Table 8.2-2: UE Specific SRS Periodicity T_{SRS} and Subframe Offset Configuration T_{offset} for trigger type 0, TDD

SRS Configuration Index I_{SRS}	SRS Periodicity T_{SRS} (ms)	SRS Subframe Offset T_{offset}
0	2	0, 1
1	2	0, 2
2	2	1, 2
3	2	0, 3
4	2	1, 3
5	2	0, 4
6	2	1, 4
7	2	2, 3
8	2	2, 4
9	2	3, 4
10 – 14	5	I_{SRS} – 10
15 – 24	10	I_{SRS} – 15
25 – 44	20	I_{SRS} – 25
45 – 84	40	I_{SRS} – 45
85 – 164	80	I_{SRS} – 85
165 – 324	160	I_{SRS} – 165
325 – 644	320	I_{SRS} – 325
645 – 1023	reserved	reserved

Table 8.2-3: k_{SRS} for TDD

	subframe index *n*										
	0	1		2	3	4	5	6		7	8	9
		1st symbol of UpPTS	2nd symbol of UpPTS					1st symbol of UpPTS	2nd symbol of UpPTS			
k_{SRS} in case UpPTS length of 2 symbols		0	1	2	3	4		5	6	7	8	9
k_{SRS} in case UpPTS length of 1 symbol		1		2	3	4		6		7	8	9

Table 8.2-4: UE Specific SRS Periodicity $T_{SRS,1}$ and Subframe Offset Configuration $T_{offset,1}$ for trigger type 1, FDD

SRS Configuration Index I_{SRS}	SRS Periodicity $T_{SRS,1}$ (ms)	SRS Subframe Offset $T_{offset,1}$
0 – 1	2	I_{SRS}
2 – 6	5	I_{SRS} – 2
7 – 16	10	I_{SRS} – 7
17 – 31	reserved	reserved

Table 8.2-5: UE Specific SRS Periodicity $T_{SRS,1}$ and Subframe Offset Configuration $T_{offset,1}$ for trigger type 1, TDD

SRS Configuration Index I_{SRS}	SRS Periodicity $T_{SRS,1}$ (ms)	SRS Subframe Offset $T_{offset,1}$
0	reserved	reserved
1	2	0, 2
2	2	1, 2
3	2	0, 3
4	2	1, 3
5	2	0, 4
6	2	1, 4
7	2	2, 3
8	2	2, 4
9	2	3, 4
10 – 14	5	I_{SRS} – 10
15 – 24	10	I_{SRS} – 15
25 – 31	reserved	reserved

8.3 UE HARQ-ACK procedure

For FDD, and serving cell with frame structure type 1, an HARQ-ACK received on the PHICH assigned to a UE in subframe *i* is associated with the PUSCH transmission in subframe *i*-4.

For FDD-TDD, and serving cell with frame structure type 1, and UE not configured to monitor PDCCH/EPDCCH in another serving cell with frame structure type 2 for scheduling the serving cell, an HARQ-ACK received on the PHICH assigned to a UE in subframe *i* is associated with the PUSCH transmission in subframe *i*-4.

For FDD-TDD, if a serving cell is a secondary cell with frame structure type 1 and if the UE is configured to monitor PDCCH/EPDCCH in another serving cell with frame structure type 2 for scheduling the serving cell, then an HARQ-ACK received on the PHICH assigned to a UE in subframe *i* is associated with PUSCH transmission on the serving cell in subframe *i*-6.

For TDD, if the UE is not configured with *EIMTA-MainConfigServCell-r12* for any serving cell and, if a UE is configured with one serving cell, or if the UE is configured with more than one serving cell and the TDD UL/DL configuration of all the configured serving cells is the same,

- For frame structure type 2 UL/DL configuration 1-6, an HARQ-ACK received on the PHICH assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i-k* as indicated by the following Table 8.3-1.
- For frame structure type 2 UL/DL configuration 0, an HARQ-ACK received on the PHICH in the resource corresponding to $I_{PHICH} = 0$, as defined in subclause 9.1.2, assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i-k* as indicated by the following Table 8.3-1. For frame structure type 2 UL/DL configuration 0, an HARQ-ACK received on the PHICH in the resource corresponding to $I_{PHICH} = 1$, as defined in subclause 9.1.2, assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i*-6.

For TDD, if a UE is configured with more than one serving cell and the TDD UL/DL configuration of at least two configured serving cells is not the same, or if the UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, or FDD-TDD and serving cell is frame structure type 2,

- For serving cell with an UL-reference UL/DL configuration (defined in subclause 8.0) belonging to {1,2,3,4,5,6}, an HARQ-ACK received on the PHICH assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i-k* for the serving cell as indicated by the following Table 8.3-1, where "TDD UL/DL Configuration" in Table 8.3-1 refers to the UL-reference UL/DL Configuration.
- For a serving cell with UL-reference UL/DL configuration 0 (defined in subclause 8.0), an HARQ-ACK received on the PHICH in the resource corresponding to $I_{PHICH} = 0$, as defined in subclause 9.1.2, assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i-k* for the serving cell as indicated by the following Table 8.3-1, where "TDD UL/DL Configuration" in Table 8.3-1 refers to the UL-reference UL/DL configuration. For a serving cell with UL-reference UL/DL configuration 0, an HARQ-ACK received on the PHICH in the resource corresponding to $I_{PHICH} = 1$, as defined in subclause 9.1.2, assigned to a UE in subframe *i* is associated with the PUSCH transmission in the subframe *i*-6 for the serving cell.
- For FDD-TDD, if a serving cell is a secondary cell with UL-reference UL/DL configuration 0 and if the UE is configured to monitor PDCCH/EPDCCH in another serving cell with frame structure type 1 for scheduling the serving cell, for downlink subframe *i*, if a transport block was transmitted in the associated PUSCH subframe *i*-6 for the serving cell then PHICH resource corresponding to that transport block is not present in subframe *i.*

Table 8.3-1 *k* for TDD configurations 0-6

TDD UL/DL Configuration	subframe number *i*									
	0	1	2	3	4	5	6	7	8	9
0	7	4				7	4			
1		4			6		4			6
2				6					6	
3	6								6	6
4									6	6
5									6	
6	6	4				7	4			6

The physical layer in the UE shall deliver indications to the higher layers as follows:

For FDD, and for TDD with a UE configured with one serving cell, and for TDD with a UE configured with more than one serving cell and with TDD UL/DL configuration of all configured serving cells the same, and UE is not configured with *EIMTA-MainConfigServCell-r12* for any serving cell, for downlink or special subframe *i*, if a transport block was transmitted in the associated PUSCH subframe then:

if ACK is decoded on the PHICH corresponding to that transport block in subframe *i*, or if that transport block is disabled by PDCCH/EPDCCH received in downlink or special subframe *i*, ACK for that transport block shall be delivered to the higher layers; else NACK for that transport block shall be delivered to the higher layers.

For TDD, if the UE is configured with more than one serving cell, and if at least two serving cells have different UL/DL configurations, or the UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, or for FDD-TDD, for downlink or special subframe *i*, if a transport block was transmitted in the associated PUSCH subframe then:

if ACK is decoded on the PHICH corresponding to that transport block in subframe *i*, or if that transport block is disabled by PDCCH/EPDCCH received in downlink or special subframe *i*, ACK for that transport block shall be delivered to the higher layers; or

if a PHICH resource corresponding to that transport block is not present in subframe *i* or if UE is not expected to receive PHICH corresponding to that transport block in subframe *i*, ACK for that transport block shall be delivered to the higher layers.

else NACK for that transport block shall be delivered to the higher layers.

8.4 UE PUSCH hopping procedure

The UE shall perform PUSCH frequency hopping if the single bit Frequency Hopping (FH) field in a corresponding PDCCH/EPDCCH with DCI format 0 is set to 1 and the uplink resource block assignment is type 0 otherwise no PUSCH frequency hopping is performed.

A UE performing PUSCH frequency hopping shall determine its PUSCH Resource Allocation (RA) for the first slot of a subframe (*SI*) including the lowest index PRB ($n_{PRB}^{SI}(n)$) in subframe n from the resource allocation field in the latest PDCCH/EPDCCH with DCI format 0 for the same transport block. If there is no PDCCH/EPDCCH for the same transport block, the UE shall determine its hopping type based on

- the hopping information in the most recent semi-persistent scheduling assignment PDCCH/EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled or
- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The resource allocation field in DCI format 0 excludes either 1 or 2 bits used for hopping information as indicated by Table 8.4-1 below where the number of PUSCH resource blocks is defined as

$$N_{RB}^{PUSCH} = \begin{cases} N_{RB}^{UL} - \tilde{N}_{RB}^{HO} - \left(N_{RB}^{UL} \bmod 2\right) & \text{Type 1 PUSCH hopping} \\ N_{RB}^{UL} & \text{Type 2 } \mathrm{N_{sb}} = 1 \text{ PUSCH hopping} \\ N_{RB}^{UL} - \tilde{N}_{RB}^{HO} & \text{Type 2 } \mathrm{N_{sb}} > 1 \text{ PUSCH hopping} \end{cases}$$

For type 1 and type 2 PUSCH hopping, $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}} + 1$ if $N_{\mathrm{RB}}^{\mathrm{HO}}$ is an odd number where $N_{\mathrm{RB}}^{\mathrm{HO}}$ defined in [3]. $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}}$ in other cases. The size of the resource allocation field in DCI format 0 after excluding either 1 or 2 bits shall be $y = \left\lceil \log_2 (N_{\mathrm{RB}}^{\mathrm{UL}} (N_{\mathrm{RB}}^{\mathrm{UL}} + 1)/2) \right\rceil - N_{UL\_hop}$, where N_{UL_hop} = 1 or 2 bits. The number of contiguous RBs that can be assigned to a type-1 hopping user is limited to $\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \rfloor$. The number of contiguous RBs that can be assigned to a type-2 hopping user is limited to $\min\left(\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \rfloor, \lfloor N_{\mathrm{RB}}^{\mathrm{PUSCH}} / N_{sb} \rfloor\right)$, where the number of sub-bands N_{sb} is given by higher layers.

A UE performing PUSCH frequency hopping shall use one of two possible PUSCH frequency hopping types based on the hopping information. PUSCH hopping type 1 is described in subclause 8.4.1 and type 2 is described in subclause 8.4.2.

Table 8.4-1: Number of Hopping Bits $N_{UL\ hop}$ vs. System Bandwidth

System BW N_{RB}^{UL}	#Hopping bits for 2nd slot RA ($N_{UL\ hop}$)
6-49	1
50-110	2

The parameter *Hopping-mode* provided by higher layers determines if PUSCH frequency hopping is "inter-subframe" or "intra and inter-subframe".

8.4.1 Type 1 PUSCH hopping

For PUSCH hopping type 1 the hopping bit or bits indicated in Table 8.4-1 determine $\tilde{n}_{PRB}(i)$ as defined in Table 8.4-2.
The lowest index PRB ($n_{PRB}^{S1}(i)$) of the 1st slot RA in subframe i is defined as $n_{PRB}^{S1}(i) = \tilde{n}_{PRB}^{S1}(i) + \tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} / 2$, where $n_{PRB}^{S1}(i) = RB_{START}$, and RB_{START} is obtained from the uplink scheduling grant as in subclause 8.4 and subclause 8.1.

The lowest index PRB ($n_{PRB}(i)$) of the 2nd slot RA in subframe i is defined as $n_{PRB}(i) = \tilde{n}_{PRB}(i) + \tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} / 2$.

The set of physical resource blocks to be used for PUSCH transmission are L_{CRBs} contiguously allocated resource blocks from PRB index $n_{PRB}^{S1}(i)$ for the 1st slot, and from PRB index $n_{PRB}(i)$ for the 2nd slot, respectively, where L_{CRBs} is obtained from the uplink scheduling grant as in subclause 8.4 and subclause 8.1.

If the *Hopping-mode* is "inter-subframe", the 1st slot RA is applied to even CURRENT_TX_NB, and the 2nd slot RA is applied to odd CURRENT_TX_NB, where CURRENT_TX_NB is defined in [8].

8.4.2 Type 2 PUSCH hopping

In PUSCH hopping type 2 the set of physical resource blocks to be used for transmission in slot n_s is given by the scheduling grant together with a predefined pattern according to [3] subclause 5.3.4.
If the system frame number is not acquired by the UE yet, the UE shall not transmit PUSCH with type-2 hopping and $N_{sb} > 1$ for TDD, where N_{sb} is defined in [3].

Table 8.4-2: PDCCH/EPDCCH DCI format 0 hopping bit definition

System BW N_{RB}^{UL}	Number of Hopping bits	Information in hopping bits	$\tilde{n}_{PRB}(i)$
6 – 49	1	0	$\left(\left\lfloor N_{RB}^{PUSCH}/2 \right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$,
		1	Type 2 PUSCH Hopp ng
50 – 110	2	00	$\left(\left\lfloor N_{RB}^{PUSCH}/4 \right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$
		01	$\left(-\left\lfloor N_{RB}^{PUSCH}/4 \right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$
		10	$\left(\left\lfloor N_{RB}^{PUSCH}/2 \right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$
		11	Type 2 PUSCH Hopp ng

8.5 UE Reference Symbol (RS) procedure

If UL sequence-group hopping or sequence hopping is configured in a serving cell, it applies to all Reference Symbols (SRS, PUSCH and PUCCH RS). If disabling of the sequence-group hopping and sequence hopping is configured for the UE in the serving cell through the higher-layer parameter *Disable-sequence-group-hopping*, the sequence-group hopping and sequence hopping for PUSCH RS are disabled.

8.6 Modulation order, redundancy version and transport block size determination

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the "modulation and coding scheme and redundancy version" field (I_{MCS}), and
- check the "CSI request" bit field, and
- compute the total number of allocated PRBs (N_{PRB}) based on the procedure defined in subclause 8.1, and
- compute the number of coded symbols for control information.

8.6.1 Modulation order and redundancy version determination

For $0 \le I_{\text{MCS}} \le 28$, the modulation order (Q_m) is determined as follows:

- If the UE is capable of supporting 64QAM in PUSCH and has not been configured by higher layers to transmit only QPSK and 16QAM, the modulation order is given by Q_m' in Table 8.6.1-1.
- If the UE is not capable of supporting 64QAM in PUSCH or has been configured by higher layers to transmit only QPSK and 16QAM, Q_m' is first read from Table 8.6.1-1. The modulation order is set to $Q_m = \min(4, Q_m')$.
- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the modulation order is set to $Q_m = 2$. Resource allocation size is restricted to $N_{\text{PRB}} \le 3$ applies in this case if the UE does not indicate support by higher layers to operate without it.

For $29 \le I_{\text{MCS}} \le 31$ the modulation order (Q_m) is determined as follows:

- if DCI format 0 is used and $I_{\text{MCS}} = 29$ or, if DCI format 4 is used and only 1 TB is enabled and $I_{\text{MCS}} = 29$ for the enabled TB and the signalled number of transmission layers is 1, and if
  - the "CSI request" bit field is 1 bit and the bit is set to trigger an aperiodic report and, $N_{\text{PRB}} \le 4$ or,
  - the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for one serving cell according to Table 7.2.1-1A, and, $N_{\text{PRB}} \le 4$ or,
  - the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for more than one serving cell according to Table 7.2.1-1A and, $N_{\text{PRB}} \le 20$, or,
  - the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for one CSI process according to Table 7.2.1-1B and $N_{\text{PRB}} \le 4$, or,
  - the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for more than one CSI process according to Table 7.2.1-1B and $N_{\text{PRB}} \le 20$,

then the modulation order is set to $Q_m = 2$.

- Otherwise, the modulation order shall be determined from the DCI transported in the latest PDCCH/EPDCCH with DCI format 0/4 for the same transport block using $0 \le I_{\text{MCS}} \le 28$. If there is no PDCCH/EPDCCH with DCI format 0/4 for the same transport block using $0 \le I_{\text{MCS}} \le 28$, the modulation order shall be determined from
  - the most recent semi-persistent scheduling assignment PDCCH/EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,

- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The UE shall use I_{MCS} and Table 8.6.1-1 to determine the redundancy version (rv_{idx}) to use in the physical uplink shared channel.

Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH

MCS Index I_{MCS}	Modulation Order Q_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	1	0
2	2	2	0
3	2	3	0
4	2	4	0
5	2	5	0
6	2	6	0
7	2	7	0
8	2	8	0
9	2	9	0
10	2	10	0
11	4	10	0
12	4	11	0
13	4	12	0
14	4	13	0
15	4	14	0
16	4	15	0
17	4	16	0
18	4	17	0
19	4	18	0
20	4	19	0
21	6	19	0
22	6	20	0
23	6	21	0
24	6	22	0
25	6	23	0
26	6	24	0
27	6	25	0
28	6	26	0
29	reserved		1
30			2
31			3

8.6.2 Transport block size determination

For $0 \le I_{MCS} \le 28$, the UE shall first determine the TBS index (I_{TBS}) using I_{MCS} and Table 8.6.1-1 except if the transport block is disabled in DCI format 4 as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in subclause 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in subclause 7.17.2.2.

For $29 \le I_{MCS} \le 31$,

- if DCI format 0 is used and $I_{MCS} = 29$ or, if DCI format 4 is used and only 1 TB is enabled and $I_{MCS} = 29$ for the enabled TB and the number of transmission layers is 1, and if
  - the "CSI request" bit field is 1 bit and is set to trigger an aperiodic CSI report and $N_{PRB} \le 4$, or
  - the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for one serving cell according to Table 7.2.1-1A, and, $N_{PRB} \le 4$ or,

- the "CSI request" bit field is 2 bits and is triggering aperiodic CSI report for more than one serving cell according to Table 7.2.1-1A and, $N_{PRB} \leq 20$, or,
- the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for one CSI process according to Table 7.2.1-1B and $N_{PRB} \leq 4$, or,
- the "CSI request" bit field is 2 bits and is triggering an aperiodic CSI report for more than one CSI process according to Table 7.2.1-1B and, $N_{PRB} \leq 20$

then there is no transport block for the UL-SCH and only the control information feedback for the current PUSCH reporting mode is transmitted by the UE.

- Otherwise, the transport block size shall be determined from the initial PDCCH/EPDCCH for the same transport block using $0 \leq I_{MCS} \leq 28$. If there is no initial PDCCH/EPDCCH with an uplink DCI format for the same transport block using $0 \leq I_{MCS} \leq 28$, the transport block size shall be determined from
  - the most recent semi-persistent scheduling assignment PDCCH/EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,
  - the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

In DCI format 4 a transport block is disabled if either the combination of $I_{MCS} = 0$ and $N_{PRB} > 1$ or the combination of $I_{MCS} = 28$ and $N_{PRB} = 1$ is signalled, otherwise the transport block is enabled.

8.6.3 Control information MCS offset determination

Offset values are defined for single codeword PUSCH transmission and multiple codeword PUSCH transmission. Single codeword PUSCH transmission offsets $\beta_{offset}^{HARQ-ACK}$, β_{offset}^{RI} and β_{offset}^{CQI} shall be configured to values according to Table 8.6.3-1,2,3 with the higher layer signalled indexes $I_{offset}^{HARQ-ACK}$, I_{offset}^{RI}, and I_{offset}^{CQI}, respectively. Multiple codeword PUSCH transmission offsets $\beta_{offset}^{HARQ-ACK}$, β_{offset}^{RI} and β_{offset}^{CQI} shall be configured to values according to Table 8.6.3-1,2,3 with the higher layer signalled indexes $I_{offset,MC}^{HARQ-ACK}$, $I_{offset,MC}^{RI}$ and $I_{offset,MC}^{CQI}$, respectively.

If the UE is configured with higher layer parameter *UplinkPowerControlDedicated-v12x0* for serving cell c, and if a subframe belongs to uplink power control subframe set 2 as indicated by the higher layer parameter *tpc-SubframeSet-r12*, then for that subframe, the UE shall use

- the higher layer indexes $I_{offset,set2}^{HARQ-ACK}$, $I_{offset,set2}^{RI}$ and $I_{offset,set2}^{CQI}$ in place of $I_{offset}^{HARQ-ACK}$, I_{offset}^{RI}, and I_{offset}^{CQI} respectively in Tables 8.6.3-1,2,3, to determine $\beta_{offset}^{HARQ-ACK}$, β_{offset}^{RI} and β_{offset}^{CQI} respectively for single codeword PUSCH transmissions, and
- the higher layer indexes $I_{offset,MC,set2}^{HARQ-ACK}$, $I_{offset,MC,set2}^{RI}$ and $I_{offset,MC,set2}^{CQI}$ in place of $I_{offset,MC}^{HARQ-ACK}$, $I_{offset,MC}^{RI}$ and $I_{offset,MC}^{CQI}$ respectively in Tables 8.6.3-1,2,3, to determine $\beta_{offset}^{HARQ-ACK}$, β_{offset}^{RI} and β_{offset}^{CQI} respectively for multiple codeword PUSCH transmissions.

Table 8.6.3-1: Mapping of HARQ-ACK offset values and the index signalled by higher layers

$I_{offset}^{HARQ-ACK}$ or $I_{offset,MC}^{HARQ-ACK}$	$\beta_{offset}^{HARQ-ACK}$
0	2.000
1	2.500
2	3.125
3	4.000
4	5.000
5	6.250
6	8.000
7	10.000
8	12.625
9	15.875
10	20.000
11	31.000
12	50.000
13	80.000
14	126.000
15	1.0

Table 8.6.3-2: Mapping of RI offset values and the index signalled by higher layers

I_{offset}^{RI} or $I_{offset,MC}^{RI}$	β_{offset}^{RI}
0	1.250
1	1.625
2	2.000
3	2.500
4	3.125
5	4.000
6	5.000
7	6.250
8	8.000
9	10.000
10	12.625
11	15.875
12	20.000
13	reserved
14	reserved
15	reserved

Table 8.6.3-3: Mapping of CQI offset values and the index signalled by higher layers

I_{offset}^{CQI} or $I_{offset,MC}^{CQI}$	β_{offset}^{CQI}
0	reserved
1	reserved
2	1.125
3	1.250
4	1.375
5	1.625
6	1.750
7	2.000
8	2.250
9	2.500
10	2.875
11	3.125
12	3.500
13	4.000
14	5.000
15	6.250

8.7 UE transmit antenna selection

UE transmit antenna selection is configured by higher layers via parameter *ue-TransmitAntennaSelection*.

A UE configured with transmit antenna selection for a serving cell is not expected to

- be configured with more than one antenna port for any uplink physical channel or signal for any configured serving cell, or
- be configured with trigger type 1 SRS transmission on any configured serving cell, or
- be configured with simultaneous PUCCH and PUSCH transmission, or
- be configured with demodulation reference signal for PUSCH with OCC for any configured serving cell (see [3], subclause 5.5.2.1.1), or
- receive DCI Format 0 indicating uplink resource allocation type 1 for any serving cell.

If UE transmit antenna selection is disabled or not supported by the UE, the UE shall transmit from UE port 0.

If closed-loop UE transmit antenna selection is enabled by higher layers the UE shall perform transmit antenna selection for PUSCH in response to the most recent command received via DCI Format 0 in subclause 5.3.3.2 of [4].
If a UE is configured with more than one serving cell, the UE may assume the same transmit antenna port value is indicated in each PDCCH/EPDCCH with DCI format 0 in a given subframe.

If open-loop UE transmit antenna selection is enabled by higher layers, the transmit antenna for PUSCH/SRS to be selected by the UE is not specified.

9 Physical downlink control channel procedures

9.1 UE procedure for determining physical downlink control channel assignment

9.1.1 PDCCH assignment procedure

The control region of each serving cell consists of a set of CCEs, numbered from 0 to $N_{\mathrm{CCE},k}-1$ according to subclause 6.8.1 in [3], where $N_{\mathrm{CCE},k}$ is the total number of CCEs in the control region of subframe k.
The UE shall monitor a set of PDCCH candidates on one or more activated serving cells as configured by higher layer signalling for control information, where monitoring implies attempting to decode each of the PDCCHs in the set according to all the monitored DCI formats.

The set of PDCCH candidates to monitor are defined in terms of search spaces, where a search space $S_k^{(L)}$ at aggregation level $L \in \{1,2,4,8\}$ is defined by a set of PDCCH candidates. For each serving cell on which PDCCH is monitored, the CCEs corresponding to PDCCH candidate *m* of the search space $S_k^{(L)}$ are given by

$$L\ \left\{(Y_k + m') \bmod \left\lfloor N_{\mathrm{CCE},k} / L \right\rfloor\right\} + i$$

where Y_k is defined below, $i = 0,\cdots,L-1$. For the common search space $m' = m$. For the PDCCH UE specific search space, for the serving cell on which PDCCH is monitored, if the monitoring UE is configured with carrier indicator field then $m' = m + M^{(L)} \cdot n_{CI}$ where n_{CI} is the carrier indicator field value, else if the monitoring UE is not configured with carrier indicator field then $m' = m$, where $m = 0,\cdots,M^{(L)}-1$. $M^{(L)}$ is the number of PDCCH candidates to monitor in the given search space.

Note that the carrier indicator field value is the same as *ServCellIndex* given in [11].

The UE shall monitor one common search space in every non-DRX subframe at each of the aggregation levels 4 and 8 on the primary cell.

The UE shall monitor common search space on a cell to decode the PDCCHs necessary to decode PMCH on that cell if configured to decode PMCH by higher layers.

If a UE is not configured for EPDCCH monitoring, and if the UE is not configured with a carrier indicator field, then the UE shall monitor one PDCCH UE-specific search space at each of the aggregation levels 1, 2, 4, 8 on each activated serving cell in every non-DRX subframe.

If a UE is not configured for EPDCCH monitoring, and if the UE is configured with a carrier indicator field, then the UE shall monitor one or more UE-specific search spaces at each of the aggregation levels 1, 2, 4, 8 on one or more activated serving cells as configured by higher layer signalling in every non-DRX subframe.

If a UE is configured for EPDCCH monitoring on a serving cell, and if that serving cell is activated, and if the UE is not configured with a carrier indicator field, then the UE shall monitor one PDCCH UE-specific search space at each of the aggregation levels 1, 2, 4, 8 on that serving cell in all non-DRX subframes where EPDCCH is not monitored on that serving cell.

If a UE is configured for EPDCCH monitoring on a serving cell, and if that serving cell is activated, and if the UE is configured with a carrier indicator field, then the UE shall monitor one or more PDCCH UE-specific search spaces at each of the aggregation levels 1, 2, 4, 8 on that serving cell as configured by higher layer signalling in all non-DRX subframes where EPDCCH is not monitored on that serving cell.

The common and PDCCH UE-specific search spaces on the primary cell may overlap.

A UE configured with the carrier indicator field associated with monitoring PDCCH on serving cell c shall monitor PDCCH configured with carrier indicator field and with CRC scrambled by C-RNTI in the PDCCH UE specific search space of serving cell c.

A UE configured with the carrier indicator field associated with monitoring PDCCH on the primary cell shall monitor PDCCH configured with carrier indicator field and with CRC scrambled by SPS C-RNTI in the PDCCH UE specific search space of the primary cell.

The UE shall monitor the common search space for PDCCH without carrier indicator field.

For the serving cell on which PDCCH is monitored, if the UE is not configured with a carrier indicator field, it shall monitor the PDCCH UE specific search space for PDCCH without carrier indicator field, if the UE is configured with a carrier indicator field it shall monitor the PDCCH UE specific search space for PDCCH with carrier indicator field.

A UE is not expected to monitor the PDCCH of a secondary cell if it is configured to monitor PDCCH with carrier indicator field corresponding to that secondary cell in another serving cell. For the serving cell on which PDCCH is monitored, the UE shall monitor PDCCH candidates at least for the same serving cell.

A UE configured to monitor PDCCH candidates with CRC scrambled by C-RNTI or SPS C-RNTI with a common payload size and with the same first CCE index n_{CCE} (as described in subclause 10.1) but with different sets of DCI information fields as defined in [4] in the

- common search space
- PDCCH UE specific search space

on the primary cell shall assume that for the PDCCH candidates with CRC scrambled by C-RNTI or SPS C-RNTI,

- if the UE is configured with the carrier indicator field associated with monitoring the PDCCH on the primary cell, only the PDCCH in the common search space is transmitted by the primary cell;
- otherwise, only the PDCCH in the UE specific search space is transmitted by the primary cell.

A UE configured to monitor PDCCH candidates in a given serving cell with a given DCI format size with CIF, and CRC scrambled by C- RNTI, where the PDCCH candidates may have one or more possible values of CIF for the given DCI format size, shall assume that a PDCCH candidate with the given DCI format size may be transmitted in the given serving cell in any PDCCH UE specific search space corresponding to any of the possible values of CIF for the given DCI format size.

The aggregation levels defining the search spaces are listed in Table 9.1.1-1. The DCI formats that the UE shall monitor depend on the configured transmission mode per each serving cell as defined in subclause 7.1.

Table 9.1.1-1: PDCCH candidates monitored by a UE

Search space $S_k^{(L)}$			Number of PDCCH candidates $M^{(L)}$
Type	Aggregation level L	Size [in CCEs]	
UE-specific	1	6	6
	2	12	6
	4	8	2
	8	16	2
Common	4	16	4
	8	16	2

For the common search spaces, Y_k is set to 0 for the two aggregation levels $L=4$ and $L=8$.

For the UE-specific search space $S_k^{(L)}$ at aggregation level L, the variable Y_k is defined by

$$Y_k = (A \cdot Y_{k-1}) \bmod D$$

where $Y_{-1} = n_{RNTI} \neq 0$, $A = 39827$, $D = 65537$ and $k = \lfloor n_s/2 \rfloor$, n_s is the slot number within a radio frame.

The RNTI value used for n_{RNTI} is defined in subclause 7.1 in downlink and subclause 8 in uplink.

