı | 1 |
| Note 2: Slot i is slot index per 2 frames | | | - | | |

Table A.3.2.2.5-7: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR2.120-1 (16QAM)

| Parameter | Unit | | Value |
|---|--------|----------------------------------|-------|
| Reference channel | | R.PDSCH.5- | |
| Reference channel | | 7.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 66 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | | 63 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs (Note 3) | | 24 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | D:4- | NI/A | |
| {3,4} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | D:4- | NI/A | |
| from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 14344 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | D:4- | 44044 | |
| {1,,79,82,,159} | Bits | 14344 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | D:4- | NI/A | |
| {3,4} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | D:4- | NI/A | |
| from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 24 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | Dito | 24 | |
| {1,,79,82,,159} | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | CBs | N/A | |
| {3,4} for i from {0,,159} | CBS | IN/A | |
| For CSI-RS Slot i, if $mod(i,5) = 1$ for i | CBs | N/A | |
| from {0,,159} | | | |
| For Slot i = 80 | CBs | 2 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | CBs | 2 | |
| {1,,79,82,,159} | CDS | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | Bits | N/A | |
| {3,4} for i from {0,,159} | סווס | 19/75 | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | Bits | N/A | |
| from {0,,159} | | | |
| For Slot i = 80 | Bits | 28776 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | Bits | 30360 | |
| {1,,79,82,,159} | טונס | 30300 | |
| Max. Throughput averaged over 2 | Mbps | 45.1836 | |
| frames | • | | |
| Note 1: CC/DDCH block is transmitted in | 1-4 40 | الا بالمناء الماء الماء ما الماء | 0 |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.2.5-8: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR2.120-2 (16QAM)

| Parameter | Unit | | Value |
|---|------|-----------------------|-------|
| Reference channel | | R.PDSCH.5- 8.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 66 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | | 59 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs (Note 3) | | 24 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,159\}$ | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,8) =1 for i from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 14344 | |
| For Slot i, if $mod(i, 8) = \{0, 4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 14344 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if $mod(i,8) = 1$ for i from $\{0,,159\}$ | Bits | N/A | |
| For Slot i = 80 | Bits | 24 | |
| For Slot i, if mod(i, 8) = $\{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,,159} | CBs | N/A | |
| For CSI-RS Slot i, if $mod(i,8) = 1$ for i from $\{0,,159\}$ | CBs | N/A | |
| For Slot i = 80 | CBs | 2 | |
| For Slot i, if mod(i, 8) = $\{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | CBs | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,159\}$ | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,8) =1 for i from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 28776 | |
| For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 30360 | |
| Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in | Mbps | 42.3148 | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

A.3.2.2.6 Reference measurement channels for E-UTRA

Table A.3.2.2.6-1: PDSCH Reference Channel for sustained data-rate test (64QAM, 2 MIMO layers)

| Parameter | Unit | | е | |
|--|------|------------|------------|------------|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- |
| | | 1.1 TDD | 1.2 TDD | 1.3 TDD |
| Channel bandwidth | MHz | 10 | 15 | 20 |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 |
| Number of HARQ Processes per component | | 10 | 10 | 10 |
| carrier | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 |
| Modulation | | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.85 | 0.88 |
| For Sub-Frame 5 | | 0.88 | 0.87 | 0.87 |
| For Sub-Frame 0 | | 0.90 | 0.88 | 0.90 |
| Information Bit Payload (Note 4) | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A |
| For Sub-Frames 3,4,8,9 | Bits | 36696 | 55056 | 75376 |
| For Sub-Frame 5 | Bits | 35160 | 52752 | 71112 |
| For Sub-Frame 0 | Bits | 36696 | 55056 | 75376 |
| Number of Code Blocks | | | | |
| (Notes 4 and 5) | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A |
| For Sub-Frames 3,4,8,9 | Bits | 6 | 9 | 13 |
| For Sub-Frame 5 | Bits | 6 | 9 | 12 |
| For Sub-Frame 0 | Bits | 6 | 9 | 13 |
| Binary Channel Bits (Note 4) | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A |
| For Sub-Frames 3,4,8,9 | Bits | 43200 | 64800 | 86400 |
| For Sub-Frame 5 | Bits | 40176 | 60912 | 82512 |
| For Sub-Frame 0 | Bits | 41184 | 62784 | 84384 |
| Number of layers | | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 21.864 | 32.803 | 44.799 |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0.3,4.8,9.

Table A.3.2.2.6-2: PDSCH Reference Channel for sustained data-rate test (64QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|---|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | | |
| | | 2.1 TDD | 2.2 TDD | 2.3 TDD | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | | |
| Number of HARQ Processes per component carrier | | 10 | 10 | 10 | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | | |
| Modulation | | 64QAM | 64QAM | 64QAM | | |
| Coding Rate | | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | | 0.78 | 0.77 | 0.79 | | |
| For Sub-Frame 5 | | 0.79 | 0.79 | 0.80 | | |
| For Sub-Frame 0 | | 0.82 | 0.79 | 0.81 | | |
| Information Bit Payload (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | Bits | 63776 | 93800 | 128496 | | |
| For Sub-Frame 5 | Bits | 59256 | 90816 | 124464 | | |
| For Sub-Frame 0 | Bits | 63776 | 93800 | 128496 | | |
| Number of Code Blocks (Notes 4 and 5) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | Bits | 11 | 16 | 21 | | |
| For Sub-Frame 5 | Bits | 10 | 15 | 21 | | |
| For Sub-Frame 0 | Bits | 11 | 16 | 21 | | |
| Binary Channel Bits (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | Bits | 81600 | 122400 | 163200 | | |
| For Sub-Frame 5 | Bits | 75840 | 115008 | 155808 | | |
| For Sub-Frame 0 | Bits | 77856 | 118656 | 159456 | | |
| Number of layers | | 4 | 4 | 4 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 37.813 | 55.981 | 76.694 | • | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-3: PDSCH Reference Channel for sustained data-rate test (256QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | | |
| | | 3.1 TDD | 3.2 TDD | 3.3 TDD | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | | |
| carrier | | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | | |
| Modulation | | 256QAM | 256QAM | 256QAM | | |
| Coding Rate | | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | | 0.74 | 0.79 | 0.74 | | |
| For Sub-Frames 8,9 | | 0.85 | 0.88 | 0.85 | | |
| For Sub-Frame 5 | | 0.76 | 0.76 | 0.74 | | |
| For Sub-Frame 0 | | 0.78 | 0.77 | 0.76 | | |
| Information Bit Payload (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 42368 | 63776 | 84760 | | |
| For Sub-Frames 8,9 | Bits | 48936 | 75376 | 97896 | | |
| For Sub-Frame 5 | Bits | 40576 | 61664 | 81176 | | |
| For Sub-Frame 0 | Bits | 42368 | 63776 | 84760 | | |
| Number of Code Blocks | | | | | | |
| (Notes 4 and 5) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 7 | 11 | 14 | | |
| For Sub-Frames 8,9 | Bits | 8 | 13 | 16 | | |
| For Sub-Frame 5 | Bits | 7 | 11 | 14 | | |
| For Sub-Frame 0 | Bits | 7 | 11 | 14 | | |
| Binary Channel Bits (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 57600 | 86400 | 115200 | | |
| For Sub-Frames 8,9 | Bits | 57600 | 86400 | 115200 | | |
| For Sub-Frame 5 | Bits | 53568 | 81216 | 110016 | | |
| For Sub-Frame 0 | Bits | 54912 | 83712 | 112512 | | |
| Number of layers | | 2 | 2 | 2 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 26.555 | 40.374 | 53.125 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-4: PDSCH Reference Channel for sustained data-rate test (256QAM, 4 MIMO layers)

| Parameter | Unit | | | | |
|--|------|---------------------------------|---------|---------|--|
| Reference channel | | R.PDSCH.6- R.PDSCH.6- R.PDSCH.6 | | | |
| | | 4.1 TDD | 4.2 TDD | 4.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 256QAM | 256QAM | 256QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | | 0.78 | 0.79 | 0.78 | |
| For Sub-Frames 8,9 | | 0.78 | 0.79 | 0.78 | |
| For Sub-Frame 5 | | 0.81 | 0.82 | 0.78 | |
| For Sub-Frame 0 | | 0.82 | 0.82 | 0.80 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 84760 | 128496 | 169544 | |
| For Sub-Frames 8,9 | Bits | 84760 | 128496 | 169544 | |
| For Sub-Frame 5 | Bits | 81176 | 124464 | 161760 | |
| For Sub-Frame 0 | Bits | 84760 | 128496 | 169544 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 14 | 21 | 28 | |
| For Sub-Frames 8,9 | Bits | 14 | 21 | 28 | |
| For Sub-Frame 5 | Bits | 14 | 21 | 27 | |
| For Sub-Frame 0 | Bits | 14 | 21 | 28 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 108800 | 163200 | 217600 | |
| For Sub-Frames 8,9 | Bits | 108800 | 163200 | 217600 | |
| For Sub-Frame 5 | Bits | 101120 | 153344 | 207744 | |
| For Sub-Frame 0 | Bits | 103808 | 158208 | 212608 | |
| Number of layers | | 4 | 4 | 4 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 50.498 | 76.694 | 100.948 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-5: PDSCH Reference Channel for sustained data-rate test (1024QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | | |
| | | 5.1 TDD | 5.2 TDD | 5.3 TDD | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | | |
| carrier | | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | | |
| Coding Rate | | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | | 0.76 | 0.75 | 0.76 | | |
| For Sub-Frames 8,9 | | 0.76 | 0.75 | 0.76 | | |
| For Sub-Frame 5 | | 0.76 | 0.78 | 0.77 | | |
| For Sub-Frame 0 | | 0.80 | 0.78 | 0.78 | | |
| Information Bit Payload (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 55056 | 81176 | 110136 | | |
| For Sub-Frames 8,9 | Bits | 55056 | 81176 | 110136 | | |
| For Sub-Frame 5 | Bits | 51024 | 78704 | 105528 | | |
| For Sub-Frame 0 | Bits | 55056 | 81176 | 110136 | | |
| Number of Code Blocks | | | | | | |
| (Notes 4 and 5) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 9 | 14 | 18 | | |
| For Sub-Frames 8,9 | Bits | 9 | 14 | 18 | | |
| For Sub-Frame 5 | Bits | 9 | 13 | 18 | | |
| For Sub-Frame 0 | Bits | 9 | 14 | 18 | | |
| Binary Channel Bits (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 72000 | 108000 | 144000 | | |
| For Sub-Frames 8,9 | Bits | 72000 | 108000 | 144000 | | |
| For Sub-Frame 5 | Bits | 66960 | 101520 | 137520 | | |
| For Sub-Frame 0 | Bits | 68640 | 104640 | 140640 | | |
| Number of layers | | 2 | 2 | 2 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 20.928 | 32.2232 | 43.5936 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-6: PDSCH Reference Channel for sustained data-rate test (1024QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | | |
| | | 6.1 TDD | 6.2 TDD | 6.3 TDD | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | | |
| carrier | | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | | |
| Coding Rate | | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | | 0.81 | 0.79 | 0.81 | | |
| For Sub-Frames 8,9 | | 0.81 | 0.79 | 0.81 | | |
| For Sub-Frame 5 | | 0.81 | 0.82 | 0.82 | | |
| For Sub-Frame 0 | | 0.85 | 0.82 | 0.83 | | |
| Information Bit Payload (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 110136 | 161760 | 220296 | | |
| For Sub-Frames 8,9 | Bits | 110136 | 161760 | 220296 | | |
| For Sub-Frame 5 | Bits | 101840 | 157432 | 211936 | | |
| For Sub-Frame 0 | Bits | 110136 | 161760 | 220296 | | |
| Number of Code Blocks | | | | | | |
| (Notes 4 and 5) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 18 | 27 | 36 | | |
| For Sub-Frames 8,9 | Bits | 18 | 27 | 36 | | |
| For Sub-Frame 5 | Bits | 17 | 26 | 35 | | |
| For Sub-Frame 0 | Bits | 18 | 27 | 36 | | |
| Binary Channel Bits (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4 | Bits | 136000 | 204000 | 272000 | | |
| For Sub-Frames 8,9 | Bits | 136000 | 204000 | 272000 | | |
| For Sub-Frame 5 | Bits | 126400 | 191680 | 259680 | | |
| For Sub-Frame 0 | Bits | 129760 | 197760 | 265760 | | |
| Number of layers | | 2 | 2 | 2 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 43.2248 | 64.2712 | 87.2824 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

