

Wideband first PMI i1,1	$\lceil \log_2(N_1 O_1 / S_1) \rceil$	$\lceil \log_2(N_1 O_1 / S_1) \rceil$	$\lceil \log_2\left(\frac{N_1 O_1}{S_1}\right) \rceil + \lfloor \frac{7-N_2}{3} \rfloor$	$\lceil \log_2\left(\frac{N_1 O_1}{S_1}\right) \rceil + \lfloor \frac{7-N_2}{3} \rfloor$
Wideband first PMI i1,2	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$
Field	Bit width			
	Rank = 5	Rank = 6	Rank = 7	Rank = 8
Wideband first PMI i1,1	$\lceil \log_2(N_1 O_1 / S_1) \rceil$	$\lceil \log_2(N_1 O_1 / S_1) \rceil$	$\lceil \log_2(N_1 O_1 / S_1) \rceil$	$\lceil \log_2(N_1 O_1 / S_1) \rceil$
Wideband first PMI i1,2	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$	$\lceil \log_2(N_2 O_2 / S_2) \rceil$

The channel quality bits in Table 5.2.3.3.1-1 through Table 5.2.3.3.1-4 form the bit sequence $a_0, a_1, a_2, a_3, \dots, a_{A-1}$ with a_0 corresponding to the first bit of the first field in each of the tables, a_1 corresponding to the second bit of the first field in each of the tables, and a_{A-1} corresponding to the last bit in the last field in each of the tables. The first bit of each field corresponds to MSB and the last bit LSB. The RI feedback for one bit is mapped according to Table 5.2.2.6-5 with o_0^{RI} replaced by a_0 . The RI feedback for two bits is mapped according to Table 5.2.2.6-6 with o_0^{RI}, o_1^{RI} replaced by a_0, a_1 . The RI feedback for three bits is mapped according to Table 5.2.2.6-7 with $o_0^{RI}, o_1^{RI}, o_2^{RI}$ replaced by a_0, a_1, a_2 . The mapping for the jointly coded RI and i1 is provided in Table 7.2.2-1E of [3].

When multiplexed with UL-SCH, the channel coding and multiplexing for the transmission configurations in Table 5.2.3.3.1-3, Table 5.2.3.3.1-3A, Table 5.2.3.3.1-3B, Table 5.2.3.3.1-3C and Table 5.2.3.3.1-3D is performed assuming RI transmission in section 5.2.2.6. All other transmission configurations in this section are coded and multiplexed assuming CQI/PMI transmission in section 5.2.2.6.

5.2.3.3.2 Channel quality information formats for UE-selected sub-band reports

Table 5.2.3.3.2-1 shows the fields and the corresponding bit widths for the sub-band channel quality information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 1, transmission mode 2, transmission mode 3, transmission mode 7, transmission mode 8 configured without PMI/RI reporting, transmission mode 9 configured without PMI/RI reporting or configured with 1 antenna port, and transmission mode 10 configured without PMI/RI reporting or configured with 1 antenna port.

Table 5.2.3.3.2-1A shows the fields and the corresponding bit widths for the sub-band channel quality information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with 2/4/8 antenna ports.

Table 5.2.3.3.2-1: UCI fields for channel quality information feedback for UE-selected sub-band CQI reports (transmission mode 1, transmission mode 2, transmission mode 3, transmission mode 7, transmission mode 8 configured without PMI/RI reporting, transmission mode 9 configured without PMI/RI reporting or configured with 1 antenna port, transmission mode 10 configured without PMI/RI reporting or configured with 1 antenna port, and transmission mode 9/10 configured without PMI/RI with Class B CSI reporting)

Field	Bit width
Sub-band CQI	4
Sub-band label	1 or 2

Table 5.2.3.3.2-1A: UCI fields for channel quality information feedback for UE-selected subband CQI reports (transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with 2/4/8 antenna ports)

Field	Bit width	
	Rank = 1	Rank > 1
Wide-band CQI	4	4
Spatial differential CQI	0	3
Sub-band label	1 or 2	1 or 2

Table 5.2.3.3.2-2 shows the fields and the corresponding bit widths for the sub-band channel quality information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 4, transmission mode 5, transmission mode 6, and transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*.

Table 5.2.3.3.2-2: UCI fields for channel quality information feedback for UE-selected sub-band reports (transmission mode 4, transmission mode 5, transmission mode 6 and transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width			
	2 antenna ports		4 antenna ports	
	Rank = 1	Rank = 2	Rank = 1	Rank > 1
Sub-band CQI	4	4	4	4
Spatial differential CQI	0	3	0	3
Sub-band label	1 or 2	1 or 2	1 or 2	1 or 2

Table 5.2.3.3.2-2A and Table 5.2.3.3.2-2B show the fields and the corresponding bit widths for the sub-band channel quality information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 10 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$, except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*. The number of CSI-RS resources K is defined in [3] and *PMI-Config* is configured by higher layers [6].

Table 5.2.3.3.2-2A-1 shows UCI fields for channel quality information feedback for UE-selected sub-band reports (transmission mode 9/10 configured with 2/4/8 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=1*, and transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with 2/4/8 antenna ports).

Table 5.2.3.3.2-2C shows the fields and the corresponding bit widths for the sub-band channel quality information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission modes 8, 9 and 10 configured with PMI/RI reporting and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 4 antenna ports for Class B CSI reporting with $K=1$ with *PMI-Config=2*, and with *alternativeCodeBookEnabledFor4TX-r12=TRUE*.

Table 5.2.3.3.2-2A: UCI fields for channel quality information feedback for UE-selected sub-band reports (transmission mode 9 configured with PMI/RI reporting with 2/4 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 10 configured with PMI/RI reporting with 2/4 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with 2/4 antenna ports for Class B CSI reporting with K=1 and *PMI-Config=2*, K>1 except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width			
	2 antenna ports		4 antenna ports	
	Rank = 1	Rank = 2	Rank = 1	Rank > 1
Wide-band CQI	0	0	0	0
Sub-band CQI	4	4	4	4
Spatial differential CQI	0	3	0	3
Wide-band i2	0	0	0	0
Sub-band i2	0	0	0	0
Sub-band label	1 or 2	1 or 2	1 or 2	1 or 2

Table 5.2.3.3.2-2A-1: UCI fields for channel quality information feedback for UE-selected sub-band reports (transmission mode 9/10 configured with 2/4/8 antenna ports for Class B CSI reporting with K=1 and *PMI-Config=1*, transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with 2/4/8 antenna ports)

Field	Bit width	
	2/4/8 antenna ports	
	Rank = 1	Rank > 1
Wide-band CQI	0	0
Sub-band CQI	4	4
Spatial differential CQI	0	3
Wide-band i2	0	0
Sub-band i2	0	0
Sub-band label	1 or 2	1 or 2

Table 5.2.3.3.2-2B: UCI fields for channel quality feedback for UE-selected sub-band reports (transmission mode 9 configured with PMI/RI reporting with 8 antenna ports, transmission mode 10 configured with PMI/RI reporting with 8 antenna ports, and transmission mode 9/10 configured with 8 antenna ports for Class B CSI reporting with K=1 with *PMI-Config=2*, and K>1)

Field	Bit width									
	8 antenna ports									
	Rank = 1		Rank = 2, 3		Rank = 4		Rank = 5, 6, 7		Rank = 8	
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1
Wide-band CQI	4	0	4	0	4	0	4	0	4	0
Sub-band CQI	0	4	0	4	0	4	0	4	0	4
Spatial differential CQI	0	0	3	3	3	3	3	3	3	3
Wide-band i2	4	0	4	0	3	0	0	0	0	0
Sub-band i2	0	4	0	2	0	2	0	0	0	0
Sub-band label	0	1 or 2	0	1 or 2	0	1 or 2	0	1 or 2	0	1 or 2

Table 5.2.3.3.2-2C: UCI fields for channel quality feedback for UE-selected sub-band reports with 4 antenna ports (transmission modes 8, 9 and 10 configured with PMI/RI reporting, 4 antenna ports and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with 4 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=2*, and $K>1$, with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width					
	4 antenna ports					
	Rank = 1		Rank = 2		Rank = 3	Rank=4
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=1	PTI=1
Wide-band CQI	4	0	4	0	0	0
Sub-band CQI	0	4	0	4	4	4
Spatial differential CQI	0	0	3	3	3	3
Wide-band i2	4	0	4	0	0	0
Sub-band i2	0	4	0	2	2	2
Sub-band label	0	1 or 2	0	1 or 2	1 or 2	1 or 2

Table 5.2.3.3.2-3 shows the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 4, transmission mode 5, transmission mode 6 and transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*.

Table 5.2.3.3.2-3: UCI fields for channel quality information feedback for UE-selected sub-band CQI reports (transmission mode 4, transmission mode 5, transmission mode 6 and transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width			
	2 antenna ports		4 antenna ports	
	Rank = 1	Rank = 2	Rank = 1	Rank > 1
Wide-band CQI	4	4	4	4
Spatial differential CQI	0	3	0	3
Precoding matrix indicator	2	1	4	4

Table 5.2.3.3.2-3A and Table 5.2.3.3.2-3B show the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, transmission mode 10 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=2*, and $K>1$, except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*

Table 5.2.3.3.2-3A-1 shows the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=1*.

Table 5.2.3.3.2-3C shows the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission modes 8, 9 and 10 configured with PMI/RI reporting, 4 antenna ports and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 4 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$ with *alternativeCodeBookEnabledFor4TX-r12=TRUE*.

Table 5.2.3.3.2-3A: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports (transmission mode 9 configured with PMI/RI reporting with 2/4 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, transmission mode 10 configured with PMI/RI reporting with 2/4 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 2/4 antenna ports for Class B CSI reporting with K=1 and *PMI-Config=2*, K>1, except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width			
	2 antenna ports		4 antenna ports	
	Rank = 1	Rank = 2	Rank = 1	Rank > 1
Wide-band CQI	4	4	4	4
Spatial differential CQI	0	3	0	3
i1	0	0	0	0
Wide-band i2	2	1	4	4

Table 5.2.3.3.2-3A-1: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports (transmission mode 9/10 configured with 2/4/8 antenna ports for Class B CSI reporting with K=1 and *PMI-Config=1*)

Field	Bit width					
	2 antenna ports		4 antenna ports			
	Rank = 1	Rank = 2	Rank = 1	Rank =2	Rank =3	Rank =4
Wideband CQI	4	4	4	4	4	4
Spatial differential CQI	0	3	0	3	3	3
i1	0	0	0	0	0	0
Wide-band i2	2	1	3	3	2	1

Field	Bit width				
	8 antenna ports				
	Rank = 1	Rank = 2	Rank = 3	Rank =4	Rank =5~8
Wideband CQI	4	4	4	4	4
Spatial differential CQI	0	3	3	3	3
i1	0	0	0	0	0
Wide-band i2	4	4	4	3	0

Table 5.2.3.3.2-3B: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports (transmission mode 9 configured with PMI/RI reporting with 8 antenna ports and transmission mode 10 configured with PMI/RI reporting with 8 antenna ports, and transmission mode 9/10 configured with PMI/RI reporting with 8 antenna ports for Class B CSI reporting with K=1 and *PMI-Config=2*, K>1)

Field	Bit width					
	8 antenna ports					
	Rank = 1		Rank = 2		Rank = 3	
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1
Wide-band CQI	0	4	0	4	0	4
Spatial differential CQI	0	0	0	3	0	3
i1	4	0	4	0	2	0
Wide-band i2	0	4	0	4	0	4

Field	Bit width					
	8 antenna ports					
	Rank = 4		Rank = 5, 6, 7		Rank = 8	
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1
Wide-band CQI	0	4	0	4	0	4
Spatial differential CQI	0	3	0	3	0	3
i1	2	0	2	0	0	0
Wide-band i2	0	3	0	0	0	0

Table 5.2.3.3.2-3B-1 shows the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured with PMI/RI reporting for Class A CSI reporting with *Codebook-Subset-SelectionConfig*=1.

Table 5.2.3.3.2-3B-2 shows the fields and the corresponding bit widths for the wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured with PMI/RI reporting for Class A CSI reporting with *Codebook-Subset-SelectionConfig*=2/3/4.

