|  |  |
| --- | --- |
| 3GPP TS 36.216 V17.0.0 (2022-03) | |
| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Evolved Universal Terrestrial Radio Access (E-UTRA);  Physical layer for relaying operation  (Release 17) | |
|  | |
|  |  |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2022, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 4

1 Scope 6

2 References 6

3 Definitions, symbols and abbreviations 6

3.1 Definitions 6

3.2 Symbols 6

3.3 Abbreviations 7

4 General 7

5 Physical channels and modulation 8

5.1 General 8

5.2 Resource partitioning and multiplexing for relays 8

5.3 Relay frame timing 9

5.4 Downlink slot structure and physical resource elements 9

5.5 Physical downlink shared channel 10

5.6 Relay physical downlink control channel 10

5.6.1 General 10

5.6.2 R-PDCCH formats without cross-interleaving 11

5.6.3 R-PDCCH formats with cross-interleaving 11

5.7 Reference signals 12

5.7.1 Downlink reference signals 12

6 Multiplexing and channel coding 12

7 Relay node procedures 12

7.1 General 12

7.2 Relay node procedures for receiving the physical downlink shared channel 12

7.3 Relay node procedures for transmitting the physical uplink shared channel 13

7.4 Relay node procedure for receiving the relay physical downlink control channel 14

7.4.1 Monitoring and demodulation 14

7.4.2 Relay node procedure for determining relay physical downlink control channel assignment without cross-interleaving 15

7.4.3 Relay node procedure for determining relay physical downlink control channel assignment with cross-interleaving 15

7.5 Relay node procedures for transmitting the physical uplink control channel 15

7.5.1 Relay node procedure for determining physical uplink control channel assignment 15

7.5.2 Relay node HARQ-ACK feedback procedure for frame structure type 2 16

Annex A (informative): Change history 17

# 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.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document describes the characteristics of eNB - relay node transmissions.

# 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 36.201: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description".

[3] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".

[4] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[5] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[6] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

## 3.2 Symbols

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

 Subcarrier spacing as defined in [3]

 R-PDCCH aggregation element index

 Slot index

 PDSCH-to-ACK/NACK timing association set

 Subcarrier index

 **th element of 

 End OFDM symbol index for R-PDCCH

 OFDM symbol index

 OFDM symbol index

 Aggregation level of R-PDCCH

 R-PDCCH candidate index

 Number of elements in the set  for subframe 

 Number of CCEs configured for detecting R-PDCCH in slot *j*

 Number of VRBs configured for detecting R-PDCCH

 Subframe index

 System frame number as defined in [3]

 Physical resource block number as defined in [3]

 Resource index for PUCCH formats 1/1a/1b for subframe index *i* as defined in [3]

 Resource index for PUCCH formats 1/1a/1b using antenna port *p* as defined in [3]

 Resource index for PUCCH format 3 using antenna port *p* as defined in [3]

 Slot number within a radio frame as defined in [3]

 Scrambling identity as defined in [3]

 Virtual resource block number as defined in [3]

 Search space for aggregation level ** in slot *j* of subframe *n*

 Equivalent to  in [5]

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

CCE Control Channel Element

CRC Cyclic Redundancy Check

CSI-RS Channel-State Information Reference Signals

DCI Downlink Control Information

eNB Evolved Node B

FDD Frequency Division Duplex

HARQ Hybrid Automatic Repeat Request

LTE Long Term Evolution

OFDM Orthogonal Frequency Division Multiplexing

PDSCH Physical Downlink Shared Channel

PDCCH Physical Downlink Control Channel

PHICH Physical Hybrid ARQ Indicator Channel

PRB Physical Resource Block

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

RB Resource Block

RE Resource Element

REG Resource Element Group

RN Relay Node

R-PDCCH Relay Physical Downlink Control Channel

TDD Time Division Duplex

UE User Equipment

VRB Virtual Resource Block

# 4 General

From a UE perspective a relay node is part of the radio access network and behaves like an eNB. A relay node is wirelessly connected to a donor eNB.