A.3.3 Reference measurement channels for PDCCH performance requirements

A.3.3.1 FDD

A.3.3.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.3.1.1-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | Value | | | | | | | |
|-------------------|------|------------|------------|------------|--|--|--|--|--|--|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | | | | | | |
| channel | | 1.1 FDD | 1.2 FDD | 1.3 FDD | | | | | | |
| Subcarrier | kHz | 15 | 15 | 15 | | | | | | |
| spacing | | | | | | | | | | |
| CORESET | | 48 | 48 | 48 | | | | | | |
| frequency domain | | | | | | | | | | |
| allocation | | | | | | | | | | |
| CORESET time | | 1 | 1 | 1 | | | | | | |
| domain allocation | | | | | | | | | | |
| Aggregation level | | 4 | 4 | 8 | | | | | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | | | | | |
| Payload (without | Bits | 39 | 52 | 52 | | | | | | |
| CRC) | | | | | | | | | | |

Table A.3.3.1.1-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | | Va | lue | | |
|-----------------------|------|------------|------------|------------|------------|------------|------------|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- |
| channel | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD | 2.5 FDD | 2.6 FDD |
| Subcarrier | kHz | 15 | 15 | 15 | 15 | 15 | 15 |
| spacing | | | | | | | |
| CORESET | | 24 | 24 | 24 | 48 | 48 | 48 |
| frequency | | | | | | | |
| domain | | | | | | | |
| allocation | | | | | | | |
| CORESET time | | 2 | 2 | 2 | 2 | 2 | 2 |
| domain | | | | | | | |
| allocation | | | | | | | |
| Aggregation | | 2 | 4 | 2 | 4 | 8 | 16 |
| level | | | | | | | |
| DCI Format | | 1_0 | 1_0 | 1_1 | 1_1 | 1_1 | 1_0 |
| Payload (without CRC) | Bits | 39 | 39 | 512 | 52 | 52 | 39 |

A.3.3.1.2 Reference measurement channels for SCS 30 kHz FR1

Table A.3.3.1.2-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | | Valu | ıe | |
|-------------------|------|------------|------------|------------|----|--|
| Reference | | R.PDCCH.2- | R.PDCCH.2- | R.PDCCH.2- | | |
| channel | | 1.1 FDD | 1.2 FDD | 1.3 FDD | | |
| Subcarrier | kHz | 30 | 30 | 30 | | |
| spacing | | | | | | |
| CORESET | | 102 | 102 | 90 | | |
| frequency domain | | | | | | |
| allocation | | | | | | |
| CORESET time | | 1 | 1 | 1 | | |
| domain allocation | | | | | | |
| Aggregation level | | 2 | 4 | 8 | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | |
| Payload (without | Bits | 41 | 53 | 53 | | |
| CRC) | | | | | | |

Table A.3.3.1.2-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Value | | | | | |
|-------------------|------|------------|-------|--|--|--|--|--|
| Reference | | R.PDCCH.2- | | | | | | |
| channel | | 2.1 FDD | | | | | | |
| Subcarrier | kHz | 30 | | | | | | |
| spacing | | | | | | | | |
| CORESET | | 48 | | | | | | |
| frequency domain | | | | | | | | |
| allocation | | | | | | | | |
| CORESET time | | 2 | | | | | | |
| domain allocation | | | | | | | | |
| Aggregation level | | 16 | | | | | | |
| DCI Format | | 1_0 | | | | | | |
| Payload (without | Bits | 41 | | | | | | |
| CRC) | | | | | | | | |

A.3.3.2 TDD

A.3.3.2.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.3.2.1-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | | Valu | ıe | |
|-------------------|------|------------|------------|------------|----|--|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | | |
| channel | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | |
| Subcarrier | kHz | 15 | 15 | 15 | | |
| spacing | | | | | | |
| CORESET | | 48 | 48 | 48 | | |
| frequency domain | | | | | | |
| allocation | | | | | | |
| CORESET time | | 1 | 1 | 1 | | |
| domain allocation | | | | | | |
| Aggregation level | | 4 | 4 | 8 | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | |
| Payload (without | Bits | 39 | 52 | 52 | | |
| CRC) | | | | | | |

Table A.3.3.2.1-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | | Va | lue | | |
|------------------|------|------------|------------|------------|------------|------------|------------|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- |
| channel | | 2.1 TDD | 2.2 TDD | 2.3 TDD | 2.4 TDD | 2.5 TDD | 2.6 TDD |
| Subcarrier | kHz | 15 | 15 | 15 | 15 | 15 | 15 |
| spacing | | | | | | | |
| CORESET | | 24 | 24 | 24 | 48 | 48 | 48 |
| frequency | | | | | | | |
| domain | | | | | | | |
| allocation | | | | | | | |
| CORESET time | | 2 | 2 | 2 | 2 | 2 | 2 |
| domain | | | | | | | |
| allocation | | | | | | | |
| Aggregation | | 2 | 4 | 2 | 4 | 8 | 16 |
| level | | | | | | | |
| DCI Format | | 1_0 | 1_0 | 1_1 | 1_1 | 1_1 | 1_0 |
| Payload (without | Bits | 39 | 39 | 52 | 52 | 52 | 39 |
| CRC) | | | | | | | |

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

Table A.3.3.2.2-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | Value | | | | | | | | |
|-------------------|------|------------|------------|------------|--|--|--|--|--|--|--|
| Reference | | R.PDCCH.2- | R.PDCCH.2- | R.PDCCH.2- | | | | | | | |
| channel | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | | | | | | |
| Subcarrier | kHz | 30 | 30 | 30 | | | | | | | |
| spacing | | | | | | | | | | | |
| CORESET | | 102 | 102 | 90 | | | | | | | |
| frequency domain | | | | | | | | | | | |
| allocation | | | | | | | | | | | |
| CORESET time | | 1 | 1 | 1 | | | | | | | |
| domain allocation | | | | | | | | | | | |
| Aggregation level | | 2 | 4 | 8 | | | | | | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | | | | | | |
| Payload (without | Bits | 41 | 53 | 53 | | | | | | | |
| CRC) | | | | | | | | | | | |

Table A.3.3.2.2-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Val | ue | |
|-------------------|------|------------|-----|----|--|
| Reference | | R.PDCCH.2- | | | |
| channel | | 2.1 TDD | | | |
| Subcarrier | kHz | 30 | | | |
| spacing | | | | | |
| CORESET | | 48 | | | |
| frequency domain | | | | | |
| allocation | | | | | |
| CORESET time | | 2 | | | |
| domain allocation | | | | | |
| Aggregation level | | 16 | | | |
| DCI Format | | 1_0 | | | |
| Payload (without | Bits | 41 | | • | |
| CRC) | | | | | |

A.3.3.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.3.2.4 Reference measurement channels for SCS 60 kHz FR2

A.3.3.2.5 Reference measurement channels for SCS 120 kHz FR2

Table A.3.3.2.5-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | Value | | | | | | | | |
|-------------------|------|------------|------------|------------|--|--|--|--|--|--|--|
| Reference | | R.PDCCH.5- | R.PDCCH.5- | R.PDCCH.5- | | | | | | | |
| channel | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | | | | | | |
| Subcarrier | kHz | 120 | 120 | 120 | | | | | | | |
| spacing | | | | | | | | | | | |
| CORESET | | 60 | 60 | 60 | | | | | | | |
| frequency domain | | | | | | | | | | | |
| allocation | | | | | | | | | | | |
| CORESET time | | 1 | 1 | 1 | | | | | | | |
| domain allocation | | | | | | | | | | | |
| Aggregation level | | 2 | 4 | 8 | | | | | | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | | | | | | |
| Payload (without | Bits | 40 | 56 | 56 | | | | | | | |
| CRC) | | | | | | | | | | | |

Table A.3.3.2.5-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Va | lue | |
|-------------------|------|------------|----|-----|--|
| Reference | | R.PDCCH.5- | | | |
| channel | | 2.1 TDD | | | |
| Subcarrier | kHz | 120 | | | |
| spacing | | | | | |
| CORESET | | 60 | | | |
| frequency domain | | | | | |
| allocation | | | | | |
| CORESET time | | 2 | | | |
| domain allocation | | | | | |
| Aggregation level | | 16 | | | |
| DCI Format | | 1_0 | | | |
| Payload (without | Bits | 40 | | | |
| CRC) | | | | | |

A.3.4 Reference measurement channels for PBCH demodulation requirements

A.3.4.1 Reference measurement channels for FR1

Table A.3.4.1-1: PBCH Reference Channel

| Parameter | Unit | Value | | |
|----------------------------------|------|----------|----------|--|
| Reference channel | | R.PBCH.1 | R.PBCH.2 | |
| SS/PBCH block subcarrier spacing | kHz | 15 | 30 | |
| Modulation | | QPSK | QPSK | |
| Target coding rate | | 56/864 | 56/864 | |
| Payload (without CRC and timing | bits | 24 | 24 | |
| related PBCH payload bits) | | | | |

A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

| Parameter | Unit | Value | | |
|--|------|----------|----------|--|
| Reference channels | | R.PBCH.5 | R.PBCH.6 | |
| SS/PBCH block subcarrier spacing | kHz | 120 | 240 | |
| Modulation | | QPSK | QPSK | |
| Target coding rate | | 56/864 | 56/864 | |
| Payload (without CRC and timing related PBCH payload bits) | bits | 24 | 24 | |

A.4 CSI reference measurement channels

This section defines the DL signal applicable to the reporting of channel status information (Clause X).