9.1.2 PHICH assignment procedure

If a UE is not configured with multiple TAGs, or if a UE is configured with multiple TAGs and PUSCH transmissions scheduled from serving cell c in subframe n are not scheduled by a Random Access Response Grant corresponding to a random access preamble transmission for a secondary cell

- For PUSCH transmissions scheduled from serving cell c in subframe n, the UE shall determine the corresponding PHICH resource of serving cell c in subframe $n+k_{PHICH}$, where
  - k_{PHICH} is always 4 for FDD.
  - k_{PHICH} is 6 for FDD-TDD and serving cell c frame structure type 2 and the PUSCH transmission is for another serving cell with frame structure type 1.
  - k_{PHICH} is 4 for FDD-TDD and serving cell c frame structure type 1and the PUSCH transmission is for a serving cell with frame structure type 1.
- - For TDD, if the UE is not configured with *EIMTA-MainConfigServCell-r12* for any serving cell and, if the UE is configured with one serving cell, or if the UE is configured with more than one serving cell and the TDD UL/DL configuration of all the configured serving cells is the same, for PUSCH transmissions scheduled from serving cell c in subframe n, the UE shall determine the corresponding PHICH resource of serving cell c in subframe $n+k_{PHICH}$, where k_{PHICH} is given in table 9.1.2-1.
- For TDD, if the UE is configured with more than one serving cell and the TDD UL/DL configuration of at least two configured serving cells is not the same, or if the UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell , or for FDD-TDD and serving cell c frame structure type 2, for PUSCH transmissions scheduled from serving cell c in subframe n, the UE shall determine the corresponding PHICH resource of serving cell c in subframe $n+k_{PHICH}$, where k_{PHICH} is given in table 9.1.2-1, where the "TDD UL/DL Configuration" in the rest of this subclause refers to the UL-reference UL/DL configuration (defined in subclause 8.0) of the serving cell corresponding to the PUSCH transmission.

If a UE is configured with multiple TAGs, for PUSCH transmissions on subframe n for a secondary cell c scheduled by a Random Access Response grant corresponding to a random access preamble transmission for the secondary cell c,

- For TDD, if the UE is configured with more than one serving cell and the TDD UL/DL configuration of at least two configured serving cells is not the same, or if the UE is configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, or for FDD-TDD and serving cell c frame structure type 2, the "TDD UL/DL Configuration" in the rest of this subclause refers to the UL-reference UL/DL configuration (defined in subclause 8.0) of secondary cell c.
- If the UE is not configured to monitor PDCCH/EPDCCH with carrier indicator field corresponding to secondary cell c in another serving cell, the UE shall determine the corresponding PHICH resource on the secondary cell c in subframe $n+k_{PHICH}$, where
  - k_{PHICH} is always 4 for FDD and where k_{PHICH} is given in table 9.1.2-1 for TDD.
  - k_{PHICH} is 4 for FDD-TDD and secondary cell c frame structure type 1.
  - k_{PHICH} is given in table 9.1.2-1 for FDD-TDD and secondary cell c frame structure type 2
- If the UE is configured to monitor PDCCH/EPDCCH with carrier indicator field corresponding to secondary cell c in another serving cell $c1$, the UE configured with multiple TAGs shall determine the corresponding PHICH resource on the serving cell $c1$ in subframe $n+k_{PHICH}$, where
  - k_{PHICH} is always 4 for FDD and where k_{PHICH} is given in table 9.1.2-1 for TDD.
  - k_{PHICH} is 4 for FDD-TDD and primary cell frame structure type 1 and frame structure type 1 for secondary cell c and serving cell $c1$

- k_{PHICH} is given in table 9.1.2-1 for FDD-TDD and serving cell c frame structure type 2
- k_{PHICH} is 6 for FDD-TDD and serving cell c frame structure type 1 and serving cell $c1$ frame structure type 2

For subframe bundling operation, the corresponding PHICH resource is associated with the last subframe in the bundle.

Table 9.1.2-1: k_{PHICH} for TDD

TDD UL/DL Configuration	subframe index n									
	0	1	2	3	4	5	6	7	8	9
0			4	7	6			4	7	6
1			4	6				4	6	
2			6					6		
3			6	6	6					
4			6	6						
5			6							
6			4	6	6			4	7	

The PHICH resource is identified by the index pair $(n_{PHICH}^{group}, n_{PHICH}^{seq})$ where n_{PHICH}^{group} is the PHICH group number and n_{PHICH}^{seq} is the orthogonal sequence index within the group as defined by:

$$n_{PHICH}^{group} = (I_{PRB\_RA} + n_{DMRS}) \bmod N_{PHICH}^{group} + I_{PHICH} N_{PHICH}^{group}$$
$$n_{PHICH}^{seq} = (\lfloor I_{PRB\_RA} / N_{PHICH}^{group} \rfloor + n_{DMRS}) \bmod 2N_{SF}^{PHICH}$$

where

- n_{DMRS} is mapped from the cyclic shift for DMRS field (according to Table 9.1.2-2) in the most recent PDCCH with uplink DCI format [4] for the transport block(s) associated with the corresponding PUSCH transmission. n_{DMRS} shall be set to zero, if there is no PDCCH with uplink DCI format for the same transport block, and
  - if the initial PUSCH for the same transport block is semi-persistently scheduled, or
  - if the initial PUSCH for the same transport block is scheduled by the random access response grant .
- N_{SF}^{PHICH} is the spreading factor size used for PHICH modulation as described in subclause 6.9.1 in [3].
- $I_{PRB\_RA} = \begin{cases} I_{PRB\_RA}^{lowest\_index} & \text{for the first TB of a PUSCH with associated PDCCH or for the case of no associated PDCCH when the number of negatively acknowledged TBs is not equal to the number of TBs indicated in the most recent PDCCH associated with the corresponding PUSCH} \\ I_{PRB\_RA}^{lowest\_index} + 1 & \text{for a second TB of a PUSCH with associated PDCCH} \end{cases}$

  where $I_{PRB\_RA}^{lowest\_index}$ is the lowest PRB index in the first slot of the corresponding PUSCH transmission
- N_{PHICH}^{group} is the number of PHICH groups configured by higher layers as described in subclause 6.9 of [3],
- $I_{PHICH} = \begin{cases} 1 & \text{for TDD UL/DL configuration 0 with PUSCH transmission in subframe } n = 4 \text{ or } 9 \\ 0 & \text{otherwise} \end{cases}$

Table 9.1.2-2: Mapping between n_{DMRS} and the cyclic shift for DMRS field in PDCCH with uplink DCI format in [4]

Cyclic Shift for DMRS Field in PDCCH with uplink DCI format in [4]	n_{DMRS}
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

9.1.3 Control Format Indicator (CFI) assignment procedure

PHICH duration is signalled by higher layers according to Table 6.9.3-1 in [3]. The duration signalled puts a lower limit on the size of the control region determined from the control format indicator (CFI). When $N_{\mathrm{RB}}^{\mathrm{DL}} > 10$, if extended PHICH duration is indicated by higher layers then the UE shall assume that CFI is equal to PHICH duration.

In subframes indicated by higher layers to decode PMCH, when $N_{\mathrm{RB}}^{\mathrm{DL}} > 10$, a UE may assume that CFI is equal to the value of the higher layer parameter *non-MBSFNregionLength* [11].

9.1.4 EPDCCH assignment procedure

For each serving cell, higher layer signalling can configure a UE with one or two EPDCCH-PRB-sets for EPDCCH monitoring. The PRB-pairs corresponding to an EPDCCH-PRB-set are indicated by higher layers as described in subclause 9.1.4.4. Each EPDCCH-PRB-set consists of set of ECCEs numbered from 0 to $N_{\mathrm{ECCE},p,k} - 1$ where $N_{\mathrm{ECCE},p,k}$ is the number of ECCEs in EPDCCH-PRB-set p of subframe k. Each EPDCCH-PRB-set can be configured for either localized EPDCCH transmission or distributed EPDCCH transmission.

The UE shall monitor a set of EPDCCH candidates on one or more activated serving cells as configured by higher layer signalling for control information, where monitoring implies attempting to decode each of the EPDCCHs in the set according to the monitored DCI formats.

The set of EPDCCH candidates to monitor are defined in terms of EPDCCH UE-specific search spaces.

For each serving cell, the subframes in which the UE monitors EPDCCH UE-specific search spaces are configured by higher layers.

The UE shall not monitor EPDCCH

- For TDD and normal downlink CP, in special subframes for the special subframe configurations 0 and 5 shown in Table 4.2-1 of [3].
- For TDD and extended downlink CP, in special subframes for the special subframe configurations 0, 4 and 7 shown in Table 4.2-1 of [3].
- In subframes indicated by higher layers to decode PMCH.
- For TDD and if the UE is configured with different UL/DL configurations for the primary and a secondary cell, in a downlink subframe on the secondary cell when the same subframe on the primary cell is a special subframe and the UE is not capable of simultaneous reception and transmission on the primary and secondary cells.

An EPDCCH UE-specific search space $ES_k^{(L)}$ at aggregation level $L \in \{1,2,4,8,16,32\}$ is defined by a set of EPDCCH candidates.

For an EPDCCH-PRB-set p, the ECCEs corresponding to EPDCCH candidate *m* of the search space $ES_k^{(L)}$ are given by

$$L\left\{(Y_{p,k}+\left\lfloor\frac{m\cdot N_{ECCE,p,k}}{L\cdot M_p^{(L)}}\right\rfloor+b)\bmod\left\lfloor N_{\mathrm{ECCE},p,k}/L\right\rfloor\right\}+i$$

where

$Y_{p,k}$ is defined below,

$i=0,\cdots,L-1$

$b=n_{CI}$ if the UE is configured with a carrier indicator field for the serving cell on which EPDCCH is monitored, otherwise $b=0$

n_{CI} is the carrier indicator field value,

$m=0,1,\ldots M_p^{(L)}-1$,

If the UE is not configured with a carrier indicator field for the serving cell on which EPDCCH is monitored, $M_p^{(L)}$ is the number of EPDCCH candidates to monitor at aggregation level L in EPDCCH-PRB-set p for the serving cell on which EPDCCH is monitored, as given in Tables 9.1.4-1a, 9.1.4-1b, 9.1.4-2a, 9.1.4-2b, 9.1.4-3a, 9.1.4-3b, 9.1.4-4a, 9.4.4-4b, 9.1.4-5a, 9.1.4-5b below; otherwise, $M_p^{(L)}$ is the number of EPDCCH candidates to monitor at aggregation level L in EPDCCH-PRB-set p for the serving cell indicated by n_{CI}.

Note that the carrier indicator field value is the same as *ServCellIndex* given in [11].

A UE is not expected to monitor an EPDCCH candidate, if an ECCE corresponding to that EPDCCH candidate is mapped to a PRB pair that overlaps in frequency with a transmission of either PBCH or primary or secondary synchronization signals in the same subframe.

If a UE is configured with two EPDCCH-PRB-sets with the same $n_{\mathrm{ID},i}^{\mathrm{EPDCCH}}$ value (where $n_{\mathrm{ID},i}^{\mathrm{EPDCCH}}$ is defined in subclause 6.10.3A.1 in [3]), if the UE receives an EPDCCH candidate with a given DCI payload size corresponding to one of the EPDCCH-PRB-sets and mapped only to a given set of REs (as described in subclause 6.8A.5 in [3]), and if the UE is also configured to monitor an EPDCCH candidate with the same DCI payload size and corresponding to the other EPDCCH-PRB-set and which is mapped only to the same set of REs, and if the number of the first ECCE of the received EPDCCH candidate is used for determining PUCCH resource for HARQ-ACK transmission (as described in subclause 10.1.2 and subclause 10.1.3), the number of the first ECCE shall be determined based on EPDCCH-PRB-set $p=0$.

The variable $Y_{p,k}$ is defined by

$$Y_{p,k}=(A_p\cdot Y_{p,k-1})\bmod D$$

where $Y_{p,-1}=n_{\mathrm{RNTI}}\neq 0$, $A_0=39827$, $A_1=39829$, $D=65537$ and $k=\lfloor n_s/2\rfloor$, n_s is the slot number within a radio frame. The RNTI value used for n_{RNTI} is defined in subclause 7.1 in downlink and subclause 8 in uplink. The DCI formats that the UE shall monitor depend on the configured transmission mode per each serving cell as defined in subclause 7.1.

The aggregation levels defining the search spaces and the number of monitored EPDCCH candidates is given as follows

- For a UE configured with only one EPDCCH-PRB-set for distributed transmission, the aggregation levels defining the search spaces and the number of monitored EPDCCH candidates are listed in Table 9.1.4-1a, Table 9.1.4-1b.
- For a UE configured with only one EPDCCH-PRB-set for localized transmission, the aggregation levels defining the search spaces and the number of monitored EPDCCH candidates are listed in Table 9.1.4-2a, Table 9.1.4-2b.
- For a UE configured with two EPDCCH-PRB-sets for distributed transmission, the aggregation levels defining the search spaces and the number of monitored EPDCCH candidates are listed in Table 9.1.4-3a, 9.1.4-3b.
- For a UE configured with two EPDCCH-PRB-sets for localized transmission, the aggregation levels defining the search spaces and the number of monitored EPDCCH candidates are listed in Table 9.1.4-4a, 9.4.4-4b.
- For a UE configured with one EPDCCH-PRB-set for distributed transmission, and one EPDCCH-PRB-set for localized transmission, the aggregation levels defining the search spaces and the number of monitored EPDCCH candidates are listed in Table 9.1.4-5a, 9.1.4-5b.

If the UE is not configured with a carrier indicator field for the serving cell on which EPDCCH is monitored, $\hat{N}_{\mathrm{RB}}^{\mathrm{DL}} = N_{\mathrm{RB}}^{\mathrm{DL}}$ of the serving cell on which EPDCCH is monitored. If the UE is configured with a carrier indicator field for the serving cell on which EPDCCH is monitored, $\hat{N}_{\mathrm{RB}}^{\mathrm{DL}} = N_{\mathrm{RB}}^{\mathrm{DL}}$ of the serving cell indicated by n_{CI}.

For Tables 9.1.4-1a, 9.1.4-1b, 9.1.4-2a, 9.1.4-2b, 9.1.4-3a, 9.1.4-3b, 9.1.4-4a, 9.4.4-4b, 9.1.4-5a, 9.1.4-5b

- Case 1 applies
  - for normal subframes and normal downlink CP when DCI formats 2/2A/2B/2C/2D are monitored and $\hat{N}_{\mathrm{RB}}^{\mathrm{DL}} \geq 25$, or
  - for special subframes with special subframe configuration 3,4,8 and normal downlink CP when DCI formats 2/2A/2B/2C/2D are monitored and $\hat{N}_{\mathrm{RB}}^{\mathrm{DL}} \geq 25$, or
  - for normal subframes and normal downlink CP when DCI formats 1A/1B/1D/1/2/2A/2B/2C/2D/0/4 are monitored, and when $n_{\mathrm{EPDCCH}} < 104$ (n_{EPDCCH} defined in subclause 6.8A.1 in [3]), or
  - for special subframes with special subframe configuration 3, 4, 8 and normal downlink CP when DCI formats 1A/1B/1D/1/2A/2/2B/2C/2D/0/4 are monitored, and when $n_{\mathrm{EPDCCH}} < 104$ (n_{EPDCCH} defined in subclause 6.8A.1 in [3]);
- Case 2 applies
  - for normal subframes and extended downlink CP when DCI formats 1A/1B/1D/1/2A/2/2B/2C/2D/0/4 are monitored or,
  - for special subframes with special subframe configuration 1,2,6,7,9 and normal downlink CP when DCI formats 1A/1B/1D/1/2A/2/2B/2C/2D/0/4 are monitored , or
  - for special subframes with special subframe configuration 1,2,3,5,6 and extended downlink CP when DCI formats 1A/1B/1D/1/2A/2/2B/2C/2D/0/4 are monitored;
- otherwise
  - Case 3 is applied.

$N_{\mathrm{RB}}^{X_p}$ is the number of PRB-pairs constituting EPDCCH-PRB-set p.

Table 9.1.4-1a: EPDCCH candidates monitored by a UE (One Distributed EPDCCH-PRB-set - Case1, Case 2)

$N_{RB}^{X_p}$	Number of EPDCCH candidates $M_p^{(L)}$ for Case 1					Number of EPDCCH candidates $M_p^{(L)}$ for Case 2				
	L=2	L=4	L=8	L=16	L=32	L=1	L=2	L=4	L=8	L=16
2	4	2	1	0	0	4	2	1	0	0
4	8	4	2	1	0	8	4	2	1	0
8	6	4	3	2	1	6	4	3	2	1

Table 9.1.4-1b: EPDCCH candidates monitored by a UE (One Distributed EPDCCH-PRB-set – Case 3)

$N_{RB}^{X_p}$	Number of EPDCCH candidates $M_p^{(L)}$ for Case 3				
	L=1	L=2	L=4	L=8	L=16
2	8	4	2	1	0
4	4	5	4	2	1
8	4	4	4	2	2

Table 9.1.4-2a: EPDCCH candidates monitored by a UE (One Localized EPDCCH-PRB-set - Case1, Case 2)

$N_{RB}^{X_p}$	Number of EPDCCH candidates $M_p^{(L)}$ for Case 1				Number of EPDCCH candidates $M_p^{(L)}$ for Case 2			
	L=2	L=4	L=8	L=16	L=1	L=2	L=4	L=8
2	4	2	1	0	4	2	1	0
4	8	4	2	1	8	4	2	1
8	6	6	2	2	6	6	2	2

Table 9.1.4-2b: EPDCCH candidates monitored by a UE (One Localized EPDCCH-PRB-set – Case 3)

$N_{RB}^{X_p}$	Number of EPDCCH candidates $M_p^{(L)}$ for Case 3			
	L=1	L=2	L=4	L=8
2	8	4	2	1
4	6	6	2	2
8	6	6	2	2

Table 9.1.4-3a: EPDCCH candidates monitored by a UE (Two Distributed EPDCCH-PRB-sets - Case1, Case 2)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $\left[M_{p1}^{(L)}, M_{p2}^{(L)}\right]$ for Case 1					Number of EPDCCH candidates $\left[M_{p1}^{(L)}, M_{p2}^{(L)}\right]$ for Case 2				
		L=2	L=4	L=8	L=16	L=32	L=1	L=2	L=4	L=8	L=16
2	2	4,4	2,2	1,1	0,0	0,0	4,4	2,2	1,1	0,0	0,0
4	4	3,3	3,3	1,1	1,1	0,0	3,3	3,3	1,1	1,1	0,0
8	8	3,3	2,2	1,1	1,1	1,1	3,3	2,2	1,1	1,1	1,1
4	2	5,3	3,2	1,1	1,0	0,0	5,3	3,2	1,1	1,0	0,0
8	2	4,2	4,2	1,1	1,0	1,0	4,2	4,2	1,1	1,0	1,0
8	4	3,3	2,2	2,1	1,1	1,0	3,3	2,2	2,1	1,1	1,0

Table 9.1.4-3b: EPDCCH candidates monitored by a UE (Two Distributed EPDCCH-PRB-sets – Case 3)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 3				
		L=1	L=2	L=4	L=8	L=16
2	2	2,2	3,3	2,2	1,1	0,0
4	4	2,2	2,2	2,2	1,1	1,1
8	8	2,2	2,2	2,2	1,1	1,1
4	2	3,1	3,2	3,1	1,1	1,0
8	2	3,1	4,1	3,1	1,1	1,0
8	4	2,2	2,2	2,2	1,1	1,1

Table 9.1.4-4a: EPDCCH candidates monitored by a UE (Two Localized EPDCCH-PRB-sets - Case1, Case 2)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 1				Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 2			
		L=2	L=4	L=8	L=16	L=1	L=2	L=4	L=8
2	2	4,4	2,2	1,1	0,0	4,4	2,2	1,1	0,0
4	4	3,3	3,3	1,1	1,1	3,3	3,3	1,1	1,1
8	8	3,3	3,3	1,1	1,1	3,3	3,3	1,1	1,1
4	2	4,3	4,2	1,1	1,0	4,3	4,2	1,1	1,0
8	2	5,2	4,2	1,1	1,0	5,2	4,2	1,1	1,0
8	4	3,3	3,3	1,1	1,1	3,3	3,3	1,1	1,1

Table 9.1.4-4b: EPDCCH candidates monitored by a UE (Two Localized EPDCCH-PRB-sets – Case 3)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 3			
		L=1	L=2	L=4	L=8
2	2	3,3	3,3	1,1	1,1
4	4	3,3	3,3	1,1	1,1
8	8	3,3	3,3	1,1	1,1
4	2	4,2	4,2	1,1	1,1
8	2	4,2	4,2	1,1	1,1
8	4	3,3	3,3	1,1	1,1

Table 9.1.4-5a: EPDCCH candidates monitored by a UE (NOTE)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 1					Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 2				
		L=2	L=4	L=8	L=16	L=32	L=1	L=2	L=4	L=8	L=16
2	2	4,4	2,2	1,1	0,0	0,0	4,4	2,2	1,1	0,0	0,0
4	4	4,2	4,3	0,2	0,1	0,0	4,2	4,3	0,2	0,1	0,0
8	8	4,1	4,2	0,2	0,2	0,1	4,1	4,2	0,2	0,2	0,1
2	4	4,3	2,4	0,2	0,1	0,0	4,3	2,4	0,2	0,1	0,0
2	8	4,1	2,2	0,4	0,2	0,1	4,1	2,2	0,4	0,2	0,1
4	2	5,2	4,2	1,1	1,0	0,0	5,2	4,2	1,1	1,0	0,0
4	8	4,1	4,2	0,2	0,2	0,1	4,1	4,2	0,2	0,2	0,1
8	2	5,1	4,2	2,1	1,0	0,0	5,1	4,2	2,1	1,0	0,0
8	4	6,1	4,2	0,2	0,1	0,0	6,1	4,2	0,2	0,1	0,0

NOTE: One oca zed EPDCCH-PRB-set and one d str buted EPDCCH-PRB-set, - Case1, Case 2;
p_1 s the dent ty of the oca zed EPDCCH-PRB-set,
p_2 s the dent ty of the d str buted EPDCCH-PRB-set

Table 9.1.4-5b: EPDCCH candidates monitored by a UE (NOTE)

$N_{RB}^{Xp_1}$	$N_{RB}^{Xp_2}$	Number of EPDCCH candidates $[M_{p1}^{(L)}, M_{p2}^{(L)}]$ for Case 3				
		L=1	L=2	L=4	L=8	L=16
2	2	4,1	4,2	2,2	0,1	0,0
4	4	4,1	4,1	2,2	0,1	0,1
8	8	4,1	4,1	2,2	0,1	0,1
2	4	4,1	4,1	2,2	0,1	0,1
2	8	4,1	4,1	2,2	0,1	0,1
4	2	4,1	4,1	2,2	1,1	0,0
4	8	4,1	4,1	2,2	0,1	0,1
8	2	4,1	4,1	4,1	0,1	0,0
8	4	4,1	4,1	2,2	0,1	0,1

NOTE: One localized EPDCCH-PRB-set and one distributed EPDCCH-PRB-set - Case 3);
p_1 is the identity of the localized EPDCCH-PRB-set,
p_2 is the identity of the distributed EPDCCH-PRB-set)

If the UE is not configured with a carrier indicator field, then the UE shall monitor one EPDCCH UE-specific search space at each of the aggregation levels given by Tables 9.1.4-1a to 9.1.4-5b on each activated serving cell for which it is configured to monitor EPDCCH.

If a UE is configured for EPDCCH monitoring, and if the UE is configured with a carrier indicator field, then the UE shall monitor one or more EPDCCH UE-specific search spaces at each of the aggregation levels given by Tables 9.1.4-1a to 9.1.4-5b on one or more activated serving cells as configured by higher layer signalling.

A UE configured with the carrier indicator field associated with monitoring EPDCCH on serving cell c shall monitor EPDCCH configured with carrier indicator field and with CRC scrambled by C-RNTI in the EPDCCH UE specific search space of serving cell c.

A UE configured with the carrier indicator field associated with monitoring EPDCCH on the primary cell shall monitor EPDCCH configured with carrier indicator field and with CRC scrambled by SPS C-RNTI in the EPDCCH UE specific search space of the primary cell.

For the serving cell on which EPDCCH is monitored, if the UE is not configured with a carrier indicator field, it shall monitor the EPDCCH UE specific search space for EPDCCH without carrier indicator field, if the UE is configured with a carrier indicator field it shall monitor the EPDCCH UE specific search space for EPDCCH with carrier indicator field.

A UE is not expected to monitor the EPDCCH of a secondary cell if it is configured to monitor EPDCCH with carrier indicator field corresponding to that secondary cell in another serving cell. For the serving cell on which EPDCCH is monitored, the UE shall monitor EPDCCH candidates at least for the same serving cell.

A UE configured to monitor EPDCCH candidates in a given serving cell with a given DCI format size with CIF, and CRC scrambled by C- RNTI, where the EPDCCH candidates may have one or more possible values of CIF for the given DCI format size, shall assume that an EPDCCH candidate with the given DCI format size may be transmitted in the given serving cell in any EPDCCH UE specific search space corresponding to any of the possible values of CIF for the given DCI format size.

For the serving cell on which EPDCCH is monitored, a UE is not required to monitor the EPDCCH in a subframe which is configured by higher layers to be part of a positioning reference signal occasion if the positioning reference signal occasion is only configured within MBSFN subframes and the cyclic prefix length used in subframe #0 is normal cyclic prefix.

A UE may assume the same c_{init} value (described in subclause 6.10.3A.1 of [3]) is used for antenna ports 107,108 while monitoring an EPDCCH candidate associated with either antenna port 107 or antenna port 108.
A UE may assume the same c_{init} value (described in subclause 6.10.3A.1 of [3]) is used for antenna ports 109,110 while monitoring an EPDCCH candidate associated with either antenna port 109 or antenna port 110.

9.1.4.1 EPDCCH starting position

For a given serving cell, if the UE is configured via higher layer signalling to receive PDSCH data transmissions according to transmission modes 1-9,

- if the UE is configured with a higher layer parameter *epdcch-StartSymbol-r11*,
  - the starting OFDM symbol for EPDCCH given by index $l_{\mathrm{EPDCCHStart}}$ in the first slot in a subframe is determined from the higher layer parameter,
- otherwise
  - the starting OFDM symbol for EPDCCH given by index $l_{\mathrm{EPDCCHStart}}$ in the first slot in a subframe is given by the CFI value in the subframe of the given serving cell when $N_{\mathrm{RB}}^{\mathrm{DL}} > 10$, and $l_{\mathrm{EPDCCHStart}}$ is given by the CFI value+1 in the subframe of the given serving cell when $N_{\mathrm{RB}}^{\mathrm{DL}} \le 10$

For a given serving cell, if the UE is configured via higher layer signalling to receive PDSCH data transmissions according to transmission mode 10, for each EPDCCH-PRB-set, the starting OFDM symbol for monitoring EPDCCH in subframe k is determined from the higher layer parameter *pdsch-Start-r11* (defined in subclause 9.1.4.3) as follows

- if the value of the parameter *pdsch-Start-r11* belongs to {1,2,3,4},
  - $l'_{EPDCCHStart}$ is given by the higher layer parameter *pdsch-Start-r11*
- otherwise
  - $l'_{EPDCCHStart}$ is given by the CFI value in subframe k of the given serving cell when $N_{\mathrm{RB}}^{\mathrm{DL}} > 10$, and $l'_{EPDCCHStart}$ is given by the CFI value+1 in subframe k of the given serving cell when $N_{\mathrm{RB}}^{\mathrm{DL}} \le 10$
- if subframe k is indicated by the higher layer parameter *mbsfn-SubframeConfigList-r11* (defined in subclause 9.1.4.3), or if subframe k is subframe 1 or 6 for frame structure type 2,
  - $l_{EPDCCHStart} = \min(2, l'_{EPDCCHStart})$,
- otherwise
  - $l_{\mathrm{EPDCCHStart}} = l'_{\mathrm{EPDCCHStart}}$.

9.1.4.2 Antenna ports quasi co-location for EPDCCH

For a given serving cell, if the UE is configured via higher layer signalling to receive PDSCH data transmissions according to transmission modes 1-9, and if the UE is configured to monitor EPDCCH,

- the UE may assume the antenna ports 0 – 3, 107 – 110 of the serving cell are quasi co-located (as defined in [3]) with respect to Doppler shift, Doppler spread, average delay, and delay spread.

For a given serving cell, if the UE is configured via higher layer signalling to receive PDSCH data transmissions according to transmission mode 10, and if the UE is configured to monitor EPDCCH, for each EPDCCH-PRB-set,

- if the UE is configured by higher layers to decode PDSCH according to quasi co-location Type-A as described in subclause 7.1.10
  - the UE may assume the antenna ports 0 – 3, 107 – 110 of the serving cell are quasi co-located (as defined in [3]) with respect to Doppler shift, Doppler spread, average delay, and delay spread.
- if the UE is configured by higher layers to decode PDSCH according to quasi co-location Type-B as described in subclause 7.1.10
  - the UE may assume antenna ports 15 – 22 corresponding to the higher layer parameter *qcl-CSI-RS-ConfigNZPId-r11* (defined in subclause 9.1.4.3) and antenna ports 107-110 are quasi co-located (as defined in [3]) with respect to Doppler shift, Doppler spread, average delay, and delay spread.

9.1.4.3 Resource mapping parameters for EPDCCH

For a given serving cell, if the UE is configured via higher layer signalling to receive PDSCH data transmissions according to transmission mode 10, and if the UE is configured to monitor EPDCCH, for each EPDCCH-PRB-set, the UE shall use the parameter set indicated by the higher layer parameter *re-MappingQCL-ConfigId-r11* for determining the EPDCCH RE mapping (defined in subclause 6.8A.5 of [3]) and EPDCCH antenna port quasi co-location. The following parameters for determining EPDCCH RE mapping (as described in subclause 6.8A.5 of [3]) and EPDCCH antenna port quasi co-location are included in the parameter set:

- - crs-PortsCount-r11.
- - crs-FreqShift-r11.
- - mbsfn-SubframeConfigList-r11.
- - csi-RS-ConfigZPId-r11.
- - pdsch-Start-r11.
- - qcl-CSI-RS-ConfigNZPId-r11.
- - csi-RS-ConfigZPId-Second -r12 if the UE is configured with the higher layer parameter EIMTA-MainConfigServCell-r12 for the serving cell, and the UE is configured with CSI subframe sets $C_{\text{CSI},0}$ and $C_{\text{CSI},1}$ for the serving cell.