A relay node includes at least two physical layer entities. One entity is used for communication with UEs as described in [3][4][5][6]. Another physical layer entity is used for communication with the donor eNB and it corresponds to UE functionality as described in [3][4][5][6]. If a relay node is configured to use relay-specific advancements, the physical layer entity for communication with the donor eNB corresponds to UE functionality as described in [3][4][5][6] extended by relay-specific advancements as described in the following.

# 5 Physical channels and modulation

## 5.1 General

Processing and mapping of physical channels shall be processed according to [3] with the exceptions described within Clause 5.

## 5.2 Resource partitioning and multiplexing for relays

Time-frequency resources shall be set aside for eNB-RN transmissions by time multiplexing eNB-RN and RN-UE transmissions. Subframes during which eNB-RN transmission may take place are configured by higher layers. Downlink subframes configured for eNB-to-RN transmission shall be configured as MBSFN subframes by the relay node. eNB-to-RN transmissions occur in downlink subframes and RN-to-eNB transmissions occur in uplink subframes. For frame structure type 1, eNB-to-RN and RN-to-UE transmissions occur in the downlink frequency band, while RN-to-eNB and UE-to-RN transmissions occur in the uplink frequency band.

For frame structure type 1, a subframe configured for eNB-to-RN transmission is a subframe satisfying  where *n*f and *n*s refer to donor eNB cell timing, with the exception that a downlink subframe that cannot be configured as MBSFN subframe in the relay node cell shall not be configured for eNB-to-RN transmission. The set  is determined as the union of the applicable offset values listed in Table 5.2-1 with respect to the parameter *SubframeConfigurationFDD*, which is configured by higher layers, and where "x" means that the corresponding bit in the bitmap can be either 0 or 1. A subframe  is configured for RN-to-eNB transmission if subframe  is configured for eNB-to-RN transmission.

Table 5.2-1: Downlink subframe configuration for eNB-to-RN transmission (frame structure type 1)

|  |  |
| --- | --- |
| *SubframeConfigurationFDD* | Offset value element of |
| {xxxxxxx1} | 7 |
| {xxxxxx1x} | 6 |
| {xxxxx1xx} | 5 |
| {xxxx1xxx} | 4 |
| {xxx1xxxx} | 3 |
| {xx1xxxxx} | 2 |
| {x1xxxxxx} | 1 |
| {1xxxxxxx} | 0 |

For frame structure type 2 the subframes that can be configured for eNB-RN transmission are listed in Table 5.2-2 where, for each subframe in a radio frame, "D" denotes the subframe is configured for downlink eNB-to-RN transmissions, "U" denotes the subframe is configured for uplink RN-to-eNB transmissions. The parameter *SubframeConfigurationTDD* is configured by higher layers. Table 5.2-2 indicates the supported uplink-downlink configurations [3] for the eNB-RN link as a function of *SubframeConfigurationTDD*.

Table 5.2-2: Supported configurations for eNB-RN transmission (frame structure type 2)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *SubframeConfigurationTDD* | eNB-RN uplink-downlink configuration | Subframe number *n* | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 1 |  |  |  |  | D |  |  |  | U |  |
| 1 |  |  |  | U |  |  |  |  |  | D |
| 2 |  |  |  |  | D |  |  |  | U | D |
| 3 |  |  |  | U | D |  |  |  |  | D |
| 4 |  |  |  | U | D |  |  |  | U | D |
| 5 | 2 |  |  | U |  |  |  |  |  | D |  |
| 6 |  |  |  | D |  |  |  | U |  |  |
| 7 |  |  | U |  | D |  |  |  | D |  |
| 8 |  |  |  | D |  |  |  | U |  | D |
| 9 |  |  | U | D | D |  |  |  | D |  |
| 10 |  |  |  | D |  |  |  | U | D | D |
| 11 | 3 |  |  |  | U |  |  |  | D |  | D |
| 12 |  |  |  | U |  |  |  | D | D | D |
| 13 | 4 |  |  |  | U |  |  |  |  |  | D |
| 14 |  |  |  | U |  |  |  | D |  | D |
| 15 |  |  |  | U |  |  |  |  | D | D |
| 16 |  |  |  | U |  |  |  | D | D | D |
| 17 |  |  |  | U | D |  |  | D | D | D |
| 18 | 6 |  |  |  |  | U |  |  |  |  | D |

## 5.3 Relay frame timing

The frame timing for downlink transmission from the relay shall be such that the relay node can receive at least the OFDM symbols from the donor eNB according to Clause 5.4.