Tables in this section specifies the mapping of CQI index to Information Bit payload, which complies with the CQI definition specified in clause 5.2.2.1 of TS 38.214 [12] and with MCS definition specified in clause 5.1.3 of TS 38.214 [12].

Table A.4-1: Mapping of CQI Index to Information Bit payload (CQI table 1)

| TBS Schem | е | | | TBS.1-1 | TBS.1-2 | | | | |
|----------------------------------|-----------------------------|--------------|----------------|--------------|------------|------------|-------------|---|---|
| MCS table | | | | | | 640 | QAM | • | |
| Number of a | Illocated PDS | CH resource | olocks | 66 | 66 | | | | |
| Number of c | onsecutive Pl | DSCH symbo | ls | 12 | 12 | | | | |
| Number of F | PDSCH MIMO | layers | | 1 | 2 | | | | |
| Number of D | Number of DMRS REs (Note 1) | | | 24 | 24 | | | | |
| Overhead for TBS determination | | | 6 | 6 | | | | | |
| Available RE-s | | | | 7920 | 7920 | | | | |
| CQI index Spectral MCS Modulatio | | | | Infor | mation Bit | Payload p | er Slot | | |
| | efficiency | index | n | | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | | | | |
| 1 | 0.1523 | 0 | | 1800 | 3624 | | | | |
| 2 | 0.2344 | 0 | | 1800 | 3624 | | | | |
| 3 | 0.3770 | 2 | QPSK | 2856 | 5640 | | | | |
| 4 | 0.6016 | 4 | QFSK | 4480 | 8968 | | | | |
| 5 | 0.8770 | 6 | | 6528 | 13064 | | | | |
| 6 | 1.1758 | 8 | | 8712 | 17928 | | | | |
| 7 | 1.4766 | 11 | | 11016 | 22032 | | | | |
| 8 | 1.9141 | 13 | 16QAM | 14343 | 28680 | | | | |
| 9 | 2.4063 | 15 | | 17928 | 35856 | | | | |
| 10 | 2.7305 | 18 | | 20496 | 40976 | | | | |
| 11 | 3.3223 | 20 | | 25104 | 50184 | | | | |
| 12 | 3.9023 | 22 | 640014 | 29192 | 58384 | | | | |
| 13 | 4.5234 | 24 | 64QAM | 33816 | 67584 | | | | |
| 14 | 5.1152 | 26 |] | 38936 | 77896 | | | | |
| 15 | 5.5547 | 28 | | 42016 | 83976 | | | | |
| Note 1: N | lumber of DMI | RS REs inclu | des the overhe | ead of the D | M-RS CDI | M groups v | vithout dat | а | • |

Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity

Table A.4-2: Mapping of CQI Index to Information Bit payload (CQI table 2)

| TBS Scheme | | | TBS.2-1 | TBS.2-2 | TBS.2-3 | TBS.2-4 | TBS.2-5 | TBS.2-6 | |
|---|---|-------------|-----------|---------|---------|--------------|-------------|---------|-------|
| MCS table | | | | | 2560 | QAM | | | |
| Number of a | Number of allocated PDSCH resource blocks | | | 52 | 52 | 106 | 106 | 8 | 16 |
| Number of c | onsecutive Pl | DSCH symbol | ls | 12 | 12 | 12 | 12 | 12 | 12 |
| Number of F | DSCH MIMO | layers | | 1 | 2 | 1 | 2 | 1 | 1 |
| Number of D | MRS REs (N | ote 1) | | 24 | 24 | 24 | 24 | 24 | 24 |
| Overhead for | r TBS determ | ination | | 0 | 0 | 0 | 0 | 0 | 0 |
| Available RE | E-s for PDSCH | 1 | | 6240 | 6240 | 12720 | 12720 | 960 | 1920 |
| CQI index | Spectral | MCS | Modulatio | | Infor | mation Bit F | Payload per | r Slot | |
| | efficiency | index | n | | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | 0.1523 | 0 | | 1480 | 2976 | 2976 | 5896 | 224 | 456 |
| 2 | 0.3770 | 1 | QPSK | 2408 | 4744 | 4744 | 9480 | 368 | 736 |
| 3 | 0.8770 | 3 | | 5504 | 11016 | 11016 | 22536 | 848 | 1736 |
| 4 | 1.4766 | 5 | | 9224 | 18432 | 18960 | 37896 | 1416 | 2856 |
| 5 | 1.9141 | 7 | 16QAM | 12040 | 24072 | 24576 | 49176 | 1864 | 3752 |
| 6 | 2.4063 | 9 | | 15112 | 30216 | 30728 | 61480 | 2408 | 4608 |
| 7 | 2.7305 | 11 | | 16896 | 33816 | 34816 | 69672 | 2600 | 5248 |
| 8 | 3.3223 | 13 |] | 20496 | 40976 | 42016 | 83976 | 3240 | 6400 |
| 9 | 3.9023 | 15 | 64QAM | 24576 | 49176 | 49176 | 98376 | 3752 | 7424 |
| 10 | 4.5234 | 17 |] | 28168 | 56368 | 57376 | 114776 | 4352 | 8712 |
| 11 | 5.1152 | 19 |] | 31752 | 63528 | 65576 | 131176 | 4864 | 9736 |
| 12 | 5.5547 | 21 | | 34816 | 69672 | 69672 | 139376 | 5248 | 10760 |
| 13 | 6.2266 | 23 | 2560 4 14 | 38936 | 77896 | 79896 | 159880 | 6016 | 12040 |
| 14 | 6.9141 | 25 | 256QAM | 43032 | 86040 | 88064 | 176208 | 6656 | 13320 |
| 15 | 7.4063 | 27 | | 46104 | 92200 | 94248 | 188576 | 7040 | 14088 |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data | | | | | | | | | |
| Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL | | | | | | | | | |
| Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity | | | | | | | | | |

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

A.5.1.1 OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs

Table A.5.1.1-1: OP.1 FDD: Generic OCNG FDD Pattern for all unused REs

| OCNG Appliance | Control Region | Data Region | | | |
|---|-----------------------------|----------------------------------|--|--|--|
| OCNG Parameters | (CORESET) | | | | |
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) | | | |
| Structure | PDCCH | PDSCH | | | |
| Content | Uncorrelated pseudo random | Uncorrelated pseudo random QPSK | | | |
| | QPSK modulated data | modulated data | | | |
| Transmission scheme for multiple | Single Tx port transmission | Spatial multiplexing using any | | | |
| antennas ports transmission | | precoding matrix with dimensions | | | |
| | | same as the precoding matrix for | | | |
| | | PDSCH | | | |
| Subcarrier Spacing | Same as for RMC PDCCH in | Same as for RMC PDSCH in the | | | |
| | the active BWP | active BWP | | | |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH | | | |
| Note 1: All unused REs in the active CORESETS appointed by the search spaces in use | | | | | |

Note 1: All unused REs in the active CORESETS appointed by the search spaces in use.

Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth.

A.5.2 OCNG Patterns for TDD

A.5.2.1 OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs

Table A.5.2.1-1: OP.1 TDD: Generic OCNG TDD Pattern for all unused REs

| OCNG Appliance OCNG Parameters | Control Region (CORESET) | Data Region |
|--|---|---|
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) |
| Structure | PDCCH | PDSCH |
| Content | Uncorrelated pseudo random QPSK modulated data | Uncorrelated pseudo random QPSK modulated data |
| Transmission scheme for multiple antennas ports transmission | Single Tx port transmission | Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH |
| Subcarrier Spacing | Same as for RMC PDCCH in the active BWP | Same as for RMC PDSCH in the active BWP |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH |

Note 1: All unused REs in the active CORESETS appointed by the search spaces in use.

Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth.

Annex B (normative): Propagation conditions

B.1 Static propagation condition

B.1.1 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
.

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}.$$

For 4 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 - j & -j \end{bmatrix}$$

For 8 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j \\ 1 & 1 & 1 & 1 - j - j - j - j \end{bmatrix}$$

B.1.2 UE Receiver with 4Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & j \\ 1 & -j \\ 1 & j \\ 1 & -j \end{bmatrix}$$

For 4 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 & -j & -j \\ 1 & -1 & j & -j \\ 1 & -1 & -j & j \end{bmatrix}.$$

For 8 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j & j \\ 1 & 1 & 1 & 1 & -j & -j & -j & -j \\ 1 & 1 & -1 & -1 & j & j & -j & -j \\ 1 & 1 & -1 & -1 & -j & -j & j & j \end{bmatrix}$$

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-lin", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.
- Different models are used for FR1 (below 6 GHz) and FR2 (above 6 GHz).

B.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [5] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in B.2.1.1 and B.2.1.2 can be used as such.

- Step 1: Use the original TDL model from TR 38.901[5].
- Step 2: Re-order the taps in ascending delays
- Step 3: Perform delay scaling according to the procedure described in subclause 7.7.3 in TR 38.901 [5].
- Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.
- Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.
- Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows
- Find the weakest tap from all taps (both merged and unmerged taps are considered)
 - If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.
- When the weakest tap is the first delay tap, merge taps as follows
 - Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.
 - Remove the second delay tap.
- When the weakest tap is the last delay tap, merge taps as follows
 - Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.
 - Remove the second-to-last tap.
- Otherwise
 - For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

- When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.
 - Select the neighbour tap that is weaker in power for merging.
- Otherwise, select the neighbour tap that has smaller delay difference for merging.
- To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.
- When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.
- When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.
- Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Merge two parallel taps with different delays (average delay, sum power) starting from the weakest ones. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. 10 ns & 20 ns → 15 ns, 10 ns & 25 ns → 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power). The weakest tap and the selected tap are removed.
- Repeat step 6 until the final number of taps is 12.
- Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB \rightarrow -8.8 dB)
- Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.
- Step 9: Re-normalize tap powers such that the strongest tap is at 0dB.
- Note: Some values of the delay profile created by the simplification steps may differ from the values in tables B.2.1.1-2, B.2.1.1-3, B.2.1.1-4, B.2.1.2-2, and B.2.1.1-3 for the corresponding model.
- Note: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

B.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of low, medium and high delay spread environment. The resulting model parameters are specified in B.2.1.1-1 and the tapped delay line models are specified in Tables B.2.1.1-2 ~ Table B.2.1.1-4.