Table 5.2.3.3.2-3B-1: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports (transmission mode 9/10 configured with Class A CSI reporting with codebook configuration (N_1, N_2, Q_1, Q_2) , and *Codebook-Subset-SelectionConfig*=1)

Field	Bit width					
	8/12/16 antenna ports					
	Rank = 1		Rank = 2		Rank = 3	
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1
Wide-band CQI	0	4	0	4	0	4
Spatial differential CQI	0	0	0	3	0	3
Wideband first PMI $i_{1,1}$	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil + \left\lceil \frac{7-N_2}{3} \right\rceil$	0
Wideband first PMI $i_{1,2}$	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0
Wide-band i_2	0	2	0	2	0	1
Field	Bit width					
	8/12/16 antenna ports					
	Rank = 4		Rank = 5 to Rank = 8			
	PTI=0	PTI=1	PTI=0		PTI=1	
Wide-band CQI	0	4	0		4	
Spatial differential CQI	0	3	0		3	
Wideband first PMI $i_{1,1}$	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil + \left\lceil \frac{7-N_2}{3} \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$		0	
Wideband first PMI $i_{1,2}$	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$		0	
Wide-band i_2	0	1	0		0	

Table 5.2.3.3.2-3B-2: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports (transmission mode 9/10 configured with Class A CSI reporting with codebook configuration (N_1, N_2, Q_1, Q_2) , and Codebook-Subset-SelectionConfig=2/3/4)

Field	Bit width					
	8/12/16 antenna ports					
	Rank = 1		Rank = 2		Rank = 3	
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=0	PTI=1
Wide-band CQI	0	4	0	4	0	4
Spatial differential CQI	0	0	0	3	0	3
Wideband first PMI $i_{1,1}$	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil + \left\lfloor \frac{7-N_2}{3} \right\rfloor$	0
Wideband first PMI $i_{1,2}$	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0
Wide-band i_2	0	4	0	4	0	4
Field	Bit width					
	8/12/16 antenna ports					
	Rank = 4		Rank = 5 to Rank = 8			
	PTI=0	PTI=1	PTI=0	PTI=1		
Wide-band CQI	0	4	0	4		
Spatial differential CQI	0	3	0	3		
Wideband first PMI $i_{1,1}$	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil + \left\lfloor \frac{7-N_2}{3} \right\rfloor$	0	$\left\lceil \log_2 \left(\frac{N_1 Q_1}{S_1} \right) \right\rceil$	0		
Wideband first PMI $i_{1,2}$	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0	$\left\lceil \log_2 \left(\frac{N_2 Q_2}{S_2} \right) \right\rceil$	0		
Wide-band i_2	0	3	0	0		

Table 5.2.3.3.2-3C: UCI fields for wide-band channel quality and precoding matrix information feedback for UE-selected sub-band reports with 4 antenna ports (transmission modes 8, 9 and 10 configured with PMI/RI reporting and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with Class B CSI reporting with $K=1$ and *PMI-Config=2*, and $K>1$, with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width					
	4 antenna ports					
	Rank = 1		Rank = 2		Rank = 3	Rank=4
	PTI=0	PTI=1	PTI=0	PTI=1	PTI=1	PTI=1
Wide-band CQI	0	4	0	4	4	4
Spatial differential CQI	0	0	0	3	3	3
i_1	4	0	4	0	0	0
Wide-band i_2	0	4	0	4	4	4

Table 5.2.3.3.2-4 shows the fields and the corresponding bit width for the rank indication feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 3, transmission mode 4, transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports with Class B CSI reporting with $K=1$ and *PMI-*

Config=1, and transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with $K=1$ and *PMI-Config=1* for 2/4/8 antenna ports.

Table 5.2.3.3.2-4: UCI fields for rank indication feedback for UE-selected sub-band reports (transmission mode 3, transmission mode 4, and transmission mode 8 configured with PMI/RI reporting except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports with Class B CSI reporting with $K=1$ and *PMI-Config=1*, and transmission mode 9/10 configured without PMI reporting for Class B CSI reporting with $K=1$ and *PMI-Config=1* for 2/4/8 antenna ports).

Field	Bit width					
	2 antenna ports	4 antenna ports		8 antenna ports		
		Max 2 layers	Max 4 layers	Max 2 layers	Max 4 layers	Max 8 layers
Rank indication	1	1	2	1	2	3

Table 5.2.3.3.2-4A shows the fields and the corresponding bit width for the rank indication and precoder type indication (PTI) feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9 configured with PMI/RI reporting with 2/4/8 antenna ports and transmission mode 10 configured with PMI/RI reporting with 2/4/8 antenna ports, and transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports for Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$ except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 8/12/16 antenna ports for Class A CSI reporting.

Table 5.2.3.3.2-4B shows the fields and the corresponding bit width for the rank indication and precoder type indication (PTI) feedback with 4 antenna ports for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 8, transmission mode 9 and transmission mode 10 configured with PMI/RI reporting and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting for Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$, with *alternativeCodeBookEnabledFor4TX-r12=TRUE*.

Table 5.2.3.3.2-4A: UCI fields for joint report of RI and PTI (transmission mode 9 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, transmission mode 10 configured with PMI/RI reporting with 2/4/8 antenna ports except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, transmission mode 9/10 configured with PMI/RI reporting with 2/4/8 antenna ports with Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$ except with *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting with 8/12/16 antenna ports for Class A CSI reporting)

Field	Bit width					
	2 antenna ports	4 antenna ports		8/12/16 antenna ports		
		Max 2 layers	Max 4 layers	Max 2 layers	Max 4 layers	Max 8 layers
Rank indication	1	1	2	1	2	3
Precoder type indication	-	-	-	1	1	1

Table 5.2.3.3.2-4B: UCI fields for joint report of RI and PTI with 4 antenna ports (transmission mode 8, transmission mode 9 and transmission mode 10 configured with PMI/RI reporting and *alternativeCodeBookEnabledFor4TX-r12=TRUE*, and transmission mode 9/10 configured with PMI/RI reporting for Class B CSI reporting with $K=1$ and *PMI-Config=2*, $K>1$, with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width	
	4 antenna ports	
	Max 2 layers	Max 4 layers
Rank indication	1	2
Precoder type indication	1	1

Table 5.2.3.3.2-4C shows the fields and the corresponding bit widths for the joint report of CRI and rank indication feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured with PMI/RI reporting for Class B CSI reporting with $K > 1$, and transmission mode 9/10 configured without PMI reporting with 2/4 antenna ports for Class B CSI reporting with $K > 1$.

Table 5.2.3.3.2-4D shows the fields and the corresponding bit widths for the joint report of CRI, rank indication and PTI feedback for UE-selected sub-band reports for PDSCH transmissions associated with transmission mode 9/10 configured with PMI/RI reporting for Class B CSI reporting with $K > 1$.

Table 5.2.3.3.2-4C: UCI fields for joint report of CRI and rank indication feedback for wideband reports (transmission mode 9/10 configured with PMI/RI reporting with 2/4 antenna ports for Class B CSI reporting with $K > 1$, and transmission mode 9/10 configured without PMI reporting with 2/4 antenna ports for Class B CSI reporting with $K > 1$).

Field	Bit width	
	Max 2 layers	Max 4 layers
CRI	$\lceil \log_2(K) \rceil$	$\lceil \log_2(K) \rceil$
Rank indication	1	2

Table 5.2.3.3.2-4D: UCI fields for joint report of CRI, RI and PTI (transmission mode 9/10 configured with PMI/RI reporting with 4/8 antenna ports with Class B CSI reporting with $K > 1$, with *alternativeCodeBookEnabledFor4TX-r12=TRUE*)

Field	Bit width				
	Maximum of number of antenna port of the configured CSI-RS resources is 4		Maximum of number of antenna port of the configured CSI-RS resources is 8		
	Max 2 layers	Max 4 layers	Max 2 layers	Max 4 layers	Max 8 layers
CRI	$\lceil \log_2(K) \rceil$	$\lceil \log_2(K) \rceil$	$\lceil \log_2(K) \rceil$	$\lceil \log_2(K) \rceil$	$\lceil \log_2(K) \rceil$
Rank indication	1	2	1	2	3
Precoder type indication	1	1	1	1	1

The channel quality bits in Table 5.2.3.3.2-1 through Table 5.2.3.3.2-4D form the bit sequence $a_0, a_1, a_2, a_3, \dots, a_{A-1}$ with a_0 corresponding to the first bit of the first field in each of the tables, a_1 corresponding to the second bit of the first field in each of the tables, and a_{A-1} corresponding to the last bit in the last field in each of the tables. The first bit of each field corresponds to MSB and the last bit LSB. The RI feedback for one bit is mapped according to Table 5.2.2.6-5 with o_0^{RI} replaced by a_0 . The RI feedback for two bits is mapped according to Table 5.2.2.6-6 with o_0^{RI}, o_1^{RI} replaced by a_0, a_1 . The RI feedback for three bits is mapped according to Table 5.2.2.6-7 with $o_0^{RI}, o_1^{RI}, o_2^{RI}$ replaced by a_0, a_1, a_2 .

When multiplexed with UL-SCH, the channel coding and multiplexing for the transmission configurations in Table 5.2.3.3.2-4, Table 5.2.3.3.2-4A, Table 5.2.3.3.2-4B, Table 5.2.3.3.2-4C and Table 5.2.3.3.2-4D is performed assuming RI transmission in section 5.2.2.6. All other transmission configurations in this section are coded and multiplexed assuming CQI/PMI transmission in section 5.2.2.6.

5.2.3.4 Channel coding for UCI channel quality information and HARQ-ACK

This section defines the channel coding scheme for the simultaneous transmission of channel quality information and HARQ-ACK information in a subframe.

When normal CP is used for uplink transmission, the channel quality information is coded according to section 5.2.3.3 with input bit sequence $a'_0, a'_1, a'_2, a'_3, \dots, a'_{A'-1}$ and output bit sequence $b'_0, b'_1, b'_2, b'_3, \dots, b'_{B'-1}$, where $B' = 20$. The

HARQ-ACK bits are denoted by a_0'' in case one HARQ-ACK bit or a_0'', a_1'' in case two HARQ-ACK bits are reported per subframe. Each positive acknowledgement (ACK) is encoded as a binary '1' and each negative acknowledgement (NACK) is encoded as a binary '0'.

The output of this channel coding block for normal CP is denoted by $b_0, b_1, b_2, b_3, \dots, b_{B-1}$, where

$$b_i = b'_i, i = 0, \dots, B' - 1$$

In case one HARQ-ACK bit is reported per subframe:

$$b_B = a_0'' \text{ and } B = (B' + 1)$$

In case two HARQ-ACK bits are reported per subframe:

$$b_B = a_0'', b_{B+1} = a_1'' \text{ and } B = (B' + 2)$$

When extended CP is used for uplink transmission, the channel quality information and the HARQ-ACK bits are jointly coded. The HARQ-ACK bits are denoted by a_0'' in case one HARQ-ACK bit or $[a_0'', a_1'']$ in case two HARQ-ACK bits are reported per subframe.

The channel quality information denoted by $a'_0, a'_1, a'_2, a'_3, \dots, a'_{A'-1}$ is multiplexed with the HARQ-ACK bits to yield the sequence $a_0, a_1, a_2, a_3, \dots, a_{A-1}$ as follows

$$a_i = a'_i, i = 0, \dots, A' - 1$$

and

$$a_{A'} = a_0'' \text{ and } A = (A' + 1) \text{ in case one HARQ-ACK bit is reported per subframe, or}$$

$$a_{A'} = a_0'', a_{(A'+1)} = a_1'' \text{ and } A = (A' + 2) \text{ in case two HARQ-ACK bits are reported per subframe.}$$

The sequence $a_0, a_1, a_2, a_3, \dots, a_{A-1}$ is encoded according to section 5.2.3.3 to yield the output bit sequence $b_0, b_1, b_2, b_3, \dots, b_{B-1}$ where $B = 20$.

5.2.4 Uplink control information on PUSCH without UL-SCH data

When control data are sent via PUSCH without UL-SCH data, the following coding steps can be identified:

- Channel coding of control information
- Control information mapping
- Channel interleaver

5.2.4.1 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication. Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When the UE transmits HARQ-ACK bits or rank indicator bits, it shall determine the number of coded symbols Q' for HARQ-ACK or rank indicator as

$$Q' = \min \left(\left\lceil \frac{O \cdot M_{sc}^{PUSCH} \cdot N_{ymb}^{PUSCH} \cdot \beta_{offset}^{PUSCH}}{O_{CQI-MIN}} \right\rceil, 4 \cdot M_{sc}^{PUSCH} \right)$$

where O is the number of HARQ-ACK bits as defined in section 5.2.2.6, or rank indicator bits, $O_{CQI-MIN}$ is the number of CQI bits including CRC bits assuming rank equals to 1 for all serving cells for which an aperiodic CSI report

is triggered [3], M_{sc}^{PUSCH} is the scheduled bandwidth for PUSCH transmission in the current subframe expressed as a number of subcarriers in [2], and N_{symp}^{PUSCH} is the number of SC-FDMA symbols in the current PUSCH transmission sub-frame given by $N_{\text{symp}}^{PUSCH} = (2 \cdot (N_{\text{symp}}^{\text{UL}} - 1) - N_{SRS})$, where N_{SRS} is equal to 1 if UE is configured to send PUSCH and SRS in the same subframe for the current subframe, or if the PUSCH resource allocation for the current subframe even partially overlaps with the cell-specific SRS subframe and bandwidth configuration defined in section 5.5.3 of [2], or if the current subframe is a UE-specific type-1 SRS subframe as defined in Section 8.2 of [3], or if the current subframe is a UE-specific type-0 SRS subframe as defined in section 8.2 of [3] and the UE is configured with multiple TAGs. Otherwise N_{SRS} is equal to 0.

For HARQ-ACK information $Q_{ACK} = Q_m \cdot Q'$ and $[\beta_{\text{offset}}^{PUSCH} = \beta_{\text{offset}}^{HARQ-ACK} / \beta_{\text{offset}}^{CQI}]$. For UEs configured with no more than five DL cells, $\beta_{\text{offset}}^{HARQ-ACK}$ shall be determined according to [3]. For UEs configured with more than five DL cells, $\beta_{\text{offset}}^{HARQ-ACK}$ shall be determined according to [3] depending on the number of HARQ-ACK feedback bits.