## 5.4 Downlink slot structure and physical resource elements

The downlink slot structure and the physical resource elements are described in Clause 6.2 of [3].

eNB-to-RN transmissions shall be restricted to a subset of the OFDM symbols in a slot. The starting and ending OFDM symbols respectively in the first slot of a subframe is given in Table 5.4-1 and in the second slot of a subframe in Table 5.4-2. The parameter *DL-StartSymbol* in Table 5.4-1 is configured by higher layers. If downlink subframes are transmitted with time aligned subframe boundaries by the donor eNB and the relay node, configuration 1 of Table 5.4-2 is used; otherwise configuration 0 is used. The simultaneous operation of configuration 0 in Table 5.4-1 and configuration 0 in Table 5.4-2 is not supported.

Table 5.4-1: OFDM symbols for eNB-to-RN transmission in the first slot (normal cyclic prefix, )

|  |  |  |
| --- | --- | --- |
| Configuration | *DL-StartSymbol* | End symbol index |
| 0 | 1 | 6 |
| 1 | 2 | 6 |
| 2 | 3 | 6 |

Table 5.4-2: OFDM symbols for eNB-to-RN transmission in the second slot (normal cyclic prefix, )

|  |  |  |
| --- | --- | --- |
| Configuration | Start symbol index | End symbol index |
| 0 | 0 | 6 |
| 1 | 0 | 5 |

## 5.5 Physical downlink shared channel

The physical downlink shared channel for eNB-to-RN transmissions shall be processed and mapped to resource elements as described in Clause 6.4 of [3] with the following exceptions:

- the PDSCH shall only be mapped to resource elements in OFDM symbols configured according to Table 5.4-1 and Table 5.4-2

- the PDSCH shall not be mapped to any resource element in the first slot of an RB pair on any antenna port when the first slot of the RB pair is used for R-PDCCH transmission on any antenna port

## 5.6 Relay physical downlink control channel

### 5.6.1 General

The relay physical downlink control channel (R-PDCCH) carries DCI for relay nodes.

An R-PDCCH is transmitted according to configuration 2 of Table 5.4-1 or configuration 0 or 1 of Table 5.4-2. In the frequency domain, a set of  VRBs is configured for potential R-PDCCH transmission by higher layers using resource allocation types 0, 1, or 2 according to Clause 7.1.6 of [5]. For resource allocation type 2 the VRB to PRB mapping is configured by higher layers. Configured VRBs are continuously numbered  such that the VRB numbered with  refers to the configured VRB with the smallest virtual resource block number  of [3] and such that the VRB numbered with  refers to the configured VRB with the largest .

An R-PDCCH can be transmitted on one or several PRBs without being cross-interleaved with other R-PDCCHs in a given PRB, see Clause 5.6.2 Alternatively, multiple R-PDCCHs can be cross-interleaved in one or several PRBs, see Clause 5.6.3.

### 5.6.2 R-PDCCH formats without cross-interleaving

Without cross-interleaving, an R-PDCCH shall be scrambled, modulated, mapped to layers and precoded according to Clause 6.8 of [3] except that

-  is equal to one.

-  is the number of bits to be transmitted on the R-PDCCH.

Without cross-interleaving, an R-PDCCH is transmitted on an aggregation of one or several PRBs.

If the set of  VRBs is configured by resource allocation type 2 with distributed VRB to PRB mapping, the provisions in Clause 6.2.3.2 of [3] for even slot numbers are always applied.

The mapping to resource elements shall follow the provisions in clause 6.3.5 in [3], with the exception that the index  first increases over the aggregated physical resource blocks, and then the index , starting with the start symbol index given in Table 5.4-1 and 5.4-2 respectively, increases.