Table B.2.1.1-1: Delay profiles for NR channel models

| Model | Number of channel taps | Delay spread (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
|---------|------------------------|--------------------------|---------------------------------|------------------|
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLB100 | 12 | 100 ns | 480 ns | 5 ns |
| TDLC300 | 12 | 300 ns | 2595 ns | 5 ns |

Table B.2.1.1-2 TDLA30 (DS = 30 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
| 8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table B.2.1.1-3 TDLB100 (DS = 100ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | 0 | Rayleigh |
| 2 | 10 | -2.2 | Rayleigh |
| 3 | 20 | -0.6 | Rayleigh |
| 4 | 30 | -0.6 | Rayleigh |
| 5 | 35 | -0.3 | Rayleigh |
| 6 | 45 | -1.2 | Rayleigh |
| 7 | 55 | -5.9 | Rayleigh |
| 8 | 120 | -2.2 | Rayleigh |
| 9 | 170 | -0.8 | Rayleigh |
| 10 | 245 | -6.3 | Rayleigh |
| 11 | 330 | -7.5 | Rayleigh |
| 12 | 480 | -7.1 | Rayleigh |

Table B.2.1.1-4 TDLC300 (DS = 300 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -6.9 | Rayleigh |
| 2 | 65 | 0 | Rayleigh |
| 3 | 70 | -7.7 | Rayleigh |
| 4 | 190 | -2.5 | Rayleigh |
| 5 | 195 | -2.4 | Rayleigh |
| 6 | 200 | -9.9 | Rayleigh |
| 7 | 240 | -8.0 | Rayleigh |
| 8 | 325 | -6.6 | Rayleigh |
| 9 | 520 | -7.1 | Rayleigh |
| 10 | 1045 | -13.0 | Rayleigh |
| 11 | 1510 | -14.2 | Rayleigh |
| 12 | 2595 | -16.0 | Rayleigh |

B.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in B.2.1.2-1 and the tapped delay line models are specified in Tables B.2.1.2-2 and table B.2.1.2-3.

Table B.2.1.2-1: Delay profiles for NR channel models

| Model | Number of channel taps | Delay spread (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
|--------|------------------------|--------------------------|---------------------------------|------------------|
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLC60 | 12 | 60 ns | 520 ns | 5 ns |

Table B.2.1.2-2 TDLA30 (DS = 30 ns)

| Tap # | Delay [ns] | Power [dB] | Fading distribution |
|-------|------------|------------|---------------------|
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
| 8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table B.2.1.2-3 TDLC60 (DS = 60 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -7.8 | Rayleigh |
| 2 | 15 | -0.3 | Rayleigh |
| 3 | 40 | 0 | Rayleigh |
| 4 | 50 | -8.9 | Rayleigh |
| 5 | 55 | -14.5 | Rayleigh |
| 6 | 75 | -8.5 | Rayleigh |
| 7 | 80 | -10.2 | Rayleigh |
| 8 | 130 | -12.1 | Rayleigh |
| 9 | 210 | -13.9 | Rayleigh |
| 10 | 300 | -15.2 | Rayleigh |
| 11 | 360 | -16.9 | Rayleigh |
| 12 | 520 | -19.4 | Rayleigh |

B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., TDLA<DS>-<Doppler>, TDLB<DS>-<Doppler> or TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table B.2.2-1 and Table B.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1 and FR2, respectively.

Table B.2.2-1 Channel model parameters for FR1

| Combination name | Model | Maximum Doppler frequency |
|------------------|---------|---------------------------|
| TDLA30-5 | TDLA30 | 5 Hz |
| TDLA30-10 | TDLA30 | 10 Hz |
| TDLB100-400 | TDLB100 | 400 Hz |
| TDLC300-100 | TDLC300 | 100 Hz |

Table B.2.2-2 Channel model parameters for FR2

| Combination name | Model | Maximum Doppler frequency |
|------------------|--------|---------------------------|
| TDLA30-35 | TDLA30 | 35 Hz |
| TDLA30-75 | TDLA30 | 75 Hz |
| TDLA30-300 | TDLA30 | 300 Hz |
| TDLC60-300 | TDLC60 | 300 Hz |

B.2.3 MIMO Channel Correlation Matrices

The MIMO channel correlation matrices defined in B.2.3 apply for the antenna configuration using uniform linear arrays at both gNB and UE and for the antenna configuration using cross polarized antennas.

B.2.3.1 MIMO Correlation Matrices using Uniform Linear Array (ULA)

The MIMO channel correlation matrices defined in B.2.3.1 apply for the antenna configuration using uniform linear array (ULA) at both gNB and UE.

B.2.3.1.1 Definition of MIMO Correlation Matrices

Table B.2.3.1.1-1 defines the correlation matrix for the gNB.

Table B.2.3.1.1-1 gNB correlation matrix

| | One antenna | Two antennas | Four antennas |
|-----------------|---------------|--|---|
| gNB Correlation | $R_{gNB} = 1$ | $R_{gNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$ | $R_{gNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ |

Table B.2.3.1.1-2 defines the correlation matrix for the UE:

Table B.2.3.1.1-2 UE correlation matrix

| | One antenna | Two antennas | Four antennas |
|----------------|-------------|---|---|
| UE Correlation | R_{UE} =1 | $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} & \beta \\ \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} \\ \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} \\ \beta^* & \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 \end{pmatrix}$ |

Table B.2.3.1.1-3 defines the channel spatial correlation matrix R_{spat} . The parameters, α and β in Table B.2.3.1-3 defines the spatial correlation between the antennas at the gNB and UE.

Table B.2.3.1.1-3: R_{spat} correlation matrices

| 1x2 case | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & oldsymbol{eta} \\ oldsymbol{eta}^* & 1 \end{bmatrix}$ |
|----------|---|
| 1x4 case | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9} & \beta^{1/9} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9} & \beta^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$ |
| 2x1 case | $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$ |
| 2x2 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$ |
| 2x4 case | $R_{spat} = R_{gNB} \otimes R_{UE} = egin{bmatrix} 1 & lpha \ lpha^* & 1 \end{bmatrix} \otimes egin{bmatrix} 1 & eta^{1\!\!/_{\!\!9}} & eta^{4\!\!/_{\!\!9}} & eta \ eta^{1\!\!/_{\!\!9}*} & eta^{1\!\!/_{\!\!9}*} & 1 & eta^{1\!\!/_{\!\!9}} \ eta^{4\!\!/_{\!\!9}*} & eta^{1\!\!/_{\!\!9}*} & 1 \end{bmatrix}$ |
| 4x1 case | $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9} & \alpha^{1/9} & 1 \end{bmatrix}$ |
| 4x2 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ $\alpha^* & \alpha^{4/9} & \alpha^{1/9} & 1 \end{bmatrix}$ |
| 4x4 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{1/9} & \beta \\ \beta^{1/9} & \beta^{1/9} & \beta^{1/9} & \beta \\ \beta^{1/9} & \beta^{1/9} & \beta^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & 1 \\ \alpha^* & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & 1 \\ \alpha^* & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} \\ \alpha^* & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} \\ \alpha^{1/9$ |

For cases with more antennas at either gNB or UE or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of R_{gNB} and R_{UE} according to $R_{spat} = R_{gNB} \otimes R_{UE}$.

B.2.3.1.2 MIMO Correlation Matrices at High, Medium and Low Level

The α and β for different correlation types are given in Table B.2.3.1.2-1.

Table B.2.3.1.2-1: The α and β parameters for ULA MIMO correlation matrices

| Correlation Model | α | β |
|-------------------|-----|--------|
| Low correlation | 0 | 0 |
| Medium | 0.3 | 0.9 |
| Correlation | | |
| Medium | 0.3 | 0.3874 |
| Correlation A | | |
| High Correlation | 0.9 | 0.9 |

The correlation matrices for high, medium, medium A and low correlation are defined in Table B.2.3.1.2-2, B.2.3.1.2-3, B.2.3.1.2-4 and B.2.3.1.2-5 as below.

The values in Table B.2.3.1.2-2 have been adjusted for the 4x2 and 4x4 high correlation cases to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$R_{high} = [R_{spat} + aI_n]/(1+a)$$

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 4x2 high correlation case, a=0.00010. For the 4x4 high correlation case, a=0.00012.

The same method is used to adjust the 2x4 and 4x4 medium correlation matrix in Table B.2.3.1.2-3 to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a = 0.00010 and a = 0.00012.

Table B.2.3.1.2-2: MIMO correlation matrices for high correlation

| 1x2 case | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$ | | | | | | | | |
|-------------|--|--|--|--|--|--|--|--|--|
| 2x1 case | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$ | | | | | | | | |
| 2x2 case | $R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$ | | | | | | | | |
| 4x2 case | $R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8999 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$ | | | | | | | | |
| 4x4 case | $R_{high} = \begin{bmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9541 & 0.9430 & 0.9105 & 0.8887 & 0.8999 & 0.8894 & 0.8587 & 0.8099 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8894 & 0.8999 & 0.8894 & 0.8587 \\ 0.9541 & 0.9882 & 1.0000 & 0.8892 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.8587 & 0.8894 & 0.8999 \\ 0.8899 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.8999 & 0.8587 & 0.8894 & 0.8999 \\ 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8587 \\ 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9430 & 0.9430 & 0.9541 & 0.9430 & 0.9541 \\ 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 \\ 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 \\ 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8587 & 0.8894 & 0.8999 & 0.8894 & 0.8999 & 0.8894 & 0.8999 & 0.8894 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8587 & 0.8999 & 0.8587 & 0.9105 & 0.9430$ | | | | | | | | |

Table B.2.3.1.2-3: MIMO correlation matrices for medium correlation

| 1x2 case | N/A | | | | | | | | | |
|-------------|---|--|--|--|--|--|--|--|--|--|
| 2x1 | N/A | | | | | | | | | |
| case | | | | | | | | | | |
| 2x2 case | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ | | | | | | | | | |
| 2x4 case | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$ | | | | | | | | | |
| 4x2 case | $R_{medium} = \left(\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | | | | | | |
| 4x4 case | 1.0000 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 0.5855 0.5787 0.5588 0.5270 0.3000 0.2965 0.2862 0.2700 | | | | | | | | | |