For rank indication or CRI, $Q_{RI} = Q_m \cdot Q'$, $Q_{CRI} = Q_m \cdot Q'$ and $[\beta_{\text{offset}}^{PUSCH} = \beta_{\text{offset}}^{RI} / \beta_{\text{offset}}^{CQI}]$, where $\beta_{\text{offset}}^{RI}$ shall be determined according to [3].

For CQI and/or PMI information $Q_{CQI} = N_{\text{symp}}^{PUSCH} \cdot M_{sc}^{PUSCH} \cdot Q_m - Q_{RI}$.

The channel coding and rate matching of the control data is performed according to section 5.2.2.6. The coded output sequence for channel quality information is denoted by $q_0, q_1, q_2, q_3, \dots, q_{Q_{CQI}-1}$, the coded vector sequence output for HARQ-ACK is denoted by $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, \dots, \underline{q}_{Q_{ACK}-1}^{ACK}$ and the coded vector sequence output for rank indication or CRI, is denoted by $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, \dots, \underline{q}_{Q_{RI}-1}^{RI}$.

5.2.4.2 Control information mapping

The input are the coded bits of the channel quality information denoted by $q_0, q_1, q_2, q_3, \dots, q_{Q_{CQI}-1}$. The output is denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, \underline{g}_3, \dots, \underline{g}_{H'-1}$, where $H = Q_{CQI}$ and $H' = H / Q_m$, and where \underline{g}_i , $i = 0, \dots, H' - 1$ are column vectors of length Q_m . H is the total number of coded bits allocated for CQI/PMI information.

The control information shall be mapped as follows:

Set j, k to 0

while $j < Q_{CQI}$

$$\underline{g}_k = [q_j \dots q_{j+Q_m-1}]^T$$

$$j = j + Q_m$$

$$k = k + 1$$

end while

5.2.4.3 Channel interleaver

The vector sequences $\underline{g}_0, \underline{g}_1, \underline{g}_2, \dots, \underline{g}_{H'-1}$, $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, \dots, \underline{q}_{Q_{RI}-1}^{RI}$ and $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, \dots, \underline{q}_{Q_{ACK}-1}^{ACK}$ are channel interleaved according section 5.2.2.8. The bits after channel interleaving are denoted by $h_0, h_1, h_2, \dots, h_{H+Q_{RI}-1}$.

5.3 Downlink transport channels and control information

If the UE is configured with a Master Cell Group (MCG) and Secondary Cell Group (SCG) [6], the procedures described in this clause are applied to the MCG and SCG, respectively. When the procedures are applied to a SCG, the term primary cell refers to the primary SCell (PSCell) of the SCG.

If the UE is configured with a PUCCH SCell [6], the procedures described in this clause are applied to the group of DL cells associated with the primary cell and the group of DL cells associated with the PUCCH SCell, respectively. When the procedures are applied to the group of DL cells associated with the PUCCH SCell, the term primary cell refers to the PUCCH SCell.

5.3.1 Broadcast channel

Figure 5.3.1-1 shows the processing structure for the BCH transport channel. Data arrives to the coding unit in the form of a maximum of one transport block every transmission time interval (TTI) of 40ms. The following coding steps can be identified:

- Add CRC to the transport block
- Channel coding
- Rate matching

The coding steps for BCH transport channel are shown in the figure below.

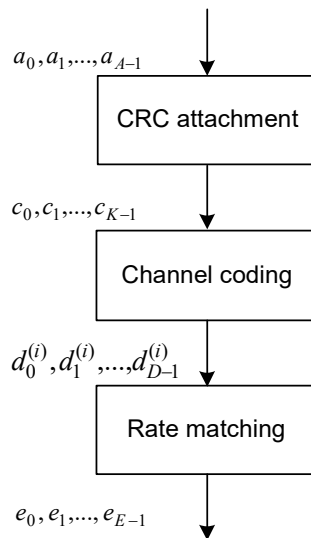


Figure 5.3.1-1: Transport channel processing for BCH.

5.3.1.1 Transport block CRC attachment

Error detection is provided on BCH transport blocks through a Cyclic Redundancy Check (CRC).

The entire transport block is used to calculate the CRC parity bits. Denote the bits in a transport block delivered to layer 1 by $a_0, a_1, a_2, a_3, \dots, a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, \dots, p_{L-1}$. A is the size of the transport block and set to 24 bits and L is the number of parity bits. The lowest order information bit a_0 is mapped to the most significant bit of the transport block as defined in section 6.1.1 of [5].

The parity bits are computed and attached to the BCH transport block according to section 5.1.1 setting L to 16 bits. After the attachment, the CRC bits are scrambled according to the eNodeB transmit antenna configuration with the sequence $x_{ant,0}, x_{ant,1}, \dots, x_{ant,15}$ as indicated in Table 5.3.1.1-1 to form the sequence of bits $c_0, c_1, c_2, c_3, \dots, c_{K-1}$ where

$$c_k = a_k \quad \text{for } k = 0, 1, 2, \dots, A-1$$

$$c_k = (p_{k-A} + x_{ant,k-A}) \bmod 2 \quad \text{for } k = A, A+1, A+2, \dots, A+15.$$

Table 5.3.1.1-1: CRC mask for PBCH.

Number of transmit antenna ports at eNodeB	PBCH CRC mask
	$\langle x_{ant,0}, x_{ant,1}, \dots, x_{ant,15} \rangle$
1	$\langle 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 \rangle$
2	$\langle 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 \rangle$
4	$\langle 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1 \rangle$

5.3.1.2 Channel coding

Information bits are delivered to the channel coding block. They are denoted by $c_0, c_1, c_2, c_3, \dots, c_{K-1}$, where K is the number of bits, and they are tail biting convolutionally encoded according to section 5.1.3.1.

After encoding the bits are denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1$, and 2 , and where D is the number of bits on the i -th coded stream, i.e., $D = K$.

5.3.1.3 Rate matching

A tail biting convolutionally coded block is delivered to the rate matching block. This block of coded bits is denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1$, and 2 , and where i is the coded stream index and D is the number of bits in each coded stream. This coded block is rate matched according to section 5.1.4.2.

After rate matching, the bits are denoted by $e_0, e_1, e_2, e_3, \dots, e_{E-1}$, where E is the number of rate matched bits as defined in section 6.6.1 of [2].

5.3.2 Downlink shared channel, Paging channel and Multicast channel

Figure 5.3.2-1 shows the processing structure for each transport block for the DL-SCH, PCH and MCH transport channels. Data arrives to the coding unit in the form of a maximum of two transport blocks every transmission time interval (TTI) per DL cell. The following coding steps can be identified for each transport block of a DL cell:

- Add CRC to the transport block
- Code block segmentation and code block CRC attachment
- Channel coding
- Rate matching
- Code block concatenation

The coding steps for PCH and MCH transport channels, and for one transport block of DL-SCH are shown in the figure below. The same processing applies for each transport block on each DL cell.

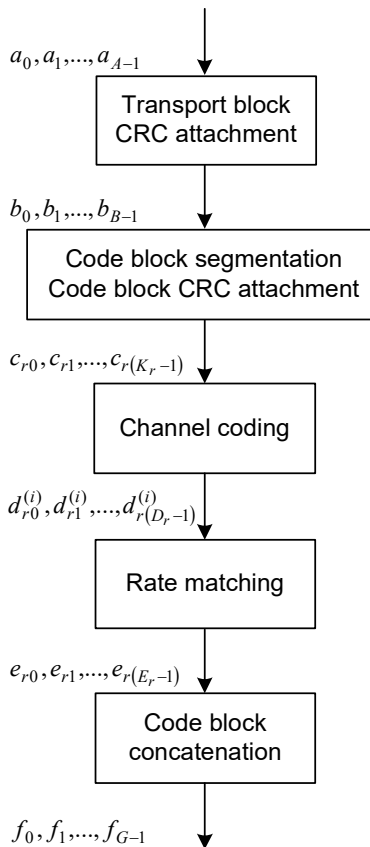


Figure 5.3.2-1: Transport block processing for DL-SCH, PCH and MCH.

5.3.2.1 Transport block CRC attachment

Error detection is provided on transport blocks through a Cyclic Redundancy Check (CRC).

The entire transport block is used to calculate the CRC parity bits. Denote the bits in a transport block delivered to layer 1 by $a_0, a_1, a_2, a_3, \dots, a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, \dots, p_{L-1}$. A is the size of the transport block and L is the number of parity bits. The lowest order information bit a_0 is mapped to the most significant bit of the transport block as defined in section 6.1.1 of [5].

The parity bits are computed and attached to the transport block according to section 5.1.1 setting L to 24 bits and using the generator polynomial $g_{\text{CRC24A}}(D)$.

5.3.2.2 Code block segmentation and code block CRC attachment

The bits input to the code block segmentation are denoted by $b_0, b_1, b_2, b_3, \dots, b_{B-1}$ where B is the number of bits in the transport block (including CRC).

Code block segmentation and code block CRC attachment are performed according to section 5.1.2.

The bits after code block segmentation are denoted by $c_{r0}, c_{r1}, c_{r2}, c_{r3}, \dots, c_{r(K_r-1)}$, where r is the code block number and K_r is the number of bits for code block number r .

5.3.2.3 Channel coding

Code blocks are delivered to the channel coding block. They are denoted by $c_{r0}, c_{r1}, c_{r2}, c_{r3}, \dots, c_{r(K_r-1)}$, where r is the code block number, and K_r is the number of bits in code block number r . The total number of code blocks is denoted by C and each code block is individually turbo encoded according to section 5.1.3.2.

After encoding the bits are denoted by $d_{r0}^{(i)}, d_{r1}^{(i)}, d_{r2}^{(i)}, d_{r3}^{(i)}, \dots, d_{r(D_r-1)}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where D_r is the number of bits on the i -th coded stream for code block number r , i.e. $D_r = K_r + 4$.

5.3.2.4 Rate matching

Turbo coded blocks are delivered to the rate matching block. They are denoted by $d_{r0}^{(i)}, d_{r1}^{(i)}, d_{r2}^{(i)}, d_{r3}^{(i)}, \dots, d_{r(D_r-1)}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where r is the code block number, i is the coded stream index, and D_r is the number of bits in each coded stream of code block number r . The total number of code blocks is denoted by C and each coded block is individually rate matched according to section 5.1.4.1.

After rate matching, the bits are denoted by $e_{r0}, e_{r1}, e_{r2}, e_{r3}, \dots, e_{r(E_r-1)}$, where r is the coded block number, and where E_r is the number of rate matched bits for code block number r .

5.3.2.5 Code block concatenation

The bits input to the code block concatenation block are denoted by $e_{r0}, e_{r1}, e_{r2}, e_{r3}, \dots, e_{r(E_r-1)}$ for $r = 0, \dots, C-1$ and where E_r is the number of rate matched bits for the r -th code block.

Code block concatenation is performed according to section 5.1.5.

The bits after code block concatenation are denoted by $f_0, f_1, f_2, f_3, \dots, f_{G-1}$, where G is the total number of coded bits for transmission. This sequence of coded bits corresponding to one transport block after code block concatenation is referred to as one codeword in section 6.3.1 of [2]. In case of multiple transport blocks per TTI, the transport block to codeword mapping is specified according to section 5.3.3.1.5, 5.3.3.1.5A or 5.3.3.1.5B, depending on the DCI Format.

5.3.3 Downlink control information

A DCI transports downlink, uplink or sidelink scheduling information, requests for aperiodic CQI reports, LAA common information, notifications of MCCH change [6] or uplink power control commands for one cell and one RNTI. The RNTI is implicitly encoded in the CRC.

Figure 5.3.3-1 shows the processing structure for one DCI. The following coding steps can be identified:

- Information element multiplexing
- CRC attachment
- Channel coding
- Rate matching

The coding steps for DCI are shown in the figure below.

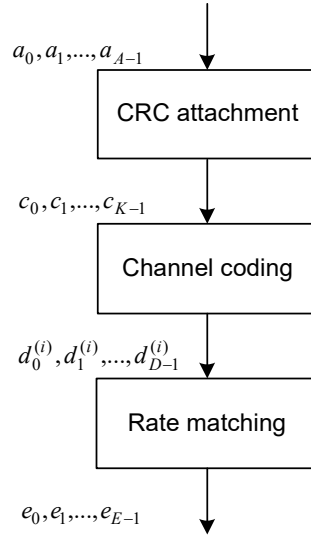


Figure 5.3.3-1: Processing for one DCI.

5.3.3.1 DCI formats

The fields defined in the DCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, including the zero-padding bit(s), if any, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0 .

5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH in one UL cell.