The following resource elements shall be considered as reserved with respect to mapping the R-PDCCH:

- resource elements that are used for reference signals

### 5.6.3 R-PDCCH formats with cross-interleaving

With cross-interleaving, for each slot the R-PDCCHs shall be multiplexed, scrambled, modulated, mapped to layers, precoded and mapped to resource elements according to Clause 6.8 of [3] except that

- an REG is composed out of 4 consecutively available REs in one OFDM symbol in a PRB configured for potential R-PDCCH transmission counted in ascending order of subcarriers, where an RE is assumed to be unavailable with respect to mapping the R-PDCCH in the following cases:

- if it is used for the transmission of cell-specific reference signals

- if the cell-specific reference signals are configured to be transmitted only on antenna port 0, it shall be assumed that REs for transmission of cell-specific reference signals on antenna port 1 are unavailable for an REG

- if zero power or non-zero power CSI-RS occurs in any resource element of an eight-port CSI-RS configuration of Table 6.10.5.2-1 of [3], it shall be assumed that all eight resource elements corresponding to the eight-port CSI-RS configuration are unavailable for an REG

- UE-specific reference signals are not mapped onto PRB pairs used for the transmission of R-PDCCH with cross-interleaving

- for the purpose of REG-to-RE mapping

- the downlink system bandwidth shall be determined as 

- the time-domain index  shall be initialized with the start symbol index given in Table 5.4-1 and Table 5.4-2 respectively and  shall be increased if , where  corresponds to the end symbol index given in Table 5.4-1 and Table 5.4-2 respectively.

- is the number of resource-element groups in the RBs configured for potential R-PDCCH transmission in the respective slot.

- is the number of transmitted R-PDCCHs in the respective slot.

## 5.7 Reference signals

### 5.7.1 Downlink reference signals

eNB-to-RN transmissions use the same reference signals as defined in [3] with the exceptions defined below.

The reference signal sequence of antenna port 7, 8, 9 and 10 shall only be mapped to resource elements in the first slot of a PRB pair used for eNB-to-RN transmission when configuration 1 in Table 5.4-2 is used.

Antenna ports 11 to 14 shall not be used for eNB-to-RN transmission.

# 6 Multiplexing and channel coding

Multiplexing and channel coding is done according to [4] with the addition that DCI shall be mapped to the R-PDCCH. The provisions in [4] for the PDCCH apply to the R-PDCCH.

# 7 Relay node procedures

## 7.1 General

The relay node acts according to the UE procedures as described in [5] with the exceptions defined in Clause 7, where DCI shall be transmitted by means of R-PDCCH. The relay node shall not expect DCI format 3/3A.

## 7.2 Relay node procedures for receiving the physical downlink shared channel

A relay node shall upon detection of an R-PDCCH intended for the relay node in a subframe, decode the corresponding PDSCH in the same subframe with the following assumptions.

- If the relay node receives a resource allocation which overlaps a PRB pair in which a downlink assignment is detected in the first slot, the relay node shall assume that there is PDSCH transmission for it in the second slot of that PRB pair.

- For a PRB pair where the relay node detects at least part of a downlink assignment in the first slot, the relay node shall assume that the first slot of the PRB pair is not used for PDSCH transmission.

If a relay node is configured by higher layers to decode R-PDCCH with CRC scrambled by the C-RNTI, and if it is configured in transmission mode 8 or transmission mode 9, the relay node shall decode the R-PDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.2-1.

Table 7.2-1: R-PDCCH and PDSCH configured by C-RNTI in transmission modes 8 or 9

|  |  |  |
| --- | --- | --- |
| Transmission mode | DCI format | Transmission scheme of PDSCH corresponding to R-PDCCH |
| Mode 8 | DCI format 1A | If the R-PDCCH is demodulated based on UE-specific reference signals:  Single antenna port; port 7 and  is used.  If the R-PDCCH is demodulated based on cell-specific reference signals:  If the number of PBCH antenna ports is one:  Single-antenna port, port 0 is used  Otherwise Transmit diversity is used |
| DCI format 2B | Dual layer transmission, port 7 and 8; or single-antenna port, port 7 or 8 |
| Mode 9 | DCI format 1A | If the R-PDCCH is demodulated based on UE-specific reference signals:  Single antenna port; port 7 and  is used.  If the R-PDCCH is demodulated based on cell-specific reference signals:  If the number of PBCH antenna ports is one:  Single-antenna port, port 0 is used  Otherwise Transmit diversity is used |
| DCI format 2C | Up to 4 layer transmission, ports 7-10 |

## 7.3 Relay node procedures for transmitting the physical uplink shared channel

The physical uplink shared channel shall be processed as described in Clause 8 of [5] with the following exceptions.

