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Contents

Foreword

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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:

Δf	Subcarrier spacing as defined in [3]
i	R-PDCCH aggregation element index
j	Slot index
K	PDSCH-to-ACK/NACK timing association set
k	Subcarrier index
κ	ιth element of K
L	End OFDM symbol index for R-PDCCH
l	OFDM symbol index
l'	OFDM symbol index

Λ	Aggregation level of R-PDCCH
m	R-PDCCH candidate index
M	Number of elements in the set K for subframe n
$N_{\mathrm{CCE},j}^{\mathrm{R-PDCCH}}$	Number of CCEs configured for detecting R-PDCCH in slot j
$N_{\mathrm{VRB}}^{\mathrm{R-PDCCH}}$	Number of VRBs configured for detecting R-PDCCH
n	Subframe index
n_f	System frame number as defined in [3]
n_{PRB}	Physical resource block number as defined in [3]
$n_{\mathrm{PUCCH},i}^{(1)}$	Resource index for PUCCH formats 1/1a/1b for subframe index i as defined in [3]
$n_{\mathrm{PUCCH}}^{(1,p)}$	Resource index for PUCCH formats 1/1a/1b using antenna port p as defined in [3]
$n_{\mathrm{PUCCH}}^{(3,p)}$	Resource index for PUCCH format 3 using antenna port p as defined in [3]
n_s	Slot number within a radio frame as defined in [3]
n_{SCID}	Scrambling identity as defined in [3]
n_{VRB}	Virtual resource block number as defined in [3]
$S_{n,j}^{(\Lambda)}$	Search space for aggregation level Λ in slot j of subframe n
Y_n	Equivalent to Y_k 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 Section 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 $\left[\left(10\cdot n_{\text{f}}+\lfloor n_{\text{s}}/2\rfloor\right)\bmod 8\right]\in\Delta_{\text{BSC}}$ 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 Δ_{BSC} 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 n is configured for RN-to-eNB transmission if subframe $n-4$ 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 Δ_{BSC}**
{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 Section 5.4.

5.4 Downlink slot structure and physical resource elements

The downlink slot structure and the physical resource elements are described in Section 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, $\Delta f = 15\,\text{kHz}$)

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, $\Delta f = 15\,\text{kHz}$)

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 Section 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 $N_{\text{VRB}}^{\text{R-PDCCH}}$ VRBs is configured for potential R-PDCCH transmission by higher layers using resource allocation types 0, 1, or 2 according to Section 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 $n_{\text{VRB}}^{\text{R-PDCCH}} = 0,1,\ldots,N_{\text{VRB}}^{\text{R-PDCCH}} - 1$ such that the VRB numbered with $n_{\text{VRB}}^{\text{R-PDCCH}} = 0$ refers to the configured VRB with the smallest virtual resource block number n_{VRB} of [3] and such that the VRB numbered with $n_{\text{VRB}}^{\text{R-PDCCH}} = N_{\text{VRB}}^{\text{R-PDCCH}} - 1$ refers to the configured VRB with the largest n_{VRB} .

An R-PDCCH can be transmitted on one or several PRBs without being cross-interleaved with other R-PDCCHs in a given PRB, see Section 5.6.2 Alternatively, multiple R-PDCCHs can be cross-interleaved in one or several PRBs, see Section 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 Section 6.8 of [3] except that

- n_{PDCCH} is equal to one.
- M_{tot} 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 $N_{\text{VRB}}^{\text{R-PDCCH}}$ VRBs is configured by resource allocation type 2 with distributed VRB to PRB mapping, the provisions in Section 6.2.3.2 of [3] for even slot numbers are always applied.

The mapping to resource elements shall follow the provisions in section 6.3.5 in [3], with the exception that the index k first increases over the aggregated physical resource blocks, and then the index l, 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 Section 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 $N_{\text{VRB}}^{\text{R-PDCCH}}$
  - the time-domain index l' shall be initialized with the start symbol index given in Table 5.4-1 and Table 5.4-2 respectively and l' shall be increased if $l' \le L$, where L corresponds to the end symbol index given in Table 5.4-1 and Table 5.4-2 respectively.

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

  - n_{PDCCH} 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 Section 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 $n_{\mathrm{SCID}}=0$ 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 $n_{\mathrm{SCID}}=0$ 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 Section 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 Section 5.6.3 shall be demodulated based on cell-specific reference signals transmitted on one set of antenna ports $\{0\}$, $\{0,1\}$, or $\{0,1,2,3\}$.

The R-PDCCH according to Section 5.6.2 shall be demodulated based on cell-specific reference signals transmitted on one set of antenna ports $\{0\}$, $\{0,1\}$, or $\{0,1,2,3\}$, or based on UE-specific reference signals transmitted on antenna port 7 assuming that $n_{\mathrm{SCID}} = 0$; the type of reference signals is configured by higher layers.

For R-PDCCH according to Section 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 section 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 $m = 0,1,...,M(\Lambda)-1$ at aggregation level Λ comprises VRB numbered with $n_{\mathrm{VRB}}^{\mathrm{R-PDCCH}} = (\Lambda \cdot m + i) \bmod N_{\mathrm{VRB}}^{\mathrm{R-PDCCH}}$, where $i = 0,1,...,\Lambda-1$ and where $M(\Lambda)$ is given by Table 7.4.2-1.

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

Aggregation level Λ	**Number of R-PDCCH candidates** $M(\Lambda)$
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 section 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 Section 9.1.1 of [5] with the following assumptions.

The set of CCEs corresponding to an R-PDCCH candidate m of the search space $S_{n,j}^{(\Lambda)}$ in slot $j \in \{0,1\}$ of subframe n is given by $\Lambda \cdot \left\{ (Y_n + m) \bmod \left\lfloor N_{\mathrm{CCE},j}^{\mathrm{R-PDCCH}} / \Lambda \right\rfloor \right\} + i$ where $i = 0,1,...,\Lambda-1$, $m = 0,1,...,M(\Lambda)-1$, and $N_{\mathrm{CCE},j}^{\mathrm{R-PDCCH}}$ 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 $\Lambda \in \{1,2,4,8\}$ 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 Section 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 $n_{\mathrm{PUCCH}}^{(1,p)}$ 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 M PUCCH format 1a/1b resources $n_{\mathrm{PUCCH},\iota}^{(1)}$, where $0 \le \iota \le M-1$ and M is the number of elements in the set K for subframe n 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 $n-\kappa_\iota$ intended for the relay node transmit the ACK/NACK response in uplink subframe n where $\kappa_\iota \in K$ and K is defined in Table 7.5.1-1.

Table 7.5.1-1: K for frame structure type 2

SubframeConfigurationTDD	K **according to subframe:** $\{\kappa_0, \kappa_1, ..., \kappa_{M-1}\}$									
	***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 Section 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], $n^{(1)}_{\text{PUCCH},\iota}$ corresponds to subframe $n-\kappa_\iota$, and HARQ-ACK(ι) is the ACK/NACK/DTX response from subframe $n-\kappa_\iota$, where $\kappa_\iota \in K$ is defined in Table 7.5.1-1 and $0 \le \iota \le M-1$.

- 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) $n-\kappa_\iota$, where $\kappa_\iota \in K$ is defined in Table 7.5.1-1, the relay node shall use PUCCH format 1a/1b to transmit the HARQ-ACK on $n^{(1,p)}_{\text{PUCCH}}$ where the value of $n^{(1,p)}_{\text{PUCCH}}$ is determined according to higher layer configuration.

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

- The HARQ-ACK corresponds to subframes $n-\kappa_\iota$ where $\kappa_\iota \in K$ 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