The following information is transmitted by means of the DCI format 0:

- Carrier indicator – 0 or 3 bits. This field is present according to the definitions in [3].
- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Frequency hopping flag – 1 bit as defined in section 8.4 of [3]. This field is used as the MSB of the corresponding resource allocation field for resource allocation type 1.
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL} + 1)/2) \right\rceil$ bits
 - For PUSCH hopping (resource allocation type 0 only):
 - N_{UL_hop} MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in section 8.4 of [3]
 - $\left(\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL} + 1)/2) \right\rceil - N_{UL_hop} \right)$ bits provide the resource allocation of the first slot in the UL subframe
 - For non-hopping PUSCH with resource allocation type 0:
 - $\left(\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL} + 1)/2) \right\rceil \right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1.1 of [3]
 - For non-hopping PUSCH with resource allocation type 1:

- The concatenation of the frequency hopping flag field and the resource block assignment and hopping resource allocation field provides the resource allocation field in the UL subframe as defined in section 8.1.2 of [3]
- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit
- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]
- Cyclic shift for DM RS and OCC index – 3 bits as defined in section 5.5.2.1.1 of [2]
- UL index – 2 bits as defined in sections 5.1.1.1, 7.2.1, 8 and 8.4 of [3] (this field is present only for TDD operation with uplink-downlink configuration 0)
- Downlink Assignment Index (DAI) – 2 bits as defined in section 7.3 of [3] (this field is present only for cases with TDD primary cell and either TDD operation with uplink-downlink configurations 1-6 or FDD operation)
- CSI request – 1, 2 or 3 bits as defined in section 7.2.1 of [3]. The 2-bit field applies to UEs configured with no more than five DL cells and to
 - UEs that are configured with more than one DL cell and when the corresponding DCI format is mapped onto the UE specific search space given by the C-RNTI as defined in [3];
 - UEs that are configured by higher layers with more than one CSI process and when the corresponding DCI format is mapped onto the UE specific search space given by the C-RNTI as defined in [3];
 - UEs that are configured with two CSI measurement sets by higher layers with the parameter *csi-MeasSubframeSet*, and when the corresponding DCI format is mapped onto the UE specific search space given by the C-RNTI as defined in [3];

the 3-bit field applies to UEs that are configured with more than five DL cells and when the corresponding DCI format is mapped onto the UE specific search space given by the C-RNTI as defined in [3];

otherwise the 1-bit field applies

- SRS request – 0 or 1 bit. This field can only be present in DCI formats scheduling PUSCH which are mapped onto the UE specific search space given by the C-RNTI as defined in [3]. The interpretation of this field is provided in section 8.2 of [3]
- Resource allocation type – 1 bit. This field is only present if $N_{RB}^{UL} \leq N_{RB}^{DL}$. The interpretation of this field is provided in section 8.1 of [3]

If the number of information bits in format 0 mapped onto a given search space is less than the payload size of format 1A for scheduling the same serving cell and mapped onto the same search space (including any padding bits appended to format 1A), zeros shall be appended to format 0 until the payload size equals that of format 1A.

5.3.3.1.2 Format 1

DCI format 1 is used for the scheduling of one PDSCH codeword in one cell.

The following information is transmitted by means of the DCI format 1:

- Carrier indicator – 0 or 3 bits. This field is present according to the definitions in [3].
- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.
- Resource block assignment:
 - For resource allocation type 0 as defined in section 7.1.6.1 of [3]:
 - $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation

- For resource allocation type 1 as defined in section 7.1.6.2 of [3]:
 - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset
 - 1 bit indicates a shift of the resource allocation span
 - $\left(\left\lceil N_{RB}^{DL} / P \right\rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section 7.1.6.1 of [3]

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- HARQ process number – 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- New data indicator – 1 bit
- Redundancy version – 2 bits
- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If the UE is not configured to decode PDCCH or EPDCCH with CRC scrambled by the C-RNTI and the number of information bits in format 1 is equal to that for format 0/1A, one bit of value zero shall be appended to format 1.

If the UE is configured to decode PDCCH or EPDCCH with CRC scrambled by the C-RNTI and the number of information bits in format 1 is equal to that for format 0/1A for scheduling the same serving cell and mapped onto the UE specific search space given by the C-RNTI as defined in [3], one bit of value zero shall be appended to format 1.

If the number of information bits in format 1 carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one or more zero bit(s) shall be appended to format 1 until the payload size of format 1 does not belong to one of the sizes in Table 5.3.3.1.2-1 and is not equal to that of format 0/1A mapped onto the same search space.

Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits.

{12, 14, 16, 20, 24, 26, 32, 40, 44, 56}
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Table 5.3.3.1.2-2: Number of bits for Downlink Assignment Index.

Number of bits	
4	For UEs configured by higher layers with <i>codebooksizeDetermination-r13</i> = 0, the 4-bit DAI further consists of a 2-bit counter DAI and a 2-bit total DAI. <ul style="list-style-type: none"> - Counter DAI – 2 bits as defined in section 7.3 of [3] - Total DAI – 2 bits as defined in section 7.3 of [3]
2	For UEs configured with no more than five DL cells, or for UEs configured by higher layers with <i>codebooksizeDetermination-r13</i> = 1, this field is present for FDD or TDD operation, for cases with TDD primary cell. <p>If the UL/DL configuration of all TDD serving cells is same and the UE is not configured to decode PDCCH with CRC scrambled by <i>eimta-RNTI</i>, then this field only applies to serving cell with UL/DL configuration 1-6</p> <p>If at least two TDD serving cells have different UL/DL configurations or the UE is configured to decode PDCCH with CRC scrambled by <i>eimta-RNTI</i>, then this field applies to a serving cell with DL-reference UL/DL configuration 1-6 as defined in section 10.2 of [3]</p>
0	For UEs configured with no more than five DL cells, or for UEs configured by higher layers with <i>codebooksizeDetermination-r13</i> = 1, this field is not present for FDD or TDD operation, for cases with FDD primary cell.

5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword in one cell and random access procedure initiated by a PDCCH order. The DCI corresponding to a PDCCH order can be carried by PDCCH or EPDCCH.

The following information is transmitted by means of the DCI format 1A:

- Carrier indicator – 0 or 3 bits. This field is present according to the definitions in [3].
- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

Format 1A is used for random access procedure initiated by a PDCCH order only if format 1A CRC is scrambled with C-RNTI and all the remaining fields are set as follows:

- Localized/Distributed VRB assignment flag – 1 bit is set to '0'
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits, where all bits shall be set to 1
- Preamble Index – 6 bits
- PRACH Mask Index – 4 bits, [5]
- All the remaining bits in format 1A for compact scheduling assignment of one PDSCH codeword are set to zero

Otherwise,

- Localized/Distributed VRB assignment flag – 1 bit as defined in 7.1.6.3 of [3]
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits as defined in section 7.1.6.3 of [3]:
 - For localized VRB:
$$\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$$
 bits provide the resource allocation
 - For distributed VRB:

- If $N_{RB}^{DL} < 50$ or if the format 1A CRC is scrambled by RA-RNTI, P-RNTI, SI-RNTI, SC-RNTI or G-RNTI:

- $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits provide the resource allocation

- Else

- 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$

- $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil - 1)$ bits provide the resource allocation,

where N_{gap} is defined in [2].

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

- HARQ process number – 3 bits (for cases with FDD primary cell) , 4 bits (for cases with TDD primary cell)

- New data indicator – 1 bit

- If the format 1A CRC is scrambled by RA-RNTI, P-RNTI, SI-RNTI, SC-RNTI or G-RNTI:

- If $N_{RB}^{DL} \geq 50$ and Localized/Distributed VRB assignment flag is set to 1

- the new data indicator bit indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$.

- Else the new data indicator bit is reserved.

- Else

- The new data indicator bit as defined in [5]

- Redundancy version – 2 bits

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]

- If the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI:

- The most significant bit of the TPC command is reserved.

- The least significant bit of the TPC command indicates column N_{PRB}^{1A} of the TBS table defined of [3].

- If least significant bit is 0 then $N_{PRB}^{1A} = 2$ else $N_{PRB}^{1A} = 3$.

- Else

- The two bits including the most significant bit indicates the TPC command

- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.

- SRS request – 0 or 1 bit. This field can only be present in DCI formats scheduling PDSCH which are mapped onto the UE specific search space given by the C-RNTI as defined in [3]. The interpretation of this field is provided in section 8.2 of [3]

- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If the UE is not configured to decode PDCCH or EPDCCH with CRC scrambled by the C-RNTI, and the number of information bits in format 1A is less than that of format 0, zeros shall be appended to format 1A until the payload size equals that of format 0.

If the UE is configured to decode PDCCH or EPDCCH with CRC scrambled by the C-RNTI and the number of information bits in format 1A mapped onto a given search space is less than that of format 0 for scheduling the same serving cell and mapped onto the same search space, zeros shall be appended to format 1A until the payload size equals that of format 0, except when format 1A assigns downlink resource on a secondary cell without an uplink configuration associated with the secondary cell.

If the number of information bits in format 1A carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 1A.

When the format 1A CRC is scrambled with a RA-RNTI, P-RNTI, SI-RNTI, SC-RNTI or G-RNTI then the following fields among the fields above are reserved:

- HARQ process number
- Downlink Assignment Index (used for cases with TDD primary cell and either FDD operation or TDD operation, and is not present for cases with FDD primary cell and either FDD operation or TDD operation)

5.3.3.1.3A Format 1B

DCI format 1B is used for the compact scheduling of one PDSCH codeword in one cell with precoding information.

The following information is transmitted by means of the DCI format 1B:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Localized/Distributed VRB assignment flag – 1 bit as defined in section 7.1.6.3 of [3]
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits as defined in section 7.1.6.3 of [3]
 - For localized VRB:
 - $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits provide the resource allocation
 - For distributed VRB:
 - For $N_{RB}^{DL} < 50$
 - $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits provide the resource allocation
 - For $N_{RB}^{DL} \geq 50$
 - 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$
 - $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil - 1)$ bits provide the resource allocation
- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]
- HARQ process number – 3 bits (for cases with FDD primary cell) , 4 bits (for cases with TDD primary cell)
- New data indicator – 1 bit
- Redundancy version – 2 bits
- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.

- TPMI information for precoding – number of bits as specified in Table 5.3.3.1.3A-1

TPMI information indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of [2] corresponding to the single-layer transmission.

- PMI confirmation for precoding – 1 bit as specified in Table 5.3.3.1.3A-2
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If PMI confirmation indicates that the eNodeB has applied precoding according to PMI(s) reported by the UE, the precoding for the corresponding RB(s) in subframe n is according to the latest PMI(s) in an aperiodic CSI reported on or before subframe $n-4$.

Table 5.3.3.1.3A-1: Number of bits for TPMI information.

Number of antenna ports at eNodeB	Number of bits
2	2
4	4

Table 5.3.3.1.3A-2: Content of PMI confirmation.

Bit field mapped to index	Message
0	Precoding according to the indicated TPMI in the TPMI information field
1	<p>Precoding using the precoder(s) according to PMI(s) indicated in the latest aperiodic CSI report.</p> <p>For aperiodic CSI mode 2-2:</p> <ul style="list-style-type: none"> - Precoding of scheduled resource blocks belonging to the reported preferred M subband(s), use precoder(s) according to the preferred M subband PMI(s) indicated in the latest aperiodic CSI report; - Precoding of scheduled resource blocks not belonging to the reported preferred M subband(s), precoding using a precoder according to the wideband PMI indicated in the latest aperiodic CSI report.

If the number of information bits in format 1B is equal to that for format 0/1A for scheduling the same serving cell and mapped onto the UE specific search space given by the C-RNTI as defined in [3], one bit of value zero shall be appended to format 1B.

If the number of information bits in format 1B carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one or more zero bit(s) shall be appended to format 1B until the payload size of format 1B does not belong to one of the sizes in Table 5.3.3.1.2-1 and is not equal to that of format 0/1A mapped onto the same search space.

5.3.3.1.4 Format 1C

DCI format 1C is used for very compact scheduling of one PDSCH codeword, notifying MCCH change [6], notifying SC-MCCH change [6], reconfiguring TDD, and LAA common information.

The following information is transmitted by means of the DCI format 1C:

If the format 1C is used for very compact scheduling of one PDSCH codeword

- 1 bit indicates the gap value, where value 0 indicates $N_{\text{gap}} = N_{\text{gap},1}$ and value 1 indicates $N_{\text{gap}} = N_{\text{gap},2}$

- For $N_{RB}^{DL} < 50$, there is no bit for gap indication
- Resource block assignment – $\left\lceil \log_2 \left(\left\lfloor N_{VRB, gap1}^{DL} / N_{RB}^{step} \right\rfloor \cdot \left(\left\lfloor N_{VRB, gap1}^{DL} / N_{RB}^{step} \right\rfloor + 1 \right) / 2 \right) \right\rceil$ bits as defined in 7.1.6.3 of [3] where $N_{VRB, gap1}^{DL}$ is defined in [2] and N_{RB}^{step} is defined in [3]
- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

Else if the format 1C is used for notifying MCCH change

- Information for MCCH change notification – 8 bits as defined in section 5.8.1.3 of [6]
- Reserved information bits are added until the size is equal to that of format 1C used for very compact scheduling of one PDSCH codeword

Else if the format 1C is used for notifying SC-MCCH change

- Information for SC-MCCH change notification – 8 bits as defined in section 5.8a.1.3 of [6]
- Reserved information bits are added until the size is equal to that of format 1C used for very compact scheduling of one PDSCH codeword

Else if the format 1C is used for reconfiguring TDD

- UL/DL configuration indication:

UL/DL configuration number 1, UL/DL configuration number 2, ..., UL/DL configuration number I

Where each UL/DL configuration is 3 bits, $I = \left\lfloor \frac{L_{format\ 1c}}{3} \right\rfloor$, $L_{format\ 1c}$ is equal to the payload size of format 1C

used for very compact scheduling of one PDSCH codeword. The parameter *eimta-UL-DL-ConfigIndex* provided by higher layers determines the index to the UL/DL configuration indication for a serving cell.