The relay node shall not expect HARQ feedback on PHICH. ACK shall be delivered to higher layers for each transport block transmitted on PUSCH.

At the relay node the number of HARQ processes depends on the subframes configured for eNB-RN transmissions.

For frame structure type 1 the number of HARQ processes is determined by the decimal equivalent of the binary number representing the 8-bit bitmap of the parameter *SubframeConfigurationFDD* as given by Table 7.3-1. HARQ processes are sequentially assigned to subframes configured for RN-to-eNB transmission.

Table 7.3-1: Number of uplink HARQ processes for frame structure type 1

|  |  |
| --- | --- |
| Decimal equivalent of *SubframeConfigurationFDD* | Number of uplink HARQ processes |
| 1, 2, 4, 8, 16, 32, 64, 128 | 1 |
| 3, 5, 6, 9, 10, 12, 17, 18, 20, 24 ,33, 34, 36, 40, 48, 65, 66, 68, 72, 80, 96, 129, 130, 132, 136, 144, 160, 192 | 2 |
| 7, 11, 13, 14, 19, 21, 22, 25, 26, 28, 35, 37, 38, 41, 42, 44, 49, 50, 52, 56, 67, 69, 70, 73, 74, 76, 81, 82, 84, 85, 88, 97, 98, 100, 104, 112, 131, 133, 134, 137, 138, 140, 145, 146, 148, 152, 161, 162, 164, 168, 170, 176, 193, 194, 196, 200, 208, 224 | 3 |
| 15, 23, 27, 29, 30, 39, 43, 45, 46, 51, 53, 54, 57, 58, 60, 71, 75, 77, 78, 83, 86, 87, 89, 90, 91, 92, 93, 99, 101, 102, 105, 106, 107, 108, 109, 113, 114, 116, 117, 120, 135, 139, 141, 142, 147, 149, 150, 153, 154, 156, 163, 165, 166, 169, 171, 172, 173, 174, 177, 178, 180, 181, 182, 184, 186, 195, 197, 198, 201, 202, 204, 209, 210, 212, 213, 214, 216, 218, 225, 226, 228, 232, 234, 240 | 4 |
| 31, 47, 55, 59, 61, 62, 79, 94, 95, 103, 110, 111, 115, 118, 119, 121, 122, 123, 124, 125, 143, 151, 155, 157, 158, 167, 175, 179, 183, 185, 187, 188, 189, 190, 199, 203, 205, 206, 211, 215, 217, 219, 220, 221, 222, 227, 229, 230, 233, 235, 236, 237, 238, 241, 242, 244, 245, 246, 248, 250 | 5 |
| 63, 126, 127, 159, 191, 207, 223, 231, 239, 243, 247, 249, 251, 252, 253, 254, 255 | 6 |

For frame structure type 2 the number of HARQ processes is given by Table 7.3-2. A re-transmission, when applicable, shall occur in a subframe with the same subframe number as the original transmission.

Table 7.3-2: Number of uplink HARQ processes for frame structure type 2

|  |  |
| --- | --- |
| *SubframeConfigurationTDD* | Number of uplink HARQ  processes |
| 0-3, 5-18 | 1 |
| 4 | 2 |

## 7.4 Relay node procedure for receiving the relay physical downlink control channel

### 7.4.1 Monitoring and demodulation

The relay node shall monitor the set of configured VRBs in the first slot for an R-PDCCH containing a downlink assignment and it shall monitor the set of configured VRBs in the second slot for an R-PDCCH containing an uplink grant.

The R-PDCCH according to Clause 5.6.3 shall be demodulated based on cell-specific reference signals transmitted on one set of antenna ports , , or .

The R-PDCCH according to Clause 5.6.2 shall be demodulated based on cell-specific reference signals transmitted on one set of antenna ports , , or , or based on UE-specific reference signals transmitted on antenna port 7 assuming that ; the type of reference signals is configured by higher layers.