9.1.4.4 PRB-pair indication for EPDCCH

For a given serving cell, for each EPDCCH-PRB-pair set p, the UE is configured with a higher layer parameter *resourceBlockAssignment-r11* indicating a combinatorial index r corresponding to the PRB index $\{k_i\}_{i=0}^{N_{RB}^{X_p}-1}$, ($1 \le k_i \le N_{RB}^{DL}$, $k_i < k_{i+1}$) and given by equation $r = \sum_{i=0}^{N_{RB}^{X_p}-1} \left\langle \begin{matrix} N_{RB}^{DL} - k_i \\ N_{RB}^{X_p} - i \end{matrix} \right\rangle$, where N_{RB}^{DL} is the number of PRB pairs associated with the downlink bandwidth, $N_{\text{RB}}^{X_p}$ is the number of PRB-pairs constituting EPDCCH-PRB-set p, and is configured by the higher layer parameter *numberPRBPairs-r11,* and $\left\langle \begin{matrix} x \\ y \end{matrix} \right\rangle = \begin{cases} \binom{x}{y} & x \ge y \\ 0 & x < y \end{cases}$ is the extended binomial coefficient, resulting in unique label $r \in \left\{ 0,...,\binom{N_{RB}^{DL}}{N_{RB}^{X_p}} - 1 \right\}$.

9.2 PDCCH/EPDCCH validation for semi-persistent scheduling

A UE shall validate a Semi-Persistent Scheduling assignment PDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the PDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

A UE shall validate a Semi-Persistent Scheduling assignment EPDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the EPDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

Validation is achieved if all the fields for the respective used DCI format are set according to Table 9.2-1 or Table 9.2-1A.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

Table 9.2-1: Special fields for Semi-Persistent Scheduling Activation PDCCH/EPDCCH Validation

	DCI format 0	DCI format 1/1A	DCI format 2/2A/2B/2C/2D
TPC command for scheduled PUSCH	set to '00'	N/A	N/A
Cyclic shift DM RS	set to '000'	N/A	N/A
Modulation and coding scheme and redundancy version	MSB s set to '0'	N/A	N/A
HARQ process number	N/A	FDD: set to '000' TDD: set to '0000'	FDD: set to '000' TDD: set to '0000'
Modulation and coding scheme	N/A	MSB s set to '0'	For the enab ed transport b ock: MSB s set to '0'
Redundancy version	N/A	set to '00'	For the enab ed transport b ock: set to '00'

Table 9.2-1A: Special fields for Semi-Persistent Scheduling Release PDCCH/EPDCCH Validation

	DCI format 0	DCI format 1A
TPC command for scheduled PUSCH	set to '00'	N/A
Cyclic shift DM RS	set to '000'	N/A
Modulation and coding scheme and redundancy version	set to '11111'	N/A
Resource block assignment and hopping resource allocation	Set to a '1's	N/A
HARQ process number	N/A	FDD: set to '000' TDD: set to '0000'
Modulation and coding scheme	N/A	set to '11111'
Redundancy version	N/A	set to '00'
Resource block assignment	N/A	Set to a '1's

For the case that the DCI format indicates a semi-persistent downlink scheduling activation, the TPC command for PUCCH field shall be used as an index to one of the four PUCCH resource values configured by higher layers, with the mapping defined in Table 9.2-2

Table 9.2-2: PUCCH resource value for downlink semi-persistent scheduling

Value of 'TPC command for PUCCH'	$n_{\mathrm{PUCCH}}^{(1,p)}$
'00'	The f rst PUCCH resource va ue conf gured by the h gher ayers
'01'	The second PUCCH resource va ue conf gured by the h gher ayers
'10'	The th rd PUCCH resource va ue conf gured by the h gher ayers
'11'	The fourth PUCCH resource va ue conf gured by the h gher ayers

9.3 PDCCH/EPDCCH control information procedure

A UE shall discard the PDCCH/EPDCCH if consistent control information is not detected.

10 Physical uplink control channel procedures

10.1 UE procedure for determining physical uplink control channel assignment

If the UE is configured for a single serving cell and is not configured for simultaneous PUSCH and PUCCH transmissions, then in subframe n uplink control information (UCI) shall be transmitted

- on PUCCH using format 1/1a/1b/3 or 2/2a/2b if the UE is not transmitting PUSCH
- on PUSCH if the UE is transmitting PUSCH in subframe n unless the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case UCI is not transmitted

If the UE is configured for a single serving cell and simultaneous PUSCH and PUCCH transmission, then in subframe n UCI shall be transmitted

- on PUCCH using format 1/1a/1b/3 if the UCI consists only of HARQ-ACK and/or SR
- on PUCCH using format 2 if the UCI consists only of periodic CSI
- on PUCCH using format 2/2a/2b/3 if the UCI consists of periodic CSI and HARQ-ACK and if the UE is not transmitting PUSCH
- on PUCCH and PUSCH if the UCI consists of HARQ-ACK/HARQ-ACK+SR/positive SR and periodic/aperiodic CSI and if the UE is transmitting PUSCH in subframe n, in which case the HARQ-ACK/HARQ-ACK+SR/positive SR is transmitted on PUCCH using format 1/1a/1b/3 and the periodic/aperiodic CSI transmitted on PUSCH unless the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case periodic/aperiodic CSI is not transmitted

If the UE is configured with more than one serving cell and is not configured for simultaneous PUSCH and PUCCH transmission, then in subframe n UCI shall be transmitted

- on PUCCH using format 1/1a/1b/3 or 2/2a/2b if the UE is not transmitting PUSCH
- on PUSCH of the serving cell given in subclause 7.2.1 if the UCI consists of aperiodic CSI or aperiodic CSI and HARQ-ACK
- on primary cell PUSCH if the UCI consists of periodic CSI and/or HARQ-ACK and if the UE is transmitting on the primary cell PUSCH in subframe n unless the primary cell PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case UCI is not transmitted
- on PUSCH of the secondary cell with smallest *SCellIndex* if the UCI consists of periodic CSI and/or HARQ-ACK and if the UE is not transmitting PUSCH on primary cell but is transmitting PUSCH on at least one secondary cell

If the UE is configured with more than one serving cell and simultaneous PUSCH and PUCCH transmission, then in subframe n UCI shall be transmitted

- on PUCCH using format 1/1a/1b/3 if the UCI consists only of HARQ-ACK and/or SR
- on PUCCH using format 2 if the UCI consists only of periodic CSI
- as described in subclause 10.1.1, if the UCI consists of periodic CSI and HARQ-ACK and if the UE is not transmitting on PUSCH
- on PUCCH and primary cell PUSCH if the UCI consists of HARQ-ACK and periodic CSI and the UE is transmitting PUSCH on the primary cell, in which case the HARQ-ACK is transmitted on PUCCH using format 1a/1b/3 and the periodic CSI is transmitted on PUSCH unless the primary cell PUSCH transmission

corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case periodic CSI is not transmitted

- on PUCCH and PUSCH of the secondary cell with the smallest *SCellIndex* if the UCI consists of HARQ-ACK and periodic CSI and if the UE is not transmitting PUSCH on primary cell but is transmitting PUSCH on at least one secondary cell, in which case, the HARQ-ACK is transmitted on PUCCH using format 1a/1b/3 and the periodic CSI is transmitted on PUSCH
- on PUCCH and PUSCH if the UCI consists of HARQ-ACK/HARQ-ACK+SR/positive SR and aperiodic CSI in which case the HARQ-ACK/HARQ-ACK+SR/positive SR is transmitted on PUCCH using format 1/1a/1b/3 and the aperiodic CSI is transmitted on PUSCH of the serving cell given in subclause 7.2.1

If the UE is configured with more than one serving cell, then reporting prioritization and collision handling of periodic CSI reports of a certain PUCCH reporting type is given in subclause 7.2.2.

A UE transmits PUCCH only on the primary cell.

A UE is configured by higher layers to transmit PUCCH on one antenna port $(p = p_0)$ or two antenna ports $(p \in [p_0, p_1])$.

For FDD or FDD-TDD and primary cell frame structure 1, with two configured serving cells and PUCCH format 1b with channel selection or for FDD with two or more configured serving cells and PUCCH format 3, $n_{\text{HARQ}} = \sum_{c=0}^{N_{cells}^{DL}-1} N_c^{\text{received}}$ where N_{cells}^{DL} is the number of configured cells and N_c^{received} is the number of transport blocks or the SPS release PDCCH/EPDCCH, if any, received in subframe $n-4$ in serving cell c.

For TDD and a UE not configured with the parameter *EIMTA-MainConfigServCell-r12* for any serving cell, if a UE is configured with one serving cell, or the UE is configured with more than one serving cell and the UL/DL configurations of all serving cells are the same, then

- For TDD with two configured serving cells and PUCCH format 1b with channel selection and a subframe *n* with *M = 1*, or for TDD UL/DL configuration 0 and PUCCH format 3, $n_{\text{HARQ}} = \sum_{c=0}^{N_{cells}^{DL}-1} \sum_{k \in K} N_{k,c}^{\text{received}}$, where $N_{k,c}^{\text{received}}$ is the number of transport blocks or the SPS release PDCCH/EPDCCH, if any, received in subframe $n-k$ in serving cell c, where $k \in K$, and *M* is the number of elements in *K*.
- For TDD UL/DL configurations 1-6 and PUCCH format 3, or for TDD with two configured serving cells and PUCCH format 1b with channel selection and *M* = 2, $n_{\text{HARQ}} = \sum_{c=0}^{N_{cells}^{DL}-1} \left(\left(\left(V_{\text{DAI},c}^{\text{DL}} - U_{\text{DAI},c} \right) \bmod 4 \right) \cdot n_c^{\text{ACK}} + \sum_{k \in K} N_{k,c}^{\text{received}} \right)$ where $V_{\text{DAI,c}}^{\text{DL}}$ is the $V_{\text{DAI}}^{\text{DL}}$ in serving cell c, $U_{\text{DAI, c}}$ is the U_{DAI} in serving cell c, and n_c^{ACK} is the number of HARQ-ACK bits corresponding to the configured DL transmission mode on serving cell c. In case spatial HARQ-ACK bundling is applied, $n_c^{ACK} = 1$ and $N_{k,c}^{\text{received}}$ is the number of PDCCH/EPDCCH or PDSCH without a corresponding PDCCH/EPDCCH received in subframe $n-k$ and serving cell c, where $k \in K$ and *M* is the number of elements in *K*. In case spatial HARQ-ACK bundling is not applied, $N_{k,c}^{\text{received}}$ is the number of transport blocks received or the SPS release PDCCH/EPDCCH received in subframe $n-k$ in serving cell c, where $k \in K$ and *M* is the number of elements in *K*. $V_{\text{DAI, c}}^{\text{DL}}$ =0 if no transport block or SPS release PDCCH/EPDCCH is detected in subframe(s) $n-k$ in serving cell c, where $k \in K$.
- For TDD with two configured serving cells and PUCCH format 1b with channel selection and *M* = 3 or 4, $n_{\text{HARQ}} = 2$ if UE receives PDSCH or PDCCH/EPDCCH indicating downlink SPS release only on one serving cell within subframes $n-k$,where $k \in K$;otherwise $n_{\text{HARQ}} = 4$.

For TDD if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations, or if the UE is configured with the parameter *EIMTA-MainConfigServCell-r12* for at least one serving cell, or for FDD-TDD and primary cell frame structure 2, then

- For PUCCH format 3, or for two configured serving cells and PUCCH format 1b with channel selection and $M \le 2$ (defined in subclause 10.1.3.2.1 for TDD and subclause 10.1.3A for FDD-TDD), $n_{\mathrm{HARQ}} = \sum_{c=0}^{N_{cells}^{DL}-1} \left(\left(V_{\mathrm{DAI},c}^{\mathrm{DL}} - U_{\mathrm{DAI},c} \right) \bmod 4 \right) \cdot n_c^{\mathrm{ACK}} + \sum_{k \in K} N_{k,c}^{\mathrm{received}} \right)$ where $V_{\mathrm{DAI},c}^{\mathrm{DL}}$ is the $V_{\mathrm{DAI}}^{\mathrm{DL}}$ in serving cell c, $U_{\mathrm{DAI,c}}$ is the U_{DAI} in serving cell c, and n_c^{ACK} is the number of HARQ-ACK bits corresponding to the configured DL transmission mode on serving cell c. In case spatial HARQ-ACK bundling is applied, $n_c^{\mathrm{ACK}} = 1$ and $N_{k,c}^{\mathrm{received}}$ is the number of PDCCH/EPDCCH or PDSCH without a corresponding PDCCH/EPDCCH received in subframe $n-k$ and serving cell c, where $k \in K$ and $K = K_c$ (defined in subclause 7.3.2.2 for TDD and subclause 7.3.4 for FDD-TDD). In case spatial HARQ-ACK bundling is not applied, $N_{k,c}^{\mathrm{received}}$ is the number of transport blocks received or the SPS release PDCCH/EPDCCH received in subframe $n-k$ in serving cell c, where $k \in K$ and $K = K_c$ (defined in subclause 7.3.2.2 for TDD and subclause 7.3.4 for FDD-TDD). $V_{\mathrm{DAI,c}}^{\mathrm{DL}}$ =0 if no transport block or SPS release PDCCH/EPDCCH is detected in subframe(s) $n-k$ in serving cell c, where $k \in K$ and $K = K_c$ (defined in subclause 7.3.2.2 for TDD and subclause 7.3.4 for FDD-TDD). For a serving cell c, set $V_{\mathrm{DAI,c}}^{\mathrm{DL}} = U_{\mathrm{DAI,c}}$ if the DL-reference UL/DL configuration (defined in subclause 10.2) for serving cell c is TDD UL/DL configuration 0,
- For two configured serving cells and PUCCH format 1b with channel selection and M = 3 or 4 (defined in subclause 10.1.3.2.1 for TDD and subclause 10.1.3A for FDD-TDD), $n_{\mathrm{HARQ}} = 2$ if UE receives PDSCH or PDCCH/EPDCCH indicating downlink SPS release only on one serving cell within subframes $n-k$,where $k \in K$ and $K = K_c$ (defined in subclause 7.3.2.2 for TDD and subclause 7.3.4 for FDD-TDD); otherwise $n_{\mathrm{HARQ}} = 4$.

Throughout the following subclauses, subframes are numbered in monotonically increasing order; if the last subframe of a radio frame is denoted as k, the first subframe of the next radio frame is denoted as $k+1$.

Throughout the following subclauses, if the UE is configured with higher layer parameter *n1PUCCH-AN-r11* then $N_{\mathrm{PUCCH}}^{(1)}$ is given by *n1PUCCH-AN-r11*, else $N_{\mathrm{PUCCH}}^{(1)}$ is given by higher layer parameter *n1PUCCH-AN*.

10.1.1 PUCCH format information

Using the PUCCH formats defined in subclause 5.4.1 and 5.4.2 in [3], the following combinations of UCI on PUCCH are supported:

- Format 1a for 1-bit HARQ-ACK or in case of FDD or FDD-TDD primary cell frame structure type 1 for 1-bit HARQ-ACK with positive SR.
- Format 1b for 2-bit HARQ-ACK or for 2-bit HARQ-ACK with positive SR.
- Format 1b for up to 4-bit HARQ-ACK with channel selection when the UE is configured with more than one serving cell or, in the case of TDD, when the UE is configured with a single serving cell.
- Format 1 for positive SR.
- Format 2 for a CSI report when not multiplexed with HARQ-ACK.
- Format 2a for a CSI report multiplexed with 1-bit HARQ-ACK for normal cyclic prefix.
- Format 2b for a CSI report multiplexed with 2-bit HARQ-ACK for normal cyclic prefix.
- Format 2 for a CSI report multiplexed with HARQ-ACK for extended cyclic prefix.

- Format 3 for up to 10-bit HARQ-ACK for FDD or FDD-TDD primary cell frame structure type 1 and for up to 20-bit HARQ-ACK for TDD and for up to 21 bit HARQ-ACK for FDD-TDD primary cell frame structure type 2.

- Format 3 for up to 11-bit corresponding to 10-bit HARQ-ACK and 1-bit positive/negative SR for FDD or FDD-TDD and for up to 21-bit corresponding to 20-bit HARQ-ACK and 1-bit positive/negative SR for TDD and for up to 22-bit corresponding to 21-bit HARQ-ACK and 1-bit positive/negative SR for FDD-TDD primary cell frame structure type 2.

- Format 3 for HARQ-ACK, 1-bit positive/negative SR (if any) and a CSI report for one serving cell.

For a UE configured with PUCCH format 3 and HARQ-ACK transmission on PUSCH or using PUCCH format 3, or for a UE configured with two serving cells and PUCCH format 1b with channel selection and HARQ-ACK transmission on PUSCH, or for UE configured with one serving cell and PUCCH format 1b with channel selection according to Tables 10.1.3-5, 10.1.3-6, 10.1.3-7 and HARQ-ACK transmission on PUSCH:

- if the configured downlink transmission mode for a serving cell supports up to 2 transport blocks and only one transport block is received in a subframe, the UE shall generate a NACK for the other transport block if spatial HARQ-ACK bundling is not applied.

- if neither PDSCH nor PDCCH/EPDCCH indicating downlink SPS release is detected in a subframe for a serving cell, the UE shall generate two NACKs when the configured downlink transmission mode supports up to 2 transport blocks and the UE shall generate a single NACK when the configured downlink transmission mode supports a single transport block.

The scrambling initialization of PUCCH format 2, 2a, 2b and 3 is by C-RNTI.

For a UE that is configured with a single serving cell and is not configured with PUCCH format 3, in case of collision between a periodic CSI report and an HARQ-ACK in a same subframe without PUSCH, the periodic CSI report is multiplexed with HARQ-ACK on PUCCH if the parameter *simultaneousAckNackAndCQI* provided by higher layers is set *TRUE*, otherwise the CSI is dropped.

For TDD and for a UE that is configured with a single serving cell and with PUCCH format 3, in case of collision between a periodic CSI report and an HARQ-ACK in a same subframe without PUSCH, if the parameter *simultaneousAckNackAndCQI* provided by higher layers is set *TRUE* or if the parameter *simultaneousAckNackAndCQI-Format3-r11* provided by higher layers is set *TRUE*, the periodic CSI report is multiplexed with HARQ-ACK or dropped as described in subclause 7.3, otherwise the CSI is dropped.

For FDD or for FDD-TDD and primary cell frame structure type 1 and for a UE that is configured with more than one serving cell, in case of collision between a periodic CSI report and an HARQ-ACK in a same subframe without PUSCH,

- if the parameter simultaneousAckNackAndCQI provided by higher layers is set TRUE and if the HARQ-ACK corresponds to a PDSCH transmission or PDCCH/EPDCCH indicating downlink SPS release only on the primary cell,

  then the periodic CSI report is multiplexed with HARQ-ACK on PUCCH using PUCCH format 2/2a/2b

- else if the UE is configured with PUCCH format 3 and if the parameter *simultaneousAckNackAndCQI-Format3-r11* provided by higher layers is set *TRUE*, and if PUCCH resource is determined according to subclause 10.1.2.2.2, and

  - if the total number of bits in the subframe corresponding to HARQ-ACKs, SR (if any), and the CSI is not larger than 22 or

  - if the total number of bits in the subframe corresponding to spatially bundled HARQ-ACKs, SR (if any), and the CSI is not larger than 22

    then the periodic CSI report is multiplexed with HARQ-ACK on PUCCH using the determined PUCCH format 3 resource according to [4]

- otherwise,

  CSI is dropped.

For TDD or for FDD-TDD and primary cell frame structure type 2 and for a UE that is configured with more than one serving cell, in case of collision between a periodic CSI report and an HARQ-ACK in a same subframe without PUSCH, if the parameter *simultaneousAckNackAndCQI* provided by higher layers is set *TRUE* or if the parameter *simultaneousAckNackAndCQI-Format3-r11* provided by higher layers is set *TRUE*, the periodic CSI report is multiplexed with HARQ-ACK or dropped as described in subclause 7.3, otherwise the CSI is dropped.

In case of collision between a periodic CSI report and an HARQ-ACK in a same subframe with PUSCH, the periodic CSI is multiplexed with the HARQ-ACK in the PUSCH transmission in that subframe if the UE is not configured by higher layers for simultaneous PUCCH and PUSCH transmissions. Otherwise, if the UE is configured by higher layers for simultaneous PUCCH and PUSCH transmissions, the HARQ-ACK is transmitted in the PUCCH and the periodic CSI is transmitted in the PUSCH.

If each of the serving cells configured for the UE has frame structure type 1, UE procedures for HARQ-ACK feedback are given in subclause 10.1.2.

If each of the serving cells configured for the UE has frame structure type 2, UE procedures for HARQ-ACK feedback are given in subclause 10.1.3.

If the UE is configured for more than one serving cell, and if the frame structure type of any two configured serving cells is different, and if the primary cell is frame structure type 1, UE procedure for HARQ-ACK feedback is given in subclause 10.1.2A.

If the UE is configured for more than one serving cell, and if the frame structure type of any two configured serving cells is different, and if the primary cell is frame structure type 2, UE procedure for HARQ-ACK feedback is given in subclause 10.1.3A.

10.1.2 FDD HARQ-ACK feedback procedures

For FDD and for a UE transmitting HARQ-ACK using PUCCH format 1b with channel selection or PUCCH format 3, the UE shall determine the number of HARQ-ACK bits, O, based on the number of configured serving cells and the downlink transmission modes configured for each serving cell. The UE shall use two HARQ-ACK bits for a serving cell configured with a downlink transmission mode that support up to two transport blocks; and one HARQ-ACK bit otherwise.

A UE that supports aggregating at most 2 serving cells with frame structure type 1 shall use PUCCH format 1b with channel selection for transmission of HARQ-ACK when configured with more than one serving cell with frame structure type 1.

A UE that supports aggregating more than 2 serving cells with frame structure type 1 is configured by higher layers to use either PUCCH format 1b with channel selection or PUCCH format 3 for transmission of HARQ-ACK when configured with more than one serving cell with frame structure type 1.

The FDD HARQ-ACK feedback procedure for one configured serving cell is given in subclause 10.1.2.1 and procedures for more than one configured serving cell are given in subclause 10.1.2.2.

10.1.2.1 FDD HARQ-ACK procedure for one configured serving cell

HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) is supported for PUCCH format 1a/1b.

For FDD and one configured serving cell, the UE shall use PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ for transmission of HARQ-ACK in subframe n for $\tilde{p}$ mapped to antenna port p for PUCCH format 1a/1b [3], where

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH in subframe $n-4$, or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$, the UE shall use $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = n_{\text{CCE}} + N_{\text{PUCCH}}^{(1)}$ for antenna port p_0, where n_{CCE} is the number of the first CCE (i.e. lowest CCE index used to construct the PDCCH) used for transmission of the corresponding DCI assignment and $N_{\text{PUCCH}}^{(1)}$ is configured by higher layers. For two antenna port transmission the PUCCH resource for antenna port p_1 is given by $n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = n_{\text{CCE}} + 1 + N_{\text{PUCCH}}^{(1)}$.

- for a PDSCH transmission on the primary cell where there is not a corresponding PDCCH/EPDCCH detected in subframe $n-4$, the value of $n_{\text{PUCCH}}^{(1,\tilde{p})}$ is determined according to higher layer configuration and Table 9.2-2. For a UE configured for two antenna port transmission, a PUCCH resource value in Table 9.2-2 maps to two PUCCH resources with the first PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0.

- for a PDSCH transmission indicated by the detection of a corresponding EPDCCH in subframe $n-4$, or for an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$, the UE shall use

  - if EPDCCH-PRB-set q is configured for distributed transmission
    $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = n_{\text{ECCE,q}} + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$
  - if EPDCCH-PRB-set q is configured for localized transmission
    $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$

  for antenna port p_0, where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1, $N_{\text{PUCCH,q}}^{(e1)}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for localized EPDCCH transmission which is described in subclause 6.8A.5 in [3]. For two antenna port transmission the PUCCH resource for antenna port p_1 is given by

  - if EPDCCH-PRB-set q is configured for distributed transmission
    $n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = n_{\text{ECCE,q}} + 1 + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$
  - if EPDCCH-PRB-set q is configured for localized transmission
    $n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + 1 + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$

Table 10.1.2.1-1: Mapping of ACK/NACK Resource offset Field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D to Δ_{ARO} values

ACK/NACK Resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	Δ_{ARO}
0	0
1	-1
2	-2
3	2

10.1.2.2 FDD HARQ-ACK procedures for more than one configured serving cell

The FDD HARQ-ACK feedback procedures for more than one configured serving cell are either based on a PUCCH format 1b with channel selection HARQ-ACK procedure as described in subclause 10.1.2.2.1 or a PUCCH format 3 HARQ-ACK procedure as described in subclause 10.1.2.2.2.

HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) is supported for PUCCH format 3.

HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) is supported for PUCCH format 1b with channel selection and FDD with two configured serving cells.

10.1.2.2.1 PUCCH format 1b with channel selection HARQ-ACK procedure

For two configured serving cells and PUCCH format 1b with channel selection, the UE shall transmit $b(0)b(1)$ on PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ for $\tilde{p}$ mapped to antenna port p using PUCCH format 1b where

- $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = n_{\text{PUCCH}}^{(1)}$ for antenna port p_0 where $n_{\text{PUCCH}}^{(1)}$ is selected from A PUCCH resources, $n_{\text{PUCCH},j}^{(1)}$ where $0 \le j \le A-1$ and $A \in \{2,3,4\}$, according to Table 10.1.2.2.1-3, Table 10.1.2.2.1-4, Table 10.1.2.2.1-5 in subframe n. HARQ-ACK(j) denotes the ACK/NACK/DTX response for a transport block or SPS release PDCCH/EPDCCH associated with serving cell c, where the transport block and serving cell for HARQ-ACK(j) and A PUCCH resources are given by Table 10.1.2.2.1-1.
- $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, where $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ is selected from A PUCCH resources, $n_{\text{PUCCH},j}^{(1,\tilde{p}_1)}$ configured by higher layers where $0 \le j \le A-1$ and $A \in \{2,3,4\}$, according to Table 10.1.2.2.1-3, Table 10.1.2.2.1-4, Table 10.1.2.2.1-5 by replacing $n_{\text{PUCCH}}^{(1)}$ with $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ and replacing $n_{\text{PUCCH},i}^{(1)}$ with $n_{\text{PUCCH},i}^{(1,\tilde{p}_1)}$ in subframe n, when the UE is configured with two antenna port transmission for PUCCH format 1b with channel selection.

A UE configured with a transmission mode that supports up to two transport blocks on serving cell, c, shall use the same HARQ-ACK response for both the transport blocks in response to a PDSCH transmission with a single transport block or a PDCCH/EPDCCH indicating downlink SPS release associated with the serving cell c.

Table 10.1.2.2.1-1: Mapping of Transport Block and Serving Cell to HARQ-ACK(*j*) for PUCCH format 1b HARQ-ACK channel selection

A	*HARQ-ACK(j)*			
	HARQ-ACK(0)	HARQ-ACK(1)	HARQ-ACK(2)	HARQ-ACK(3)
2	TB1 Pr mary ce	TB1 Secondary ce	NA	NA
3	TB1 Serv ng ce 1	TB2 Serv ng ce 1	TB1 Serv ng ce 2	NA
4	TB1 Pr mary ce	TB2 Pr mary ce	TB1 Secondary ce	TB2 Secondary ce

The UE shall determine the A PUCCH resources, $n_{\text{PUCCH},j}^{(1)}$ associated with HARQ-ACK(j) where $0 \le j \le A-1$ in Table 10.1.2.2.1-1, according to

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH in subframe $n-4$ on the primary cell, or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$ on the primary cell, the PUCCH resource is $n_{\text{PUCCH,j}}^{(1)} = n_{\text{CCE}} + N_{\text{PUCCH}}^{(1)}$, and for transmission mode that supports up to two transport blocks, the PUCCH resource $n_{\text{PUCCH},j+1}^{(1)}$ is given by $n_{\text{PUCCH},j+1}^{(1)} = n_{\text{CCE}} + 1 + N_{\text{PUCCH}}^{(1)}$ where n_{CCE} is the number of the first CCE used for transmission of the corresponding PDCCH and $N_{\text{PUCCH}}^{(1)}$ is configured by higher layers.
- for a PDSCH transmission on the primary cell where there is not a corresponding PDCCH/EPDCCH detected in subframe $n-4$, the value of $n_{\text{PUCCH},j}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2. For transmission mode that supports up to two transport blocks, the PUCCH resource $n_{\text{PUCCH},j+1}^{(1)}$ is given by $n_{\text{PUCCH},j+1}^{(1)} = n_{\text{PUCCH},j}^{(1)} + 1$

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH/EPDCCH in subframe $n-4$ on the secondary cell, the value of $n^{(1)}_{\text{PUCCH},j}$, and the value of $n^{(1)}_{\text{PUCCH},j+1}$ for the transmission mode that supports up to two transport blocks is determined according to higher layer configuration and Table 10.1.2.2.1-2. The TPC field in the DCI format of the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource values from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.1-2. For a UE configured for a transmission mode that supports up to two transport blocks a PUCCH resource value in Table 10.1.2.2.1-2 maps to two PUCCH resources $(n^{(1)}_{\text{PUCCH},j}, n^{(1)}_{\text{PUCCH},j+1})$, otherwise, the PUCCH resource value maps to a single PUCCH resource $n^{(1)}_{\text{PUCCH},j}$.

- for a PDSCH transmission indicated by the detection of a corresponding EPDCCH in subframe $n-4$ on the primary cell, or for an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$ on the primary cell, the PUCCH resource is given by

  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n^{(1)}_{\text{PUCCH,j}} = n_{\text{ECCE,q}} + \Delta_{ARO} + N^{(\text{e1})}_{\text{PUCCH,q}}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n^{(1)}_{\text{PUCCH,j}} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N^{ECCE,q}_{RB}} \right\rfloor \cdot N^{ECCE,q}_{RB} + n' + \Delta_{ARO} + N^{(\text{e1})}_{\text{PUCCH,q}}$$

  where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1, $N^{(\text{e1})}_{\text{PUCCH,q}}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N^{ECCE,q}_{RB}$ for EPDCCH-PRB-set q is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for localized EPDCCH transmission which is described in subclause 6.8A.5 in [3].