Table B.2.3.1.2-4: MIMO correlation matrices for medium correlation A

| | | | | | , | | | | | | | | | | _ | | 1 |
|------|------------------|--------|-----------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|
| | | | | | 1.0000 | 0.90 | 000 0 | .6561 | 0.3874 | 0.300 | 00 0.2 | 2700 | 0.1968 | 0.1162 | 2) | | |
| | | | | | 0.9000 | 1.00 | 000 0 | .9000 | 0.6561 | 0.270 | 0.3 | 3000 | 0.2700 | 0.196 | 3 | | |
| | | | | | 0.656 | 0.90 | 000 1 | .0000 | 0.9000 | 0.196 | 8 0.2 | 2700 | 0.3000 | 0.270 |) | | |
| 2x4 | | | | | 0.3874 | 4 0.65 | 561 0 | .9000 | 1.0000 | 0.116 | 52 0. | 1968 | 0.2700 | 0.3000 |) | | |
| case | | | R_{med} | $_{lium\ A}=$ | 0.3000 | 0.23 | | .1968 | 0.1162 | | | | 0.6561 | 0.3874 | 1 | | |
| | | | | | 0.000 | J 0 | | | | | | | | | | | |
| | | | | | 0.2700 | 0.30 | 000 0 | .2700 | 0.1968 | 0.900 | 00 1.0 | 0000 | 0.9000 | 0.656 | 1 | | |
| | | | | | 0.1968 | 3 0.27 | 700 0 | .3000 | 0.2700 | 0.65 | 51 0.9 | 9000 | 1.0000 | 0.900 | C | | |
| | | | | | 0.1162 | 2 0.19 | 968 0 | .2700 | 0.3000 | 0.38 | 74 0. | 6561 | 0.9000 | 1.000 | 0) | | |
| | | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 0.5856 | 0.5270 | 0.3842 | 2 0.2269 | 0.3000 | 0.2700 | 0.1968 | 0.1162 |
| | | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.2700 | 0.3000 | 0.2700 | 0.1968 |
| | | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.1968 | 0.2700 | 0.3000 | 0.2700 |
| | | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.1162 | 0.1968 | 0.2700 | 0.3000 |
| | | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 0.5856 | 0.5270 | 0.3842 | 0.2269 |
| | | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.5270 | 0.5856 | 0.5270 | 0.3842 |
| | | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.3842 | 0.5270 | 0.5856 | 0.5270 |
| 4x4 | R = | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.2269 | 0.3842 | 0.5270 | 0.5856 |
| case | $R_{medium A} =$ | 0.5856 | 0.5270 | 0.3842 | 0.2269 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 | 0.6561 | 0.3874 | 0.8748 | 0.7873 | 0.5739 | 0.3389 |
| | | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 | 0.9000 | 0.6561 | 0.7873 | 0.8748 | 0.7873 | 0.5739 |
| | | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 | 1.0000 | 0.9000 | 0.5739 | 0.7873 | 0.8748 | 0.7873 |
| | | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 | 0.9000 | 1.0000 | 0.3389 | 0.5739 | 0.7873 | 0.8748 |
| | | 0.3000 | 0.2700 | 0.1968 | 0.1162 | 0.5856 | 0.5270 | 0.3842 | 0.2269 | 0.8748 | 0.7873 | 0.5739 | 0.3389 | 1.0000 | 0.9000 | 0.6561 | 0.3874 |
| | | 0.2700 | 0.3000 | 0.2700 | 0.1968 | 0.5270 | 0.5856 | 0.5270 | 0.3842 | 0.7873 | 0.8748 | 0.7873 | 0.5739 | 0.9000 | 1.0000 | 0.9000 | 0.6561 |
| | | 0.1968 | 0.2700 | 0.3000 | 0.2700 | 0.3842 | 0.5270 | 0.5856 | 0.5270 | 0.5739 | 0.7873 | 0.8748 | 0.7873 | 0.6561 | 0.9000 | 1.0000 | 0.9000 |
| | | 0.1162 | 0.1968 | 0.2700 | 0.3000 | 0.2269 | 0.3842 | 0.5270 | 0.5856 | 0.3389 | 0.5739 | 0.7873 | 0.8748 | 0.3874 | 0.6561 | 0.9000 | 1.0000 |
| | | | | | | | | | | | | | | | | | |

Table B.2.3.1.2-5: MIMO correlation matrices for low correlation

| 1x2 case | $R_{low} = \mathbf{I}_2$ |
|----------|-----------------------------|
| 1x4 case | $R_{low} = \mathbf{I}_4$ |
| 2x1 case | $R_{low} = \mathbf{I}_2$ |
| 2x2 case | $R_{low} = \mathbf{I}_4$ |
| 2x4 case | $R_{low} = \mathbf{I}_8$ |
| 4x1 case | $R_{low} = \mathbf{I}_4$ |
| 4x2 case | $R_{low} = \mathbf{I}_8$ |
| 4x4 case | $R_{low} = \mathbf{I}_{16}$ |

In Table B.2.3.1.2-5, \mathbf{I}_d is the $d \times d$ identity matrix.

B.2.3.2 MIMO Correlation Matrices using Cross Polarized Antennas (X-pol)

The MIMO channel correlation matrices defined in B.2.3.2 apply for the antenna configuration using cross polarized (XP/X-pol) antennas at both gNB and UE. The cross-polarized antenna elements with ± 1.45 degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with ± 1.45 degrees polarization slant angles are deployed at UE.

For the 2D cross-polarized antenna array at eNodeB, the N antennas are indexed by (N_1, N_2, P) , and total number of antennas is $N = P \cdot N_1 \cdot N_2$, where

- N_1 is the number of antenna elements in first dimension with same polarization,
- N_2 is the number of antenna elements in second dimension with same polarization, and
- *P* is the number of polarization groups.

For the 2D cross-polarized antennas at gNB, the N antennas are labelled such that antennas shall be in increasing order of the second dimension firstly, then the first dimension, and finally the polarization group. For a specific antenna element at p-th polarization, n_1 -th row, and n_2 -th column within the 2D antenna array, the following index number is used for antenna labelling:

$$Inde(p, n_1, n_2) = p \cdot N_1 \cdot N_2 + n_1 \cdot N_2 + n_2 + 1;$$
 $p = 0,1; n_1 = 0, \dots, N_1 - 1; n_2 = 0, \dots, N_2 - 1.$

where N is the number of transmit antennas, p is the polarization group index, n_1 is the row index, and n_2 is the column index of the antenna element.

For the linear (single dimension, 1D) cross-polarized antenna, the N antennas are labelled following the above equations with $N_2=1$.

B.2.3.2.1 Definition of MIMO Correlation Matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P(R_{gNB} \otimes \Gamma \otimes R_{UE})P^{T}$$

where

- $R_{U\!E}$ is the spatial correlation matrix at the UE with same polarization,
- R_{gNB} is the spatial correlation matrix at the gNB with same polarization,
- Γ is a polarization correlation matrix, and
- $(\bullet)^T$ denotes transpose.

The matrix Γ is defined as

$$\Gamma = \begin{bmatrix} 1 & 0 & -\gamma & 0 \\ 0 & 1 & 0 & \gamma \\ -\gamma & 0 & 1 & 0 \\ 0 & \gamma & 0 & 1 \end{bmatrix}$$

A permutation matrix P elements are defined as

$$P(a,b) = \begin{cases} 1 & \text{for } a = (j-1)Nr + i \text{ and } b = 2(j-1)Nr + i, & i = 1, \dots, Nr, j = 1, \dots Nt/2 \\ 1 & \text{for } a = (j-1)Nr + i \text{ and } b = 2(j-Nt/2)Nr - Nr + i, & i = 1, \dots, Nr, j = Nt/2 + 1, \dots, Nt + i, \\ 0 & \text{otherwise} \end{cases}$$

where *Nt* and *Nr* is the number of transmitter and receiver respectively. This is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in B.2.3.2.

For the 2D cross-polarized antenna array at gNB, the spatial correlation matrix at the gNB is further expressed as following for 2D cross-polarized antenna array at gNB:

$$R_{gNB} = R_{gNB_Dim,1} \otimes R_{gNB_Dim,2}$$

where

- - $R_{gNB\ Dim1}$ is the correlation matrix of antenna elements in first dimension with same polarization, and
- - R_{gNB_Dim2} is the correlation matrix of antenna elements in second dimension with same polarization.

For the 2D cross polarized antenna array at gNB side, the spatial correlation matrices in one direction of antenna array are as follows:

For 1 antenna element with the same polarization in one direction,

$$R_{oNB}$$
 Dim.i = 1.

- For 2 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = \begin{pmatrix} 1 & \alpha_i \\ \alpha_i^* & 1 \end{pmatrix}.$$

- For 3 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = egin{pmatrix} 1 & lpha_i^{1/4} & lpha_i \ lpha_i^{1/4*} & 1 & lpha_i^{1/4} \ lpha_i^* & lpha_i^{1/4*} & 1 \end{pmatrix}.$$

- For 4 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = egin{pmatrix} 1 & lpha_i^{1/9} & lpha_i^{4/9} & lpha_i \ lpha_i^{1/9^*} & 1 & lpha_i^{1/9} & lpha_i^{4/9} \ lpha_i^{4/9^*} & lpha_i^{1/9^*} & 1 & lpha_i^{1/9} \ lpha_i^* & lpha_i^{4/9^*} & lpha_i^{1/9^*} & 1 \end{pmatrix}.$$

where the index i = 1,2 stands for first dimension and second dimension respectively.

For the 1D cross-polarized antenna array at gNB, the matrix of R_{gNB} is determined by follow the equations for 2D cross-polarized antenna array and letting $R_{gNB\ Dim2} = 1$, i.e.,

$$R_{gNB} = R_{gNB_Dim,1}$$

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UF} = 1$$
.

- For 2 antenna elements with the same polarization,

$$R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}.$$

B.2.3.2.2 MIMO Correlation Matrices using cross polarized antennas

The values for parameters α , β and γ for the cross polarized antenna models are given in Table B.2.3.2.2-1.

Table B.2.3.2.2-1: The α and β parameters for cross-polarized MIMO correlation matrices

| Correlation Mode | α_1 | <i>0</i> ⁄2 | β | γ | | | | |
|--|---|-------------|-----|-----|-----|--|--|--|
| Medium Correlation | ı A | 0.3 | N/A | 0.6 | 0.2 | | | |
| High Correlation | | 0.9 | 0.9 | 0.9 | 0.3 | | | |
| antenna ele Note 2: Value of α_2 antenna ele Note 3: Value of β | 1: Value of α₁ applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side. 2: Value of α₂ applies when more than one pair of cross-polarized antenna elements in second dimension at gNB side. | | | | | | | |

For the 1D cross polarized antenna array at gNB side, the correlation matrices for high spatial correlation and medium correlation A are defined in Table B.2.3.2.2-2 and Table B.2.3.2.2-3 as below.

The values in Table B.2.3.2.2-2 have been adjusted to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$R_{high} = [R_{spat} + aI_n]/(1+a)$$
 or $R_{mediumA} = [R_{spat} + aI_n]/(1+a)$

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 8x2 high spatial correlation case, a=0.00010.