For R-PDCCH according to Clause 5.6.2, if the RN is configured to receive PDSCH data transmissions according to transmission mode 9, the RN may assume that the REs for UE-specific reference signals according to the maximum restricted rank are reserved in the first slot of VRB pairs that are used for R-PDCCH transmission, where the higher-layer parameter *codebookSubsetRestriction-r10* indicates the maximum restricted rank.

### 7.4.2 Relay node procedure for determining relay physical downlink control channel assignment without cross-interleaving

This clause applies if higher-layers configure the R-PDCCH to be not cross-interleaved.

The same set of VRBs is configured for a potential R-PDCCH in the first and in the second slot.

In each slot, an R-PDCCH candidate at aggregation level  comprises VRB numbered with ,where  and where  is given by Table 7.4.2-1.

Table 7.4.2-1: R-PDCCH candidates monitored by a relay node

|  |  |
| --- | --- |
| *Aggregation level* | Number of R-PDCCH candidates |
| 1 | 6 |
| 2 | 6 |
| 4 | 2 |
| 8 | 2 |

### 7.4.3 Relay node procedure for determining relay physical downlink control channel assignment with cross-interleaving

This clause applies if higher-layers configure the R-PDCCH to be cross-interleaved.

The relay node procedure for determining the relay physical downlink control channel assignment is according to the UE procedure for determining physical downlink control channel assignment in Clause 9.1.1 of [5] with the following assumptions.

The set of CCEs corresponding to an R-PDCCH candidate  of the search space  in slot  of subframe  is given by  where , , and  is the total number of CCEs in the set of RBs configured for potential R-PDCCH transmission.

The relay node shall only monitor one RN-specific search space according to the UE-specific search space in [5] at each of the aggregation levels  with the number of candidates per aggregation level as in Table 7.4.2-1.

## 7.5 Relay node procedures for transmitting the physical uplink control channel

### 7.5.1 Relay node procedure for determining physical uplink control channel assignment

The physical uplink control channel shall be processed as described in Clause 10 of [5] with the following exceptions.

For a PDSCH transmission for which HARQ-ACK is transmitted on PUCCH, and which is indicated by the detection of a corresponding R-PDCCH, the relay node shall use PUCCH resources for transmission of HARQ-ACK.

For frame structure type 1, the value of  for PUCCH antenna port *p* is configured by higher layers.

For frame structure type 2, for a relay node configured with HARQ-ACK bundling, or for a relay node configured with PUCCH format 1b with channel selection either according to the set of Tables 10.1.3-2, 10.1.3-3, and 10.1.3-4 of [5] or according to the set of Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7 of [5], higher layer configures  PUCCH format 1a/1b resources , where  and  is the number of elements in the set  for subframe  as defined in Table 7.5.1-1.

The relay node shall transmit SR only in uplink subframes that are configured for RN-to-eNB transmissions.

For frame structure type 2 the relay node shall upon detection of a PDSCH transmission within subframe intended for the relay node transmit the ACK/NACK response in uplink subframe  where  and  is defined in Table 7.5.1-1.

Table 7.5.1-1:  for frame structure type 2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *SubframeConfigurationTDD* | according to subframe: | | | | | | | | | |
| *n*=0 | *n*=1 | *n*=2 | *n*=3 | *n*=4 | *n*=5 | *n*=6 | *n*=7 | *n*=8 | *n*=9 |
| 0 |  |  |  |  |  |  |  |  | 4 |  |
| 1 |  |  |  | 4 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  | 4,9 |  |
| 3 |  |  |  | 4,9 |  |  |  |  |  |  |
| 4 |  |  |  | 4 |  |  |  |  | 4 |  |
| 5 |  |  | 4 |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  | 4 |  |  |
| 7 |  |  | 4,8 |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  | 4,8 |  |  |
| 9 |  |  | 4,8,9 |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  | 4,8,9 |  |  |
| 11 |  |  |  | 4,6 |  |  |  |  |  |  |
| 12 |  |  |  | 4,5,6 |  |  |  |  |  |  |
| 13 |  |  |  | 4 |  |  |  |  |  |  |
| 14 |  |  |  | 4,6 |  |  |  |  |  |  |
| 15 |  |  |  | 4,5 |  |  |  |  |  |  |
| 16 |  |  |  | 4,5,6 |  |  |  |  |  |  |
| 17 |  |  |  | 4,5,6,9 |  |  |  |  |  |  |
| 18 |  |  |  |  | 5 |  |  |  |  |  |

### 7.5.2 Relay node HARQ-ACK feedback procedure for frame structure type 2

The HARQ-ACK feedback procedure on PUCCH for frame structure type 2 shall be as described in Clause 10.1.3 of [5] with the following exceptions.