  For transmission mode that supports up to two transport blocks, the PUCCH resource $n^{(1)}_{\text{PUCCH},j+1}$ is given by

  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n^{(1)}_{\text{PUCCH,j+1}} = n_{\text{ECCE,q}} + 1 + \Delta_{ARO} + N^{(\text{e1})}_{\text{PUCCH,q}}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n^{(1)}_{\text{PUCCH,j+1}} = \left\lfloor \frac{n_{ECCE,q}}{N^{ECCE,q}_{RB}} \right\rfloor \cdot N^{ECCE,q}_{RB} + 1 + n' + \Delta_{ARO} + N^{(\text{e1})}_{\text{PUCCH,q}}$$

Table 10.1.2.2.1-2: PUCCH Resource Value for HARQ-ACK Resource for PUCCH

Value of 'TPC command for PUCCH'	$n^{(1)}_{\text{PUCCH},j}$ or $(n^{(1)}_{\text{PUCCH},j}, n^{(1)}_{\text{PUCCH},j+1})$
'00'	The 1st PUCCH resource va ue conf gured by the h gher ayers
'01'	The 2nd PUCCH resource va ue conf gured by the h gher ayers
'10'	The 3rd PUCCH resource va ue conf gured by the h gher ayers
'11'	The 4th PUCCH resource va ue conf gured by the h gher ayers
NOTE: $(n^{(1)}_{\text{PUCCH},j}, n^{(1)}_{\text{PUCCH},j+1})$ are determ ned from the f rst and second PUCCH resource sts conf gured by *n1PUCCH-AN-CS-List-r10* n 11], respect ve y.	

Table 10.1.2.2.1-3: Transmission of Format 1b HARQ-ACK channel selection for $A = 2$

HARQ-ACK(0)	HARQ-ACK(1)	$n^{(1)}_{PUCCH}$	$b(0)b(1)$
ACK	ACK	$n^{(1)}_{PUCCH,1}$	1,1
ACK	NACK/DTX	$n^{(1)}_{PUCCH,0}$	1,1
NACK/DTX	ACK	$n^{(1)}_{PUCCH,1}$	0,0
NACK	NACK/DTX	$n^{(1)}_{PUCCH,0}$	0,0
DTX	NACK/DTX	No Transm ss on	

Table 10.1.2.2.1-4: Transmission of Format 1b HARQ-ACK channel selection for $A = 3$

HARQ-ACK(0)	HARQ-ACK(1)	HARQ-ACK(2)	$n^{(1)}_{PUCCH}$	$b(0)b(1)$
ACK	ACK	ACK	$n^{(1)}_{PUCCH,1}$	1,1
ACK	NACK/DTX	ACK	$n^{(1)}_{PUCCH,1}$	1,0
NACK/DTX	ACK	ACK	$n^{(1)}_{PUCCH,1}$	0,1
NACK/DTX	NACK/DTX	ACK	$n^{(1)}_{PUCCH,2}$	1,1
ACK	ACK	NACK/DTX	$n^{(1)}_{PUCCH,0}$	1,1
ACK	NACK/DTX	NACK/DTX	$n^{(1)}_{PUCCH,0}$	1,0
NACK/DTX	ACK	NACK/DTX	$n^{(1)}_{PUCCH,0}$	0,1
NACK/DTX	NACK/DTX	NACK	$n^{(1)}_{PUCCH,2}$	0,0
NACK	NACK/DTX	DTX	$n^{(1)}_{PUCCH,0}$	0,0
NACK/DTX	NACK	DTX	$n^{(1)}_{PUCCH,0}$	0,0
DTX	DTX	DTX	No Transm ss on	

Table 10.1.2.2.1-5: Transmission of Format 1b HARQ-ACK channel selection for $A = 4$

HARQ-ACK(0)	HARQ-ACK(1)	HARQ-ACK(2)	HARQ-ACK(3)	$n^{(1)}_{\text{PUCCH}}$	$b(0)b(1)$
ACK	ACK	ACK	ACK	$n^{(1)}_{\text{PUCCH},1}$	1,1
ACK	NACK/DTX	ACK	ACK	$n^{(1)}_{\text{PUCCH},2}$	0,1
NACK/DTX	ACK	ACK	ACK	$n^{(1)}_{\text{PUCCH},1}$	0,1
NACK/DTX	NACK/DTX	ACK	ACK	$n^{(1)}_{\text{PUCCH},3}$	1,1
ACK	ACK	ACK	NACK/DTX	$n^{(1)}_{\text{PUCCH},1}$	1,0
ACK	NACK/DTX	ACK	NACK/DTX	$n^{(1)}_{\text{PUCCH},2}$	0,0
NACK/DTX	ACK	ACK	NACK/DTX	$n^{(1)}_{\text{PUCCH},1}$	0,0
NACK/DTX	NACK/DTX	ACK	NACK/DTX	$n^{(1)}_{\text{PUCCH},3}$	1,0
ACK	ACK	NACK/DTX	ACK	$n^{(1)}_{\text{PUCCH},2}$	1,1
ACK	NACK/DTX	NACK/DTX	ACK	$n^{(1)}_{\text{PUCCH},2}$	1,0
NACK/DTX	ACK	NACK/DTX	ACK	$n^{(1)}_{\text{PUCCH},3}$	0,1
NACK/DTX	NACK/DTX	NACK/DTX	ACK	$n^{(1)}_{\text{PUCCH},3}$	0,0
ACK	ACK	NACK/DTX	NACK/DTX	$n^{(1)}_{\text{PUCCH},0}$	1,1
ACK	NACK/DTX	NACK/DTX	NACK/DTX	$n^{(1)}_{\text{PUCCH},0}$	1,0
NACK/DTX	ACK	NACK/DTX	NACK/DTX	$n^{(1)}_{\text{PUCCH},0}$	0,1
NACK/DTX	NACK	NACK/DTX	NACK/DTX	$n^{(1)}_{\text{PUCCH},0}$	0,0
NACK	NACK/DTX	NACK/DTX	NACK/DTX	$n^{(1)}_{\text{PUCCH},0}$	0,0
DTX	DTX	NACK/DTX	NACK/DTX	No Transm ss on	

10.1.2.2.2 PUCCH format 3 HARQ-ACK procedure

For PUCCH format 3, the UE shall use PUCCH resource $n^{(3,\tilde{p})}_{\text{PUCCH}}$ or $n^{(1,\tilde{p})}_{\text{PUCCH}}$ for transmission of HARQ-ACK in subframe n for $\tilde{p}$ mapped to antenna port p where

- for a PDSCH transmission only on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-4$, or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$ on the primary cell, the UE shall use PUCCH format 1a/1b and PUCCH resource $n^{(1,\tilde{p})}_{\text{PUCCH}}$ with $n^{(1,\tilde{p}_0)}_{\text{PUCCH}} = n_{\text{CCE}} + N^{(1)}_{\text{PUCCH}}$ for antenna port p_0, where n_{CCE} is the number of the first CCE (i.e. lowest CCE index used to construct the PDCCH) used for transmission of the corresponding PDCCH and $N^{(1)}_{\text{PUCCH}}$ is configured by higher layers. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by $n^{(1,\tilde{p}_1)}_{\text{PUCCH}} = n_{\text{CCE}} + 1 + N^{(1)}_{\text{PUCCH}}$.
- for a PDSCH transmission only on the primary cell where there is not a corresponding PDCCH/EPDCCH detected in subframe $n-4$, the UE shall use PUCCH format 1a/1b and PUCCH resource $n^{(1,\tilde{p})}_{\text{PUCCH}}$ where the value of $n^{(1,\tilde{p})}_{\text{PUCCH}}$ is determined according to higher layer configuration and Table 9.2-2. For a UE configured for two antenna port transmission for PUCCH format 1a/1b, a PUCCH resource value in Table 9.2-2 maps to two PUCCH resources with the first PUCCH resource $n^{(1,\tilde{p}_0)}_{\text{PUCCH}}$ for antenna port p_0 and the second PUCCH

resource $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0.

- for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding PDCCH/EPDCCH in subframe $n-4$, the UE shall use PUCCH format 3 and PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p})}$ where the value of $n_{\text{PUCCH}}^{(3,\tilde{p})}$ is determined according to higher layer configuration and Table 10.1.2.2.2-1. The TPC field in the DCI format of the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource values from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. For a UE configured for two antenna port transmission for PUCCH format 3, a PUCCH resource value in Table 10.1.2.2.2-1 maps to two PUCCH resources with the first PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_0)}$ for antenna port p_0. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted in each DCI format of the corresponding secondary cell PDCCH assignments in a given subframe.
- for a PDSCH transmission only on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-4$, or for a EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-4$ on the primary cell, the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ given by
  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = n_{\text{ECCE,q}} + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

  for antenna port p_0, where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1, $N_{\text{PUCCH,q}}^{(\text{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for localized EPDCCH transmission which is described in subclause 6.8A.5 in [3]. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by.

  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = n_{\text{ECCE,q}} + 1 + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + 1 + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

Table 10.1.2.2.2-1: PUCCH Resource Value for HARQ-ACK Resource for PUCCH

Value of 'TPC command for PUCCH' or 'HARQ-ACK resource offset'	$n_{\mathrm{PUCCH}}^{(3,\tilde{p})}$
'00'	The 1st PUCCH resource va ue conf gured by the h gher ayers
'01'	The 2nd PUCCH resource va ue conf gured by the h gher ayers
'10'	The 3rd PUCCH resource va ue conf gured by the h gher ayers
'11'	The 4th PUCCH resource va ue conf gured by the h gher ayers

10.1.2A FDD-TDD HARQ-ACK feedback procedures for primary cell frame structure type 1

For a UE transmitting HARQ-ACK using PUCCH format 1b with channel selection or PUCCH format 3, the UE shall determine the number of HARQ-ACK bits, O in subframe n, based on the number of configured serving cells with subframe $n-4$ configured as a downlink or special subframe according to the DL-reference UL/DL configuration (defined in subclause 10.2) of each serving cell and the downlink transmission modes configured for each serving cell. The UE shall use two HARQ-ACK bits for a serving cell configured with a downlink transmission mode that support up to two transport blocks; and one HARQ-ACK bit otherwise.

A UE that supports aggregating at most 2 serving cells shall use PUCCH format 1b with channel selection for transmission of HARQ-ACK when configured with primary cell frame structure type 1 and secondary cell frame structure type 2.

A UE that supports aggregating more than 2 serving cells with primary cell frame structure type 1 is configured by higher layers to use either PUCCH format 1b with channel selection or PUCCH format 3 for transmission of HARQ-ACK when configured with more than one serving cell and primary cell frame structure type 1 and at least one secondary cell with frame structure type 2.

For HARQ-ACK transmission in subframe n with PUCCH format 1b with channel selection, the FDD-TDD HARQ-ACK procedure follows HARQ-ACK procedure described in subclause 10.1.2.1 if subframe $n-4$ is an uplink subframe for the secondary cell, and HARQ-ACK procedure described in subclause 10.1.2.2.1 otherwise.

The FDD-TDD HARQ-ACK feedback procedure for PUCCH format 3 HARQ-ACK procedure as described in subclause 10.1.2.2.2.

HARQ-ACK transmission on two antenna ports $(p \in [p_0, p_1])$ is supported for PUCCH format 3.

HARQ-ACK transmission on two antenna ports $(p \in [p_0, p_1])$ is supported for PUCCH format 1b with channel selection and with two configured serving cells.

10.1.3 TDD HARQ-ACK feedback procedures

For TDD and a UE that does not support aggregating more than one serving cell with frame structure type 2, two HARQ-ACK feedback modes are supported by higher layer configuration.

- HARQ-ACK bundling and
- HARQ-ACK multiplexing

For TDD UL/DL configuration 5 and a UE that does not support aggregating more than one serving cell with frame structure type 2 and the UE is not configured with *EIMTA-MainConfigServCell-r12* for the serving cell, only HARQ-ACK bundling is supported.

A UE that supports aggregating more than one serving cell with frame structure type 2 is configured by higher layers to use either PUCCH format 1b with channel selection or PUCCH format 3 for transmission of HARQ-ACK when configured with more than one serving cell with frame structure type 2.

A UE that supports aggregating more than one serving cell with frame structure type 2 and is not configured with the parameter *EIMTA-MainConfigServCell-r12* for any serving cell is configured by higher layers to use HARQ-ACK bundling, PUCCH format 1b with channel selection according to the set of Tables 10.1.3-2/3/4 or according to the set of

Tables 10.1.3-5/6/7, or PUCCH format 3 for transmission of HARQ-ACK when configured with one serving cell with frame structure type 2.

A UE that is configured with the parameter *EIMTA-MainConfigServCell-r12* for at least one serving cell is configured by higher layers to use PUCCH format 1b with channel selection according to the set of Tables 10.1.3-5/6/7, or PUCCH format 3 for transmission of HARQ-ACK.

PUCCH format 1b with channel selection according to the set of Tables 10.1.3-2/3/4 or according to the set of Tables 10.1.3-5/6/7 is not supported for TDD UL/DL configuration 5.

TDD HARQ-ACK bundling is performed per codeword across M multiple downlink or special subframes associated with a single UL subframe *n*, where M is the number of elements in the set K defined in Table 10.1.3.1-1, by a logical AND operation of all the individual PDSCH transmission (with and without corresponding PDCCH/EPDCCH) HARQ-ACKs and ACK in response to PDCCH/EPDCCH indicating downlink SPS release. For one configured serving cell the bundled 1 or 2 HARQ-ACK bits are transmitted using PUCCH format 1a or PUCCH format 1b, respectively.

For TDD HARQ-ACK multiplexing and a subframe *n* with $M > 1$, where M is the number of elements in the set K defined in Table 10.1.3.1-1, spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe is performed by a logical AND operation of all the corresponding individual HARQ-ACKs. PUCCH format 1b with channel selection is used in case of one configured serving cell. For TDD HARQ-ACK multiplexing and a subframe *n* with $M = 1$, spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe is not performed, 1 or 2 HARQ-ACK bits are transmitted using PUCCH format 1a or PUCCH format 1b, respectively for one configured serving cell.

In the case of TDD and more than one configured serving cell with PUCCH format 1b with channel selection and more than 4 HARQ-ACK bits for M multiple downlink or special subframes associated with a single UL subframe *n*, where M is defined in subclause 10.1.3.2.1, and for the configured serving cells, spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe for all configured cells is performed and the bundled HARQ-ACK bits for each configured serving cell is transmitted using PUCCH format 1b with channel selection. For TDD and more than one configured serving cell with PUCCH format 1b with channel selection and up to 4 HARQ-ACK bits for M multiple downlink or special subframes associated with a single UL subframe *n*, where M is defined in subclause 10.1.3.2.1, and for the configured serving cells, spatial HARQ-ACK bundling is not performed and the HARQ-ACK bits are transmitted using PUCCH format 1b with channel selection.

In the case of TDD and more than one configured serving cell with PUCCH format 3 and more than 20 HARQ-ACK bits for M multiple downlink or special subframes associated with a single UL subframe *n*, where M is the number of elements in the set K defined in subclause 10.1.3.2.2 and for the configured serving cells, spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe is performed for each serving cell by a logical AND operation of all of the corresponding individual HARQ-ACKs and PUCCH format 3 is used. For TDD and more than one configured serving cell with PUCCH format 3 and up to 20 HARQ-ACK bits for M multiple downlink or special subframes associated with a single UL subframe *n*, where M is the number of elements in the set K defined in subclause 10.1.3.2.2 and for the configured serving cells, spatial HARQ-ACK bundling is not performed and the HARQ-ACK bits are transmitted using PUCCH format 3.

For TDD with PUCCH format 3, a UE shall determine the number of HARQ-ACK bits, O, associated with an UL subframe *n*

according to $O = \sum_{c=1}^{N_{cells}^{DL}} O_c^{ACK}$ where N_{cells}^{DL} is the number of configured cells, and O_c^{ACK} is the number of HARQ-bits for the *c*-th serving cell defined in subclause 7.3.

TDD HARQ-ACK feedback procedures for one configured serving cell are given in subclause 10.1.3.1 and procedures for more than one configured serving cell are given in subclause 10.1.3.2.

10.1.3.1 TDD HARQ-ACK procedure for one configured serving cell

HARQ-ACK transmission on two antenna ports $(p \in [p_0, p_1])$ is supported for PUCCH format 1a/1b with TDD HARQ-ACK bundling feedback mode and for PUCCH format 3.

A UE that supports aggregating more than one serving cell with frame structure type 2 can be configured by higher layers for HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) for PUCCH format 1b with channel selection.

The TDD HARQ-ACK procedure for a UE configured with PUCCH format 3 is as described in subclause 10.1.3.2.2 when the UE receives PDSCH and/or SPS release PDCCH/EPDCCH only on the primary cell.

If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* for TDD HARQ-ACK bundling or TDD HARQ-ACK multiplexing for one configured serving cell and a subframe *n* with $M = 1$ where M is the number of elements in the set K defined in Table 10.1.3.1-1, the UE shall use PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ for transmission of HARQ-ACK in subframe n for $\tilde{p}$ mapped to antenna port *p* for PUCCH format 1a/1b, where

- If there is PDSCH transmission indicated by the detection of corresponding PDCCH/EPDCCH or there is PDCCH/EPDCCH indicating downlink SPS release within subframe(s) $n-k$, where $k \in K$ and K (defined in Table 10.1.3.1-1) is a set of *M* elements $\{k_0, k_1, \cdots k_{M-1}\}$ depending on the subframe *n* and the UL/DL configuration (defined in Table 4.2-2 in [3]), and if PDCCH indicating PDSCH transmission or downlink SPS release is detected in subframe $n-k_m$, where k_m is the smallest value in set K such that UE detects a PDCCH/EPDCCH indicating PDSCH transmission or downlink SPS release within subframe(s) $n-k$ and $k \in K$, the UE first selects a c value out of {0, 1, 2, 3} which makes $N_c \le n_{\text{CCE}} < N_{c+1}$ and shall use $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = (M-m-1)\cdot N_c + m \cdot N_{c+1} + n_{\text{CCE}} + N_{\text{PUCCH}}^{(1)}$ for antenna port p_0, where $N_{\text{PUCCH}}^{(1)}$ is configured by higher layers, $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, and n_{CCE} is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$ and the corresponding *m*. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for HARQ-ACK bundling for antenna port p_1 is given by $n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = (M-m-1)\cdot N_c + m \cdot N_{c+1} + n_{\text{CCE}} + 1 + N_{\text{PUCCH}}^{(1)}$.
- If there is only a PDSCH transmission where there is not a corresponding PDCCH/EPDCCH detected within subframe(s) $n-k$, where $k \in K$ and K is defined in Table 10.1.3.1-1, the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ with the value of $n_{\text{PUCCH}}^{(1,\tilde{p})}$ is determined according to higher layer configuration and Table 9.2-2. For a UE configured for two antenna port transmission for PUCCH format 1a/1b and HARQ-ACK bundling, a PUCCH resource value in Table 9.2-2 maps to two PUCCH resources with the first PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0.
- If there is PDSCH transmission indicated by the detection of corresponding PDCCH/EPDCCH or there is PDCCH/EPDCCH indicating downlink SPS release within subframe(s) $n-k$, where $k \in K$ and K (defined in Table 10.1.3.1-1) is a set of *M* elements $\{k_0, k_1, \cdots k_{M-1}\}$ depending on the subframe *n* and the UL/DL configuration (defined in Table 4.2-2 in [3]), and if EPDCCH indicating PDSCH transmission or downlink SPS release is detected in subframe $n-k_m$, where k_m is the smallest value in set K such that UE detects a PDCCH/EPDCCH indicating PDSCH transmission or downlink SPS release within subframe(s) $n-k$ and $k \in K$, the UE shall use
  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = n_{\text{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

for antenna port p_0, where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$ and the corresponding m, $N^{(e1)}_{\mathrm{PUCCH,q}}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N^{ECCE,q}_{RB}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for HARQ-ACK bundling for antenna port p_1 is given by

- if EPDCCH-PRB-set q is configured for distributed transmission

$$n^{(1,\tilde{p}_1)}_{\mathrm{PUCCH}} = n_{\mathrm{ECCE,q}} + 1 + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N^{(e1)}_{\mathrm{PUCCH,q}}$$

- if EPDCCH-PRB-set q is configured for localized transmission

$$n^{(1,\tilde{p}_1)}_{\mathrm{PUCCH}} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N^{ECCE,q}_{RB}} \right\rfloor \cdot N^{ECCE,q}_{RB} + 1 + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N^{(e1)}_{\mathrm{PUCCH,q}}$$

Table 10.1.3.1-1: Downlink association set $K: \{k_0, k_1, \cdots k_{M-1}\}$ for TDD

UL/DL Configuration	Subframe *n*									
	0	1	2	3	4	5	6	7	8	9
0	-	-	6	-	4	-	-	6	-	4
1	-	-	7, 6	4	-	-	-	7, 6	4	-
2	-	-	8, 7, 4, 6	-	-	-	-	8, 7, 4, 6	-	-
3	-	-	7, 6, 11	6, 5	5, 4	-	-	-	-	-
4	-	-	12, 8, 7, 11	6, 5, 4, 7	-	-	-	-	-	-
5	-	-	13, 12, 9, 8, 7, 5, 4, 11, 6	-	-	-	-	-	-	-
6	-	-	7	7	5	-	-	7	7	-

Table 10.1.3.1-1A: eIMTA downlink association set $K^A:\{k_0^A,k_1^A,\ldots,k_{M^A-1}^A\}$ for TDD

Higher layer parameter '*eimta-HarqReferenceConfig-r12*'	Higher layer parameter '*subframeAssignment*'	Subframe *n*									
		0	1	2	3	4	5	6	7	8	9
2	0	-	-	7,8,4	-	-	-	-	7,8,4	-	-
	1	-	-	8,4	-	-	-	-	8,4	-	-
	6	-	-	6,8,4	-	-	-	-	8,6,4	-	-
4	0	-	-	12,7,11,8	7,4,5,6	-	-	-	-	-	-
	1	-	-	12,8,11	7,5,6	-	-	-	-	-	-
	3	-	-	12,8	4,7	-	-	-	-	-	-
	6	-	-	12,11,8	4,5,6	-	-	-	-	-	-
5	0	-	-	12,7,11,13,8,4,9,5	-	-	-	-	-	-	-
	1	-	-	13,12,8,11,4,9,5	-	-	-	-	-	-	-
	2	-	-	13,12,9,11,5	-	-	-	-	-	-	-
	3	-	-	13,12,5,4,8,9	-	-	-	-	-	-	-
	4	-	-	13,5,4,6,9	-	-	-	-	-	-	-
	6	-	-	13,12,11,6,8,4,9,5	-	-	-	-	-	-	-

Table 10.1.3.1-2: Mapping of ACK/NACK Resource offset Field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D to Δ_{ARO} values for TDD when $m>0$

ACK/NACK Resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	Δ_{ARO}
0	0
1	$-\sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} - 2$
2	$-\sum_{i1=m-\lceil m/3\rceil}^{m-1} N_{ECCE,q,n-k_{i1}} - 1$
3	2

Table 10.1.3.1-3: Mapping of ACK/NACK Resource offset Field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D to Δ'_{ARO} values for TDD when $i4=M'$ and $i5\neq 0$

ACK/NACK Resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	Δ'_{ARO}
0	0
1	$-\sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} - \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k^A_{i1}} - 2$
2	$-\sum_{i1=\min(i4,\,i4-\delta+i5)}^{i4-1} N'_{ECCE,q,n-k'_{i1}} - \sum_{i1=\max(0,\,i5-\delta)}^{i5-1} N'_{ECCE,q,n-k^A_{i1}} - 1 \quad ,\delta=\left\lceil\frac{(i4+i5)}{3}\right\rceil$
3	2

If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* for TDD HARQ-ACK multiplexing and sub-frame n with $M>1$ and one configured serving cell, where M is the number of elements in the set K defined in Table 10.1.3.1-1, denote $n^{(1)}_{\mathrm{PUCCH},i}$ as the PUCCH resource derived from sub-frame $n-k_i$ and HARQ-ACK(i) as the ACK/NACK/DTX response from sub-frame $n-k_i$, where $k_i\in K$ (defined in Table 10.1.3.1-1) and $0\le i\le M-1$.

- For a PDSCH transmission indicated by the detection of corresponding PDCCH or a PDCCH indicating downlink SPS release in sub-frame $n-k_i$ where $k_i\in K$, the PUCCH resource

$n^{(1)}_{\mathrm{PUCCH},i} = (M-i-1)\cdot N_c + i\cdot N_{c+1} + n_{\mathrm{CCE},i} + N^{(1)}_{\mathrm{PUCCH}}$, where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\mathrm{CCE},i} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N^{\mathrm{DL}}_{\mathrm{RB}} \cdot (N^{\mathrm{RB}}_{\mathrm{sc}} \cdot c - 4)]/36 \right\rfloor\right\}$, $n_{\mathrm{CCE},i}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_i$, and $N^{(1)}_{\mathrm{PUCCH}}$ is configured by higher layers.

- For a PDSCH transmission where there is not a corresponding PDCCH/EPDCCH detected in subframe $n-k_i$, the value of $n^{(1)}_{\mathrm{PUCCH},i}$ is determined according to higher layer configuration and Table 9.2-2.

- For a PDSCH transmission indicated by the detection of corresponding EPDCCH or a EPDCCH indicating downlink SPS release in sub-frame $n-k_i$ where $k_i \in K$, the UE shall use

  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n^{(1)}_{\mathrm{PUCCH,i}} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{i-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$$

  - if EPDCCH-PRB-set q is configured for localized transmission

$$n^{(1)}_{\mathrm{PUCCH,i}} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N^{ECCE,q}_{RB}} \right\rfloor \cdot N^{ECCE,q}_{RB} + \sum_{i1=0}^{i-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$$

  where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_i$, $N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N^{ECCE,q}_{RB}$ for EPDCCH-PRB-set q in subframe $n-k_i$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_i$ which is described in subclause 6.8A.5 in [3]. If $i=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $i>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2, where the variable m in the table is substituted with i. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0.

If a UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*, then $K'=K$ where the set K is defined in Table 10.1.3.1-1 (where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAsssignment*), and M' is the number of elements in set K'.

If a UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*, then the set K for the rest of this subclause is as defined in Sec 10.2, and M is the number of elements for subframe n in the set K

If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* for TDD HARQ-ACK multiplexing and sub-frame n, denote $n^{(1)}_{\mathrm{PUCCH},i0}$ as the PUCCH resource derived from sub-frame $n-k_i$ and HARQ-ACK(i0) as the ACK/NACK/DTX response from sub-frame $n-k_i$, where $k_i \in K$, and $0 \le i \le M-1$.

- $i0$ corresponding to each subframe $n-k_i, \forall i, 0 \le i \le M-1$ is determined as follows

Set $b = 0$;

for $i = 0,1,\ldots M-1$

if the value of k_i is the same as the value of an element k'_{i2} in set K',

$i0$ corresponding to subframe $n - k_i = b$;

$b = b + 1$

end if

end for

for $i = 0,1,\ldots M-1$

if the value of k_i is same as the value of an element k_{i3}^A in set K^A, where $k_{i3}^A \in K^A$ (defined in Table 10.1.3.1-1A)

$i0$ corresponding to subframe $n - k_i = b$;

$b = b + 1$

end if

end for

- For a PDSCH transmission indicated by the detection of corresponding PDCCH or a PDCCH indicating downlink SPS release in sub-frame $n - k_i$,

  - if the value of k_i is same as the value of an element k'_{i2} in set K', the PUCCH resource $n_{\text{PUCCH},i0}^{(1)}$ is given by $n_{\text{PUCCH},i0}^{(1)} = (M' - i2 - 1) \cdot N_c + i2 \cdot N_{c+1} + n_{\text{CCE},i} + N_{\text{PUCCH}}^{(1)}$;

  - otherwise, if the value of k_i is same as the value of an element k_{i3}^A in set K^A, where $k_{i3}^A \in K^A$ (defined in Table 10.1.3.1-1A), the UE shall set, the PUCCH resource $n_{\text{PUCCH},i0}^{(1)}$ is given by $n_{\text{PUCCH},i0}^{(1)} = (M^A - i3 - 1) \cdot N_c + i3 \cdot N_{c+1} + n_{\text{CCE},i} + N_{\text{PUCCH}}^{\text{K}_\text{A}}$;

  where M_A is the number of elements in the set K^A defined in Table 10.1.3.1-1A, c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE},i} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, $n_{\text{CCE},i}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n - k_i$, and $N_{\text{PUCCH}}^{\text{K}_\text{A}}$, $N_{\text{PUCCH}}^{(1)}$, are configured by higher layers.

- For a PDSCH transmission where there is not a corresponding PDCCH/EPDCCH detected in subframe $n - k_i$, the value of $n_{\text{PUCCH},i0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2.

- For a PDSCH transmission indicated by the detection of corresponding EPDCCH or a EPDCCH indicating downlink SPS release in sub-frame $n - k_i$ where $k_i \in K$, the UE shall use

  - if EPDCCH-PRB-set q is configured for distributed transmission

    $$n_{\text{PUCCH,i0}}^{(1)} = n_{\text{ECCE,q}} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^A} + \Delta'_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

- if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH,i0}}^{(1)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + n' + \Delta'_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

where

- if the value of k_i is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$ and $i5 = 0$;
- otherwise, if the value of k_i is same as the value of an index k_{i3}^{A}, where $k_{i3}^{A} \in K^{A}$, then $i4 = M'$ and $i5 = i3$;

, and where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n - k_i$, $N_{\text{PUCCH,q}}^{(e1)}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n - k_i$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n - k_i$ which is described in subclause 6.8A.5 in [3].

Δ'_{ARO} is determined as follows

- If $i4 = 0$ and $i5 = 0$, Δ'_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1.
- If $0 < i4 < M'$ and $i5 = 0$, Δ'_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2, where the variable Δ_{ARO} in the table is substituted with Δ'_{ARO}, the variable m in the table is substituted with $i4$, the variable N in the table is substituted with N' and the variable k_{i1} in the table is substituted with k'_{i1}.
- If $i4 = M'$ and $i5 \neq 0$, Δ'_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-3,

For a given subframe u, $N'_{ECCE,q,u}$ is determined as follows

- If the UE is configured to monitor EPDCCH in subframe u, $N'_{ECCE,q,u}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe u.
- If the UE is not configured to monitor EPDCCH in subframe u, $N'_{ECCE,q,u}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe u.
- For normal downlink CP, if subframe u is a special subframe with special subframe configuration 0 or 5, $N'_{ECCE,q,u}$ is equal to 0.
- For extended downlink CP, if subframe u is a special subframe with special subframe configuration 0 or 4 or 7, $N'_{ECCE,q,u}$ is equal to 0.