Table B.2.3.2.2-2: MIMO correlation matrices for high spatial correlation

| | | | | _ | | | | | | | | | | | | _ | |
|------|--------------|---------|--------------|---------|--------|---------|--------|---------|----------|---------|--------|---------|--------|---------|--------|---------|--------|
| | | | | 1.00 | 000 | 0.0000 | 0.90 | 000 | 0.0000 | -0.30 | 000 0 | .0000 | -0.27 | 700 (| 0.0000 |] | |
| | | | | 0.0 | 000 | 0000.1 | 0.00 | 000 | 0.9000 | 0.00 | 000 0 | .3000 | 0.00 | 000 | 0.2700 | | |
| | | | | 0.9 | 000 | 0.0000 | 1.00 | 000 | 0.0000 | -0.27 | 00 0 | .0000 | -0.30 | 000 (| 0.0000 | | |
| | | | | 0.0 | 000 (| 0.9000 | 0.00 | 000 | 1.0000 | 0.00 | 000 (| .2700 | 0.00 | 00 (| 0.3000 | | |
| 4x2 | | | $R_{high} =$ | | | | | | | | | | | | | | |
| case | | | | -0.3 | 000 (| 0.0000 | -0.2 | /00 (| 0.0000 | 1.000 | | .0000 | 0.90 | 00 (| 0.0000 | | |
| | | | | 0.0 | 000 | 0.3000 | 0.0 | 000 | 0.2700 | 0.00 | 00 1 | .0000 | 0.00 | 00 (| 0.9000 | | |
| | | | | -0.2 | 700 (| 0.0000 | -0.30 | 000 | 0.0000 | 0.90 | 00 0 | .0000 | 1.00 | 00 (| 0.0000 | | |
| | | | | 0.0 | 000 | 0.2700 | 0.0 | 000 | 0.3000 | 0.00 | 00 0 | .9000 | 0.00 | 000 1 | .0000 | | |
| | | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 | 0.8999 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 0.0000 | -0.2862 | 0.0000 | -0.2700 | 0.0000 |
| | | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 | 0.8999 | 0.0000 | 0.3000 | 0.0000 | 0.2965 | 0.0000 | 0.2862 | 0.0000 | 0.2700 |
| | | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 2 0.0000 | -0.2965 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 0.0000 | -0.2862 | 0.0000 |
| | | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 | 0.2965 | 0.0000 | 0.3000 | 0.0000 | 0.2965 | 0.0000 | 0.2862 |
| | | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | -0.2862 | 0.0000 | -0.2965 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 0.0000 |
| | | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.000 | 0.9883 | 0.0000 | 0.2862 | 0.0000 | 0.2965 | 0.0000 | 0.3000 | 0.0000 | 0.2965 |
| | | 0.8999 | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | -0.2700 | 0.0000 | -0.2862 | 0.0000 | -0.2965 | 0.0000 | -0.3000 | 0.0000 |
| 8x2 | D | 0.0000 | 0.8999 | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.2700 | 0.0000 | 0.2862 | 0.0000 | 0.2965 | 0.0000 | 0.3000 |
| case | $R_{high} =$ | -0.3000 | 0.0000 | -0.2965 | 0.0000 | -0.2862 | 0.0000 | -0.2700 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 | 0.8999 | 0.0000 |
| | | 0.0000 | 0.3000 | 0.0000 | 0.2965 | 0.0000 | 0.2862 | 0.000 | 0.2700 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 | 0.8999 |
| | | -0.2965 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 0.0000 | -0.2862 | 2 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 | 0.0000 |
| | | 0.0000 | 0.2965 | 0.0000 | 0.3000 | 0.0000 | 0.2965 | 0.000 | 0.2862 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 | 0.9542 |
| | | -0.2862 | 0.0000 | -0.2965 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 5 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 | 0.0000 |
| | | 0.0000 | 0.2862 | 0.0000 | 0.2965 | 0.0000 | 0.3000 | 0.000 | 0.2965 | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 | 0.9883 |
| | | -0.2700 | 0.0000 | -0.2862 | 0.0000 | -0.2965 | 0.0000 | -0.3000 | 0.0000 | 0.8999 | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 | 0.0000 |
| | | 0.0000 | 0.2700 | 0.0000 | 0.2862 | 0.0000 | 0.2965 | 0.000 | 0.3000 | 0.0000 | 0.8999 | 0.0000 | 0.9542 | 0.0000 | 0.9883 | 0.0000 | 1.0000 |

B.2.3.2.3 Beam steering approach

For the 2D cross-polarized antenna array at gNB, given the channel spatial correlation matrix in B.2.3.2.1 and B.2.3.2.2, the corresponding random channel matrix H can be calculated. The signal model for the k-th slot is denoted as

$$y = HD_{\theta_{k+1},\theta_{k+2}}Wx + n$$

And the steering matrix is further expressed as following:

$$D_{\theta_{k,1},\theta_{k,2}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \left(D_{\theta_{k,1}}(N_1) \otimes D_{\theta_{k,2}}(N_2) \right)$$

where

- H is the $Nr \times Nt$ channel matrix per subcarrier.
- $D_{\theta_{k,1},\theta_{k,2}}$ is the steering matrix,
- $D_{\theta_{k,1}}(N_1)$ is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$ is the steering matrix in second dimension with same polarization,
- N_1 is the number of antenna elements in first dimension with same polarization,
- N_2 is the number of antenna elements in second dimension with same polarization,
- For antenna array with only one direction, number of antenna element in second direction N_2 equals 1.

For 1 antenna element with the same polarization in one direction,

$$D_{\theta_{-}}(1) = 1$$
.

For 2 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(2) = \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

For 3 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(3) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & e^{j1.5\theta_{k,i}} & 0 \\ 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

For 4 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_{k,i}} & 0 & 0 \\ 0 & 0 & e^{j2\theta_{k,i}} & 0 \\ 0 & 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

where the index i=1,2 stands for first dimension and second dimension respectively.

- $\theta_{k,i}$ controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by $\theta_{k,i} = \theta_{0,i} + \Delta\theta \cdot k$, where $\theta_{0,i}$ is the random start value with the uniform distribution, i.e., $\theta_{0,i} \in [0,2\pi]$, $\Delta\theta$ is the step of phase variation, which is defined in Table B.2.3B.4-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index i=1,2 stands for first dimension and second dimension respectively.
- w is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- μ corresponds to subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15 \text{[kHz]}$

For the 1D cross-polarized antenna array at gNB, the corresponding random channel matrix H can be calculated by letting N_2 =1, i.e.,

$$D_{\theta_{k,1}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes D_{\theta_{k,1}}(N_1)$$

Table B.2.3B.4-1: The step of phase variation

| Variation Step | Value (rad/ms) |
|----------------|-------------------------|
| $\Delta 	heta$ | 1.2566×10 ⁻³ |

B.2.4 Two-tap propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t,\tau) = \delta(\tau) + a \exp(-i2\pi f_D t)\delta(\tau - \tau_d)$$

in continuous time (t,τ) representation, with \mathcal{T}_d the delay, a constant value of a and f_D the Doppler frequency. The same $h(t,\tau)$ is used to describe the fading channel between every pair of Tx and Rx.

B.3 High Speed Train Scenario

B.3.1 Single Tap Channel Profile

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos \theta(t) \tag{B.3.1.1}$$

where $f_s(t)$ is the Doppler shift and f_d is the maximum Doppler frequency. The cosine of angle $\theta(t)$ is given by

$$\cos \theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \ 0 \le t \le D_s/v$$
(B.3.1.2)

$$\cos \theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}^2 + (-1.5D_s + vt)^2}}, \ D_s/v < t \le 2D_s/v$$
(B.3.1.3)

$$\cos\theta(t) = \cos\theta(t \mod(2D_s/v)), \ t > 2D_s/v \tag{B.3.1.4}$$

where $D_s/2$ is the initial distance of the train from gNB, and D_{\min} is gNB Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1.1 and B.3.1.2-B.3.1.4 respectively, where the required input parameters listed in table B.3.1-1 and the resulting Doppler shift shown in Figure B.3.1-1 are applied for all frequency bands.

| Parameter | Value | | | | | | | | |
|------------|----------------------------|-----------------------------|--|--|--|--|--|--|--|
| Parameter | HST-750 | HST-1000 | | | | | | | |
| D_s | 300 m | 300 m | | | | | | | |
| D_{\min} | 2 m | 2 m | | | | | | | |
| ν | 300 km/h | 300 km/h | | | | | | | |
| f_d | 750 Hz for 15 kHz SCS test | 1000 Hz for 30 kHz SCS test | | | | | | | |

Table B.3.1-1: High speed train scenario

NOTE 1: Parameters for HST conditions in table B.3.1-1 including f_d and Doppler shift trajectories presented on figure B.3.1-1 for 750 Hz for 15 kHz SCS and figure B.3.1-2 for 1000 Hz for 30 kHz SCS are applied for performance verification in all frequency bands.

NOTE 2: The propagation conditions used for the performance requirements under high speed train condition are indicated as a combination of "HST" and Doppler shift f_d , i.e. HST-<Doppler shift>, where '<Doppler shift>' indicates the maximum Doppler shift (Hz).

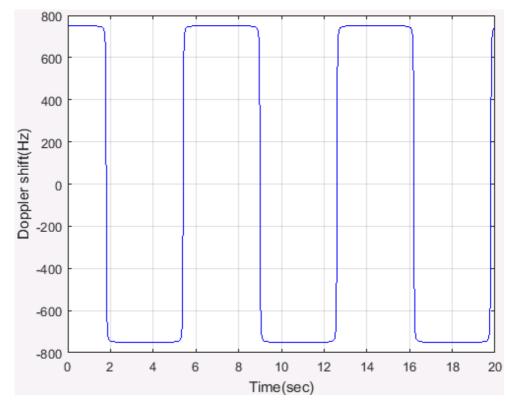


Figure B.3.1-1: Doppler shift trajectory ($f_{\scriptscriptstyle d}$ = 750 Hz)

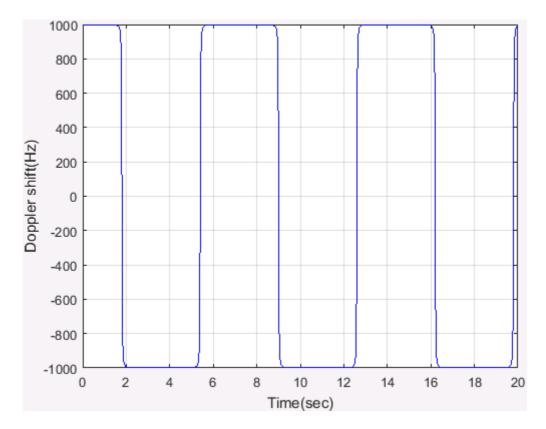


Figure B.3.1-2: Doppler shift trajectory (f_d = 1000 Hz)

For 1x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx. For 1x4 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx.

B.4 Beamforming Model

B.4.1 Generic beamforming model

The transmission on antenna port(s) $p = p_0, p_0 + 1, \ldots, p_0 + N_p - 1$ is defined by using a precoder matrix W(i) of size $N_{ANT} \times N_p$, where N_{ANT} is the number of physical transmit antenna elements configured per test, N_p is the number of ports for a reference signal or physical channel configured per test, and p_0 is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s) $p = p_0, p_0 + 1, \ldots, p_0 + N_p - 1, y^{(p)}(i) = \left[y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \ldots \ y^{(p_0+N_p-1)}(i)\right]^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$, with $M_{\text{symb}}^{\text{ap}}$ being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals $y_{bf}^{(q)}(i) = \left[y_{bf}^{(0)}(i) \ y_{bf}^{(1)}(i) \ \ldots \ y_{bf}^{(N_{ANT}-1)}(i)\right]^T$ the elements of which are to be mapped onto the frequency-time index pair (k,l) as per the test configuration but transmitted on different physical antenna elements:

$$y_{bf}^{(q)}(i) = W(i)y^{(p)}(i)$$

The precoder matrix W(i) is specific to the test case configuration.