- For a relay node configured with HARQ-ACK bundling or configured with PUCCH format 1b with channel selection either according to the set of Tables 10.1.3-2, 10.1.3-3, and 10.1.3-4 of [5] or according to the set of Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7 of [5],  corresponds to subframe , and HARQ-ACK() is the ACK/NACK/DTX response from subframe , where  is defined in Table 7.5.1-1 and .

- For a relay node configured with PUCCH format 3 for HARQ-ACK transmission, if the relay node receives a single PDSCH transmission within subframe(s) , where is defined in Table 7.5.1-1, the relay node shall use PUCCH format 1a/1b to transmit the HARQ-ACK on where the value of  is determined according to higher layer configuration.

The HARQ-ACK feedback procedure on PUSCH for frame structure type 2 shall be as described in Clause 7.3 of [5] with the following exception:

- The HARQ-ACK corresponds to subframes  where  is defined in Table 7.5.1-1.

Annex A (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| Sept 10 | RAN\_49 | RP-100967 | - | - | RAN1 agreed version for approval by plenary | - | 1.0.0 |
| Sept 10 | RAN\_49 | - | - | - | Release 10 is created following RAN decision to go under change control | 1.0.0 | 10.0.0 |
| 07/12/10 | RAN\_50 | RP-101321 | 0001 | - | Capturing of further agreements on relaying | 10.0.0 | 10.1.0 |
| 15/03/11 | RAN\_51 | RP-110257 | 0002 | - | Capturing of agreements on relaying from RAN1 #64 | 10.1.0 | 10.2.0 |
| 01/06/11 | RAN\_52 | RP-110822 | 4 | 2 | Capturing of agreement on reserving muted CSI-RS for REG in cross-interleaved R-PDCCH | 10.2.0 | 10.3.0 |
| 01/06/11 | RAN\_52 | RP-110822 | 7 | 1 | Clarifications on R-PDCCH transmission and antenna port selection | 10.2.0 | 10.3.0 |
| 01/06/11 | RAN\_52 | RP-110822 | 8 | - | Correction to DM-RS transmission and assumption | 10.2.0 | 10.3.0 |
| 01/06/11 | RAN\_52 | RP-110822 | 9 | - | Clarification on Un subframe configuration | 10.2.0 | 10.3.0 |
| 01/06/11 | RAN\_52 | RP-110822 | 10 | 1 | Correction to physical downlink shared channel mapping | 10.2.0 | 10.3.0 |
| 01/06/11 | RAN\_52 | RP-110853 | 11 | 1 | Correction on HARQ-ACK procedure | 10.2.0 | 10.3.0 |
| 15/09/11 | - | - | - | - | Minor editorial changes made by MCC – 3GPP is corrected on cover page and unnecessary red underlined text (page 14) is removed | 10.3.0 | 10.3.1 |
| 2012-09 | SP\_57 | - | - | - | Update to Rel-11 version (MCC) | 10.3.1 | 11.0.0 |
| 2014-09 | SP\_65 | - | - | - | Update to Rel-12 version (MCC) | 11.0.0 | 12.0.0 |
| 2015-12 | SP\_70 | - | - | - | Update to Rel-13 version (MCC) | 12.0.0 | 13.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2017-03 | SA#75 | - | - | - | - | Promotion to Release 14 without technical change (MCC) | 14.0.0 |
| 2018-06 | SA#80 | - | - | - |  | Update to Rel-15 version (MCC) | 15.0.0 |
| 2020-06 | SA#88-e | - | - | - |  | Update to Rel-16 version (MCC) | 16.0.0 |
| 2022-03 | SA#95-e | - | - | - |  | Update to Rel-17 version (MCC) | 17.0.0 |