If a UE is not configured with two antenna port transmission for PUCCH format 1b with channel selection, and if the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* based on higher layer signalling the UE configured with a single serving cell will perform channel selection either according to the set of Tables 10.1.3-2, 10.1.3-3, and 10.1.3-4 or according to the set of Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7.

If a UE is configured with two antenna port transmission for PUCCH format 1b with channel selection, and if the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* then the UE will perform channel selection according to the set of Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7.

If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*, the UE configured with a single serving cell will perform channel selection according to the set of Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7.

For the selected table set, the UE shall transmit $b(0),b(1)$ on PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ in sub-frame n for $\tilde{p}$ mapped to antenna port p using PUCCH format 1b according to subclause 5.4.1 in [3] where

- $n_{\text{PUCCH}}^{(1,\tilde{p})} = n_{\text{PUCCH}}^{(1)}$ for antenna port p_0 and the value of $b(0),b(1)$ and the PUCCH resource $n_{\text{PUCCH}}^{(1)}$ are generated by channel selection according to the selected set of Tables for $M = 2$, 3, and 4 respectively
- $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, where $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ is selected from PUCCH resources $n_{\text{PUCCH},i}^{(1,\tilde{p}_1)}$ configured by higher layers where $0 \le i \le M-1$, according to selected set of Tables for $M = 2$, 3, and 4 respectively by replacing $n_{\text{PUCCH}}^{(1)}$ with $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ and replacing $n_{\text{PUCCH},i}^{(1)}$ with $n_{\text{PUCCH},i}^{(1,\tilde{p}_1)}$, when the UE is configured with two antenna port transmission for PUCCH format 1b with channel selection.

Table 10.1.3-2: Transmission of HARQ-ACK multiplexing for *M* = 2

HARQ-ACK(0), HARQ-ACK(1)	$n_{\text{PUCCH}}^{(1)}$	$b(0),b(1)$
ACK, ACK	$n_{\text{PUCCH},1}^{(1)}$	1, 1
ACK, NACK/DTX	$n_{\text{PUCCH},0}^{(1)}$	0, 1
NACK/DTX, ACK	$n_{\text{PUCCH},1}^{(1)}$	0, 0
NACK/DTX, NACK	$n_{\text{PUCCH},1}^{(1)}$	1, 0
NACK, DTX	$n_{\text{PUCCH},0}^{(1)}$	1, 0
DTX, DTX	No transm ss on	

Table 10.1.3-3: Transmission of HARQ-ACK multiplexing for *M* = 3

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2)	$n_{\text{PUCCH}}^{(1)}$	$b(0),b(1)$
ACK, ACK, ACK	$n_{\text{PUCCH},2}^{(1)}$	1, 1
ACK, ACK, NACK/DTX	$n_{\text{PUCCH},1}^{(1)}$	1, 1
ACK, NACK/DTX, ACK	$n_{\text{PUCCH},0}^{(1)}$	1, 1
ACK, NACK/DTX, NACK/DTX	$n_{\text{PUCCH},0}^{(1)}$	0, 1
NACK/DTX, ACK, ACK	$n_{\text{PUCCH},2}^{(1)}$	1, 0
NACK/DTX, ACK, NACK/DTX	$n_{\text{PUCCH},1}^{(1)}$	0, 0
NACK/DTX, NACK/DTX, ACK	$n_{\text{PUCCH},2}^{(1)}$	0, 0
DTX, DTX, NACK	$n_{\text{PUCCH},2}^{(1)}$	0, 1
DTX, NACK, NACK/DTX	$n_{\text{PUCCH},1}^{(1)}$	1, 0
NACK, NACK/DTX, NACK/DTX	$n_{\text{PUCCH},0}^{(1)}$	1, 0
DTX, DTX, DTX	No transm ss on	

Table 10.1.3-4: Transmission of HARQ-ACK multiplexing for *M* = 4

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2), HARQ-ACK(3)	$n^{(1)}_{PUCCH}$	$b(0),b(1)$
ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,1}$	1, 1
ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,1}$	1, 0
NACK/DTX,NACK/DTX,NACK,DTX	$n^{(1)}_{PUCCH,2}$	1, 1
ACK, ACK, NACK/DTX, ACK	$n^{(1)}_{PUCCH,1}$	1, 0
NACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,0}$	1, 0
ACK, ACK, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,1}$	1, 0
ACK, NACK/DTX, ACK, ACK	$n^{(1)}_{PUCCH,3}$	0, 1
NACK/DTX, NACK/DTX, NACK/DTX, NACK	$n^{(1)}_{PUCCH,3}$	1, 1
ACK, NACK/DTX, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	0, 1
ACK, NACK/DTX, NACK/DTX, ACK	$n^{(1)}_{PUCCH,0}$	0, 1
ACK, NACK/DTX, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,0}$	1, 1
NACK/DTX, ACK, ACK, ACK	$n^{(1)}_{PUCCH,3}$	0, 1
NACK/DTX, NACK, DTX, DTX	$n^{(1)}_{PUCCH,1}$	0, 0
NACK/DTX, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	1, 0
NACK/DTX, ACK, NACK/DTX, ACK	$n^{(1)}_{PUCCH,3}$	1, 0
NACK/DTX, ACK, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,1}$	0, 1
NACK/DTX, NACK/DTX, ACK, ACK	$n^{(1)}_{PUCCH,3}$	0, 1
NACK/DTX, NACK/DTX, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	0, 0
NACK/DTX, NACK/DTX, NACK/DTX, ACK	$n^{(1)}_{PUCCH,3}$	0, 0
DTX, DTX, DTX, DTX	No transm ss on	

Table 10.1.3-5: Transmission of HARQ-ACK multiplexing for *M* = 2

HARQ-ACK(0), HARQ-ACK(1)	$n^{(1)}_{PUCCH}$	$b(0)b(1)$
ACK, ACK	$n^{(1)}_{PUCCH,1}$	1, 0
ACK, NACK/DTX	$n^{(1)}_{PUCCH,0}$	1, 1
NACK/DTX, ACK	$n^{(1)}_{PUCCH,1}$	0, 1
NACK, NACK/DTX	$n^{(1)}_{PUCCH,0}$	0, 0
DTX, NACK/DTX	No Transm ss on	

Table 10.1.3-6: Transmission of HARQ-ACK multiplexing for *M* = 3

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2)	$n_{PUCCH}^{(1)}$	$b(0)b(1)$
ACK, ACK, ACK	$n_{PUCCH,2}^{(1)}$	1, 1
ACK, ACK, NACK/DTX	$n_{PUCCH,1}^{(1)}$	1, 0
ACK, NACK/DTX, ACK	$n_{PUCCH,2}^{(1)}$	1, 0
ACK, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	1, 1
NACK/DTX, ACK, ACK	$n_{PUCCH,2}^{(1)}$	0, 1
NACK/DTX, ACK, NACK/DTX	$n_{PUCCH,1}^{(1)}$	0, 1
NACK/DTX, NACK/DTX, ACK	$n_{PUCCH,2}^{(1)}$	0, 0
NACK, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	0, 0
DTX, NACK/DTX, NACK/DTX	No Transm ss on	

Table 10.1.3-7: Transmission of HARQ-ACK multiplexing for *M* = 4

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2), HARQ-ACK(3)	$n_{PUCCH}^{(1)}$	$b(0)b(1)$
ACK, ACK, ACK, ACK	$n_{PUCCH,1}^{(1)}$	1, 1
ACK, ACK, ACK, NACK/DTX	$n_{PUCCH,2}^{(1)}$	1, 1
ACK, ACK, NACK/DTX, ACK	$n_{PUCCH,0}^{(1)}$	1, 0
ACK, ACK, NACK/DTX, NACK/DTX	$n_{PUCCH,1}^{(1)}$	1, 0
ACK, NACK/DTX, ACK, ACK	$n_{PUCCH,3}^{(1)}$	1, 1
ACK, NACK/DTX, ACK, NACK/DTX	$n_{PUCCH,2}^{(1)}$	1, 0
ACK, NACK/DTX, NACK/DTX, ACK	$n_{PUCCH,0}^{(1)}$	0, 1
ACK, NACK/DTX, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	1, 1
NACK/DTX, ACK, ACK, ACK	$n_{PUCCH,1}^{(1)}$	0, 0
NACK/DTX, ACK, ACK, NACK/DTX	$n_{PUCCH,2}^{(1)}$	0, 1
NACK/DTX, ACK, NACK/DTX, ACK	$n_{PUCCH,3}^{(1)}$	1, 0
NACK/DTX, ACK, NACK/DTX, NACK/DTX	$n_{PUCCH,1}^{(1)}$	0, 1
NACK/DTX, NACK/DTX, ACK, ACK	$n_{PUCCH,3}^{(1)}$	0, 1
NACK/DTX, NACK/DTX, ACK, NACK/DTX	$n_{PUCCH,2}^{(1)}$	0, 0
NACK/DTX, NACK/DTX, NACK/DTX, ACK	$n_{PUCCH,3}^{(1)}$	0, 0
NACK, NACK/DTX, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	0, 0
DTX, NACK/DTX, NACK/DTX, NACK/DTX	No Transm ss on	

10.1.3.2 TDD HARQ-ACK procedure for more than one configured serving cell

If a UE configured with *EIMTA-MainConfigServCell-r12* for a serving cell, "UL/DL configuration" of the serving cell in the rest of this subclause refers to the UL/DL configuration given by the parameter *eimta-HarqReferenceConfig-r12* for the serving cell unless specified otherwise.

The TDD HARQ-ACK feedback procedures for more than one configured serving cell are either based on a PUCCH format 1b with channel selection HARQ-ACK procedure as described in subclause 10.1.3.2.1 or a PUCCH format 3 HARQ-ACK procedure as described in subclause 10.1.3.2.2.

HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) is supported for PUCCH format 3 and TDD with more than one configured serving cell.

If a UE is configured with more than one serving cell and the TDD UL/DL configurations of all serving cells are the same, TDD UL/DL configuration 5 with PUCCH format 3 is only supported for up to two configured serving cells. If a UE is configured with two serving cells and the TDD UL/DL configuration of the two serving cells is the same, TDD UL/DL configuration 5 with PUCCH format 1b with channel selection for two configured serving cells is not supported. If a UE is configured with two serving cells and if the TDD UL/DL configuration of the two serving cells are not the same and if the DL-reference UL/DL configuration (as defined in subclause 10.2) of at least one serving cell is TDD UL/DL Configuration 5, PUCCH format 1b with channel selection is not supported.

If a UE is configured with the parameter *EIMTA-MainConfigServCell-r12* for at least one serving cell, the UE is not expected to be configured with more than two serving cells having UL/DL Configuration 5 as a DL-reference UL/DL configuration.

HARQ-ACK transmission on two antenna ports ($p \in [p_0, p_1]$) is supported for PUCCH format 1b with channel selection and TDD with two configured serving cells.

10.1.3.2.1 PUCCH format 1b with channel selection HARQ-ACK procedure

If a UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*, then $K' = K$ where the set K is defined in Table 10.1.3.1-1 (where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAssignment*), and M' is the number of elements in set K'.

If a UE is configured with two serving cells with the same UL/DL configurations, then in the rest of this subcaluse, K is as defined in Sec 10.2 and M is the number of elements for subframe *n* in the set K, and $M_{primary} = M$.

If a UE is configured with two serving cells with different UL/DL configurations,

- then the UE shall determine M for a subframe *n* in this subclause as $M = \max\left(M_{primary}, M_{\sec ondary}\right)$, where
  - $M_{primary}$ is the number of elements for subframe *n* in the set K defined in Table 10.1.3.1-1 for the primary cell TDD UL/DL configuration , and
  - $M_{\sec ondary}$ denotes the number of elements for subframe *n* in the set K_c for the secondary serving cell (as defined in subclause 10.2)
- if $M_{\sec ondary} < M$, then the UE shall, for the secondary serving cell, set HARQ-ACK(j) to DTX for $j = M_{\sec ondary}$ to $M-1$.
- if $M_{primary} < M$, then the UE shall, for the primary cell, set HARQ-ACK(j) to DTX for $j = M_{primary}$ to $M-1$

If the UE is configured with two serving cells with different UL/DL configurations, then in the rest of this subclause, $K = K_c$ where K_c is defined in subclause 10.2.

For TDD HARQ-ACK multiplexing with PUCCH format 1b with channel selection and two configured serving cells and a subframe *n* with $M = 1$, a UE shall determine the number of HARQ-ACK bits, O, based on the number of

configured serving cells and the downlink transmission modes configured for each serving cell. The UE shall use two HARQ-ACK bits for a serving cell configured with a downlink transmission mode that supports up to two transport blocks; and one HARQ-ACK bit otherwise.

For TDD HARQ-ACK multiplexing with PUCCH format 1b with channel selection and two configured serving cells and a subframe n with $M \le 2$, the UE shall transmit $b(0)b(1)$ on PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ for $\tilde{p}$ mapped to antenna port p using PUCCH format 1b where

- $n_{\text{PUCCH}}^{(1,\tilde{p})} = n_{\text{PUCCH}}^{(1)}$ for antenna port p_0, where $n_{\text{PUCCH}}^{(1)}$ selected from A PUCCH resources, $n_{\text{PUCCH},j}^{(1)}$ where $0 \le j \le A-1$ and $A \in \{2,3,4\}$, according to Tables 10.1.3.2-1, 10.1.3.2-2, and 10.1.3.2-3 in subframe n using PUCCH format 1b.
- $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, where $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ selected from A PUCCH resources, $n_{\text{PUCCH},j}^{(1,\tilde{p}_1)}$ configured by higher layers where $0 \le j \le A-1$ and $A \in \{2,3,4\}$, according to Tables 10.1.3.2-1, 10.1.3.2-2, and 10.1.3.2-3 by replacing $n_{\text{PUCCH}}^{(1)}$ with $n_{\text{PUCCH}}^{(1,\tilde{p}_1)}$ and replacing $n_{\text{PUCCH},i}^{(1)}$ with $n_{\text{PUCCH},i}^{(1,\tilde{p}_1)}$ in subframe n, when the UE is configured with two antenna port transmission for PUCCH format 1b with channel selection,

and for a subframe n with $M = 1$, HARQ-ACK(j) denotes the ACK/NACK/DTX response for a transport block or SPS release PDCCH/EPDCCH associated with serving cell, where the transport block and serving cell for HARQ-ACK(j) and A PUCCH resources are given by Table 10.1.2.2.1-1. For a subframe n with $M = 2$, HARQ-ACK(j) denotes the ACK/NACK/DTX response for a PDSCH transmission or SPS release PDCCH/EPDCCH within subframe(s) given by set K on each serving cell, where the subframes on each serving cell for HARQ-ACK(j) and A PUCCH resources are given by Table 10.1.3.2-4.

If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12,* the UE shall determine the A PUCCH resources, $n_{\text{PUCCH},j}^{(1)}$ associated with HARQ-ACK(j) where $0 \le j \le A-1$ in Table 10.1.2.2.1-1 for $M = 1$ and Table 10.1.3.2-4 for $M = 2$, according to

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$ on the primary cell, or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ on the primary cell, the PUCCH resource is $n_{\text{PUCCH},j}^{(1)} = \left(M_{primary} - m - 1\right) \cdot N_c + m \cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{(1)}$, where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$ where $N_{\text{RB}}^{\text{DL}}$ is determined from the primary cell, and for a subframe n with $M = 1$ and a transmission mode that supports up to two transport blocks on the serving cell where the corresponding PDSCH transmission occurs, the PUCCH resource $n_{\text{PUCCH},j+1}^{(1)}$ is given by $n_{\text{PUCCH},j+1}^{(1)} = \left(M_{primary} - m - 1\right) \cdot N_c + m \cdot N_{c+1} + n_{\text{CCE},m} + 1 + N_{\text{PUCCH}}^{(1)}$ where $n_{\text{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding DCI assignment and $N_{\text{PUCCH}}^{(1)}$ is configured by higher layers.
- for a PDSCH transmission on the primary cell where there is not a corresponding PDCCH/EPDCCH detected within subframe(s) $n-k$, where $k \in K$, the value of $n_{\text{PUCCH},j}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2.
- For a PDSCH transmission indicated by the detection of corresponding EPDCCH or a EPDCCH indicating downlink SPS release in sub-frame $n-k_m$ where $k_m \in K$ on the primary cell, the PUCCH resource $n_{\text{PUCCH},j}^{(1)}$ is given by
  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\text{PUCCH,j}}^{(1)} = n_{\text{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

- if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH,j}}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(e1)}$$

where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(e1)}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11* , $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For a subframe *n* with $M=1$ and a transmission mode that supports up to two transport blocks on the serving cell where the corresponding PDSCH transmission occurs, the PUCCH resource $n_{\mathrm{PUCCH},j+1}^{(1)}$ is given by

- if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{ECCE,q}} + 1 + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(e1)}$$

- if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + 1 + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(e1)}$$

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH/EPDCCH within subframe(s) $n-k$, where $k \in K$ on the secondary cell, the value of $n_{\mathrm{PUCCH},j}^{(1)}$, and the value of $n_{\mathrm{PUCCH},j+1}^{(1)}$ for a subframe *n* with $M=2$ or for a subframe *n* with $M=1$ and a transmission mode on the secondary cell that supports up to two transport blocks is determined according to higher layer configuration and Table 10.1.2.2.1-2. The TPC field in the DCI format of the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource values from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.1-2. For a UE configured for a transmission mode on the secondary cell that supports up to two transport blocks and a subframe *n* with $M=1$, or for a subframe *n* with $M=2$, a PUCCH resource value in Table 10.1.2.2.1-2 maps to two PUCCH resources $(n_{\mathrm{PUCCH},j}^{(1)}, n_{\mathrm{PUCCH},j+1}^{(1)})$, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\mathrm{PUCCH},j}^{(1)}$. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted in the TPC field on all PDCCH/EPDCCH assignments on the secondary cell within subframe(s) $n-k$, where $k \in K$.

Table 10.1.3.2-1: Transmission of HARQ-ACK multiplexing for *A* = 2

HARQ-ACK(0), HARQ-ACK(1)	$n_{PUCCH}^{(1)}$	$b(0)b(1)$
ACK, ACK	$n_{PUCCH,1}^{(1)}$	1, 0
ACK, NACK/DTX	$n_{PUCCH,0}^{(1)}$	1, 1
NACK/DTX, ACK	$n_{PUCCH,1}^{(1)}$	0, 1
NACK, NACK/DTX	$n_{PUCCH,0}^{(1)}$	0, 0
DTX, NACK/DTX	No Transm ss on	

Table 10.1.3.2-2: Transmission of HARQ-ACK multiplexing for *A* = 3

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2)	$n_{PUCCH}^{(1)}$	$b(0)b(1)$
ACK, ACK, ACK	$n_{PUCCH,2}^{(1)}$	1, 1
ACK, ACK, NACK/DTX	$n_{PUCCH,1}^{(1)}$	1, 0
ACK, NACK/DTX, ACK	$n_{PUCCH,2}^{(1)}$	1, 0
ACK, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	1, 1
NACK/DTX, ACK, ACK	$n_{PUCCH,2}^{(1)}$	0, 1
NACK/DTX, ACK, NACK/DTX	$n_{PUCCH,1}^{(1)}$	0, 1
NACK/DTX, NACK/DTX, ACK	$n_{PUCCH,2}^{(1)}$	0, 0
NACK, NACK/DTX, NACK/DTX	$n_{PUCCH,0}^{(1)}$	0, 0
DTX, NACK/DTX, NACK/DTX	No Transm ss on	

Table 10.1.3.2-3: Transmission of HARQ-ACK multiplexing for *A* = 4

HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2), HARQ-ACK(3)	$n^{(1)}_{PUCCH}$	$b(0)b(1)$
ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,1}$	1, 1
ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	1, 1
ACK, ACK, NACK/DTX, ACK	$n^{(1)}_{PUCCH,0}$	1, 0
ACK, ACK, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,1}$	1, 0
ACK, NACK/DTX, ACK, ACK	$n^{(1)}_{PUCCH,3}$	1, 1
ACK, NACK/DTX, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	1, 0
ACK, NACK/DTX, NACK/DTX, ACK	$n^{(1)}_{PUCCH,0}$	0, 1
ACK, NACK/DTX, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,0}$	1, 1
NACK/DTX, ACK, ACK, ACK	$n^{(1)}_{PUCCH,1}$	0, 0
NACK/DTX, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	0, 1
NACK/DTX, ACK, NACK/DTX, ACK	$n^{(1)}_{PUCCH,3}$	1, 0
NACK/DTX, ACK, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,1}$	0, 1
NACK/DTX, NACK/DTX, ACK, ACK	$n^{(1)}_{PUCCH,3}$	0, 1
NACK/DTX, NACK/DTX, ACK, NACK/DTX	$n^{(1)}_{PUCCH,2}$	0, 0
NACK/DTX, NACK/DTX, NACK/DTX, ACK	$n^{(1)}_{PUCCH,3}$	0, 0
NACK, NACK/DTX, NACK/DTX, NACK/DTX	$n^{(1)}_{PUCCH,0}$	0, 0
DTX, NACK/DTX, NACK/DTX, NACK/DTX	No Transm ss on	

Table 10.1.3.2-4: Mapping of subframes on each serving cell to HARQ-ACK(*j*) for PUCCH format 1b HARQ-ACK channel selection for TDD with $M = 2$

A	HARQ-ACK(j)			
	HARQ-ACK(0)	HARQ-ACK(1)	HARQ-ACK(2)	HARQ-ACK(3)
4	The f rst subframe of Pr mary ce	The second subframe of Pr mary ce	The f rst subframe of Secondary ce	The second subframe of Secondary ce

For TDD HARQ-ACK multiplexing with PUCCH format 1b with channel selection and sub-frame n with $M > 2$ and two configured serving cells, denotes $n^{(1)}_{PUCCH,i}$ $0 \le i \le 3$ as the PUCCH resource derived from the transmissions in M downlink or special sub-frames associated with the UL subframe n . $n^{(1)}_{PUCCH,0}$ and $n^{(1)}_{PUCCH,1}$ are associated with the PDSCH transmission(s) or a PDCCH/EPDCCH indicating downlink SPS release (defined in subclause 9.2) on the primary cell and $n^{(1)}_{PUCCH,2}$ and $n^{(1)}_{PUCCH,3}$ are associated with the PDSCH transmission(s) on the secondary cell.

For Primary cell:

- If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, and if there is a PDSCH transmission on the primary cell without a corresponding PDCCH/EPDCCH detected within the subframe(s) $n-k$, where $k \in K$,
  - the value of $n^{(1)}_{PUCCH,0}$ is determined according to higher layer configuration and Table 9.2-2.

- for a PDSCH transmission on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to '1' (defined in Table 7.3-X) or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to '1', the PUCCH resource $n_{\mathrm{PUCCH},1}^{(1)} = \left(M_{primary} - m - 1\right)\cdot N_c + m \cdot N_{c+1} + n_{\mathrm{CCE},m} + N_{\mathrm{PUCCH}}^{(1)}$ where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\mathrm{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\mathrm{RB}}^{\mathrm{DL}} \cdot (N_{\mathrm{sc}}^{\mathrm{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, where $n_{\mathrm{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$ and $N_{\mathrm{PUCCH}}^{(1)}$ is configured by higher layers.
- for a PDSCH transmission on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the EPDCCH equal to '1' (defined in Table 7.3-X) or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the EPDCCH equal to '1', the PUCCH resource is given by
  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH},1}^{(1)} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  - If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH},1}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0.
- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, and if there is a PDSCH transmission on the primary cell without a corresponding PDCCH/EPDCCH detected within the subframe(s) $n-k$, where $k \in K$,
  - the value of $n_{\mathrm{PUCCH},0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2.

- for a PDSCH transmission on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_i$, where $k_i \in K$ with the DAI value in the PDCCH equal to '1' (defined in Table 7.3-X) or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_i$, where $k_i \in K$ with the DAI value in the PDCCH equal to '1',

  - if the value of k_i is same as the value of an element k'_{i2}, where $k'_{i2} \in K'$, the PUCCH resource $n^{(1)}_{\mathrm{PUCCH,1}}$ is given by $n^{(1)}_{\mathrm{PUCCH,1}} = (M'-i2-1)\cdot N_c + i2\cdot N_{c+1} + n_{\mathrm{CCE},i} + N^{(1)}_{\mathrm{PUCCH}}$;

  - otherwise, if the value of k_i is same as the value of an element k^A_{i3} in set K^A, where $k^A_{i3} \in K^A$(defined in Table 10.1.3.1-1A), the PUCCH resource $n^{(1)}_{\mathrm{PUCCH,1}}$ is given by $n^{(1)}_{\mathrm{PUCCH,1}} = (M^A - i3 - 1)\cdot N_c + i3\cdot N_{c+1} + n_{\mathrm{CCE},i} + N^{\mathrm{K_A}}_{\mathrm{PUCCH}}$;

  where M_A is the number of elements in the set K^A defined in Table 10.1.3.1-1A , where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\mathrm{CCE},i} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N^{\mathrm{DL}}_{\mathrm{RB}}\cdot(N^{\mathrm{RB}}_{\mathrm{sc}}\cdot c - 4)]/36 \right\rfloor\right\}$ where $N^{\mathrm{DL}}_{\mathrm{RB}}$ is determined from the primary cell, $n_{\mathrm{CCE},i}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_i$, and $N^{\mathrm{K_A}}_{\mathrm{PUCCH}}$, $N^{(1)}_{\mathrm{PUCCH}}$, are configured by higher layers .

- for a PDSCH transmission on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_i$, where $k_i \in K$ with the DAI value in the EPDCCH equal to '1' (defined in Table 7.3-X) or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_i$, where $k_i \in K$ with the DAI value in the EPDCCH equal to '1', the PUCCH resource is given by

  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n^{(1)}_{\mathrm{PUCCH,1}} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k^A_{i1}} + \Delta'_{ARO} + N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$$

  - If EPDCCH-PRB-set q is configured for localized transmission

$$n^{(1)}_{\mathrm{PUCCH,1}} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N^{ECCE,q}_{RB}} \right\rfloor \cdot N^{ECCE,q}_{RB} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k^A_{i1}} + n' + \Delta'_{ARO} + N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$$

  where

  - if the value of k_i is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$ and $i5 = 0$;

  - otherwise, if the value of k_i is same as the value of an index k^A_{i3}, where $k^A_{i3} \in K^A$, then $i4 = M'$ and $i5 = i3$;

  , and where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_i$, $N^{(\mathrm{e1})}_{\mathrm{PUCCH,q}}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N^{ECCE,q}_{RB}$ for EPDCCH-PRB-set q in subframe $n-k_i$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. Δ'_{ARO}, $N'_{ECCE,q,n-k'_{i1}}$, $N'_{ECCE,q,n-k^A_{i1}}$ are determined as described in section 10.1.3.1.

- HARQ-ACK(0) is the ACK/NACK/DTX response for the PDSCH transmission without a corresponding PDCCH/EPDCCH. For $1 \le j \le M-1$, if a PDSCH transmission with a corresponding PDCCH/EPDCCH and DAI value in the PDCCH/EPDCCH equal to 'j' or a PDCCH/EPDCCH indicating downlink SPS release and with DAI value in the PDCCH/EPDCCH equal to 'j' is received, HARQ-ACK(j) is the corresponding ACK/NACK/DTX response; otherwise HARQ-ACK(j) shall be set to DTX.

- Otherwise,

  - If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the PDCCH equal to either '1' or '2' or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the PDCCH equal to either '1' or '2', the PUCCH resource $n^{(1)}_{\text{PUCCH},i} = \left(M_{primary} - m - 1\right)\cdot N_c + m\cdot N_{c+1} + n_{\text{CCE},m} + N^{(1)}_{\text{PUCCH}}$, where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N^{\text{DL}}_{\text{RB}}\cdot(N^{\text{RB}}_{\text{sc}}\cdot c - 4)]/36 \right\rfloor\right\}$, where $n_{\text{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$, $N^{(1)}_{\text{PUCCH}}$ is configured by higher layers and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6}, $i=0$ for the corresponding PDCCH with the DAI value equal to '1' and $i=1$ for the corresponding PDCCH with the DAI value equal to '2', and for the primary cell with TDD UL/DL configuration 0 $i=0$ for the corresponding PDCCH.

  - If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the PDCCH equal to either '1' or '2' or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the PDCCH equal to either '1' or '2',

    - if the value of k_m is same as the value of an element k'_{i2}, where $k'_{i2} \in K'$, the PUCCH resource $n^{(1)}_{\text{PUCCH},i}$ is given by $n^{(1)}_{\text{PUCCH},i} = (M'-i2-1)\cdot N_c + i2\cdot N_{c+1} + n_{\text{CCE},m} + N^{(1)}_{\text{PUCCH}}$;

    - otherwise, if the value of k_m is same as the value of an element k^A_{i3} in set K^A, where $k^A_{i3} \in K^A$ (defined in Table 10.1.3.1-1A), the PUCCH resource $n^{(1)}_{\text{PUCCH},i}$ is given by $n^{(1)}_{\text{PUCCH},i} = (M^A - i3 - 1)\cdot N_c + i3\cdot N_{c+1} + n_{\text{CCE},m} + N^{\text{K}_\text{A}}_{\text{PUCCH}}$;

    where M_A is the number of elements in the set K^A, where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N^{\text{DL}}_{\text{RB}}\cdot(N^{\text{RB}}_{\text{sc}}\cdot c - 4)]/36 \right\rfloor\right\}$ where $N^{\text{DL}}_{\text{RB}}$ is determined from the primary cell, $n_{CCE,m}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$, and $N^{\text{K}_\text{A}}_{\text{PUCCH}}$, $N^{(1)}_{\text{PUCCH}}$, are configured by higher layers. Here, for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6}, $i=0$ for the corresponding PDCCH with the DAI value equal to '1' and $i=1$ for the corresponding PDCCH with the DAI value equal to '2', and for the primary cell with TDD UL/DL configuration 0 $i=0$ for the corresponding PDCCH.

  - If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell for a PDSCH transmission on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the EPDCCH equal to either '1' or '2' or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration

of the primary cell belonging to {1,2,3,4,6}the DAI value in the EPDCCH equal to either '1' or '2', the PUCCH resource is given by

- If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

- If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. Here, for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} $i=0$ for the corresponding EPDCCH with the DAI value equal to '1' and $i=1$ for the corresponding EPDCCH with the DAI value equal to '2', and for the primary cell with TDD UL/DL configuration 0 $i=0$ for the corresponding EPDCCH.

- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell for a PDSCH transmission on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} the DAI value in the EPDCCH equal to either '1' or '2' or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ and for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6}the DAI value in the EPDCCH equal to either '1' or '2', the PUCCH resource is given by

- If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{i4-1} N_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N_{ECCE,q,n-k_{i1}^{A}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

- If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{i4-1} N_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N_{ECCE,q,n-k_{i1}^{A}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

where

- if the value of k_m is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$;
- otherwise, if the value of k_m is same as the value of an index k^A_{i3}, where $k^A_{i3} \in K^A$, then $i4 = i3$;

, and where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N^{(\text{e1})}_{\text{PUCCH,q}}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N^{ECCE,q}_{RB}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3].. Δ'_{ARO}, $N_{ECCE,q,n-k'_{i1}}$, $N_{ECCE,q,n-k^A_{i1}}$ are determined as described in section 10.1.3.1. Here, for TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6} $i=0$ for the corresponding EPDCCH with the DAI value equal to '1' and $i=1$ for the corresponding EPDCCH with the DAI value equal to '2', and for the primary cell with TDD UL/DL configuration 0 $i=0$ for the corresponding EPDCCH.

- For $0 \le j \le M-1$ and TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,6}, if a PDSCH transmission with a corresponding PDCCH/EPDCCH and DAI value in the PDCCH/EPDCCH equal to '$j+1$' or a PDCCH/EPDCCH indicating downlink SPS release and with DAI value in the PDCCH/EPDCCH equal to '$j+1$' is received, HARQ-ACK(j) is the corresponding ACK/NACK/DTX response; otherwise HARQ-ACK(j) shall be set to DTX. For $0 \le j \le M-1$ and the primary cell with TDD UL/DL configuration 0, if a PDSCH transmission with a corresponding PDCCH/EPDCCH or a PDCCH/EPDCCH indicating downlink SPS release is received, HARQ-ACK(0) is the corresponding ACK/NACK/DTX response; otherwise HARQ-ACK(j) shall be set to DTX.

For Secondary cell:

- If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding PDCCH on the primary cell in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to either '1' or '2', the PUCCH resources $n^{(1)}_{\text{PUCCH},i} = \left(M_{primary} - m - 1\right)\cdot N_c + m \cdot N_{c+1} + n_{\text{CCE},m} + N^{(1)}_{\text{PUCCH}}$, where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE,m}} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N^{\text{DL}}_{\text{RB}} \cdot (N^{\text{RB}}_{\text{sc}} \cdot c - 4)]/36 \right\rfloor\right\}$, where $N^{\text{DL}}_{\text{RB}}$ is determined from the primary cell, $n_{\text{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$, $N^{(1)}_{\text{PUCCH}}$ is configured by higher layers, $i=2$ for the corresponding PDCCH with the DAI value equal to '1' and $i=3$ for the corresponding PDCCH with the DAI value equal to '2'.
- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding PDCCH on the primary cell in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to either '1' or '2',
  - if the value of k_m is same as the value of an element k'_{i2}, where $k'_{i2} \in K'$, the PUCCH resource $n^{(1)}_{\text{PUCCH},i}$ is given by $n^{(1)}_{\text{PUCCH},i} = (M'-i2-1)\cdot N_c + i2 \cdot N_{c+1} + n_{\text{CCE},m} + N^{(1)}_{\text{PUCCH}}$;
  - otherwise, if the value of k_m is same as the value of an element k^A_{i3} in set K^A, where $k^A_{i3} \in K^A$ (defined in Table 10.1.3.1-1A, where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAssignment*), the PUCCH resource $n^{(1)}_{\text{PUCCH},i}$ is given by $n^{(1)}_{\text{PUCCH},i} = (M^A - i3 - 1)\cdot N_c + i3 \cdot N_{c+1} + n_{\text{CCE},m} + N^{\text{K}_\text{A}}_{\text{PUCCH}}$;

where M_A is the number of elements in the set K^A defined in Table 10.1.3.1-1A , where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\mathrm{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\mathrm{RB}}^{\mathrm{DL}} \cdot (N_{\mathrm{sc}}^{\mathrm{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$ where $N_{\mathrm{RB}}^{\mathrm{DL}}$ is determined from the primary cell, $n_{CCE,m}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$, and $N_{\mathrm{PUCCH}}^{\mathrm{K_A}}$, $N_{\mathrm{PUCCH}}^{(1)}$, are configured by higher layers. Here, $i=2$ for the corresponding PDCCH with the DAI value equal to '1' and $i=3$ for the corresponding PDCCH the DAI value in the PDCCH equal to either '1' or '2'.

- If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding EPDCCH on the primary cell in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to either '1' or '2', the PUCCH resources are given by
  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  - If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11* , $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. Here, $i=2$ for the corresponding EPDCCH with the DAI value equal to '1' and $i=3$ for the corresponding EPDCCH with the DAI value equal to '2'.

- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding EPDCCH on the primary cell in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to either '1' or '2', the PUCCH resources are given by
  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + \Delta'_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

- If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH,i}}^{(1)} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + n' + \Delta'_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

where

- if the value of k_m is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$;
- otherwise, if the value of k_m is same as the value of an index k_{i3}^{A}, where $k_{i3}^{A} \in K^{A}$, then $i4 = i3$;

and where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n - k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n - k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n - k_m$ which is described in subclause 6.8A.5 in [3]. Δ'_{ARO}, $N'_{ECCE,q,n-k'_{i1}}$, $N'_{ECCE,q,n-k_{i1}^{A}}$ are determined as described in subclause 10.1.3.1. For extended downlink CP, if subframe $n - k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. Here, $i = 2$ for the corresponding EPDCCH with the DAI value equal to '1' and $i = 3$ for the corresponding EPDCCH with the DAI value equal to '2'.

- for a PDSCH transmission indicated by the detection of a corresponding PDCCH/EPDCCH within the subframe(s) $n - k$, where $k \in K$ on the secondary cell, the value of $n_{\mathrm{PUCCH},2}^{(1)}$ and $n_{\mathrm{PUCCH},3}^{(1)}$ is determined according to higher layer configuration and Table 10.1.2.2.1-2. The TPC field in the DCI format of the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource values from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.1-2. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted in the TPC field on all PDCCH/EPDCCH assignments on the secondary cell within subframe(s) $n - k$, where $k \in K$.
- For $0 \le j \le M - 1$, if a PDSCH transmission with a corresponding PDCCH/EPDCCH and DAI value in the PDCCH/EPDCCH equal to '$j + 1$' is received, HARQ-ACK(j) is the corresponding ACK/NACK/DTX response; otherwise HARQ-ACK(j) shall be set to DTX.

A UE shall perform channel selection according to the Tables 10.1.3.2-5, and 10.1.3.2-6 and transmit $b(0), b(1)$ on PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ for $\tilde{p}$ mapped to antenna port p using PUCCH format 1b according to subclause 5.4.1 in [3] where

- $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{PUCCH}}^{(1)}$ in sub-frame n for $\tilde{p}$ mapped to antenna port p_0 where "any" in Tables 10.1.3.2-5, and 10.1.3.2-6 represents any response of ACK, NACK, or DTX. The value of $b(0), b(1)$ and the PUCCH resource $n_{\mathrm{PUCCH}}^{(1)}$ are generated by channel selection according to Tables 10.1.3.2-5, and 10.1.3.2-6 for $M = 3$, and 4 respectively.
- $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, where $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)}$ selected from PUCCH resources, $n_{\mathrm{PUCCH},i}^{(1,\tilde{p}_1)}$ configured by higher layers where $0 \le i \le 3$ according Tables 10.1.3.2-5, and 10.1.3.2-6 for $M = 3$, and 4 respectively by replacing $n_{\mathrm{PUCCH}}^{(1)}$ with $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)}$ and replacing $n_{\mathrm{PUCCH},i}^{(1)}$ with $n_{\mathrm{PUCCH},i}^{(1,\tilde{p}_1)}$, where "any" in Tables 10.1.3.2-5, and 10.1.3.2-6 represents any response of ACK, NACK, or DTX, when the UE is configured with two antenna port transmission for PUCCH format 1b with channel selection.

Table 10.1.3.2-5: Transmission of HARQ-ACK multiplexing for *M* = 3

Primary Cell	Secondary Cell	Resource	Constellation	RM Code Input Bits
HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2)	HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2)	$n^{(1)}_{PUCCH}$	$b(0),b(1)$	$o(0),o(1),o(2),o(3)$
ACK, ACK, ACK	ACK, ACK, ACK	$n^{(1)}_{PUCCH,1}$	1, 1	1,1,1,1
ACK, ACK, NACK/DTX	ACK, ACK, ACK	$n^{(1)}_{PUCCH,1}$	0, 0	1,0,1,1
ACK, NACK/DTX, any	ACK, ACK, ACK	$n^{(1)}_{PUCCH,3}$	1, 1	0,1,1,1
NACK/DTX, any, any	ACK, ACK, ACK	$n^{(1)}_{PUCCH,3}$	0, 1	0,0,1,1
ACK, ACK, ACK	ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,0}$	1, 0	1,1,1,0
ACK, ACK, NACK/DTX	ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	1, 0	1,0,1,0
ACK, NACK/DTX, any	ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,0}$	0, 1	0,1,1,0
NACK/DTX, any, any	ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	0, 0	0,0,1,0
ACK, ACK, ACK	ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,2}$	1, 1	1, 1, 0, 1
ACK, ACK, NACK/DTX	ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,2}$	0, 1	1, 0, 0, 1
ACK, NACK/DTX, any	ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,2}$	1, 0	0, 1, 0, 1
NACK/DTX, any, any	ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,2}$	0, 0	0, 0, 0, 1
ACK, ACK, ACK	NACK/DTX, any, any	$n^{(1)}_{PUCCH,1}$	1, 0	1, 1, 0, 0
ACK, ACK, NACK/DTX	NACK/DTX, any, any	$n^{(1)}_{PUCCH,1}$	0, 1	1, 0, 0, 0
ACK, NACK/DTX, any	NACK/DTX, any, any	$n^{(1)}_{PUCCH,0}$	1, 1	0, 1, 0, 0
NACK, any, any	NACK/DTX, any, any	$n^{(1)}_{PUCCH,0}$	0, 0	0, 0, 0, 0
DTX, any, any	NACK/DTX, any, any	No Transm ss on		0, 0, 0, 0

Table 10.1.3.2-6: Transmission of HARQ-ACK multiplexing for $M = 4$

Primary Cell	Secondary Cell	Resource	Constellation	RM Code Input Bits
HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2), HARQ-ACK(3)	HARQ-ACK(0), HARQ-ACK(1), HARQ-ACK(2), HARQ-ACK(3)	$n^{(1)}_{PUCCH}$	$b(0), b(1)$	$o(0), o(1), o(2), o(3)$
ACK, ACK, ACK, NACK/DTX	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,1}$	1, 1	1, 1, 1, 1
ACK, ACK, NACK/DTX, any	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,1}$	0, 0	1, 0, 1, 1
ACK, DTX, DTX, DTX	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	1, 1	0, 1, 1, 1
ACK, ACK, ACK, ACK	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	1, 1	0, 1, 1, 1
NACK/DTX, any, any, any	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	0, 1	0, 0, 1, 1
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	ACK, ACK, ACK, NACK/DTX	$n^{(1)}_{PUCCH,3}$	0, 1	0, 0, 1, 1
ACK, ACK, ACK, NACK/DTX	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,0}$	1, 0	1, 1, 1, 0
ACK, ACK, NACK/DTX, any	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,3}$	1, 0	1, 0, 1, 0
ACK, DTX, DTX, DTX	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,0}$	0, 1	0, 1, 1, 0
ACK, ACK, ACK, ACK	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,0}$	0, 1	0, 1, 1, 0
NACK/DTX, any, any, any	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,3}$	0, 0	0, 0, 1, 0
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	ACK, ACK, NACK/DTX, any	$n^{(1)}_{PUCCH,3}$	0, 0	0, 0, 1, 0
ACK, ACK, ACK, NACK/DTX	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	1, 1	1, 1, 0, 1
ACK, ACK, ACK, NACK/DTX	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	1, 1	1, 1, 0, 1
ACK, ACK, NACK/DTX, any	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	0, 1	1, 0, 0, 1
ACK, ACK, NACK/DTX, any	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	0, 1	1, 0, 0, 1
ACK, DTX, DTX, DTX	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	1, 0	0, 1, 0, 1
ACK, DTX, DTX, DTX	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	1, 0	0, 1, 0, 1
ACK, ACK, ACK, ACK	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	1, 0	0, 1, 0, 1
ACK, ACK, ACK, ACK	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	1, 0	0, 1, 0, 1
NACK/DTX, any, any, any	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	0, 0	0, 0, 0, 1
NACK/DTX, any, any, any	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	0, 0	0, 0, 0, 1
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	ACK, DTX, DTX, DTX	$n^{(1)}_{PUCCH,2}$	0, 0	0, 0, 0, 1
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	ACK, ACK, ACK, ACK	$n^{(1)}_{PUCCH,2}$	0, 0	0, 0, 0, 1
ACK, ACK, ACK, NACK/DTX	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,1}$	1, 0	1, 1, 0, 0
ACK, ACK, ACK, NACK/DTX	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,1}$	1, 0	1, 1, 0, 0
ACK, ACK, NACK/DTX, any	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,1}$	0, 1	1, 0, 0, 0

ACK, ACK, NACK/DTX, any	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,1}$	0, 1	1, 0, 0, 0
ACK, DTX, DTX, DTX	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,0}$	1, 1	0, 1, 0, 0
ACK, DTX, DTX, DTX	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,0}$	1, 1	0, 1, 0, 0
ACK, ACK, ACK, ACK	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,0}$	1, 1	0, 1, 0, 0
ACK, ACK, ACK, ACK	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,0}$	1, 1	0, 1, 0, 0
NACK, any, any, any	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,0}$	0, 0	0, 0, 0, 0
NACK, any, any, any	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,0}$	0, 0	0, 0, 0, 0
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	NACK/DTX, any, any, any	$n^{(1)}_{PUCCH,0}$	0, 0	0, 0, 0, 0
(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	$n^{(1)}_{PUCCH,0}$	0, 0	0, 0, 0, 0
DTX, any, any, any	NACK/DTX, any, any, any	No Transm ss on		0, 0, 0, 0
DTX, any, any, any	(ACK, NACK/DTX, any, any), except for (ACK, DTX, DTX, DTX)	No Transm ss on		0, 0, 0, 0

10.1.3.2.2 PUCCH format 3 HARQ-ACK procedure

If a UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*, then $K' = K$ where the set K is defined in Table 10.1.3.1-1 (where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAssignment*), and M' is the number of elements in set K'.

If a UE is configured with one serving cell, or if a UE is configured with more than one serving cells and the UL/DL configuration of all serving cells is same, then in the rest of this subclause K is as defined in Sec 10.2, and M is the number of elements in the set K.

If a UE is configured with more than one serving cell and if at least two cells have different UL/DL configurations, then K in this subclause refers to K_c (as defined in subclause 10.2) , and M is the number of elements in the set K.

For TDD HARQ-ACK transmission with PUCCH format 3 and sub-frame n with $M \geq 1$ and more than one configured serving cell, where M is the number of elements in the set K, the UE shall use PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p})}$ or $n_{\text{PUCCH}}^{(1,\tilde{p})}$ for transmission of HARQ-ACK in subframe n for $\tilde{p}$ mapped to antenna port p where

- If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a single PDSCH transmission only on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the PDCCH is equal to '1' (defined in Table 7.3-X), or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the PDCCH is equal to '1', the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ with
  $n_{\text{PUCCH}}^{(1,\tilde{p}_0)} = (M-m-1)\cdot N_c + m\cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{(1)}$ for antenna port p_0, where $N_{\text{PUCCH}}^{(1)}$ is configured by higher layers, c is selected from {0, 1, 2, 3} such that $N_c \leq n_{\text{CCE},m} < N_{c+1}$,
  $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, and $n_{\text{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n-k_m$ where $k_m \in K$. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by
  $n_{\text{PUCCH}}^{(1,\tilde{p}_1)} = n_{\text{PUCCH}}^{(1,\tilde{p}_0)} + 1$
- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a single PDSCH transmission only on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the PDCCH is equal to '1' (defined in Table 7.3-X), or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the PDCCH is equal to '1', the UE shall use PUCCH format 1a/1b and
  - if the value of k_m is same as the value of an element k'_{i2}, where $k'_{i2} \in K'$, the PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ is given by $n_{\text{PUCCH}}^{(1,\tilde{p})} = (M'-i2-1)\cdot N_c + i2\cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{(1)}$;
  - otherwise, if the value of k_m is same as the value of an element k_{i3}^A in set K^A, where $k_{i3}^A \in K^A$ (defined in Table 10.1.3.1-1A, where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAssignment*), the PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ is given by
    $n_{\text{PUCCH}}^{(1,\tilde{p})} = (M^A - i3 - 1)\cdot N_c + i3\cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{\text{K}_\text{A}}$;

  where M_A is the number of elements in the set K^A defined in Table 10.1.3.1-1A , where c is selected from {0, 1, 2, 3} such that $N_c \leq n_{\text{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$ where $N_{\text{RB}}^{\text{DL}}$ is determined from the primary cell, $n_{CCE,m}$ is the number of the first CCE used for transmission of the

corresponding PDCCH in subframe $n-k_m$, and $N_{\mathrm{PUCCH}}^{\mathrm{K_A}}$, $N_{\mathrm{PUCCH}}^{(1)}$, are configured by higher layers. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} + 1$

- If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a single PDSCH transmission only on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the EPDCCH is equal to '1' (defined in Table 7.3-X), or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the EPDCCH is equal to '1', the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ given by

  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p})} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  - If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p})} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

  where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter pucch-ResourceStartOffset-r11, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} + 1$.

- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, for a single PDSCH transmission only on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the EPDCCH is equal to '1' (defined in Table 7.3-X), or for a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$, and for a TDD UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} the DAI value in the EPDCCH is equal to '1', the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ given by

  - if EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p})} = n_{\mathrm{ECCE,q}} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + \Delta'_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

- if EPDCCH-PRB-set q is configured for localized transmission

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p})} = \left\lfloor \frac{n_{\mathrm{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + n' + \Delta'_{ARO} + N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$$

where

- if the value of k_m is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$;
- otherwise, if the value of k_m is same as the value of an index k_{i3}^{A}, where $k_{i3}^{A} \in K^{A}$, then $i4 = i3$;

and where $n_{\mathrm{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\mathrm{PUCCH,q}}^{(\mathrm{e1})}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. Δ'_{ARO}, $N'_{ECCE,q,n-k'_{i1}}$, $N'_{ECCE,q,n-k_{i1}^{A}}$ are determined as described in section 10.1.3.1. When two antenna port transmission is configured for PUCCH format 1a/1b, the PUCCH resource for antenna port p_1 is given by $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} + 1$.

- for a single PDSCH transmission only on the primary cell where there is not a corresponding PDCCH/EPDCCH detected within subframe(s) $n-k$, where $k \in K$ and no PDCCH/EPDCCH indicating downlink SPS release (defined in subclause 9.2) within subframe(s) $n-k$, where $k \in K$, the UE shall use PUCCH format 1a/1b and PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ with the value of $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ is determined according to higher layer configuration and Table 9.2-2. For a UE configured for two antenna port transmission for PUCCH format 1a/1b, a PUCCH resource value in Table 9.2-2 maps to two PUCCH resources with the first PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)}$ for antenna port p_0.

- for $M > 1$ and a PDSCH transmission only on the primary cell where there is not a corresponding PDCCH detected within subframe(s) $n-k$, where $k \in K$ and an additional PDSCH transmission only on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to '1' (defined in Table 7.3-X) or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n-k_m$, where $k_m \in K$ with the DAI value in the PDCCH equal to '1', the UE shall transmit $b(0), b(1)$ in subframe n using PUCCH format 1b on PUCCH resource $n_{\mathrm{PUCCH}}^{(1)}$ selected from A PUCCH resources $n_{\mathrm{PUCCH},i}^{(1)}$ where $0 \le i \le A-1$, according to Table 10.1.3.2-1 and Table 10.1.3.2-2 for $A = 2$ and $A = 3$, respectively. For a UE configured with a transmission mode that supports up to two transport blocks on the primary cell, $A = 3$; otherwise, $A = 2$.
  - If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, the PUCCH resource $n_{\mathrm{PUCCH},0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2.
    The PUCCH resource $n_{\mathrm{PUCCH},1}^{(1)}$ is determined as
    $n_{\mathrm{PUCCH},1}^{(1)} = (M-m-1)\cdot N_c + m\cdot N_{c+1} + n_{\mathrm{CCE},m} + N_{\mathrm{PUCCH}}^{(1)}$, where $N_{\mathrm{PUCCH}}^{(1)}$ is configured by higher layers, c is selected from {0, 1, 2, 3} such that $N_c \le n_{\mathrm{CCE},m} < N_{c+1}$,

$N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, and $n_{\text{CCE,m}}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n - k_m$ where $k_m \in K$.

- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, the PUCCH resource $n_{\text{PUCCH},0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2. The PUCCH resource $n_{\text{PUCCH},1}^{(1)}$ is determined as

  - if the value of k_m is same as the value of an element k'_{i2} , where $k'_{i2} \in K'$, the PUCCH resource $n_{\text{PUCCH},1}^{(1)}$ is given by $n_{\text{PUCCH},1}^{(1)} = (M' - i2 - 1) \cdot N_c + i2 \cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{(1)}$;

  - otherwise, if the value of k_m is same as the value of an element k_{i3}^A in set K^A, where $k_{i3}^A \in K^A$ (defined in Table 10.1.3.1-1A, where "UL/DL configuration" in the table refers to the higher layer parameter *subframeAssignment*), the PUCCH resource $n_{\text{PUCCH},1}^{(1)}$ is given by $n_{\text{PUCCH},1}^{(1)} = (M^A - i3 - 1) \cdot N_c + i3 \cdot N_{c+1} + n_{\text{CCE},m} + N_{\text{PUCCH}}^{\text{K}_\text{A}}$;

  where M_A is the number of elements in the set K^A defined in Table 10.1.3.1-1A , where c is selected from {0, 1, 2, 3} such that $N_c \le n_{\text{CCE},m} < N_{c+1}$, $N_c = \max\left\{0, \left\lfloor [N_{\text{RB}}^{\text{DL}} \cdot (N_{\text{sc}}^{\text{RB}} \cdot c - 4)]/36 \right\rfloor\right\}$, $n_{CCE,m}$ is the number of the first CCE used for transmission of the corresponding PDCCH in subframe $n - k_m$, and $N_{\text{PUCCH}}^{\text{K}_\text{A}}$, $N_{\text{PUCCH}}^{(1)}$, are configured by higher layers.

- For a UE configured with a transmission mode that supports up to two transport blocks on the primary cell, the PUCCH resource $n_{\text{PUCCH},2}^{(1)}$ is determined as $n_{\text{PUCCH},2}^{(1)} = n_{\text{PUCCH},1}^{(1)} + 1$ .HARQ-ACK(0) is the ACK/NACK/DTX response for the PDSCH without a corresponding PDCCH detected. HARQ-ACK(1) is the ACK/NACK/DTX response for the first transport block of the PDSCH indicated by the detection of a corresponding PDCCH for which the value of the DAI field in the corresponding DCI format is equal to '1' or for the PDCCH indicating downlink SPS release for which the value of the DAI field in the corresponding DCI format is equal to '1'. HARQ-ACK(2) is the ACK/NACK/DTX response for the second transport block of the PDSCH indicated by the detection of a corresponding PDCCH for which the value of the DAI field in the corresponding DCI format is equal to '1'.

- for $M > 1$ and a PDSCH transmission only on the primary cell where there is not a corresponding EPDCCH detected within subframe(s) $n - k$, where $k \in K$ and an additional PDSCH transmission only on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the EPDCCH equal to '1' (defined in Table 7.3-X) or a EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the EPDCCH equal to '1', the UE shall transmit $b(0), b(1)$ in subframe n using PUCCH format 1b on PUCCH resource $n_{\text{PUCCH}}^{(1)}$ selected from A PUCCH resources $n_{\text{PUCCH},i}^{(1)}$ where $0 \le i \le A - 1$, according to Table 10.1.3.2-1 and Table 10.1.3.2-2 for $A = 2$ and $A = 3$, respectively. For a UE configured with a transmission mode that supports up to two transport blocks on the primary cell, $A = 3$; otherwise, $A = 2$.

  - If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, the PUCCH resource $n_{\text{PUCCH},0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2. The PUCCH resource $n_{\text{PUCCH},1}^{(1)}$ is determined as

    - If EPDCCH-PRB-set q is configured for distributed transmission

      $$n_{\text{PUCCH},1}^{(1)} = n_{\text{ECCE,q}} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(\text{e1})}$$

    - If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH},1}^{(1)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{m-1} N_{ECCE,q,n-k_{i1}} + n' + \Delta_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\text{PUCCH,q}}^{(e1)}$ for EPDCCH-PRB-set q is configured by the higher layer parameter pucch-ResourceStartOffset-r11, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. If $m=0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.2.1-1. If $m>0$, Δ_{ARO} is determined from the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH as given in Table 10.1.3.1-2. If the UE is configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs in EPDCCH-PRB-set q configured for that UE in subframe $n-k_{i1}$. If the UE is not configured to monitor EPDCCH in subframe $n-k_{i1}$, $N_{ECCE,q,n-k_{i1}}$ is equal to the number of ECCEs computed assuming EPDCCH-PRB-set q is configured for that UE in subframe $n-k_{i1}$. For normal downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 5, $N_{ECCE,q,n-k_{i1}}$ is equal to 0. For extended downlink CP, if subframe $n-k_{i1}$ is a special subframe with special subframe configuration 0 or 4 or 7, $N_{ECCE,q,n-k_{i1}}$ is equal to 0.

- If the UE is configured with the higher layer parameter *EIMTA-MainConfigServCell-r12* on the primary cell, the PUCCH resource $n_{\text{PUCCH},0}^{(1)}$ is determined according to higher layer configuration and Table 9.2-2. The PUCCH resource $n_{\text{PUCCH},1}^{(1)}$ is determined as

  - If EPDCCH-PRB-set q is configured for distributed transmission

$$n_{\text{PUCCH,i}}^{(1)} = n_{\text{ECCE,q}} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + \Delta'_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

  - If EPDCCH-PRB-set q is configured for localized transmission

$$n_{\text{PUCCH,i}}^{(1)} = \left\lfloor \frac{n_{\text{ECCE,q}}}{N_{RB}^{ECCE,q}} \right\rfloor \cdot N_{RB}^{ECCE,q} + \sum_{i1=0}^{i4-1} N'_{ECCE,q,n-k'_{i1}} + \sum_{i1=0}^{i5-1} N'_{ECCE,q,n-k_{i1}^{A}} + n' + \Delta'_{ARO} + N_{\text{PUCCH,q}}^{(e1)}$$

  where

  - if the value of k_m is same as the value of an index k'_{i2}, where $k'_{i2} \in K'$, then $i4 = i2$;
  - otherwise, if the value of k_m is same as the value of an index k_{i3}^{A}, where $k_{i3}^{A} \in K^{A}$, then $i4 = i3$;

  and where $n_{\text{ECCE,q}}$ is the number of the first ECCE (i.e. lowest ECCE index used to construct the EPDCCH) used for transmission of the corresponding DCI assignment in EPDCCH-PRB-set q in subframe $n-k_m$, $N_{\text{PUCCH,q}}^{(e1)}$ for EPDCCH-PRB-set q is configured by the higher layer parameter *pucch-ResourceStartOffset-r11*, $N_{RB}^{ECCE,q}$ for EPDCCH-PRB-set q in subframe $n-k_m$ is given in subclause 6.8A.1 in [3], n' is determined from the antenna port used for EPDCCH transmission in subframe $n-k_m$ which is described in subclause 6.8A.5 in [3]. Δ'_{ARO}, $N'_{ECCE,q,n-k'_{i1}}$, $N'_{ECCE,q,n-k_{i1}^{A}}$ are determined as described in section 10.1.3.1.

- For a UE configured with a transmission mode that supports up to two transport blocks on the primary cell, the PUCCH resource $n^{(1)}_{\text{PUCCH},2}$ is determined as $n^{(1)}_{\text{PUCCH},2} = n^{(1)}_{\text{PUCCH},1} + 1$.HARQ-ACK(0) is the ACK/NACK/DTX response for the PDSCH without a corresponding EPDCCH detected. HARQ-ACK(1) is the ACK/NACK/DTX response for the first transport block of the PDSCH indicated by the detection of a corresponding EPDCCH for which the value of the DAI field in the corresponding DCI format is equal to '1' or for the EPDCCH indicating downlink SPS release for which the value of the DAI field in the corresponding DCI format is equal to '1'. HARQ-ACK(2) is the ACK/NACK/DTX response for the second transport block of the PDSCH indicated by the detection of a corresponding EPDCCH for which the value of the DAI field in the corresponding DCI format is equal to '1'.

- for $M > 1$ and a PDSCH transmission only on the primary cell indicated by the detection of a corresponding PDCCH in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the PDCCH greater than '1' (defined in Table 7.3-X) or a PDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the PDCCH greater than '1', the UE shall use PUCCH format 3 and PUCCH resource $n^{(3,\tilde{p})}_{\text{PUCCH}}$ where the value of $n^{(3,\tilde{p})}_{\text{PUCCH}}$ is determined according to higher layer configuration and Table 10.1.2.2.2-1 and the TPC field in a PDCCH assignment with DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four PUCCH resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all PDCCH assignments used to determine the PUCCH resource values within the subframe(s) $n - k$, where $k \in K$.

- for $M > 1$ and a PDSCH transmission only on the primary cell indicated by the detection of a corresponding EPDCCH in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the EPDCCH greater than '1' (defined in Table 7.3-X) or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) in subframe $n - k_m$, where $k_m \in K$ with the DAI value in the EPDCCH greater than '1', the UE shall use PUCCH format 3 and PUCCH resource $n^{(3,\tilde{p})}_{\text{PUCCH}}$ where the value of $n^{(3,\tilde{p})}_{\text{PUCCH}}$ is determined according to higher layer configuration and Table 10.1.2.2.2-1 and the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH assignment with DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four PUCCH resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all EPDCCH assignments used to determine the PUCCH resource values within the subframe(s) $n - k$, where $k \in K$.