- Zeros are added until the size is equal to that of format 1C used for very compact scheduling of one PDSCH codeword

Else

- Subframe configuration for LAA – 4 bits as defined in section x.y.z of [3]
- Reserved information bits are added until the size is equal to that of format 1C used for very compact scheduling of one PDSCH codeword

5.3.3.1.4A Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword in one cell with precoding and power offset information.

The following information is transmitted by means of the DCI format 1D:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Localized/Distributed VRB assignment flag – 1 bit as defined in section 7.1.6.3 of [3]
- Resource block assignment – $\left\lceil \log_2 (N_{RB}^{DL} (N_{RB}^{DL} + 1) / 2) \right\rceil$ bits as defined in section 7.1.6.3 of [3]:
 - For localized VRB:
 - $\left\lceil \log_2 (N_{RB}^{DL} (N_{RB}^{DL} + 1) / 2) \right\rceil$ bits provide the resource allocation
 - For distributed VRB:
 - For $N_{RB}^{DL} < 50$

- $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ bits provide the resource allocation

- For $N_{RB}^{DL} \geq 50$

- 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$

- $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil - 1)$ bits provide the resource allocation

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]
- HARQ process number – 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- New data indicator – 1 bit
- Redundancy version – 2 bits
- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- TPMI information for precoding – number of bits as specified in Table 5.3.3.1.4A-1

TPMI information indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of [2] corresponding to the single-layer transmission.
- Downlink power offset – 1 bit as defined in section 7.1.5 of [3]
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

Table 5.3.3.1.4A-1: Number of bits for TPMI information.

Number of antenna ports at eNodeB	Number of bits
2	2
4	4

If the number of information bits in format 1D is equal to that for format 0/1A for scheduling the same serving cell and mapped onto the UE specific search space given by the C-RNTI as defined in [3], one bit of value zero shall be appended to format 1D.

If the number of information bits in format 1D carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one or more zero bit(s) shall be appended to format 1D until the payload size of format 1D does not belong to one of the sizes in Table 5.3.3.1.2-1 and is not equal to that of format 0/1A mapped onto the same search space.

5.3.3.1.5 Format 2

The following information is transmitted by means of the DCI format 2:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

- For resource allocation type 0 defined in section 7.1.6.1 of [3]:
 - $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation
- For resource allocation type 1 as defined in section 7.1.6.2 of [3]:
 - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset
 - 1 bit indicates a shift of the resource allocation span
 - $\left(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section 7.1.6.1 of [3]

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- HARQ process number - 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- Transport block to codeword swap flag – 1 bit

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits
- Precoding information – number of bits as specified in Table 5.3.3.1.5-3
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If both transport blocks are enabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-1.

In case one of the transport blocks is disabled as specified in section 7.1.7.2 of [3], the transport block to codeword swap flag is reserved and the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2.

Table 5.3.3.1.5-1: Transport block to codeword mapping (two transport blocks enabled).

transport block to codeword swap flag value	codeword 0 (enabled)	codeword 1 (enabled)
0	transport block 1	transport block 2
1	transport block 2	transport block 1

**Table 5.3.3.1.5-2: Transport block to codeword mapping
(one transport block enabled).**

transport block 1	transport block 2	codeword 0 (enabled)	codeword 1 (disabled)
enabled	disabled	transport block 1	-
disabled	enabled	transport block 2	-

The interpretation of the precoding information field depends on the number of enabled codewords according to Table 5.3.3.1.5-4 and Table 5.3.3.1.5-5. Note that TPMI indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of [2]. For a single enabled codeword, indices 18 to 34 inclusive in Table 5.3.3.1.5-5 are only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two layers with closed-loop spatial multiplexing.

If the number of information bits in format 2 carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2.

Some entries in Table 5.3.3.1.5-4 and Table 5.3.3.1.5-5 are used for indicating that the eNodeB has applied precoding according to PMI(s) reported by the UE. In these cases the precoding for the corresponding RB(s) in subframe n is according to the latest PMI(s) in an aperiodic CSI reported on or before subframe $n-4$. For aperiodic CSI mode 2-2: Precoding of scheduled resource blocks belonging to the reported preferred M subband(s) use precoder(s) according to the preferred M subband PMI indicated by the latest aperiodic CSI report; Precoding of scheduled resource blocks not belonging to the reported preferred M subband(s) use a precoder according to the wideband PMI indicated by the latest aperiodic CSI report.

Table 5.3.3.1.5-3: Number of bits for precoding information.

Number of antenna ports at eNodeB	Number of bits for precoding information
2	3
4	6

Table 5.3.3.1.5-4: Content of precoding information field for 2 antenna ports.

One codeword: Codeword 0 enabled, Codeword 1 disabled		Two codewords: Codeword 0 enabled, Codeword 1 enabled	
Bit field mapped to index	Message	Bit field mapped to index	Message
0	2 layers: Transmit diversity	0	2 layers: Precoding corresponding to precoder matrix $\frac{1}{2} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$
1	1 layer: Precoding corresponding to precoding vector $[1 \ 1]^T / \sqrt{2}$	1	2 layers: Precoding corresponding to precoder matrix $\frac{1}{2} \begin{bmatrix} 1 & 1 \\ j & -j \end{bmatrix}$
2	1 layer: Precoding corresponding to precoder vector $[1 \ -1]^T / \sqrt{2}$	2	2 layers: Precoding according to the latest PMI report on PUSCH, using the precoder(s) indicated by the reported PMI(s)
3	1 layer: Precoding corresponding to precoder vector $[1 \ j]^T / \sqrt{2}$	3	reserved
4	1 layer: Precoding corresponding to precoder vector $[1 \ -j]^T / \sqrt{2}$	4	reserved
5	1 layer: Precoding according to the latest PMI report on PUSCH, using the precoder(s) indicated by the reported PMI(s), if RI=2 was reported, using 1 st column multiplied by $\sqrt{2}$ of all precoders implied by the reported PMI(s)	5	reserved
6	1 layer: Precoding according to the latest PMI report on PUSCH, using the precoder(s) indicated by the reported PMI(s), if RI=2 was reported, using 2 nd column multiplied by $\sqrt{2}$ of all precoders implied by the reported PMI(s)	6	reserved
7	reserved	7	reserved

Table 5.3.3.1.5-5: Content of precoding information field for 4 antenna ports.

One codeword: Codeword 0 enabled, Codeword 1 disabled		Two codewords: Codeword 0 enabled, Codeword 1 enabled	
Bit field mapped to index	Message	Bit field mapped to index	Message
0	4 layers: Transmit diversity	0	2 layers: TPMI=0
1	1 layer: TPMI=0	1	2 layers: TPMI=1
2	1 layer: TPMI=1	⋮	⋮
⋮	⋮	15	2 layers: TPMI=15
16	1 layer: TPMI=15	16	2 layers: Precoding according to the latest PMI report on PUSCH using the precoder(s) indicated by the reported PMI(s)
17	1 layer: Precoding according to the latest PMI report on PUSCH using the precoder(s) indicated by the reported PMI(s)	17	3 layers: TPMI=0
18	2 layers: TPMI=0	18	3 layers: TPMI=1
19	2 layers: TPMI=1	⋮	⋮
⋮	⋮	32	3 layers: TPMI=15
33	2 layers: TPMI=15	33	3 layers: Precoding according to the latest PMI report on PUSCH using the precoder(s) indicated by the reported PMI(s)
34	2 layers: Precoding according to the latest PMI report on PUSCH using the precoder(s) indicated by the reported PMI(s)	34	4 layers: TPMI=0
35 – 63	reserved	35	4 layers: TPMI=1
		⋮	⋮
		49	4 layers: TPMI=15
		50	4 layers: Precoding according to the latest PMI report on PUSCH using the precoder(s) indicated by the reported PMI(s)
		51 – 63	Reserved

5.3.3.1.5A Format 2A

The following information is transmitted by means of the DCI format 2A:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

- For resource allocation type 0 as defined in section 7.1.6.1 of [3]

- $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation

- For resource allocation type 1 as defined in section 7.1.6.2 of [3]

- $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset

- 1 bit indicates a shift of the resource allocation span

- $\left(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section 7.1.6.1 of [3]

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]

- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.

- HARQ process number - 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)

- Transport block to codeword swap flag – 1 bit

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

- Precoding information – number of bits as specified in Table 5.3.3.1.5A-1

- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If both transport blocks are enabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-1.

In case one of the transport blocks is disabled, the transport block to codeword swap flag is reserved and the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2.

The precoding information field is defined according to Table 5.3.3.1.5A-2. For a single enabled codeword, index 1 in Table 5.3.3.1.5A-2 is only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two layers with large delay CDD.

For transmission with 2 antenna ports, the precoding information field is not present. The number of transmission layers is equal to 2 if both codewords are enabled; transmit diversity is used if codeword 0 is enabled while codeword 1 is disabled.

If the number of information bits in format 2A carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2A.

Table 5.3.3.1.5A-1: Number of bits for precoding information.

Number of antenna ports at eNodeB	Number of bits for precoding information
2	0
4	2

Table 5.3.3.1.5A-2: Content of precoding information field for 4 antenna ports.

One codeword: Codeword 0 enabled, Codeword 1 disabled		Two codewords: Codeword 0 enabled, Codeword 1 enabled	
Bit field mapped to index	Message	Bit field mapped to index	Message
0	4 layers: Transmit diversity	0	2 layers: precoder cycling with large delay CDD
1	2 layers: precoder cycling with large delay CDD	1	3 layers: precoder cycling with large delay CDD
2	reserved	2	4 layers: precoder cycling with large delay CDD
3	reserved	3	reserved

5.3.3.1.5B Format 2B

The following information is transmitted by means of the DCI format 2B:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

- For resource allocation type 0 as defined in section 7.1.6.1 of [3]

- $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation

- For resource allocation type 1 as defined in section 7.1.6.2 of [3]

- $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset

- 1 bit indicates a shift of the resource allocation span

- $\left(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section [7.1.6.1] of [3]

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- HARQ process number - 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- Scrambling identity– 1 bit as defined in section 6.10.3.1 of [2]
- SRS request – [0-1] bit. This field can only be present for TDD operation and if present is defined in section 8.2 of [3]

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If both transport blocks are enabled, the number of layers equals two; transport block 1 is mapped to codeword 0; and transport block 2 is mapped to codeword 1. Antenna ports 7 and 8 are used for spatial multiplexing.

In case one of the transport blocks is disabled, the number of layers equals one; the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2; and the antenna port for single-antenna port transmission is according to Table 5.3.3.1.5B-1.

Table 5.3.3.1.5B-1: Antenna port for single-antenna port transmission (one transport block disabled).

New data indicator of the disabled transport block	Antenna port
0	7
1	8

If the number of information bits in format 2B carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2B.

5.3.3.1.5C Format 2C

The following information is transmitted by means of the DCI format 2C:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]
 - If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.
- Resource block assignment:
 - For resource allocation type 0 as defined in section 7.1.6.1 of [3]

- $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation
- For resource allocation type 1 as defined in section 7.1.6.2 of [3]
 - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset
 - 1 bit indicates a shift of the resource allocation span
 - $\left(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section [7.1.6.1] of [3]

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- HARQ process number - 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- Antenna port(s), scrambling identity and number of layers – 3 bits as specified in Table 5.3.3.1.5C-1 where n_{SCID} is the scrambling identity for antenna ports 7 and 8 defined in section 6.10.3.1 of [2], or 4bits as specified in Table 5.3.3.1.5C-2 where n_{SCID} is the scrambling identity for antenna ports 7, 8, 11 and 13 defined in section 6.10.3.1 of [2] when higher layer parameter *Rel-13-DMRS-table* is set to 1.
- SRS request – [0-1] bit. This field can only be present for TDD operation and if present is defined in section 8.2 of [3]

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If both transport blocks are enabled; transport block 1 is mapped to codeword 0; and transport block 2 is mapped to codeword 1.

In case one of the transport blocks is disabled; the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2. For the single enabled codeword, Value = 4, 5, 6 in Table 5.3.3.1.5C-1 are only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two, three or four layers, respectively.

If the number of information bits in format 2C carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2C.