The transimison on PT-RS antenna port is associated (using same precoder) with the lowest indexed DM-RS antenna port among the DM-RS antenna ports assigned for the PDSCH.

The physical antenna elements are identified by indices $j = 0,1,...,N_{ANT}-1$, where N_{ANT} is the number of physical antenna elements configured per test.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for tracking with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for beam refinement with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}^{(p)}$ for NZP CSI-RS which configured for CSI acquisition with $p \in \{p_0, p_0 + 1, ..., p_0 + N_{CSI} - 1\}$ are mapped to the physical antenna index $j = p - p_0$ where N_{CSI} is the number of NZP CSI-RS ports configured per test.

Annex C (normative): Downlink physical channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Setup (Conducted)

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

| Physical Channel |
|------------------|
| PBCH |
| SSS |
| PSS |
| PDCCH |
| PDSCH |
| PBCH DMRS |
| PDCCH DMRS |
| PDSCH DMRS |
| CSI-RS |

C.3 Connection (Conducted)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Performance requirements

< Editor's note: OCNG for DMRS is FFS in Annex A.>

Table C.3.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

| Parameter | Unit | Value |
|---|---------|---|
| SSS transmit power | W | Test specific |
| EPRE ratio of PSS to SSS | dB | 0 |
| EPRE ratio of PBCH to SSS | dB | 0 |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 |
| EPRE ratio of PDCCH to SSS | dB | 0 |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 |
| EPRE ratio of PDSCH to SSS | dB | 0 |
| EPRE ratio of PDSCH to PDSCH DMRS | dB | Test specific (Note 1) |
| EPRE ratio of CSI-RS to SSS | dB | 0 |
| EPRE ratio of OCNG to SSS | dB | 0 |
| Note 1. Value is derived from Table 4.1 | 1 in TO | 2.29.214 [12] based on "Number of DM DS CDM |

Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test

C.4 Setup (Radiated)

Table C.4-1 describes the downlink Physical Channels that are required for connection set up.

Table C.4-1: Downlink Physical Channels required for connection set-up

| Physical Channel |
|------------------|
| PBCH |
| SSS |
| PSS |
| PDCCH |
| PDSCH |
| PBCH DMRS |
| PDCCH DMRS |
| PDSCH DMRS |
| CSI-RS |
| PTRS |

C.5 Connection (Radiated)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.5.1 Measurement of Receiver Characteristics

< Editor's note: OCNG for DMRS is FFS in Annex A.>

Table C.5.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.5.1-1: Downlink Physical Channels transmitted during a connection (TDD)

| Parameter | Unit | Value | | | | | |
|---|------|------------------------|--|--|--|--|--|
| SSS transmit power | W | Test specific | | | | | |
| EPRE ratio of PSS to SSS | dB | 0 | | | | | |
| EPRE ratio of PBCH to SSS | dB | 0 | | | | | |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 | | | | | |
| EPRE ratio of PDCCH to SSS | dB | 0 | | | | | |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 | | | | | |
| EPRE ratio of PDSCH to SSS | dB | 0 | | | | | |
| EPRE ratio of PDSCH to PDSCH DMRS | dB | Test specific (Note 1) | | | | | |
| EPRE ratio of CSI-RS to SSS | dB | 0 | | | | | |
| EPRE ratio of PTRS to PDSCH | dB | Test specific | | | | | |
| EPRE ratio of OCNG to SSS | dB | 0 | | | | | |
| Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test | | | | | | | |

Annex D (informative): Void

Annex E (normative): Environmental conditions

E.1 General

This annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental (Conducted)

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the temperature range defined in Table E.2.1-1.

Table E.2.1-1: Temperature conditions

| +15°C to +35°C | For normal conditions (with relative humidity of 25 % to 75 %) |
|----------------|--|
|----------------|--|

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-1 [6] for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the voltage range defined in Table E.2.2-1.

Table E.2.2-1: Voltage conditions

| Power source | Normal conditions voltage |
|-----------------------------|---------------------------|
| AC mains | nominal |
| Regulated lead acid battery | 1,1 * nominal |
| Non regulated batteries: | |
| Leclanché | Nominal |
| Lithium | 1,1 * Nominal |
| Mercury/nickel & cadmium | Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6, Section 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1: Vibration conditions

| Frequency | ASD (Acceleration Spectral Density) random vibration |
|-----------------|---|
| 5 Hz to 20 Hz | $0.96 \text{ m}^2/\text{s}^3$ |
| 20 Hz to 500 Hz | 0,96 m ² /s ³ at 20 Hz, thereafter –3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6] for extreme operation.

E.3 Environmental (Radiated)

The requirements in this clause apply to all types of UE(s).

E.3.1 Temperature

All requirements for UEs operating in FR2 are defined over the air and can only be tested in an OTA chamber.

The UE shall fulfil all the requirements in the temperature range defined in Table E.3.1-1.

Table E.3.1-1: Temperature conditions

| + 25 °C ± 10 °C | For normal (room temperature) conditions with relative |
|-----------------|--|
| | humidity of 25% to 75% |

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation.

E.3.2 Voltage

< Editor's note: This requirement is incomplete. The following aspects are either missing or not yet determined:

Methodology to control the voltage in a case which a power cable is not connected to DUT is FFS since it is not agreed whether we can connect the power cable to DUT at the OTA measurement situation yet.

>

The UE shall fulfil all the requirements in the voltage range defined in Table E.3.2-1.

Table E.3.2-1: Voltage conditions

| Power source | Normal conditions voltage |
|-----------------------------|---------------------------|
| AC mains | nominal |
| Regulated lead acid battery | 1,1 * nominal |
| Non regulated batteries: | |
| Leclanché | Nominal |
| Lithium | 1,1 * Nominal |
| Mercury/nickel & cadmium | Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.3.3 Void

| Annex G (informative): Void | |
|-----------------------------|--|
| Annex H (informative): Void | |
| Annex I (informative): Void | |
| Annex J (informative): Void | |
| Annex K (informative): Void | |

Annex L (informative): Change history

| Data | Mooting | 4Daa | CD | Day | Cat | Change history | Mour |
|---------|--------------------|----------------|----|-----|-----|--|-------------|
| Date | Meeting | tDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2018-07 | RAN4 | R4- | | | | Draft skeleton | 0.0.1 |
| 2018-08 | AH18-07 RAN4#88 | 1809554 R4- | | | | Skeleton update | 0.0.2 |
| 2010-00 | KAN4#00 | 1811357 | | | | Skeleton update | 0.0.2 |
| 2018-10 | RAN4#88 | R4- | | | | Approved Text Proposal in RAN4#88bis: | 0.1.0 |
| | bis | 1814237 | | | | R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part" | |
| | | | | | | R4-1814054, "TP to TS 38.101-4: FR1 PDSCH demodulation | |
| | | | | | | requirements (5.2)" | |
| | | | | | | R4-1813924, "TP for introducing FR1 PDCCH requirements in TS 38.101-4 section 5.3" | |
| | | | | | | R4-1814058, "TP for 38.101-4 section 6.3 FR1 PMI test cases" | |
| | | | | | | R4-1814060, "Draft TP on FR1 Rank Indication Reporting | |
| | | | | | | Performance Requirements" R4-1814055, "Draft TP on FR2 PDSCH Demodulation Performance | |
| | | | | | | Requirements" | |
| | | | | | | R4-1814022, "TP to TS38.101-4 Section 7.3: PDCCH demodulation | |
| | | | | | | requirements" R4-1814059, "TP for 38.101-4 section 8.3 FR2 PMI test cases" | |
| | | | | | | R4-1814061, "Draft TP on FR2 Rank Indication Reporting | |
| | | | | | | Performance Requirements" | |
| | | | | | | R4-1813925, "TP for introducing demodulation performance requirements for interworking TS 38.101-4 section 9" | |
| | | | | | | R4-1814052, "TP for 38.101-4 section 10 CSI test cases of | |
| | | | | | | interworking" | |
| | | | | | | R4-1814066, "TP on channel models for TS38.101-4" R4-1814023, "TP to TS38.101-4 Annex C: Downlink physical | |
| | | | | | | channels" | |
| | | | | | | R4-1814024, "TP to TS38.101-4 Annex E: Environmental | |
| 2018-11 | RAN4#89 | R4- | | | | conditions" Approved Text Proposal in RAN4#89: | 0.2.0 |
| 2010 11 | 10.00 | 1816559 | | | | R4-1814053, "TP on performance specification 38.101-4 Chapter 4 | 0.2.0 |
| | | | | | | general part" | |
| | | | | | | R4-1814487, "TP for TS38.101-4 section 2 (Reference)" R4-1814488, "TP for TS38.101-4 section 3 (Definitions, symbols and | |
| | | | | | | abbreviations)" | |
| | | | | | | R4-1814579, "TP to TS 38.101-4: Annex A Measurement channels – | |
| | | | | | | PDSCH" R4-1814580, "TP to TS 38.101-4: Annex A Measurement channels - | |
| | | | | | | DL Control" | |
| | | | | | | R4-1814581, "TP to TS 38.101-4: Annex A Measurement channels – CSI" | |
| | | | | | | R4-1816395, "FR2 demod: Noc, Band groups and Ref point - TP for | |
| | | | | | | TS 38.101-4" | |
| | | | | | | R4-1816692, "TP to TS 38.101-4: Requirements applicability" R4-1816693, "TP for performance requirements for interworking (9)" | |
| | | | | | | R4-1816694, "TP to TS 38.101-4: FR1 PDSCH demodulation | |
| | | | | | | requirements (5.2)" | |
| | | | | | | R4-1816695, "Draft TP on FR2 PDSCH Demodulation Performance Requirements" | |
| | | | | | | R4-1816697, "TP for updating FR1 PDCCH requirements in TS | |
| | | | | | | 38.101-4 section 5.3" | |
| | | | | | | R4-1816699, "TP to TS 38.101-4: 5.4 FR1 PBCH demodulation requirements" | |
| | | | | | | R4-1816700, "TP to TS 38.101-4: 7.4 FR2 PBCH demodulation | |
| | | | | 1 | | requirements" R4-1816701, "TP of introduction of FR1 CQI requirement (6.2)" | |
| | | | | 1 | | R4-1816701, 1P of introduction of FR1 CQ1 requirement (6.2) R4-1816702, "TP to TS 38.101-4: FR2 CQ1 requirements (8.2)" | |
| | | | | 1 | | R4-1816703, "Draft TP on FR1 Rank Indication Reporting" | |
| | | | | 1 | | Performance Requirements" R4-1816704, "Draft TP on FR2 Rank Indication Reporting | |
| | | | | | | Performance Requirements" | |
| | | | | 1 | | R4-1816705, "TP for TS 38.101-4 FR1 PMI test requirement" | |
| | | | | | | R4-1816706, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816712, "TP to TS 38.101-4: FR1 SDR requirements (5.5) " | |
| | | | | 1 | | R4-1816713, "TP to TS38.101-4. FK1 3DK requirements (3.3) | |
| | | | | 1 | | requirements" | |
| | | | | 1 | | R4-1816714, "TP for propagation conditions in TS 38.104-4(Annex B)" | |
| 2018-12 | RAN#82 | RP-182408 | | | | V1.0.0 is submitted to RAN for 1-step approval | 1.0.0 |
| 2018-12 | RAN#82 | RP-182704 | | | | V1.0.1 with editorial changes | 1.0.1 |
| 2018-12 | RAN#82 | | | | | Approved by plenary – Rel-15 spec under change control | 15.0.0 |