- If the UL/DL configurations of all serving cells are the same, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding PDCCH/EPDCCH within subframe(s) $n - k$, where $k \in K$, the UE shall use PUCCH format 3 and PUCCH resource $n^{(3,\tilde{p})}_{\text{PUCCH}}$ where the value of $n^{(3,\tilde{p})}_{\text{PUCCH}}$ is determined according to higher layer configuration and Table 10.1.2.2.2-1 and the TPC field in the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. For TDD UL/DL configurations 1-6, if a PDCCH corresponding to a PDSCH on the primary cell within subframe(s) $n - k$, where $k \in K$, or a PDCCH indicating downlink SPS release (defined in subclause 9.2) within subframe(s) $n - k$, where $k \in K$, is detected, the TPC field in the PDCCH with the DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all PDCCH assignments in the primary cell and in each secondary cell that are used to determined the PUCCH resource value within the subframe(s) $n - k$, where $k \in K$. For TDD UL/DL configurations 1-6, if an EPDCCH corresponding to a PDSCH on the primary cell within subframe(s) $n - k$, where $k \in K$, or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) within subframe(s) $n - k$, where $k \in K$, is detected, the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH assignment with the DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all EPDCCH assignments in the primary cell and in each secondary cell that are used to determined the PUCCH resource value within the subframe(s) $n - k$, where $k \in K$.

- If the UL/DL configurations of at least two serving cells are different, for a PDSCH transmission on the secondary cell indicated by the detection of a corresponding PDCCH/EPDCCH within subframe(s) $n-k$, where $k \in K$, the UE shall use PUCCH format 3 and PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p})}$ where the value of $n_{\text{PUCCH}}^{(3,\tilde{p})}$ is determined according to higher layer configuration and Table 10.1.2.2.2-1 and the TPC field in the corresponding PDCCH/EPDCCH shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. For a UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} as defined in subclause 10.2, if a PDCCH corresponding to a PDSCH on the primary cell within subframe(s) $n-k$, where $k \in K$, or a PDCCH indicating downlink SPS release (defined in subclause 9.2) within subframe(s) $n-k$, where $k \in K$, is detected, the TPC field in the PDCCH with the DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all PDCCH assignments in the primary cell and in each secondary cell that are used to determined the PUCCH resource value within the subframe(s) $n-k$, where $k \in K$. For a UL/DL configuration of the primary cell belonging to {1,2,3,4,5,6} as defined in subclause 10.2, if an EPDCCH corresponding to a PDSCH on the primary cell within subframe(s) $n-k$, where $k \in K$, or an EPDCCH indicating downlink SPS release (defined in subclause 9.2) within subframe(s) $n-k$, where $k \in K$, is detected, the HARQ-ACK resource offset field in the DCI format of the corresponding EPDCCH assignment with the DAI value greater than '1' shall be used to determine the PUCCH resource value from one of the four resource values configured by higher layers, with the mapping defined in Table 10.1.2.2.2-1. A UE shall assume that the same HARQ-ACK PUCCH resource value is transmitted on all EPDCCH assignments in the primary cell and in each secondary cell that are used to determined the PUCCH resource value within the subframe(s) $n-k$, where $k \in K$.

- For PUCCH format 3 and PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p})}$ and a UE configured for two antenna port transmission, a PUCCH resource value in Table 10.1.2.2.2-1 maps to two PUCCH resources with the first PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH}}^{(3,\tilde{p}_0)}$ for antenna port p_0.

10.1.3A FDD-TDD HARQ-ACK feedback procedures for primary cell frame structure type 2

A UE is configured by higher layers to use either PUCCH format 1b with channel selection or PUCCH format 3 for transmission of HARQ-ACK.

For a serving cell, if the serving cell is frame structure type 1, and a UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, set K is defined in Table 10.1.3A-1, otherwise set K is defined in Table 10.1.3.1-1.

PUCCH format 1b with channel selection is not supported if a UE is configured with more than two serving cells, or if the DL-reference UL/DL configuration 5 (as defined in subclause 10.2) is defined for any serving cell, or if the DL-reference UL/DL configuration of a serving cell with frame structure type 1 belongs to {2, 3, 4} and the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell.

If a UE is configured with the parameter *EIMTA-MainConfigServCell-r12* for at least one serving cell, the UE is not expected to be configured with more than two serving cells having DL-reference UL/DL configuration 5.

If a UE is configured to use PUCCH format 1b with channel selection for HARQ-ACK transmission, for the serving cells,

- if more than 4 HARQ-ACK bits for M multiple downlink and special subframes associated with a single UL subframe *n*, where M is as defined in subclause 10.1.3.2.1 for case where the UE is configured with two serving cells with different UL/DL configurations,
  - spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe is performed for each serving cell by a logical AND operation of all the corresponding individual HARQ-ACKs, and the bundled HARQ-ACK bits for each serving cell is transmitted using PUCCH format 1b with channel selection,
- otherwise,

- spatial HARQ-ACK bundling is not performed, and the HARQ-ACK bits are transmitted using PUCCH format 1b with channel selection.

If a UE is configured to use PUCCH format 3 for HARQ-ACK transmission, for the serving cells,

- if more than 21 HARQ-ACK bits for M multiple downlink and special subframes associated with a single UL subframe n, where M as defined in subclause 10.1.3.2.2 for the case of UE configured with more than one serving cell and if at least two cells have different UL/DL configurations,
  - spatial HARQ-ACK bundling across multiple codewords within a downlink or special subframe is performed for each serving cell by a logical AND operation of all of the corresponding individual HARQ-ACKs, and PUCCH format 3 is used,
- otherwise,
  - spatial HARQ-ACK bundling is not performed, and the HARQ-ACK bits are transmitted using PUCCH format 3.
- UE shall determine the number of HARQ-ACK bits, O, associated with an UL subframe n according to $O=\sum_{c=1}^{N_{cells}^{DL}} O_c^{ACK}$ where N_{cells}^{DL} is the number of configured cells, and O_c^{ACK} is the number of HARQ-bits for the c-th serving cell defined in subclause 7.3.4. If a UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling a serving cell with frame structure type 1, and the DL-reference UL/DL configuration of the serving cell belongs to {2, 3, 4, 5}, then the UE is not expected to be configured with N_{cells}^{DL} which result in $O>21$.

HARQ-ACK transmission on two antenna ports $(p\in[p_0,p_1])$ is supported for PUCCH format 3.

HARQ-ACK transmission on two antenna ports $(p\in[p_0,p_1])$ is supported for PUCCH format 1b with channel selection and with two configured serving cells.

The FDD-TDD HARQ-ACK feedback procedure for PUCCH format 1b with channel selection follows the HARQ-ACK procedure described in subclause 10.1.3.2.1 for the case of UE configured with two serving cells with different UL/DL configurations, and for PUCCH format 3 follows the HARQ-ACK procedure described in subclause 10.1.3.2.2 for the case of UE configured with more than one serving cell and if at least two cells have different UL/DL configurations.

Table 10.1.3A-1: Downlink association set $K:\{k_0,k_1,\cdots k_{M-1}\}$ for FDD-TDD and serving cell frame structure type 1

DL-reference UL/DL Configuration	Subframe *n*									
	0	1	2	3	4	5	6	7	8	9
0	-	-	6, 5	5, 4	4	-	-	6, 5	5, 4	4
1	-	-	7, 6	6, 5, 4	-	-	-	7, 6	6, 5, 4	-
2	-	-	8, 7, 6, 5, 4	-	-	-	-	8, 7, 6, 5, 4	-	-
3	-	-	11, 10, 9, 8, 7, 6	6, 5	5, 4	-	-	-	-	-
4	-	-	12, 11, 10, 9, 8, 7	7, 6, 5, 4	-	-	-	-	-	-
5	-	-	13, 12, 11, 10, 9, 8, 7, 6, 5, 4	-	-	-	-	-	-	-
6	-	-	8, 7	7, 6	6, 5	-	-	7	7, 6, 5	-

10.1.4 HARQ-ACK Repetition procedure

HARQ-ACK repetition is enabled or disabled by a UE specific parameter *ackNackRepetition* configured by higher layers. Once enabled, the UE shall repeat any HARQ-ACK transmission with a repetition factor N_{ANRep}, where N_{ANRep} is provided by higher layers and includes the initial HARQ-ACK transmission, until HARQ-ACK repetition is disabled by higher layers. For a PDSCH transmission without a corresponding PDCCH/EPDCCH detected, the UE shall transmit the corresponding HARQ-ACK response N_{ANRep} times using PUCCH resource $n_{\text{PUCCH}}^{(1,\tilde{p})}$ configured by higher layers. For a PDSCH transmission with a corresponding PDCCH/EPDCCH detected,

or for a PDCCH/EPDCCH indicating downlink SPS release, the UE shall first transmit the corresponding HARQ-ACK response once using PUCCH resource derived from the corresponding PDCCH CCE index or EPDCCH ECCE index (as described in subclauses 10.1.2 and 10.1.3), and repeat the transmission of the corresponding HARQ-ACK response $N_{\text{ANRep}} - 1$ times always using PUCCH resource $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p})}$, where $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p})}$ is configured by higher layers.

HARQ-ACK repetition is only applicable for UEs configured with one serving cell for FDD and TDD. For TDD, HARQ-ACK repetition is only applicable for HARQ-ACK bundling.

HARQ-ACK repetition can be enabled with PUCCH format 1a/1b on two antenna ports. For a UE configured for two antenna port transmission for HARQ-ACK repetition with PUCCH format 1a/1b, a PUCCH resource value $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p})}$ maps to two PUCCH resources with the first PUCCH resource $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p}_0)}$ for antenna port p_0 and the second PUCCH resource $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p}_1)}$ for antenna port p_1, otherwise, the PUCCH resource value maps to a single PUCCH resource $n_{\text{PUCCH, ANRep}}^{(1,\tilde{p}_0)}$ for antenna port p_0.

10.1.5 Scheduling Request (SR) procedure

A UE is configured by higher layers to transmit the SR on one antenna port or two antenna ports.
The scheduling request shall be transmitted on the PUCCH resource(s) $n_{\text{PUCCH}}^{(1,\tilde{p})} = n_{\text{PUCCH,SRI}}^{(1,\tilde{p})}$ for $\tilde{p}$ mapped to antenna port p as defined in [3], where $n_{\text{PUCCH,SRI}}^{(1,\tilde{p})}$ is configured by higher layers unless the SR coincides in time with the transmission of HARQ-ACK using PUCCH Format 3 in which case the SR is multiplexed with HARQ-ACK according to subclause 5.2.3.1 of [4]. The SR configuration for SR transmission periodicity $SR_{\text{PERIODICITY}}$ and SR subframe offset $N_{\text{OFFSET,SR}}$ is defined in Table 10.1.5-1 by the parameter *sr-ConfigIndex* I_{SR} given by higher layers.

SR transmission instances are the uplink subframes satisfying
$\left(10 \times n_f + \lfloor n_s / 2 \rfloor - N_{\text{OFFSET,SR}}\right) \bmod SR_{\text{PERIODICITY}} = 0$.

Table 10.1.5-1: UE-specific SR periodicity and subframe offset configuration

SR configuration Index I_{SR}	SR periodicity (ms) $SR_{\text{PERIODICITY}}$	SR subframe offset $N_{\text{OFFSET,SR}}$
0 – 4	5	I_{SR}
5 – 14	10	$I_{SR} - 5$
15 – 34	20	$I_{SR} - 15$
35 – 74	40	$I_{SR} - 35$
75 – 154	80	$I_{SR} - 75$
155 – 156	2	$I_{SR} - 155$
157	1	$I_{SR} - 157$

10.2 Uplink HARQ-ACK timing

For TDD or for FDD-TDD and primary cell frame structure type 2, if a UE configured with *EIMTA-MainConfigServCell-r12* for a serving cell, "UL/DL configuration" of the serving cell in subclause 10.2 refers to the UL/DL configuration given by the parameter *eimta-HarqReferenceConfig-r12* for the serving cell unless specified otherwise.

For FDD or for FDD-TDD and primary cell frame structure type 1, the UE shall upon detection of a PDSCH transmission in subframe *n-4* intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response in subframe *n*. If HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission in subframe *n-4* intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe n corresponding to a PDSCH transmission in subframes $n-N_{\text{ANRep}}-3, \ldots, n-5$, the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe $n-4$) on PUCCH in subframes $n, n+1, \ldots, n+N_{\text{ANRep}}-1$;
- shall not transmit any other signal in subframes $n, n+1, \ldots, n+N_{\text{ANRep}}-1$; and
- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes $n-3, \ldots, n+N_{\text{ANRep}}-5$.

For TDD and a UE configured with *EIMTA-MainConfigServCell-r12* for at least one serving cell, if the UE is configured with one serving cell or if the UE is configured with more than one serving cell and the TDD UL/DL configuration of all the configured serving cells is the same, the DL-reference UL/DL configuration for a serving cell is the UL/DL configuration of the serving cell

For TDD, if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations and if a serving cell is a primary cell, then the primary cell UL/DL configuration is the DL-reference UL/DL configuration for the serving cell.

For FDD-TDD and primary cell frame structure type 2, if a serving cell is a primary cell or if a serving cell is a secondary cell with frame structure type 1, then the primary cell UL/DL configuration is the DL-reference UL/DL configuration for the serving cell.

For TDD and if the UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations and if a serving cell is a secondary cell, or for FDD-TDD and primary cell frame structure type 2 and if a serving cell is a secondary cell with frame structure type 2

- if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration) belongs to Set 1 in Table 10.2-1 or
- if the UE is not configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration) belongs to Set 2 or Set 3 in Table 10.2-1 or
- if the UE is configured to monitor PDCCH/EPDCCH in another serving cell for scheduling the serving cell, and if the pair formed by (primary cell UL/DL configuration, serving cell UL/DL configuration) belongs to Set 4 or Set 5 in Table 10.2-1

then the DL-reference UL/DL configuration for the serving cell is defined in the corresponding Set in Table 10.2-1.

For TDD and if a UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations or for FDD-TDD and primary cell frame structure type 2, if the DL-reference UL/DL configuration for at least one serving cell is TDD UL/DL Configuration 5, then the UE is not expected to be configured with more than two serving cells.

For TDD, if a UE is configured with one serving cell, or the UE is configured with more than one serving cell and the UL/DL configurations of all serving cells is same, then the UE shall upon detection of a PDSCH transmission within subframe(s) $n-k$, where $k \in K$ and K is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*.

For TDD and if a UE is configured with more than one serving cell and if at least two serving cells have different UL/DL configurations, or for FDD-TDD and primary cell frame structure type 2 and if a serving cell *c* is frame structure type 2, then the UE shall upon detection of a PDSCH transmission within subframe(s) $n-k$ for serving cell *c*, where $k \in K_c$ intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in UL subframe *n*, wherein set K_c contains values of $k \in K$ such that subframe *n-k* corresponds to a DL subframe or a special subframe for serving cell *c*, K defined in Table 10.1.3.1-1 (where "UL/DL configuration" in Table 10.1.3.1-1 refers to the "DL-reference UL/DL configuration") is associated with subframe *n*.

For FDD-TDD and primary cell frame structure type 2, if a serving cell *c* is frame structure type 1, then the UE shall upon detection of a PDSCH transmission within subframe(s) $n-k$ for serving cell *c*, where $k \in K_c$, $K_c = K$ and K is defined in Table 10.1.3A-1 intended for the UE and for which HARQ-ACK response shall be provided, transmit the HARQ-ACK response in subframe *n*.

For TDD, if HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission within subframe(s) $n-k$, where $k \in K$ and K is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe n corresponding to a PDSCH transmission in a downlink or special subframe earlier than subframe $n-k$, the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe $n-k$) on PUCCH in UL subframe n and the next $N_{\text{ANRep}}-1$ UL subframes denoted as n_1, …, $n_{N_{\text{ANRep}}-1}$;
- shall not transmit any other signal in UL subframe n, n_1, …, $n_{N_{\text{ANRep}}-1}$; and
- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes n_i-k, where $k \in K_i$, K_i is the set defined in Table 10.1.3.1-1 corresponding to UL subframe n_i, and $1 \le i \le N_{\text{ANRep}}-1$.

For TDD, HARQ-ACK bundling, if the UE detects that at least one downlink assignment has been missed as described in subclause 7.3, the UE shall not transmit HARQ-ACK on PUCCH if HARQ-ACK is the only UCI present in a given subframe.

The uplink timing for the ACK corresponding to a detected PDCCH/EPDCCH indicating downlink SPS release shall be the same as the uplink timing for the HARQ-ACK corresponding to a detected PDSCH, as defined above.

Table 10.2-1: DL-reference UL/DL configuration for serving cell based on pair formed by (primary cell UL/DL configuration, secondary cell UL/DL configuration)

Set #	(Primary cell UL/DL configuration, Secondary cell UL/DL configuration)	DL-reference UL/DL configuration
Set 1	(0,0)	0
	(1,0),(1,1),(1,6)	1
	(2,0),(2,2),(2,1),(2,6)	2
	(3,0),(3,3),(3,6)	3
	(4,0),(4,1),(4,3),(4,4),(4,6)	4
	(5,0),(5,1),(5,2),(5,3),(5,4),(5,5),(5,6)	5
	(6,0),(6,6)	6
Set 2	(0,1),(6,1)	1
	(0,2),(1,2),(6,2)	2
	(0,3),(6,3)	3
	(0,4),(1,4),(3,4),(6,4)	4
	(0,5),(1,5),(2,5),(3,5),(4,5),(6,5)	5
	(0,6)	6
Set 3	(3,1),(1,3)	4
	(3,2),(4,2),(2,3),(2,4)	5
Set 4	(0,1),(0,2),(0,3),(0,4),(0,5),(0,6)	0
	(1,2),(1,4),(1,5)	1
	(2,5)	2
	(3,4),(3,5)	3
	(4,5)	4
	(6,1),(6,2),(6,3),(6,4),(6,5)	6
Set 5	(1,3)	1
	(2,3),(2,4)	2
	(3,1),(3,2)	3
	(4,2)	4

11 Physical Multicast Channel (PMCH) related procedures

11.1 UE procedure for receiving the PMCH

The UE shall decode the PMCH when configured by higher layers. The UE may assume that an eNB transmission on the PMCH is performed according to subclause 6.5 of [3].

The I_{MCS} for the PMCH is configured by higher layers. If the UE is configured by higher layers to decode the PMCH based on QPSK, 16QAM, 64QAM, and 256QAM then the UE shall use I_{MCS} and Table 7.1.7.1-1A to determine the modulation order (Q_m) and TBS index (I_{TBS}) used in the PMCH. Else the UE shall use I_{MCS} for the PMCH and Table 7.1.7.1-1 to determine the modulation order (Q_m) and TBS index (I_{TBS}) used in the PMCH.

The UE shall then follow the procedure in subclause 7.1.7.2.1 to determine the transport block size, assuming N_{PRB} is equal to N_{RB}^{DL}. The UE shall set the redundancy version to 0 for the PMCH.

11.2 UE procedure for receiving MCCH change notification

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the M-RNTI, the UE shall decode the PDCCH according to the combination defined in Table 11.2-1.

Table 11.2-1: PDCCH configured by M-RNTI

DCI format	Search Space
DCI format 1C	Common

The 8-bit information for MCCH change notification [11], as signalled on the PDCCH, shall be delivered to higher layers.

12 Assumptions independent of physical channel

A UE shall not assume that two antenna ports are quasi co-located unless specified otherwise.

A UE may assume the antenna ports 0 – 3 of a serving cell are quasi co-located (as defined in [3]) with respect to delay spread, Doppler spread, Doppler shift, average gain, and average delay.

13 Uplink/Downlink configuration determination procedure for Frame Structure Type 2

For each serving cell

If the UE is not configured with the higher layer parameter *EIMTA-MainConfigServCell-r12*,

- the UE shall set the UL/DL configuration equal to the UL/DL configuration (i.e., the parameter *subframeAssignment*) indicated by higher layers.

If the UE is configured by higher layers with the parameter *EIMTA-MainConfigServCell-r12*, then for each radio frame,

- the UE shall determine eIMTA-UL/DL-configuration as described in subclause 13.1.
- the UE shall set the UL/DL configuration for each radio frame equal to the eIMTA-UL/DL-configuration of that radio frame

13.1 UE procedure for determining eIMTA-uplink/downlink configuration

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the eIMTA-RNTI, the UE shall decode the PDCCH according to the combination defined in Table 13.1-1.

Table 13.1-1: PDCCH configured by eIMTA-RNTI

DCI format	Search Space
DCI format 1C	Common

The subframes in which the UE monitors PDCCH with CRC scrambled by eIMTA-RNTI are configured by higher layers.

For each serving cell,

- if T= 10,
  - if the UE detects PDCCH with CRC scrambled by eIMTA-RNTI in subframe 0 of a radio frame m,
    - the eIMTA-UL/DL-configuration for radio frame m is given by the UL/DL configuration indication signalled on the PDCCH as described in [4],
  - or if the UE detects PDCCH with CRC scrambled by eIMTA-RNTI in a subframe other than subframe 0 of a radio frame m-1
    - the eIMTA-UL/DL-configuration for radio frame m is given by the UL/DL configuration indication signalled on the PDCCH as described in [4],
    - the UE may assume that the same UL/DL configuration indication is indicated by PDCCH with CRC scrambled by eIMTA-RNTI in all the subframes other than subframe 0 of radio frame m-1 and subframe 0 of radio frame m in which PDCCH with CRC scrambled by eIMTA-RNTI is monitored,
  - otherwise
    - the eIMTA-UL/DL-configuration for radio frame m is same as the UL/DL configuration (i.e., the parameter *subframeAssignment*) indicated by higher layers;
- if T is a value other than 10,
  - if the UE detects PDCCH with CRC scrambled by eIMTA-RNTI in a subframe in radio frame $mT/10$,
    - the eIMTA-UL/DL-configuration for radio frames $\{mT/10+1 , mT/10+2,\ldots. (m+1)T/10\}$ is given by the UL/DL configuration indication signalled on the PDCCH as described [4],
    - the UE may assume that the same UL/DL configuration indication is indicated by PDCCH with CRC scrambled by eIMTA-RNTI in all the subframes of radio frame $mT/10$ in which PDCCH with CRC scrambled by eIMTA-RNTI is monitored,
  - otherwise
    - the eIMTA-UL/DL-configuration for radio frames $\{mT/10+1 , mT/10+2,\ldots. (m+1) T/10\}$ is same as the UL/DL configuration (i.e., the parameter *subframeAssignment*) indicated by higher layers.

where T denotes the value of parameter *eimta-CommandPeriodicity-r12*.

For a serving cell c, if subframe *i* is indicated as uplink subframe or a special subframe by higher layer parameter *eimta-HarqReferenceConfig-r12*, the UE is not expected to receive a PDCCH with CRC scrambled by eIMTA-RNTI containing an UL/DL configuration for serving cell c that would indicate subframe *i* as a downlink subframe.

For a serving cell c, if subframe *i* is indicated as downlink subframe or a special subframe by higher layer parameter *subframeAssignment*, the UE is not expected to receive a PDCCH with CRC scrambled by eIMTA-RNTI containing an UL/DL configuration for serving cell c that would indicate subframe *i* as an uplink subframe.

For a serving cell c, a UE is not expected to be configured with parameter *eimta-HarqReferenceConfig-r12* if a subframe indicated as an uplink subframe by *eimta-HarqReferenceConfig-r12* is not indicated as an uplink subframe by the UL-reference UL/DL configuration.

If UE is not configured with the parameter *EIMTA-MainConfigServCell-r12* for any activated serving cell, the UE is not expected to monitor PDCCH with CRC scrambled by eIMTA-RNTI.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2006 09					Draft vers on created		0.0.0
2006 10					Endorsed by RAN1	0.0.0	0.1.0
2007 01					Inc us on of dec s ons from RAN1#46b s and RAN1#47	0.1.0	0.1.1
2007 01					Endorsed by RAN1	0.1.1	0.2.0
2007 02					Inc us on of dec s ons from RAN1#47b s	0.2.0	0.2.1
2007 02					Endorsed by RAN1	0.2.1	0.3.0
2007 02					Ed tor's vers on nc ud ng dec s ons from RAN1#48 & RAN1#47b s	0.3.0	0.3.1
2007 03					Updated Ed tor's vers on	0.3.1	0.3.2
2007 03	RAN 35	RP 070171			For nformat on at RAN#35	0.3.2	1.0.0
2007 03					Random access text mod f ed to better ref ect RAN1 scope	1.0.0	1.0.1
2007 03					Updated Ed tor's vers on	1.0.1	1.0.2
2007 03					Endorsed by RAN1	1.0.2	1.1.0
2007 05					Updated Ed tor's vers on	1.1.0	1.1.1
2007 05					Updated Ed tor's vers on	1.1.1	1.1.2
2007 05					Endorsed by RAN1	1.1.2	1.2.0
2007 08					Updated Ed tor's vers on	1.2.0	1.2.1
2007 08					Updated Ed tor's vers on up nk power contro from RAN1#49b s	1.2.1	1.2.2
2007 08					Endorsed by RAN1	1.2.2	1.3.0
2007 09					Updated Ed tor's vers on ref ect ng RAN#50 dec s ons	1.3.0	1.3.1
2007 09					Updated Ed tor's vers on ref ect ng comments	1.3.1	1.3.2
2007 09					Updated Ed tor's vers on ref ect ng further comments	1.3.2	1.3.3
2007 09					Updated Ed tor's vers on ref ect ng further comments	1.3.3	1.3.4
2007 09					Updated Edt or's vers on ref ect ng further comments	1.3.4	1.3.5
2007 09	RAN 37	RP 070731			Endorsed by RAN1	1.3.5	2.0.0
2007 09	RAN 37	RP 070737			For approva at RAN#37	2.0.0	2.1.0
12/09/07	RP 37	RP 070737			Approved vers on	2.1.0	8.0.0
28/11/07	RP 38	RP 070949	0001	2	Update of 36.213	8.0.0	8.1.0
05/03/08	RP 39	RP 080145	0002		Update of TS 36.213 according to changes listed in cover sheet	8.1.0	8.2.0
28/05/08	RP 40	RP 080434	0003	1	PUCCH t m ng and other formatt ng and typo correct ons	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0006	1	PUCCH power contro for non un cast nformat on	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0008		UE ACK/NACK Procedure	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0009		UL ACK/NACK t m ng for TDD	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0010		Spec f cat on of UL contro channe ass gnment	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0011		Precod ng Matr x for 2Tx Open oop SM	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0012		C ar f cat ons on UE se ected CQI reports	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0013	1	UL HARQ Operat on and T m ng	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0014		SRS power contro	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0015	1	Correct on of UE PUSCH frequency hopp ng procedure	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0017	4	B nd PDCCH decod ng	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0019	1	Tx Mode vs DCI format s c ar f ed	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0020		Resource a ocat on for d str buted VRB	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0021	2	Power Headroom	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0022		C ar f cat on for RI report ng n PUCCH and PUSCH report ng modes	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0025		Correct on of the descr pt on of PUSCH power contro for TDD	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0026		UL ACK/NACK procedure for TDD	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0027		Ind cat on of rad o prob em detect on	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0028		Def n t on of Re at ve Narrowband TX Power Ind cator	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0029		Ca cu at on of $\Delta_{TF}(i)$ for UL PC	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0030		CQI reference and set S def n t on, CQI mode remova , and M sce an ous	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0031		Modu at on order and TBS determ nat on for PDSCH and PUSCH	8.2.0	8.3.0
28/05/08	RP 40	RP 080434	0032		On Sound ng RS	8.2.0	8.3.0
28/05/08	RP 40	RP 080426	0033		Mu t p ex ng of rank and CQI/PMI reports on PUCCH	8.2.0	8.3.0
28/05/08	RP 40	RP 080466	0034		T m ng advance command respond ng t me	8.2.0	8.3.0
09/09/08	RP 41	RP 080670	37	2	SRS hopp ng pattern for c osed oop antenna se ect on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	39	2	C ar f cat on on up nk power contro	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	41		C ar f cat on on DCI formats us ng resource a ocat on type 2	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	43	2	C ar f cat on on tree structure of CCE aggregat ons	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	46	2	Correct on of the descr pt on of PUCCH power contro for TDD	8.3.0	8.4.0