Table 5.3.3.1.5C-1: Antenna port(s), scrambling identity and number of layers indication

One Codeword: Codeword 0 enabled, Codeword 1 disabled		Two Codewords: Codeword 0 enabled, Codeword 1 enabled	
Value	Message	Value	Message
0	1 layer, port 7, $n_{SCID}=0$	0	2 layers, ports 7-8, $n_{SCID}=0$
1	1 layer, port 7, $n_{SCID}=1$	1	2 layers, ports 7-8, $n_{SCID}=1$
2	1 layer, port 8, $n_{SCID}=0$	2	3 layers, ports 7-9
3	1 layer, port 8, $n_{SCID}=1$	3	4 layers, ports 7-10
4	2 layers, ports 7-8	4	5 layers, ports 7-11
5	3 layers, ports 7-9	5	6 layers, ports 7-12
6	4 layers, ports 7-10	6	7 layers, ports 7-13
7	Reserved	7	8 layers, ports 7-14

Table 5.3.3.1.5C-2: Antenna port(s), scrambling identity and number of layers indication

One Codeword: Codeword 0 enabled, Codeword 1 disabled		Two Codewords: Codeword 0 enabled, Codeword 1 enabled	
Value	Message	Value	Message
0	1 layer, port 7, $n_{SCID}=0$ (OCC=2)	0	2 layer, port 7-8, $n_{SCID}=0$ (OCC=2)
1	1 layer, port 7, $n_{SCID}=1$ (OCC=2)	1	2 layer, port 7-8, $n_{SCID}=1$ (OCC=2)
2	1 layer, port 8, $n_{SCID}=0$ (OCC=2)	2	2 layer, port 7-8, $n_{SCID}=0$ (OCC=4)
3	1 layer, port 8, $n_{SCID}=1$ (OCC=2)	3	2 layer, port 7-8, $n_{SCID}=1$ (OCC=4)
4	1 layer, port 7, $n_{SCID}=0$ (OCC=4)	4	2 layer, port 11,13, $n_{SCID}=0$ (OCC=4)
5	1 layer, port 7, $n_{SCID}=1$ (OCC=4)	5	2 layer, port 11,13, $n_{SCID}=1$ (OCC=4)
6	1 layer, port 8, $n_{SCID}=0$ (OCC=4)	6	3 layer, port 7-9
7	1 layer, port 8, $n_{SCID}=1$ (OCC=4)	7	4 layer, port 7-10
8	1 layer, port 11, $n_{SCID}=0$ (OCC=4)	8	5 layer, port 7-11
9	1 layer, port 11, $n_{SCID}=1$ (OCC=4)	9	6 layer, port 7-12
10	1 layer, port 13, $n_{SCID}=0$ (OCC=4)	10	7 layers, ports 7-13
11	1 layer, port 13, $n_{SCID}=1$ (OCC=4)	11	8 layers, ports 7-14
12	2 layers, ports 7-8	12	Reserved
13	3 layers, ports 7-9	13	Reserved
14	4 layers, ports 7-10	14	Reserved
15	Reserved	15	Reserved

5.3.3.1.5D Format 2D

The following information is transmitted by means of the DCI format 2D:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:
 - For resource allocation type 0 as defined in section 7.1.6.1 of [3]

- $\lceil N_{RB}^{DL} / P \rceil$ bits provide the resource allocation
- For resource allocation type 1 as defined in section 7.1.6.2 of [3]
 - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset
 - 1 bit indicates a shift of the resource allocation span
 - $(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1)$ bits provide the resource allocation

where the value of P depends on the number of DL resource blocks as indicated in section [7.1.6.1] of [3]

- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of [3]
- Downlink Assignment Index – number of bits as specified in Table 5.3.3.1.2-2.
- HARQ process number - 3 bits (for cases with FDD primary cell), 4 bits (for cases with TDD primary cell)
- Antenna port(s), scrambling identity and number of layers – 3 bits as specified in Table 5.3.3.1.5C-1 where n_{SCID} is the scrambling identity for antenna ports 7 and 8 defined in section 6.10.3.1 of [2], or 4bits as specified in Table 5.3.3.1.5C-2 where n_{SCID} is the scrambling identity for antenna ports 7, 8, 11 and 13 defined in section 6.10.3.1 of [2] when higher layer parameter *Rel-13-DMRS-table* is set to 1.
- SRS request – [0-1] bit. This field can only be present for TDD operation and if present is defined in section 8.2 of [3]

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits
- PDSCH RE Mapping and Quasi-Co-Location Indicator – 2 bits as defined in sections 7.1.9 and 7.1.10 of [3]
- HARQ-ACK resource offset (this field is present when this format is carried by EPDCCH. This field is not present when this format is carried by PDCCH) – 2 bits as defined in section 10.1 of [3]. The 2 bits are set to 0 when this format is carried by EPDCCH on a secondary cell, or when this format is carried by EPDCCH on the primary cell scheduling PDSCH on a secondary cell and the UE is configured with PUCCH format 3 for HARQ-ACK feedback.

If both transport blocks are enabled; transport block 1 is mapped to codeword 0; and transport block 2 is mapped to codeword 1.

In case one of the transport blocks is disabled; the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2. For the single enabled codeword, Value = 4, 5, 6 in Table 5.3.3.1.5C-1 are only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two, three or four layers, respectively.

If the number of information bits in format 2D carried by PDCCH belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2D.

5.3.3.1.6 Format 3

DCI format 3 is used for the transmission of TPC commands for PUCCH and PUSCH with 2-bit power adjustments.

The following information is transmitted by means of the DCI format 3:

- TPC command number 1, TPC command number 2, ..., TPC command number N

where $N = \left\lfloor \frac{L_{\text{format } 0}}{2} \right\rfloor$, and where $L_{\text{format } 0}$ is equal to the payload size of format 0 before CRC attachment when format 0 is mapped onto the common search space, including any padding bits appended to format 0. The parameter *tpc-Index* or *tpc-Index-PUCCH-SCell-r13* provided by higher layers determines the index to the TPC command for a given UE.

If $\left\lfloor \frac{L_{\text{format } 0}}{2} \right\rfloor < \frac{L_{\text{format } 0}}{2}$, a bit of value zero shall be appended to format 3.

5.3.3.1.7 Format 3A

DCI format 3A is used for the transmission of TPC commands for PUCCH and PUSCH with single bit power adjustments.

The following information is transmitted by means of the DCI format 3A:

- TPC command number 1, TPC command number 2, ..., TPC command number M

where $M = L_{\text{format } 0}$, and where $L_{\text{format } 0}$ is equal to the payload size of format 0 before CRC attachment when format 0 is mapped onto the common search space, including any padding bits appended to format 0. The parameter *tpc-Index* or *tpc-Index-PUCCH-SCell-r13* provided by higher layers determines the index to the TPC command for a given UE.

5.3.3.1.8 Format 4

DCI format 4 is used for the scheduling of PUSCH in one UL cell with multi-antenna port transmission mode,

The following information is transmitted by means of the DCI format 4:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource block assignment - $\max \left(\left\lceil \log_2(N_{\text{RB}}^{\text{UL}}(N_{\text{RB}}^{\text{UL}} + 1)/2) \right\rceil, \left\lceil \log_2 \left(\left(\left\lceil \frac{N_{\text{RB}}^{\text{UL}}}{P+1} \right\rceil \right)^4 \right) \right\rceil \right)$ bits, where P is the UL RBG size as defined in section 8.1.2 of [3]
- For resource allocation type 0:
 - The $\left\lceil \log_2(N_{\text{RB}}^{\text{UL}}(N_{\text{RB}}^{\text{UL}} + 1)/2) \right\rceil$ LSBs provide the resource allocation in the UL subframe as defined in section 8.1.1 of [3]
- For resource allocation type 1:
 - The $\left\lceil \log_2 \left(\left(\left\lceil \frac{N_{\text{RB}}^{\text{UL}}}{P+1} \right\rceil \right)^4 \right) \right\rceil$ LSBs provide the resource allocation in the UL subframe as defined in section 8.1.2 of [3]
- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]
- Cyclic shift for DM RS and OCC index – 3 bits as defined in section 5.5.2.1.1 of [2]
- UL index – 2 bits as defined in sections 5.1.1.1, 7.2.1, 8 and 8.4 of [3] (this field is present only for TDD operation with uplink-downlink configuration 0)

- Downlink Assignment Index (DAI) – 2 bits as defined in section 7.3 of [3] (this field is present only for cases with TDD primary cell and either TDD operation with uplink-downlink configurations 1-6 or FDD operation)
- CSI request – 1, 2 or 3 bits as defined in section 7.2.1 of [3]. The 2-bit field applies to UEs configured with no more than five DL cells and to
 - UEs that are configured with more than one DL cell;
 - UEs that are configured by higher layers with more than one CSI process;
 - UEs that are configured with two CSI measurement sets by higher layers with the parameter *csi-MeasSubframeSet*;

the 3-bit field applies to UEs that are configured with more than five DL cells;

otherwise the 1-bit field applies

- SRS request – 2 bits as defined in section 8.2 of [3]
- Resource allocation type – 1 bit as defined in section 8.1 of [3]

In addition, for transport block 1:

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit

In addition, for transport block 2:

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit

Precoding information and number of layers: number of bits as specified in Table 5.3.3.1.8-1. Bit field as shown in Table 5.3.3.1.8-2 and Table 5.3.3.1.8-3. Note that TPMI for 2 antenna ports indicates which codebook index is to be used in Table 5.3.3A.2-1 of [2], and TPMI for 4 antenna ports indicates which codebook index is to be used in Table 5.3.3A.2-2, Table 5.3.3A.2-3, Table 5.3.3A.2-4 and Table 5.3.3A.2-5 of [2]. If both transport blocks are enabled, transport block 1 is mapped to codeword 0; and transport block 2 is mapped to codeword 1. In case one of the transport blocks is disabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2. For a single enabled codeword, indices 24 to 39 in Table 5.3.3.1.8-3 are only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two layers.

Table 5.3.3.1.8-1: Number of bits for precoding information.

Number of antenna ports at UE	Number of bits for precoding information
2	3
4	6

Table 5.3.3.1.8-2: Content of precoding information field for 2 antenna ports

One codeword: Codeword 0 enabled Codeword 1 disabled		Two codewords: Codeword 0 enabled Codeword 1 enabled	
Bit field mapped to index	Message	Bit field mapped to index	Message
0	1 layer: TPMI=0	0	2 layers: TPMI=0
1	1 layer: TPMI=1	1-7	reserved
2	1 layer: TPMI=2		
...	...		
5	1 layer: TPMI=5		
6-7	reserved		

Table 5.3.3.1.8-3: Content of precoding information field for 4 antenna ports

One codeword: Codeword 0 enabled Codeword 1 disabled		Two codewords: Codeword 0 enabled Codeword 1 enabled	
Bit field mapped to index	Message	Bit field mapped to index	Message
0	1 layer: TPMI=0	0	2 layers: TPMI=0
1	1 layer: TPMI=1	1	2 layers: TPMI=1
...
23	1 layer: TPMI=23	15	2 layers: TPMI=15
24	2 layers: TPMI=0	16	3 layers: TPMI=0
25	2 layers: TPMI=1	17	3 layers: TPMI=1
...
39	2 layers: TPMI=15	27	3 layers: TPMI=11
40-63	reserved	28	4 layers: TPMI=0
		29 - 63	Reserved

If the number of information bits in format 4 is equal to the payload size for DCI format 1, 2, 2A, 2B, 2C or 2D associated with the configured DL transmission mode in the same serving cell, one zero bit shall be appended to format 4.

5.3.3.1.9 Format 5

DCI format 5 is used for the scheduling of PSCCH, and also contains several SCI format 0 fields used for the scheduling of PSSCH.

The following information is transmitted by means of the DCI format 5:

- Resource for PSCCH – 6 bits as defined in section 14.2.1 of [3]
- TPC command for PSCCH and PSSCH – 1 bit as defined in sections 14.2.1 and 14.1.1 of [3]
- SCI format 0 fields according to 5.4.3.1.1:
 - Frequency hopping flag
 - Resource block assignment and hopping resource allocation
 - Time resource pattern

If the number of information bits in format 5 mapped onto a given search space is less than the payload size of format 0 for scheduling the same serving cell, zeros shall be appended to format 5 until the payload size equals that of format 0 including any padding bits appended to format 0.

5.3.3.2 CRC attachment

Error detection is provided on DCI transmissions through a Cyclic Redundancy Check (CRC).

The entire payload is used to calculate the CRC parity bits. Denote the bits of the payload by $a_0, a_1, a_2, a_3, \dots, a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, \dots, p_{L-1}$. A is the payload size and L is the number of parity bits.

The parity bits are computed and attached according to section 5.1.1 setting L to 16 bits, resulting in the sequence $b_0, b_1, b_2, b_3, \dots, b_{B-1}$, where $B = A + L$.

In the case where closed-loop UE transmit antenna selection is not configured or applicable, after attachment, the CRC parity bits are scrambled with the corresponding RNTI $x_{rnti,0}, x_{rnti,1}, \dots, x_{rnti,15}$, where $x_{rnti,0}$ corresponds to the MSB of the RNTI, to form the sequence of bits $c_0, c_1, c_2, c_3, \dots, c_{B-1}$. The relation between c_k and b_k is:

$$c_k = b_k \quad \text{for } k = 0, 1, 2, \dots, A-1$$

$$c_k = (b_k + x_{rnti,k-A}) \bmod 2 \quad \text{for } k = A, A+1, A+2, \dots, A+15.$$

In the case where closed-loop UE transmit antenna selection is configured and applicable, after attachment, the CRC parity bits with DCI format 0 are scrambled with the antenna selection mask $x_{AS,0}, x_{AS,1}, \dots, x_{AS,15}$ as indicated in Table 5.3.3.2-1 and the corresponding RNTI $x_{rnti,0}, x_{rnti,1}, \dots, x_{rnti,15}$ to form the sequence of bits $c_0, c_1, c_2, c_3, \dots, c_{B-1}$. The relation between c_k and b_k is:

$$c_k = b_k \quad \text{for } k = 0, 1, 2, \dots, A-1$$

$$c_k = (b_k + x_{rnti,k-A} + x_{AS,k-A}) \bmod 2 \quad \text{for } k = A, A+1, A+2, \dots, A+15.$$

Table 5.3.3.2-1: UE transmit antenna selection mask.