| 2019-03 | RAN#83 | RP-190403 | 0001 | В | CR on UE demodulation and CSI requirements for 38.101-4 | 15.1.0 |
|---------|--------|-----------|------|---|--|--------|
| | | | | | This CR comboines all the endorsed draft CRs as list below: General sections | |
| | | | | | R4-1902427, Draft CR on NR UE demodulation requirements | |
| | | | | | applicability (Intel Corporation) | |
| | | | | | R4-1902576, Draft CR on General Applicability of Requirements (Qualcomm Incorporated) | |
| | | | | | R4-1902412, Editorial cleanup of FR2 Radiated Requirements | |
| | | | | | General section (ANRITSU) | |
| | | | | | PDSCH | |
| | | | | | R4-1902414, Draft CR on FR1 normal PDSCH demodulation requirements (Intel Corporation) | |
| | | | | | R4-1902415, Draft CR on FR2 PDSCH Requirements (Qualcomm | |
| | | | | | Incorporated) | |
| | | | | | R4-1902411, Draft CR on FR1 SDR requirements (Intel Corporation) | |
| | | | | | PDCCH | |
| | | | | | R4-1902416 Draft CR for updating FR1 PDCCH performance requirements in TS38.101-4Huawei, HiSilicon | |
| | | | | | R4-1902423 Draft CR for updating FR2 PDCCH performance | |
| | | | | | requirements in TS38.101-4 section 7.3 CATT | |
| | | | | | PBCH P4 1003430 Proff CB on 3By PBCH demodulation requirement for | |
| | | | | | R4-1902420, Draft CR on 2Rx PBCH demodulation requirement for FR1 (CMCC) | |
| | | | | | R4-1902421, Draft CR on 4Rx PBCH demodulation requirements for | |
| | | | | | FR1 (CMCC) | |
| | | | | | R4-1902422, Draft CR on 2Rx PBCH demodulation requirement for | |
| | | | | | FR2 (CMCC) CSI | |
| | | | | | R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm | |
| | | | | | Incorporated) | |
| | | | | | R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm | |
| | | | | | Incorporated) R4-1900105, Draft CR on NR CSI reporting (Intel Corporation) | |
| | | | | | R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei, | |
| | | | | | HiSilicon) | |
| | | | | | R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel) | |
| | | | | | R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2, A.3.2.2.5 (Samsung) | |
| | | | | | R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm) | |
| | | | | | Annex | |
| | | | | | R4-1900369, Draft CR on PDSCH FRC (Intel Corporation) | |
| | | | | | R4-1900370, Draft CR on PDCCH FRC (Intel Corporation) R4-1902424, Corrections to 38.101-4 subclause B.2.1 Delay profile | |
| | | | | | calculation (Huawei, HiSilicon) | |
| | | | | | R4-1902575, Draft CR on Beamforming Model (Qualcomm) | |
| | | | | | Additional modifications: | |
| | | | | | - Compared to endorsed CR R4-1902414, requirements for several | |
| | | | | | FR1 PDSCH test cases were modified to correct stat error | |
| | | | | | - Correct table number under PDSCH section 5.3.3.1.3 | |
| | | | | | - Correct table number under PDSCH section 5.2.3.1.3 - Some minor editorial changes | |
| | | | | | E III | |
| | | | | | Editorial changes after RAN#83 | |
| | | | | | To align the annex numbering with other specifications (TS 38.101-x series), annexes J and K were added and Change history was | |
| | | | | | numbered as annex L. | |

| endorsed draft CRs from RAN4#90bis R4-1902885, Draft CR on DL power allocation for TS 38.101 R4-1903387, Draft CR for adding applicable rules on CSI tes | |
|--|----------|
| R4-1902885, Draft CR on DL power allocation for TS 38.101 | |
| | |
| | |
| 6, 8, 10 | i cases. |
| R4-1903471, Draft CR on PBCH requirements | |
| R4-1904750, draftCR on RMC for demod requirement for 38. | .101-4 |
| R4-1904751, Clarification on step 5 and step 6 for delay profi | iles |
| calculation in B.2.1 | |
| R4-1904756, Draft CR on FR1 normal PDSCH demodulation | 1 |
| requirements R4-1904757, Draft CR on FR2 PDSCH Demodulation Perform | mance |
| Tests | |
| R4-1904758, Draft CR on EN-DC SDR requirements | |
| R4-1904759, Addition of alternative TDD configuration for UE | Ē |
| demodulation requirements | um anta |
| R4-1904765, Draft CR on FR2 PDCCH demodulation require R4-1904766, draftCR: Updates to FR1 PDCCH demodulation | |
| requirements | ' |
| R4-1904767, Draft CR for Beamforming model: Annex B.4.1 | |
| R4-1904768, Draft CR for modification on CSI test cases: 6, | 8, 10 |
| R4-1904776, Draft CR on FR1 SDR requirements | |
| R4-1904777, Draft CR on FR2 SDR Requirements | |
| R4-1904778, Draft CR on PDSCH DL RMC | |
| R4-1904779, Draft CR to TS38.101-4: Correction to FR1 CSI cases | test |
| R4-1904780, Draft CR to TS38.101-4: Correction to FR2 CSI cases | l test |
| R4-1904796, Draft CR to 38.101-4 on applicable SNR level for | or FR2 |
| R4-1904833, Draft CR to TS 38.101-4 on SNR, Es and Noc s | |
| endorsed draft CRs from RAN4#91 | |
| R4-1906069, Draft CR on PBCH requirements | |
| R4-1906706, Editorial corrections for 38.101-4 PBCH tables | |
| R4-1907194, Draft CR on Noc and Es setup | |
| R4-1907293, Draft CR to TS38.101-4 for FR2 SDR test case | |
| R4-1907294, draftCR: Introduce single-tap HST channel mod | del in |
| TS 38.101-4 | |
| R4-1907295, draftCR: updates to FR2 PDSCH test paramete | ers |
| R4-1907296, draftCR: updates to FRC for demodulation performance | |
| R4-1907297, draftCR: updates to FR1 CQI reporting test cas | es in |
| section 6.2 | 100 111 |
| R4-1907298, Draft CR to 38.101-4 on Applicability of require | ments |
| R4-1907299, Draft CR to 38.101-4 on Demodulation requirer | |
| for interworking | |
| R4-1907300, Draft CR to 38.101-4 on CSI requirements for | |
| interworking | |
| R4-1907301, Draft CR on FR1 normal PDSCH demodulation | |
| requirements R4-1907302, Draft CR on PDSCH FRC | |
| R4-1907302, Draft CR on FR2 CSI Reporting tests | |
| R4-1907304, Editorial corrections for 38.101-4 PDCCH table | s |
| R4-1907307, draftCR: updates to FR1 PDSCH test paramete | |
| R4-1907308, Draft CR on EN-DC SDR requirements | |
| R4-1907309, Draft CR to TS38.101-4 on adding FRC for sub | -band |
| CQI test cases | |
| R4-1907310, Draft CR to TS38.101-4: Environmental condition (Annex E) | ons |
| R4-1907315, Draft CR on SDR requirements for NR CA betw | veen |
| FR1 and FR2 | |

| 2019-09 | RAN#85 | RP-192022 | 8000 | F CR to TS 38.101-4: Implementation of endorsed draft CRs from RAN4#92 (Rel-15) | 15.3.0 |
|---------|--------|-----------|------|--|--------|
| | | | | R4-1907978, Update of Noc values for Power class 2 demodulation test | |
| | | | | R4-1908202, Draft CR to TS 38.101-4: Environmental conditions | |
| | | | | R4-1908215, Draft CR to TS 38.101-4: Clarification of PTRS configuration for FR2 tests | |
| | | | | R4-1908217, Draft CR to TS 38.101-4: DL power configuration in | |
| | | | | radiated tests | |
| | | | | R4-1908517, Draft CR to TS 38.101-4: Corrections of FRC for FR2 | |
| | | | | PMI tests | |
| | | | | R4-1909250, Editorial change to correct TDD measurement channels | |
| | | | | R4-1909252, Editorial correction to PBCH requirements | |
| | | | | R4-1909253, Editorial correction to PDSCH reference channels | |
| | | | | R4-1909862, draft CR: updates to FR2 PDSCH test parameters | |
| | | | | R4-1909864, draftCR: Introduce single-tap HST channel model in | |
| | | | | TS 38.101-4 | |
| | | | | R4-1910020, Antenna configuration for LTE cell in EN-DC | |
| | | | | R4-1910021, DraftCR to 38.101-4: Corrections to Interworking | |
| | | | | requirements R4-1910023, Draft CR to TS 38.101-4: Enhanced SU-MIMO receiver | |
| | | | | definition | |
| | | | | R4-1910024, draftCR: addition of test applicability for features with | |
| | | | | UE capability | |
| | | | | R4-1910053, Draft CR on corrections and missing parameters for | |
| | | | | PDSCH demodulation performance tests | |
| | | | | R4-1910054, Draft CR to TS 38.101-4: NR FR1 PDSCH | |
| | | | | requirements finalization | |
| | | | | R4-1910055, Draft CR to TS 38.101-4: Corrections for SDR requirements | |
| | | | | R4-1910056, Editorial correction to formatting on SDR table | |
| | | | | R4-1910057, draft CR: updates to FR1 PDSCH test parameters | |
| | | | | R4-1910058, Draft CR on corrections for PDCCH demodulation | |
| | | | | performance tests | |
| | | | | R4-1910060, Draft CR on corrections for CSI Reporting performance | |
| | | | | tests | |
| | | | | R4-1910061, Draft CR on updates to FR1 CSI reporting test | |
| | | | | R4-1910062, Draft CR on updates to FR2 CSI reporting test | |
| | | | | R4-1910129, Draft CR to TS 38.101-4: Applicability of minimum requirements | |
| | | | | R4-1910563, Updates to NR PDCCH test parameters | |

History

| Document history | | | | | | | |
|------------------|--------------|-------------|--|--|--|--|--|
| V15.0.0 | April 2019 | Publication | | | | | |
| V15.1.0 | May 2019 | Publication | | | | | |
| V15.2.0 | July 2019 | Publication | | | | | |
| V15.3.0 | October 2019 | Publication | | | | | |
| | | | | | | | |