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
09/09/08	RP 41	RP 080670	47	1	Remova of CR0009	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	48	1	Correct on of mapp ng of cyc c sh ft va ue to PHICH mod f er	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	49		TBS d sab ng for DCI formats 2 and 2A	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	50		Correct on of max mum TBS s zes	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	51		Comp et on of the tab e spec fy ng the number of b ts for the per od c feedback	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	54		C ar f cat on of RNTI for PUSCH/PUCCH power contro w th DCI formats 3/3A	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	55	1	C ar f cat on on mapp ng of D fferent a CQI f e ds	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	59	1	PUSCH Power Contro	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	60		RB restr ct on and modu at on order for CQI on y transm ss on on PUSCH	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	61		Modu at on order determ nat on for up nk retransm ss ons	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	62	2	Introduc ng m ss ng L1 parameters nto 36.213	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	63	2	Correct ng the range and representat on of de ta TF PUCCH	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	64	1	Ad ust ng TBS s zes to for VoIP	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	67		Correct on to the down nk resource a ocat on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	68		Remova of spec a hand ng for PUSCH mapp ng n PUCCH reg on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	69		Correct on to the formu as for up nk power contro	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	70	1	Def n t on of B t Mapp ng for DCI S gna ng	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	71		C ar f cat on on PUSCH TPC commands	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	72	1	Reference for CQI/PMI Report ng Offset	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	74		Correct on to the down nk/up nk t m ng	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	75		Correct on to the t me a gnment command	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	77	1	Correct on of offset s gna ng of UL Contro nformat on MCS	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	78	2	DCI format1C	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	80		Correct on to Precoder Cyc ng for Open oop Spat a Mu t p ex ng	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	81	1	C ar fy ng Per od c CQI Report ng us ng PUCCH	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	84	1	CQI reference measurement per od	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	86		Correct on on down nk mu t user MIMO	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	87		PUCCH Report ng	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	88	1	Hand ng of Up nk Grant n Random Access Response	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	89		Correct on to UL Hopp ng operat on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	90		DRS EPRE	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	92		Up nk ACK/NACK mapp ng for TDD	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	93		UL SRI Parameters Conf gurat on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	94		M sce aneous updates for 36.213	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	95		C ar fy ng Requ rement for Max PDSCH Cod ng Rate	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	96		UE Spec f c SRS Conf gurat on	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	97		DCI Format 1A changes needed for schedu ng Broadcast Contro	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	98		Process ng of TPC b ts n the random access response	8.3.0	8.4.0
09/09/08	RP 41	RP 080670	100	1	Support of mu t b t ACK/NAK transm ss on n TDD	8.3.0	8.4.0
03/12/08	RP 42	RP 081075	82	3	Correct ons to RI for CQI report ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	83	2	Mov ng descr pt on of arge de ay CDD to 36.211	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	102	3	Recept on of DCI formats	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	105	8	A gnment of RAN1/RAN2 spec f cat on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	107	1	Genera correct on of reset of power contro and random access response message	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	108	2	F na deta s on codebook subset restr ct ons	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	109		Correct on on the def n t on of Pmax	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	112	2	CQI/PMI reference measurement per ods	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	113		Correct on of ntroduct on of shortened SR	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	114		RAN1/2 spec f cat on a gnment on HARQ operat on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	115		Introduc ng other m ss ng L1 parameters n 36.213	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	116		PDCCH b nd decod ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	117		PDCCH search space	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	119		De ta TF for PUSCH	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	120		De ta preamb e msg3 parameter va ues and TPC command n RA response	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	122	1	Correct on of offset s gna ng of up nk contro nformat on MCS	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	124		M sce aneous Correct ons	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	125		C ar f cat on of the up nk ndex n TDD mode	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	126		C ar f cat on of the up nk transm ss on conf gurat ons	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	127	2	Correct on to the PHICH ndex ass gnment	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	128		C ar f cat on of type 2 PDSCH resource a ocat on for format 1C	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	129		C ar f cat on of up nk grant n random access response	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	130		UE sound ng procedure	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	134		Change for determ n ng DCI format 1A TBS tab e co umn nd cator for broadcast contro	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	135		C ar fy ng UL VRB A ocat on	8.4.0	8.5.0

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
03/12/08	RP 42	RP 081075	136	1	Correct on for Aper od c CQI	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	137	1	Correct on for Aper od c CQI Report ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	138	1	Correct on to PUCCH CQI report ng mode for N^DL RB <= 7	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	140	1	On sound ng procedure n TDD	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	141	1	A gnment of RAN1/RAN3 spec f cat on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	143	1	TTI bund ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	144	1	ACK/NACK transm ss on on PUSCH for LTE TDD	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	145	1	T m ng re at onsh p between PHICH and ts assoc ated PUSCH	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	147	1	Def n t on of parameter for down nk reference s gna transm t power	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	148	1	Rad o nk mon tor ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	149	1	Correct on n 36.213 re ated to TDD down nk HARQ processes	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	151		Nom na PDSCH to RS EPRE Offset for CQI Report ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	152	1	Support of UL ACK/NAK repet t on n Re 8	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	155		C ar f cat on of m sconf gurat on of aper od c CQI and SR	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	156	1	Correct on of contro nformat on mu t p ex ng n subframe bund ng mode	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	157		Correct on to the PHICH ndex ass gnment	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	158	1	UE transm t antenna se ect on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	159		C ar f cat on of spat a d fferent CQI for CQI report ng Mode 2 1	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	160	1	Correct ons for TDD ACK/NACK bund ng and mu t p ex ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	161		Correct on to RI for Open Loop Spat a Mu t p ex ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	162		Correct on of d fferent a CQI	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	163		Incons stency between PMI def n t on and codebook ndex	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	164		PDCCH va dat on for sem pers stent schedu ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	165	1	Correct on to the UE behav or of PUCCH CQI p ggybacked on PUSCH	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	166		Correct on on SRS procedure when shortened PUCCH format s used	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	167	1	Transm ss on over app ng of phys ca channe s/s gna s w th PDSCH for transm ss on mode 7	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	169		C ar f cat on of SRS and SR transm ss on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	171		C ar f cat on on UE behav or when sk pp ng decod ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	172	1	PUSCH Hopp ng operat on correct ons	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	173		C ar f cat on on message 3 transm ss on t m ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	174		MCS hand ng for DwPTS	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	175		C ar f cat on of UE spec f c t me doma n pos t on for SR transm ss on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	176	1	Phys ca ayer parameters for CQI report ng	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	177		A per od c CQI c ar f cat on for TDD UL/DL conf gurat on 0	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	179	1	Correct on to the def n t ons of rho_A and rho_B (down nk power a ocat on)	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	180		C ar f cat on of up nk A/N resource nd cat on	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	181		PDCCH format 0 for message 3 adapt ve retransm ss on and transm ss on of contro nformat on n message 3 dur ng content on based random access procedure	8.4.0	8.5.0
03/12/08	RP 42	RP 081075	182		To F x the D screpancy of Up nk Power Contro and Channe Cod ng of Contro Informat on n PUSCH	8.4.0	8.5.0
03/12/08	RP 42	RP 081122	183	1	CQI report ng for antenna port 5	8.4.0	8.5.0
03/12/08	RP 42	RP 081110	168	1	C ar f cat on on path oss def n t on	8.4.0	8.5.0
04/03/09	RP 43	RP 090236	184	1	Correct ons to Transm tted Rank Ind cat on	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	185	4	Correct ons to transm ss on modes	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	186	2	De ta TF conf gurat on for contro on y PUSCH	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	187	1	Correct on to concurrent SRS and ACK/NACK transm ss on	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	191	1	PDCCH re ease for sem pers stent schedu ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	192	1	Correct on on ACKNACK transm ss on on PUSCH for LTE TDD	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	193		Correct on to subband d fferent a CQI va ue to offset eve mapp ng for aper od c CQI report ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	194		Correct on for DRS Co s on hand ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	196	2	A gnment of RAN1/RAN4 spec f cat on on UE max mum output power	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	197		Transm ss on scheme for transm ss on mode 7 w th SPS C RNTI	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	198		C ar fy ng bandw dth parts for per od c CQI report ng and CQI refererence per od	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	199	2	Correct on to the ACK/NACK bund ng n case of transm ss on mode 3 and 4	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	200		ACK/NAK repet t on for TDD ACK/NAK mu t p ex ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	201		C ar fy ng UL ACK/NAK transm ss on n TDD	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	202		Correct ons to UE Transm t Antenna Se ect on	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	203		Correct on to UE PUSCH hopp ng procedure	8.5.0	8.6.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
04/03/09	RP 43	RP 090236	204		Correct on to PHICH resource assoc at on n TTI bund ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	205		C ar f cat on of the ength of resource ass gnment	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	206		Correct on on ACK/NACK transm ss on for down nk SPS resource re ease	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	207		Introduct on of add t ona va ues of w deband CQI/PMI per od c t es	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	208	2	Correct on to CQI/PMI/RI report ng f e d	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	209	2	Correct on to rho A def n t on for CQI ca cu at on	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	210		Correct on to erroneous cases n PUSCH near b ock codes	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	211	1	Remov ng RL mon tor ng start and stop	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	214	1	Correct on to type 1 and type 2 PUSCH hopp ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	215		Contrad ct ng statements on determ nat on of CQI subband s ze	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	216		Correct ons to SRS	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	219	2	M sce aneous correct ons on TDD ACKNACK	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	221	1	CR for Redundancy Vers on mapp ng funct on for DCI 1C	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	223		Scramb ng of PUSCH correspond ng to Random Access Response Grant	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	225		Remova of SRS w th message 3	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	226	3	PRACH retransm ss on t m ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	227		C ar fy ng error hand ng of PDSCH and PUSCH ass gnments	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	228		C ar fy PHICH ndex mapp ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	229		Correct on of CQI t m ng	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	230		A gnment of CQI parameter names w th RRC	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	231	1	Remova of 'Off' va ues for per od c report ng n L1	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	232		Defau t va ue of RI	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	233	1	C ar f cat on of up nk t m ng ad ustments	8.5.0	8.6.0
04/03/09	RP 43	RP 090236	234		C ar f cat on on ACK/NAK repet t on	8.5.0	8.6.0
27/05/09	RP 44	RP 090529	235	1	Correct on to the cond t on of resett ng accumu ated up nk power correct on	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	236		Correct on to the random access channe parameters rece ved from h gher ayer	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	237		Correct on on TDD ACKNACK	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	238	1	Correct on on CQI report ng	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	239		Correct on on the HARQ process number	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	241	1	CR correct on of the descr pt on on TTI bund ng	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	242	1	C ar fy atest and n t a PDCCH for PDSCH and PUSCH transm s sons, and NDI for SPS act vat on	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	243		C ar fy DRS EPRE	8.6.0	8.7.0
27/05/09	RP 44	RP 090529	244	1	C ar f cat on on TPC commands for SPS	8.6.0	8.7.0
15/09/09	RP 45	RP 090888	245	1	Correct on to PUSCH hopp ng and PHICH mapp ng procedures	8.7.0	8.8.0
15/09/09	RP 45	RP 090888	246		C ar f cat on on subband ndex ng n per od c CQI report ng	8.7.0	8.8.0
15/09/09	RP 45	RP 090888	247	2	Correct on to DVRB operat on n TDD transm ss on mode 7	8.7.0	8.8.0
15/09/09	RP 45	RP 090888	249		C ar f cat on of concurrent ACKNACK and per od c PMI/RI transm ss on on PUCCH for TDD	8.7.0	8.8.0
15/09/09	RP 45	RP 090888	250		C ar fy Inter ce synchron zat on text	8.7.0	8.8.0
01/12/09	RP 46	RP 091172	248	1	Introduct on of LTE pos t on ng	8.8.0	9.0.0
01/12/09	RP 46	RP 091172	254		C ar f cat on of PDSCH and PRS n comb nat on for LTE pos t on ng	8.8.0	9.0.0
01/12/09	RP 46	RP 091177	255	5	Ed tor a correct ons to 36.213	8.8.0	9.0.0
01/12/09	RP 46	RP 091257	256	1	Introduct on of enhanced dua ayer transm ss on	8.8.0	9.0.0
01/12/09	RP 46	RP 091177	257	1	Add shorter SR per od c ty	8.8.0	9.0.0
01/12/09	RP 46	RP 091256	258		Introduct on of LTE MBMS	8.8.0	9.0.0
17/12/09	RP 46	RP 091257	256	1	Correct on by MCC due to wrong mp ementat on of CR0256r1 Sentence s added to S ng e antenna port scheme subc ause 7.1.1	9.0.0	9.0.1
16/03/10	RP 47	RP 100211	259	3	UE behav or when co s on of antenna port 7/8 w th PBCH or SCH happened and when d str buted VRB s used w th antenna port 7	9.0.1	9.1.0
16/03/10	RP 47	RP 100210	260	1	MCCH change not f cat on us ng DCI format 1C	9.0.1	9.1.0
16/03/10	RP 47	RP 100211	263		Correct on on PDSCH EPRE and UE spec f c RS EPRE for Re 9 enhanced DL transm ss ons	9.0.1	9.1.0
01/06/10	RP 48	RP 100589	265		C ar f cat on for TDD when mu t p ex ng ACK/NACK w th SR of ACK/NACK w th CQI/PMI or RI	9.1.0	9.2.0
01/06/10	RP 48	RP 100590	268	1	C ar f cat on of PRS EPRE	9.1.0	9.2.0
14/09/10	RP 49	RP 100900	269		C ar f cat on on Extended CP support w th Transm ss on Mode 8	9.2.0	9.3.0
07/12/10	RP 50	RP 101320	270		Introduct on of Re 10 LTE Advanced features n 36.213	9.3.0	10.0.0
27/12/10					Ed tor a change to correct a copy/past error n subc ause 7.2.2	10.0.0	10.0.1
15/03/11	RP 51	RP 110255	271	1	A c ar f cat on for redundancy vers on of PMCH	10.0.1	10.1.0
15/03/11	RP 51	RP 110258	272		RLM Procedure w th restr cted measurements	10.0.1	10.1.0
15/03/11	RP 51	RP 110256	273		Correct ons to Re 10 LTE Advanced features n 36.213	10.0.1	10.1.0
01/06/11	RP 52	RP 110819	274	3	Correct on to HARQ ACK procedure for TDD mode b w th M=2	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	275	3	Determ nat on of PUSCH A/N codebook s ze for TDD	10.1.0	10.2.0
01/06/11	RP 52	RP 110823	276		The tr gger ng of aper od c SRS n DCI formats 2B and 2C	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	278	3	Correct ons to power headroom	10.1.0	10.2.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
01/06/11	RP 52	RP 110819	279	1	Remova of square brackets for PUCCH format 3 ACK/NACK	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	281	1	Correct on of AN repet t on and PUCCH format 3	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	282	2	Correct on to t m ng for secondary ce act vat on and deact vat on	10.1.0	10.2.0
01/06/11	RP 52	RP 110823	283	1	Correct on to MCS offset for mu t p e TBs	10.1.0	10.2.0
01/06/11	RP 52	RP 110820	286	1	M sce aneous Correct ons	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	288	1	Correct ons on UE procedure for determ n ng PUCCH Ass gnment	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	289	2	Correct on to Mu t c uster f ag n DCI format 0	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	290	2	Jo nt transm ss on of ACK/NACK and SR w th PUCCH format 3	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	291	3	Correct on of up nk resource a ocat on type 1	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	292	1	Correct on on CSI RS conf gurat on	10.1.0	10.2.0
01/06/11	RP 52	RP 110818	294		ACK/NACK and CQI s mu taneous transm ss on n ACK/NACK bund ng n TDD	10.1.0	10.2.0
01/06/11	RP 52	RP 110823	295		UE spec f c d sab ng of UL DMRS sequence hopp ng	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	296		PDSCH transm ss on n MBSFN subframes	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	297		Introduct on of PCMAX for PUSCH power sca ng	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	298		Power contro for SR and ACK/NACK w th PUCCH format 3	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	299	2	CR on power contro for HARQ ACK transm ss on on PUCCH	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	300	2	Correct on to hand ng of search space over ap	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	301	1	Correct on to s mu taneous transm ss on of SRS and PUCCH format 2/2a/2b	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	302	1	Correct on for S mu taneous PUCCH and SRS Transm ss ons on CA	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	303		Correct on on 8Tx Codebook Sub samp ng for PUCCH Mode 1 1	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	304	1	Correct ons on CQI type n PUCCH mode 2 1 and c ar f cat on on s mu taneous PUCCH and PUSCH transm ss on for UL SCH subframe bund ng	10.1.0	10.2.0
01/06/11	RP 52	RP 110818	305	1	Correct on on UE behav our upon report ng per od c CSI us ng PUCCH Mode1 1	10.1.0	10.2.0
01/06/11	RP 52	RP 110818	306		C ar f cat on for the def n t on of CQI	10.1.0	10.2.0
01/06/11	RP 52	RP 110818	307		C ar f cat on for the def n t on of Precod ng Matr x Ind cator	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	308		S mu taneous SRS transm ss ons n more than one ce	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	310	1	M sce aneous Correct ons for TS 36.213	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	311	1	Conf gurat on of pm RI Report	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	312	1	Correct on on the support of PUCCH format 3 and channe se ect on	10.1.0	10.2.0
01/06/11	RP 52	RP 110821	313		Correct on on UE behav our dur ng DM RS transm ss on on subframes carry ng synchron zat on s gna s	10.1.0	10.2.0
01/06/11	RP 52	RP 110820	314	1	36.213 CR on antenna se ect on	10.1.0	10.2.0
01/06/11	RP 52	RP 110823	316	1	Number of HARQ process for UL spat a mu t p ex ng	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	317		PUCCH format 3 Fa back procedure n TDD	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	318		C ar f cat on on CSI report ng under an nva d down nk subframe	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	320		Mu t p e Aper od c SRS Tr ggers for Same Conf gurat on	10.1.0	10.2.0
01/06/11	RP 52	RP 110823	321		UE antenna sw tch n UL MIMO	10.1.0	10.2.0
01/06/11	RP 52	RP 110819	322		UE behav our for PDSCH recept on w th m ted soft buffer n CA	10.1.0	10.2.0
01/06/11	RP 52	RP 110859	323		Jo nt transm ss on of ACK/NACK and SR or CSI w th PUCCH format 3 and channe se ect on	10.1.0	10.2.0
15/09/11	RP 53	RP 111229	277	1	Correct on to recept on of PRS n MBSFN subframes	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	325	3	Correct ons on UE procedure for report ng HARQ ACK	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	326	2	Correct ons on Phys ca Up nk Contro Channe Procedure	10.2.0	10.3.0
15/09/11	RP 53	RP 111231	331	1	Correct on to up nk transm ss on scheme usage for random access response and PHICH tr ggered retransm ss ons	10.2.0	10.3.0
15/09/11	RP 53	RP 111229	336		Correct ons on transm ss on mode 9	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	339		Correct ons on HARQ ACK codebook s ze determ nat on	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	340		Correct ons on TDD PUCCH format 1b w th channe se ect on and HARQ ACK transm ss on on PUSCH	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	341		Correct ons on NACK generat on	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	342		Correct ons on power headroom report ng	10.2.0	10.3.0
15/09/11	RP 53	RP 111229	346		Correct on on TBS trans at on tab e	10.2.0	10.3.0
15/09/11	RP 53	RP 111229	347	2	Correct on to the cond t on of enab ng PMI feedback	10.2.0	10.3.0
15/09/11	RP 53	RP 111232	348		M sce aneous correct ons to 36.213	10.2.0	10.3.0
15/09/11	RP 53	RP 111229	349		Correct ons on PUSCH and PUCCH modes	10.2.0	10.3.0
15/09/11	RP 53	RP 111231	350	1	CR on UL HARQ ACK determ nat on	10.2.0	10.3.0
15/09/11	RP 53	RP 111231	351	1	Correct on on UL DMRS resources for PHICH tr ggered retransm ss on	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	352		C ar f cat on on the common search space descr pt on	10.2.0	10.3.0
15/09/11	RP 53	RP 111232	353	1	C ar f cat on on amb guous DCI nformat on between UE spec f c search space and common search space for DCI formats 0 and 1A	10.2.0	10.3.0
15/09/11	RP 53	RP 111229	354		C ar f cat on of Reference PDSCH Power for CSI RS based CSI Feedback	10.2.0	10.3.0
15/09/11	RP 53	RP 111230	355	2	Correct ons on report ng Channe State Informat on	10.2.0	10.3.0

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Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
05/12/11	RP 54	RP 111669	324	3	Accumu at on of power contro commands from DCI format 3/3A	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	357	1	M sce aneous correct ons on up nk power contro	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	358		Correct ons on N c^{rece ved}	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	359		Correct ons on TDD PUCCH format 1b w th channe se ect on and two conf gured serv ng ce s	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	360		Correct ons on the notat on of k and k m	10.3.0	10.4.0
05/12/11	RP 54	RP 111668	361	1	Correct ons on PUCCH mode 2 1	10.3.0	10.4.0
05/12/11	RP 54	RP 111668	362	3	A correct on to PDSCH transm ss on assumpt on for CQI ca cu at on	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	363	1	Correct ons on PUCCH Resource Notat on	10.3.0	10.4.0
05/12/11	RP 54	RP 111667	364		Correct on on the notat on of SRS transm ss on comb	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	365		C ar f cat on on the HARQ ACK procedure of TDD UL DL conf gurat on 5	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	366	2	C ar f cat on on the determ nat on of resource for PUCCH Format 1b w th channe se ect on n TDD mode	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	367	1	Correct on on HARQ ACK procedure	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	368		Correct on for A/N on PUSCH w th W=1,2 n case of TDD channe se ect on	10.3.0	10.4.0
05/12/11	RP 54	RP 111668	369		C ar f cat on of PUCCH 2 1 Operat on	10.3.0	10.4.0
05/12/11	RP 54	RP 111668	370	1	Correct on on PMI ndex	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	371	2	Correct on to per od c CSI reports for carr er aggregat on	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	373	1	Remova of square bracket n HARQ ACK procedure	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	374	1	C ar f cat on on UE's capab ty of support ng PUCCH format 3	10.3.0	10.4.0
05/12/11	RP 54	RP 111666	375	1	C ar f cat ons of UE behav or on PUSCH power contro	10.3.0	10.4.0
28/02/12	RP 55	RP 120286	376	1	RNTI Conf gurat on assoc ated w th DL Resource A ocat on Type 2	10.4.0	10.5.0
28/02/12	RP 55	RP 120283	377	2	Correct on for ACK/NACK re ated procedure n case of TDD UL DL conf gurat on 0	10.4.0	10.5.0
13/06/12	RP 56	RP 120737	378	3	Correct on of FDD channe se ect on HARQ ACK and SR transm ss on	10.5.0	10.6.0
13/06/12	RP 56	RP 120738	379		Remova of descr pt on w th square brackets	10.5.0	10.6.0
13/06/12	RP 56	RP 120738	381		Correct on on transm ss on mode 9 w th a s ng e antenna port transm ss on	10.5.0	10.6.0
04/09/12	RP 57	RP 121265	382		C ar f cat on of codebook subsamp ng for PUCCH 2 1	10.6.0	10.7.0
04/09/12	RP 57	RP 121266	383		Correct on to UE transm t antenna se ect on	10.6.0	10.7.0
04/09/12	RP 57	RP 121264	384		TDD HARQ ACK procedure for PUCCH format 1b w th channe se ect on n carr er aggregat on	10.6.0	10.7.0
04/09/12	RP 57	RP 121265	385		Correct ons for Hand ng CSI RS patterns	10.6.0	10.7.0
04/09/12	RP 57	RP 121264	386	1	Reference serv ng ce for path oss est mat on	10.6.0	10.7.0
04/09/12	RP 57	RP 121264	387		Power contro for PUCCH format 3 w th s ng e conf gured ce	10.6.0	10.7.0
04/09/12	RP 57	RP 121264	388		ACK/NACK resource n case of channe se ect on	10.6.0	10.7.0
04/09/12	RP 57	RP 121274	380	4	Introduct on of an add t ona spec a subframe conf gurat on	10.7.0	11.0.0
04/09/12	RP 57	RP 121272	389		Introduct on of Re 11 features	10.7.0	11.0.0
04/12/12	RP 58	RP 121839	393		Correct on to the parameter ue Category v10xy	11.0.0	11.1.0
04/12/12	RP 58	RP 121837	395		Correct on of reference s gna scramb ng sequence n t a zat on for SPS n transm ss on mode 7	11.0.0	11.1.0
04/12/12	RP 58	RP 121846	396		F na sat on for ntroduc ng Re 11 features	11.0.0	11.1.0
26/02/13	RP 59	RP 130254	398		Correct on on UE procedure for report ng HARQ ACK	11.1.0	11.2.0
26/02/13	RP 59	RP 130252	400		Correct ons for SRS power sca ng n UpPTS	11.1.0	11.2.0
26/02/13	RP 59	RP 130252	403		CR on UE spec f c search and Common search space over ap on PDCCH	11.1.0	11.2.0
26/02/13	RP 59	RP 130358	404		Add t ona c ar f cat ons/correct ons for ntroduc ng Re 11 features	11.1.0	11.2.0
11/06/13	RP 60	RP 130752	405		Correct on to EPDCCH mon tor ng n case of cross carr er schedu ng	11.2.0	11.3.0
11/06/13	RP 60	RP 130751	407	1	Correct on on the RI b t w dth	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	408		Correct on on para e recept on of PDSCH and Msg 2	11.2.0	11.3.0
11/06/13	RP 60	RP 130747	409		Correct on on zero power CSI RS resource conf gurat on	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	410	1	Correct ons on d fferent TDD UL DL conf gurat ons on d fferent bands	11.2.0	11.3.0
11/06/13	RP 60	RP 130752	411		Correct on on EPDCCH PRB pa r nd cat on	11.2.0	11.3.0
11/06/13	RP 60	RP 130752	412		Correct on on EPDCCH hash ng funct on	11.2.0	11.3.0
11/06/13	RP 60	RP 130752	413		Correct on on PUCCH resource determ nat on for FDD EPDCCH	11.2.0	11.3.0
11/06/13	RP 60	RP 130752	414	2	CR on amb gu ty n EPDCCH decod ng cand dates under two over apped EPDCCH resource sets	11.2.0	11.3.0
11/06/13	RP 60	RP 130749	415		Remova of the case for spat a doma n bund ng n TDD UL/DL conf gurat on 0	11.2.0	11.3.0
11/06/13	RP 60	RP 130752	416		Correct ons to EPDCCH PRB pa r nd cat on	11.2.0	11.3.0
11/06/13	RP 60	RP 130753	417	1	Correct on to PUSCH/PUCCH transm t power after PRACH power ramp ng	11.2.0	11.3.0
11/06/13	RP 60	RP 130747	418		CR on RI Reference CSI Process w th Subframe Sets	11.2.0	11.3.0
11/06/13	RP 60	RP 130747	420		Correct on on UE spec f c RS scramb ng for SPS PDSCH n TM10	11.2.0	11.3.0

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
11/06/13	RP 60	RP 130747	421		CR on reso v ng amb guous UE capab ty s gna ng for CoMP	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	422		Correct on of va d down nk subframe	11.2.0	11.3.0
11/06/13	RP 60	RP 130749	424		Correct on on HARQ ACK transm ss on for a UE conf gured w th PUCCH format 3	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	425		Correct on of PHICH resource for ha f dup ex TDD UE	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	426		Correct on on n {HARQ} for TDD CA w th d fferent UL DL conf gurat ons	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	427		Correct on on mp c t HARQ ACK resource determ nat on for PUCCH format 1b w th channe se ect on for TDD CA w th d fferent UL DL conf gurat ons	11.2.0	11.3.0
11/06/13	RP 60	RP 130750	428		Correct on on SRS power sca ng w th mu t p e TAGs	11.2.0	11.3.0
11/06/13	RP 60	RP 130747	429		Correct on on MBSFN subframe conf gurat on	11.2.0	11.3.0
11/06/13	RP 60	RP 130749	430		CR on SCe act vat on t m ng	11.2.0	11.3.0
03/09/13					MCC c ean up	11.3.0	11.4.0
03/09/13	RP 61	RP 131249	432		Correct on for EPDCCH Search Space	11.3.0	11.4.0
03/09/13	RP 61	RP 131250	433		Correct on to QCL behav our on CRS	11.3.0	11.4.0
03/09/13	RP 61	RP 131250	434		Correct on on PUCCH power contro	11.3.0	11.4.0
03/09/13	RP 61	RP 131248	435		Correct on on the rat o of PDSCH EPRE to CRS EPRE for TM10	11.3.0	11.4.0
03/09/13	RP 61	RP 131249	436		CR on EPDCCH Search Space for Cross Carr er Schedu ng	11.3.0	11.4.0
03/09/13	RP 61	RP 131249	437		Correct on to the UE behav our n case of co s on between PRS and EPDCCH n d fferent CP case	11.3.0	11.4.0
03/09/13	RP 61	RP 131249	438		On correct on to h gher ayer parameter name for EPDCCH resource mapp ng	11.3.0	11.4.0
03/09/13	RP 61	RP 131248	439		Correct on to PDSCH mapp ng for CoMP	11.3.0	11.4.0
03/12/13	RP 62	RP 131893	440	1	Correct on on parameter ue Category	11.4.0	11.5.0
03/12/13	RP 62	RP 131892	442	1	Correct on on determ nat on of modu at on order and transport b ock s ze	11.4.0	11.5.0
03/12/13	RP 62	RP 132024	445	3	Correct on on CSI report ng type and parameters	11.4.0	11.5.0
03/12/13	RP 62	RP 131894	446		Correct on on der v ng the ength of the non MBSFN reg on	11.4.0	11.5.0
03/12/13	RP 62	RP 131896	431	5	Introduct on of Re 12 feature for Down nk MIMO Enhancement	11.5.0	12.0.0
03/03/14	RP 63	RP 140286	447		Correct on to CSI Report ng	12.0.0	12.1.0
03/03/14	RP 63	RP 140291	448		C ar f cat on on PUCCH Mode 1 1 for 4Tx Dua Codebook	12.0.0	12.1.0
03/03/14	RP 63	RP 140287	450	1	Common search space mon tor ng for MBMS	12.0.0	12.1.0
03/03/14	RP 63	RP 140290	452		Introduct on of new UE categor es	12.0.0	12.1.0
03/03/14	RP 63	RP 140288	455	1	Mod f cat on to I_SRS = 0 for tr gger type 1 SRS and TDD	12.0.0	12.1.0
03/03/14	RP 63	RP 140289	458		Correct on to CSI process ng n TM10	12.0.0	12.1.0
10/06/14	RP 64	RP 140858	459	1	C ar f cat on on PUCCH report ng type pay oad s ze	12.1.0	12.2.0
10/06/14	RP 64	RP 140858	461		C ar f cat on on SRS co d ng w th PUCCH n the same ce when the UE s conf gured w th mu t p e TAGs	12.1.0	12.2.0
10/06/14	RP 64	RP 140858	462	1	C ar f cat on on SRS antenna sw tch ng	12.1.0	12.2.0
10/06/14	RP 64	RP 140862	463		Introduct on of Re 12 LTE Advanced features n 36.213	12.1.0	12.2.0
10/09/14	RP 65	RP 141479	464		Correction on SRS transmission for TDD-FDD CA	12.2.0	12.3.0
10/09/14	RP 65	RP 141478	465		Correct on on beta {offset}^{HARQ ACK} determ nat on for a UE conf gured w th two up nk power contro subframe sets	12.2.0	12.3.0
10/09/14	RP 65	RP 141478	466		Correct ons for TDD eIMTA	12.2.0	12.3.0
10/09/14	RP 65	RP 141479	467	3	CR on HARQ ACK Mu t p ex ng n PUSCH for TDD FDD CA	12.2.0	12.3.0
10/09/14	RP 65	RP 141474	469		Correct on to UCI embedd ng n case of a s ng e serv ng ce and s mu taneous PUSCH and PUCCH transm ss on	12.2.0	12.3.0
10/09/14	RP 65	RP 141478	470		Correct ons on UL reference UL/DL conf gurat on	12.2.0	12.3.0
10/09/14	RP 65	RP 141473	471		CR for C ar f cat on of spec a subframe and usage a gnment	12.2.0	12.3.0
10/09/14	RP 65	RP 141485	472		Introduct on of ow cost MTC and 256QAM features	12.2.0	12.3.0