UE transmit antenna selection	Antenna selection mask $\langle x_{AS,0}, x_{AS,1}, \dots, x_{AS,15} \rangle$
UE port 0	$\langle 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 \rangle$
UE port 1	$\langle 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1 \rangle$

5.3.3.3 Channel coding

Information bits are delivered to the channel coding block. They are denoted by $c_0, c_1, c_2, c_3, \dots, c_{K-1}$, where K is the number of bits, and they are tail biting convolutionally encoded according to section 5.1.3.1.

After encoding the bits are denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where D is the number of bits on the i -th coded stream, i.e., $D = K$.

5.3.3.4 Rate matching

A tail biting convolutionally coded block is delivered to the rate matching block. This block of coded bits is denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where i is the coded stream index and D is the number of bits in each coded stream. This coded block is rate matched according to section 5.1.4.2.

After rate matching, the bits are denoted by $e_0, e_1, e_2, e_3, \dots, e_{E-1}$, where E is the number of rate matched bits.

5.3.4 Control format indicator

Data arrives each subframe to the coding unit in the form of an indicator for the time span, in units of OFDM symbols, of the DCI carried by PDCCH in that subframe of the corresponding DL cell. The CFI takes values CFI = 1, 2 or 3. For system bandwidths $N_{RB}^{DL} > 10$, the span of the DCI carried by PDCCH in units of OFDM symbols, 1, 2 or 3, is given by the CFI. For system bandwidths $N_{RB}^{DL} \leq 10$, the span of the DCI carried by PDCCH in units of OFDM symbols, 2, 3 or 4, is given by CFI+1.

The coding flow is shown in Figure 5.3.4-1.

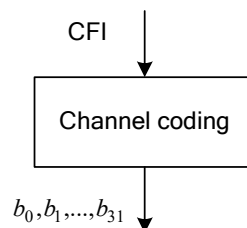


Figure 5.3.4-1 Coding for CFI.

5.3.4.1 Channel coding

The control format indicator is coded according to Table 5.3.4-1.

Table 5.3.4-1: CFI code words.

CFI	CFI code word < b_0, b_1, \dots, b_{31} >
1	<0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1>
2	<1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0>
3	<1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1>
4 (Reserved)	<0,0>

5.3.5 HARQ indicator (HI)

Data arrives to the coding unit in the form of indicators for HARQ acknowledgement for one transport block.

The coding flow is shown in Figure 5.3.5-1.

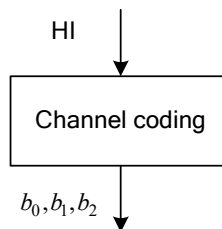


Figure 5.3.5-1 Coding for HI.

5.3.5.1 Channel coding

The HI is coded according to Table 5.3.5-1, where for a positive acknowledgement HI = 1 and for a negative acknowledgement HI = 0.

Table 5.3.5-1: HI code words.

HI	HI code word < b_0, b_1, b_2 >
0	< 0,0,0 >
1	< 1,1,1 >

5.4 Sidelink transport channels and control information

5.4.1 Sidelink broadcast channel

Figure 5.4.1-1 shows the processing structure for the SL-BCH transport channel. Data arrives to the coding unit in the form of a maximum of one transport block. The following coding steps can be identified:

- Add CRC to the transport block
- Channel coding
- Rate matching

The coding steps for SL-BCH transport channel are shown in the figure below. In addition, after rate matching PUSCH interleaving is applied according to sections 5.2.2.7 and 5.2.2.8 without any control information in order to apply a time-first rather than frequency-first mapping, where $C_{mux} = 2 \cdot (N_{\text{syml}}^{\text{SL}} - 3)$ and the sequence of bits f is equal to e .

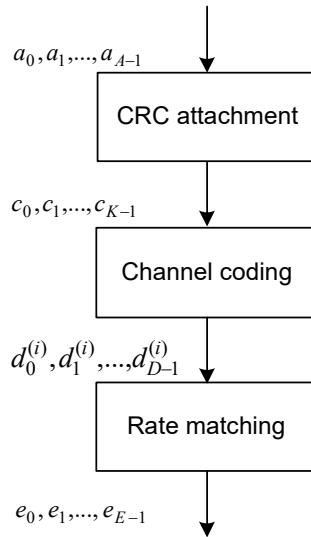


Figure 5.4.1-1: Transport channel processing for SL-BCH.

5.4.1.1 Transport block CRC attachment

Error detection is provided on transport blocks through a Cyclic Redundancy Check (CRC).

The entire transport block is used to calculate the CRC parity bits. Denote the bits in a transport block delivered to layer 1 by $a_0, a_1, a_2, a_3, \dots, a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, \dots, p_{L-1}$. A is the size of the transport block and L is the number of parity bits. The lowest order information bit a_0 is mapped to the most significant bit of the transport block as defined in section 6.1.1 of [5].

The parity bits are computed and attached according to section 5.1.1 setting L to 16 bits, resulting in the sequence of bits $c_0, c_1, c_2, c_3, \dots, c_{K-1}$ where $c_k = b_k$ for $k = 0, 1, 2, \dots, K-1$ and $K=A+L$.

5.4.1.2 Channel coding

Information bits are delivered to the channel coding block. They are denoted by $c_0, c_1, c_2, c_3, \dots, c_{K-1}$, where K is the number of bits, and they are tail biting convolutionally encoded according to section 5.1.3.1.

After encoding the bits are denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where D is the number of bits on the i -th coded stream, i.e., $D = K$.

5.4.1.3 Rate matching

A tail biting convolutionally coded block is delivered to the rate matching block. This block of coded bits is denoted by $d_0^{(i)}, d_1^{(i)}, d_2^{(i)}, d_3^{(i)}, \dots, d_{D-1}^{(i)}$, with $i = 0, 1, \text{ and } 2$, and where i is the coded stream index and D is the number of bits in each coded stream. This coded block is rate matched according to section 5.1.4.2.

After rate matching, the bits are denoted by $e_0, e_1, e_2, e_3, \dots, e_{E-1}$, where E is the number of rate matched bits as defined in section 9.6.1 of [2].

5.4.2 Sidelink shared channel

The processing of the sidelink shared channel follows the downlink shared channel according to section 5.3.2, with the following differences:

- Data arrives to the coding unit in the form of a maximum of one transport block every transmission time interval (TTI)
- In the step of code block concatenation, the sequence of coded bits corresponding to one transport block after code block concatenation is referred to as one codeword in section 9.3.1 of [2].
- PUSCH interleaving is applied according to sections 5.2.2.7 and 5.2.2.8 without any control information in order to apply a time-first rather than frequency-first mapping, where $C_{max} = 2 \cdot (N_{\text{syml}}^{\text{SL}} - 1)$.

5.4.3 Sidelink control information

An SCI transports sidelink scheduling information for one destination ID.

The processing for one SCI follows the downlink control information according to section 5.3.3, with the following differences:

- In the step of CRC attachment, no scrambling is performed.
- PUSCH interleaving is applied according to sections 5.2.2.7 and 5.2.2.8 without any control information in order to apply a time-first rather than frequency-first mapping, where $C_{max} = 2 \cdot (N_{\text{syml}}^{\text{SL}} - 1)$ and the sequence of bits f is equal to e .

5.4.3.1 SCI formats

The fields defined in the SCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0 .

5.4.3.1.1 SCI format 0

SCI format 0 is used for the scheduling of PSSCH.

The following information is transmitted by means of the SCI format 0:

- Frequency hopping flag – 1 bit as defined in section 14.1.1 of [3].
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{\text{RB}}^{\text{SL}}(N_{\text{RB}}^{\text{SL}} + 1)/2) \right\rceil$ bits
 - For PSSCH hopping:
 - $N_{\text{SL_hop}}$ MSB bits are used to obtain the value of $\tilde{n}_{\text{PRB}}(i)$ as indicated in section 8.4 of [3]
 - $\left(\left\lceil \log_2(N_{\text{RB}}^{\text{SL}}(N_{\text{RB}}^{\text{SL}} + 1)/2) \right\rceil - N_{\text{SL_hop}} \right)$ bits provide the resource allocation in the subframe
 - For non-hopping PSSCH:

- $\left(\left\lceil \log_2(N_{RB}^{SL}(N_{RB}^{SL} + 1)/2) \right\rceil \right)$ bits provide the resource allocation in the subframe as defined in section 8.1.1 of [3]

- Time resource pattern – 7 bits as defined in section 14.1.1 of [3].
- Modulation and coding scheme – 5 bits as defined in section 14.1.1 of [3]
- Timing advance indication – 11 bits as defined in section 14.2.1 of [3]
- Group destination ID – 8 bits as defined by higher layers

5.4.4 Sidelink discovery channel

The processing of the sidelink discovery channel follows the downlink shared channel according to section 5.3.2, with the following differences:

- Data arrives to the coding unit in the form of a maximum of one transport block every transmission time interval (TTI)
- In the step of code block concatenation, the sequence of coded bits corresponding to one transport block after code block concatenation is referred to as one codeword in section 9.5.1 of [2].
- PUSCH interleaving is applied according to sections 5.2.2.7 and 5.2.2.8 without any control information in order to apply a time-first rather than frequency-first mapping, where $C_{mux} = 2 \cdot (N_{\text{ymb}}^{SL} - 1)$.

Annex A (informative): Change history

Change history								
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New	
2006-09					Skeleton		0.0.0	0.0.0
2006-10					Updated skeleton	0.0.0	0.0.1	
2006-10					Endorsed skeleton	0.0.1	0.1.0	
2006-11					Added TC. Added Broadcast, Paging and MBMS transport channels in Table 4.2-1.	0.1.0	0.1.1	
2006-11					Endorsed v 0.2.0	0.1.1	0.2.0	
2006-12					Added CC. Added type of coding for each transport channel or control information.	0.2.0	0.2.1	
2007-01					Editor's version	0.2.1	0.2.2	
2007-01					Endorsed v 0.3.0	0.2.2	0.3.0	
2007-02					Added QPP turbo Interleaver description.	0.3.0	0.3.1	
2007-02					Editor's version	0.3.1	0.3.2	
2007-02					Endorsed v 0.4.0	0.3.2	0.4.0	
2007-02					Added CRC details for PDSCH, PDCCH and PUSCH. Added QPP turbo-interleaver parameters. Set Z to 6144. Added details on code block segmentation.	0.4.0	0.4.1	
2007-02					Editor's version	0.4.1	0.4.2	
2007-03	RAN#35	RP-070170			For information at RAN#35	0.4.2	1.0.0	
2007-03					Editor's version	1.0.0	1.0.1	
2007-03					Editor's version	1.0.1	1.1.0	
2007-05					Editor's version	1.1.0	1.1.1	
2007-05					Editor's version	1.1.1	1.1.2	
2007-05					Editor's version	1.1.2	1.2.0	
2007-06					Added circular buffer rate matching for PDSCH and PUSCH. Miscellaneous changes.	1.2.0	1.2.1	
2007-06					Editor's version	1.2.1	1.2.2	
2007-07					Editor's version	1.2.2	1.2.3	
2007-07					Endorsed by email following decision taken at RAN1#49b	1.2.3	1.3.0	
2007-08					Editor's version including decision from RAN1#49bis.	1.3.0	1.3.1	
2007-08					Editor's version	1.3.1	1.3.2	
2007-08					Editor's version	1.3.2	1.4.0	
2007-09					Editor's version with decisions from RAN1#50	1.4.0	1.4.1	
2007-09					Editor's version	1.4.1	1.4.2	
10/09/07	RAN#37	RP-070730	-	-	For approval at RAN#37	1.4.2	2.0.0	
12/09/07	RAN 37	RP-070730	-	-	Approved version	2.0.0	8.0.0	
28/11/07	RAN 38	RP-070949	0001	-	Update of 36.212	8.0.0	8.1.0	
05/03/08	RAN_39	RP-080145	0002	-	Update to 36.212 incorporating decisions from RAN1#51bis and RAN1#52	8.1.0	8.2.0	
28/05/08	RAN 40	RP-080433	0003	-	Joint coding of CQI and ACK on PUCCH	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0004	1	ACK insertion into PUSCH	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0005	1	Introduction of format 1C	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0006	1	Miscellaneous fixes to 36.212	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0008	1	On multiplexing scheme for indicators	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0009	1	On the soft buffer split of MIMO and TDD	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0010	-	Resource assignment field for distributed VRB	8.2.0	8.3.0	
28/05/08	RAN_40	RP-080433	0011	-	Clarifying the use of the different DCI formats	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0012	1	Clarifying the value of N_L	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0013	-	Payload size for DCI formats 3 and 3A	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0014	-	Coding of ACK on PUSCH	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0015	1	Coding of RI on PUSCH and mapping	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0016	-	CRC for control information on PUSCH	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0017	-	Introduction of Downlink Assignment Index	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0018	-	Coding of CQI/PMI on PUSCH coming from PUCCH	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0019	-	Simultaneous transmission of aperiodic CQI and UL control	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0020	-	Encoding of antenna indicator on DCI format 0	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0021	-	PDCCH coverage in narrow bandwidths	8.2.0	8.3.0	
28/05/08	RAN 40	RP-080433	0022	-	Closed-loop and open-loop spatial multiplexing	8.2.0	8.3.0	
28/05/08	RAN_40	RP-080457	0023	-	Formula for linkage between PUSCH MCS and amount of resources used for control	8.2.0	8.3.0	
09/09/08	RAN 41	RP-080669	0026	-	Correction to PUSCH Channel Interleaver	8.3.0	8.4.0	
09/09/08	RAN 41	RP-080669	0028	-	Correction of mapping of ACK/NAK to binary bit values	8.3.0	8.4.0	
09/09/08	RAN 41	RP-080669	0029	-	Correction to bit collection, selection and transmission	8.3.0	8.4.0	

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
09/09/08	RAN_41	RP-080669	0030	-	Padding one bit to DCI format 1 when format 1 and format 0/1A have the same size	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0031	-	Modification of M_limit	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0032	-	Definition of Formats 2 and 2A	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0033	2	Corrections to DCI formats	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0035	1	Format 1B confirmation flag	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0036	-	Corrections to Rank information scrambling in Uplink Shared Channel	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0037	2	Clarification of TPC commands signaled in DCI formats 3/3A	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0038	-	Clarification on UE transmit antenna selection mask	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0039	1	Linking of control resources in PUSCH to data MCS	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0041	-	Definition of Bit Mapping for DCI signalling	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0042	1	Clarification on resource allocation in DCI format 1/2/2A	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0043	-	DCI Format 1A changes needed for scheduling Broadcast Control	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0044	-	DCI format1C	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0045	-	Miscellaneous corrections	8.3.0	8.4.0
11/09/08	RAN_41	RP-080736	0046	1	Correction on downlink multi-user MIMO	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0047	-	Corrections to DL DCI Formats In case of Ambiguous Payload Sizes	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0048	-	CR for RE provisioning for the control information in case of CQI-only transmission on PUSCH	8.3.0	8.4.0
09/09/08	RAN_41	RP-080669	0091	2	Coding and multiplexing of multiple ACK/NACK in PUSCH	8.3.0	8.4.0
03/12/08	RAN_42	RP-080983	0050	2	Clarification of input bits corresponding to 2-bit HARQ-ACK and 2-bit RI	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0053	-	Editorial corrections to 36.212	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0055	-	Miscellaneous Corrections	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0057	-	Clarification of mapping of information bits	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0058	-	Completion of 36.212 CR47 (R1-083421) for "new" DCI Formats	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0059	-	Change for determining DCI format 1A TBS table column indicator for broadcast control	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0061	2	Defining DCI format 1A for downlink data arrival	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0063	1	ACK/NACK transmission on PUSCH for LTE TDD	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0065	-	Correction in 36.212 related to TDD downlink HARQ processes	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0067	1	Correction of control MCS offset and SRS symbol puncturing	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0068	1	DCI format 2/2A	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0069	-	Correction to zero padding in DCI format 1	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0071	-	Clarification of RI bit field mapping for PUCCH	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0072	-	Clarifying RNTI bit mapping for PDCCH CRC scrambling	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0073	-	Clarification on BCH transport block size	8.4.0	8.5.0
03/12/08	RAN_42	RP-080983	0076	-	Clarification on the number of PUCCH-based CQI/PMI bits when reported on PUSCH	8.4.0	8.5.0
04/03/09	RAN_43	RP-090235	77	1	Corrections to Transmitted Rank Indication	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	79	1	Correction to the bundled ACK/NACK and DAI transmission	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	80	2	Corrections to transmission modes	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	81	1	Correction on ACKNACK transmission on PUSCH for LTE TDD	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	82	2	Corrections to CQI and RI fields description	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	83	-	Clarifying DCI format 1A and DCI Format 1B	8.5.0	8.6.0
04/03/09	RAN_43	RP-090235	92	1	Clarification on channel coding for UCI HARQ-ACK	8.5.0	8.6.0
27/05/09	RAN_44	RP-090528	87	-	Clarify some parameters for determining control resources on PUSCH	8.6.0	8.7.0
01/12/09	RAN_46	RP-091168	89	-	Clarification on bitwidth of RI	8.7.0	8.8.0
01/12/09	RAN_46	RP-091168	94	-	Correction to Channel interleaver for PUSCH RE Mapping	8.7.0	8.8.0
01/12/09	RAN_46	RP-091177	88	1	Editorial corrections to 36.212	8.8.0	9.0.0
01/12/09	RAN_46	RP-091257	95	1	Introduction of enhanced dual layer transmission	8.8.0	9.0.0
16/03/10	RAN_47	RP-100210	96	1	MCCH change notification using DCI format 1C	9.0.0	9.1.0
16/03/10	RAN_47	RP-100211	97	-	Addition of missing reference to DCI format 2B + typo corrections	9.0.0	9.1.0
01/06/10	RAN_48	RP-100589	98	-	Correction to TBS determination for DCI format 1C	9.1.0	9.2.0
14/09/10	RAN_49	RP-100899	99	-	Clarify soft buffer size determination for MCH	9.2.0	9.3.0
07/12/10	RAN_50	RP-101320	100	-	Introduction of Rel-10 LTE-Advanced features in 36.212	9.3.0	10.0.0
15/03/11	RAN_51	RP-110254	101	-	Correction on UE behavior upon receiving DCI format 1B	10.0.0	10.1.0
15/03/11	RAN_51	RP-110256	102	-	Corrections to Rel-10 LTE-Advanced features in 36.212	10.0.0	10.1.0
01/06/11	RAN_52	RP-110819	103	3	Correction of DCI format 0 and 4 resource allocation	10.1.0	10.2.0
01/06/11	RAN_52	RP-110819	104	2	Correction to Multi-cluster flag in DCI format 0	10.1.0	10.2.0
01/06/11	RAN_52	RP-110819	107	2	Corrections on HARQ-ACK Channel Coding in the PUSCH	10.1.0	10.2.0
01/06/11	RAN_52	RP-110820	108	3	A clarification for DCI format payload size	10.1.0	10.2.0
01/06/11	RAN_52	RP-110819	110	1	Correction the search space and RNTI for CQI and SRS request flag	10.1.0	10.2.0
01/06/11	RAN_52	RP-110819	111	-	Resource dimensioning for CQI only PUSCH transmission	10.1.0	10.2.0

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
01/06/11	RAN_52	RP-110820	112	1	Correction on bit representations of transport block processing for UL-SCH	10.1.0	10.2.0
01/06/11	RAN_52	RP-110818	113	-	Clarification on PMI indication in DCI format1B and format 2	10.1.0	10.2.0
01/06/11	RAN_52	RP-110820	114	1	Rate matching parameters for CA	10.1.0	10.2.0
01/06/11	RAN_52	RP-110819	116	-	HARQ-ACK on PUSCH for TDD with channel selection configured for 2 serving cells	10.1.0	10.2.0
01/06/11	RAN_52	RP-110823	117	-	Single codeword multiple layer transmission in uplink	10.1.0	10.2.0
15/09/11	RAN_53	RP-111228	119	1	Corrections on transport block processing for UL-SCH	10.2.0	10.3.0
15/09/11	RAN_53	RP-111230	120	2	On correction of channel coding of control information	10.2.0	10.3.0
15/09/11	RAN_53	RP-111230	122	1	Size adjustment of DCI format 0, 1A and 1	10.2.0	10.3.0
15/09/11	RAN_53	RP-111232	123	1	Corrections on Nsrs	10.2.0	10.3.0
15/09/11	RAN_53	RP-111232	124	2	Corrections on DCI format 1B/1D	10.2.0	10.3.0
15/09/11	RAN_53	RP-111228	125	-	Minor Correction on DCI Format 1 Description	10.2.0	10.3.0
15/09/11	RAN_53	RP-111226	127	-	Correction on ACK/NACK mapping	10.2.0	10.3.0
15/09/11	RAN_53	RP-111231	128	-	Corrections on channel coding of control information and DCI Format 4.	10.2.0	10.3.0
15/09/11	RAN_53	RP-111229	129	-	Clarification and correction to configuration signalling condition for channel quality information formats	10.2.0	10.3.0
05/12/11	RAN_54	RP-111667	130	1	Corrections on codebook index indication in DCI format 4	10.3.0	10.4.0
05/12/11	RAN_54	RP-111666	131	-	HARQ-ACK on UCI-only PUSCH without UL-SCH data	10.3.0	10.4.0
28/02/12	RAN_55	RP-120283	132	2	Corrections on payload size adjustment for DCI format 1A and 1	10.4.0	10.5.0
28/02/12	RAN_55	RP-120283	133	1	Correction of two HARQ-ACK feedback on PUSCH	10.4.0	10.5.0
28/02/12	RAN_55	RP-120285	134	1	Miscellaneous corrections	10.4.0	10.5.0
13/06/12	RAN_56	RP-120739	136	-	Correction to Data and control multiplexing	10.5.0	10.6.0
13/06/12	RAN_56	RP-120737	138	-	Correction to CSI request field size in DCI format 0 and DCI format 4	10.5.0	10.6.0
04/09/12	RAN_57	RP-121272	139	-	Introduction of Rel-11 LTE-Advanced features in 36.212	10.6.0	11.0.0
04/12/12	RAN_58	RP-121839	143	-	Correction to the parameter ue-Category-v10xy	11.0.0	11.1.0
04/12/12	RAN_58	RP-121846	144	-	Finalisation for introducing Rel-11 features	11.0.0	11.1.0
26/02/13	RAN_59	RP-130255	145	-	Additional clarifications/corrections for introducing Rel-11 features	11.1.0	11.2.0
11/06/13	RAN_60	RP-130751	147	2	Correction on the RI bit width	11.2.0	11.3.0
11/06/13	RAN_60	RP-130747	148	-	CR on DCI Format 4 payload size	11.2.0	11.3.0
11/06/13	RAN_60	RP-130752	149	-	Correction on the time span of the DCI	11.2.0	11.3.0
11/06/13	RAN_60	RP-130752	150	-	Correction on ARO bit setting for DL DCIs carried by EPDCCH	11.2.0	11.3.0
11/06/13	RAN_60	RP-130750	151	-	Clarification on DL DAI usage in inter-band TDD CA	11.2.0	11.3.0
11/06/13	RAN_60	RP-130749	153	-	Correction to bit padding of DCI format 1A for secondary cell without uplink component carrier	11.2.0	11.3.0
03/12/13	RAN_62	RP-131893	155	1	Correction on parameter ue-Category	11.3.0	11.4.0
03/12/13	RAN_62	RP-131896	154	3	Introduction of Rel 12 feature for Downlink MIMO Enhancement	11.4.0	12.0.0
10/06/14	RAN_64	RP-140858	156	-	Clarification on UE antenna port based CRC masking	12.0.0	12.1.0
10/06/14	RAN_64	RP-140859	157	1	Correction on UCI multiplexing on PUSCH	12.0.0	12.1.0
10/06/14	RAN_64	RP-140862	158	-	Introduction of Rel 12 features of TDD-FDD CA and eIMTA	12.0.0	12.1.0
10/06/14	RAN_64	RP-140858	159	-	Clarification of downlink subframes	12.0.0	12.1.0
10/09/14	RAN_65	RP-141485	161	-	CR for 36.212 on 256QAM and LC-MTC	12.1.0	12.2.0
08/12/14	RAN_66	RP-142106	163	3	CR for 36.212 on 256QAM and LC-MTC	12.2.0	12.3.0
08/12/14	RAN_66	RP-142098	164	3	Clarification of PUSCH rate matching with SRS	12.2.0	12.3.0
08/12/14	RAN_66	RP-142107	166	-	Introduction of Dual Connectivity feature into 36.212	12.2.0	12.3.0
09/03/15	RAN_67	RP-150366	162	3	Introduction of D2D feature into 36.212	12.3.0	12.4.0
15/06/15	RAN_68	RP-150936	169	-	Corrections on eIMTA RRC parameter naming	12.4.0	12.5.0
15/06/15	RAN_68	RP-150937	171	1	Correction for 36.212 on soft buffer assumption	12.4.0	12.5.0
14/09/15	RAN_69	RP-151466	174	1	Introducing 4-layer MIMO transmission in TM3 and TM4	12.5.0	12.6.0
14/09/15	RAN_69	RP-151467	175	2	Introduction of MIMO capability signalling for intra-band contiguous CA	12.5.0	12.6.0
07/12/15	RAN_70	RP-152038	177	-	Correction on rank indication bit widths	12.6.0	12.7.0
07/12/15	RAN_70	RP-152027	178	1	Introduction of Rel 13 feature of eCA	12.7.0	13.0.0
07/12/15	RAN_70	RP-152025	179	1	Introduction of EB/FD-MIMO	12.7.0	13.0.0
07/12/15	RAN_70	RP-152026	180	2	Introduction of Rel 13 feature of LAA	12.7.0	13.0.0
07/12/15	RAN_70	RP-152031	182	-	Introduction of Rel 13 features for SC-PTM	12.7.0	13.0.0