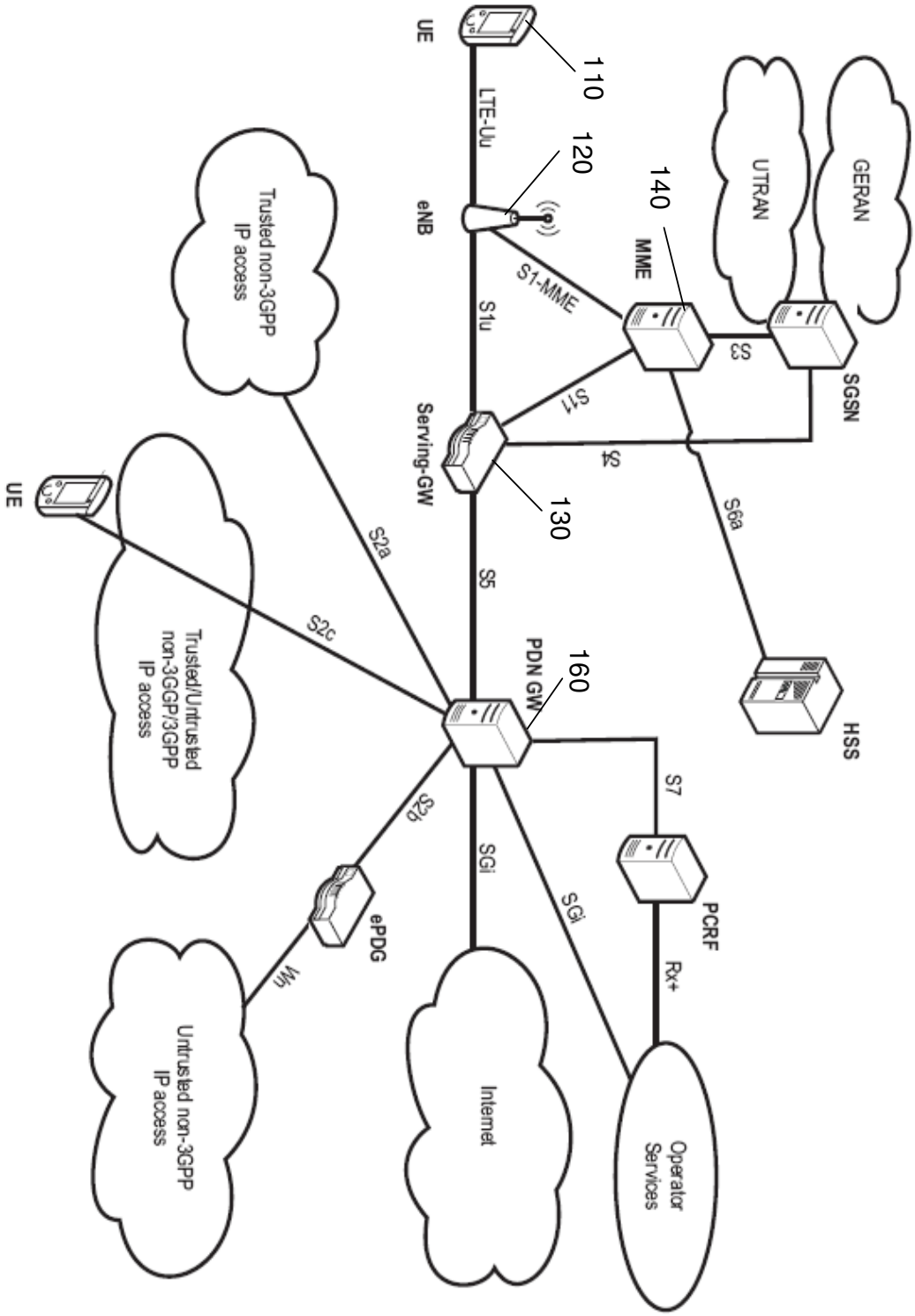
UE
110
LTE-Uu
eNB
120
S1-MME
S1u
MME
140
S3
GERAN
UTRAN
SGSN
S11
S4
Serving-GW
130
S5
S6a
HSS
PDN GW
160
S7
PCRF
Rx+
Operator Services
SGi
Internet
S2b
ePDG
Wn
Untrusted non-3GPP IP access
S2a
Trusted non-3GPP IP access
S2c
UE
Trusted/Untrusted non-3GPP/3GPP IP access

Fig. 1

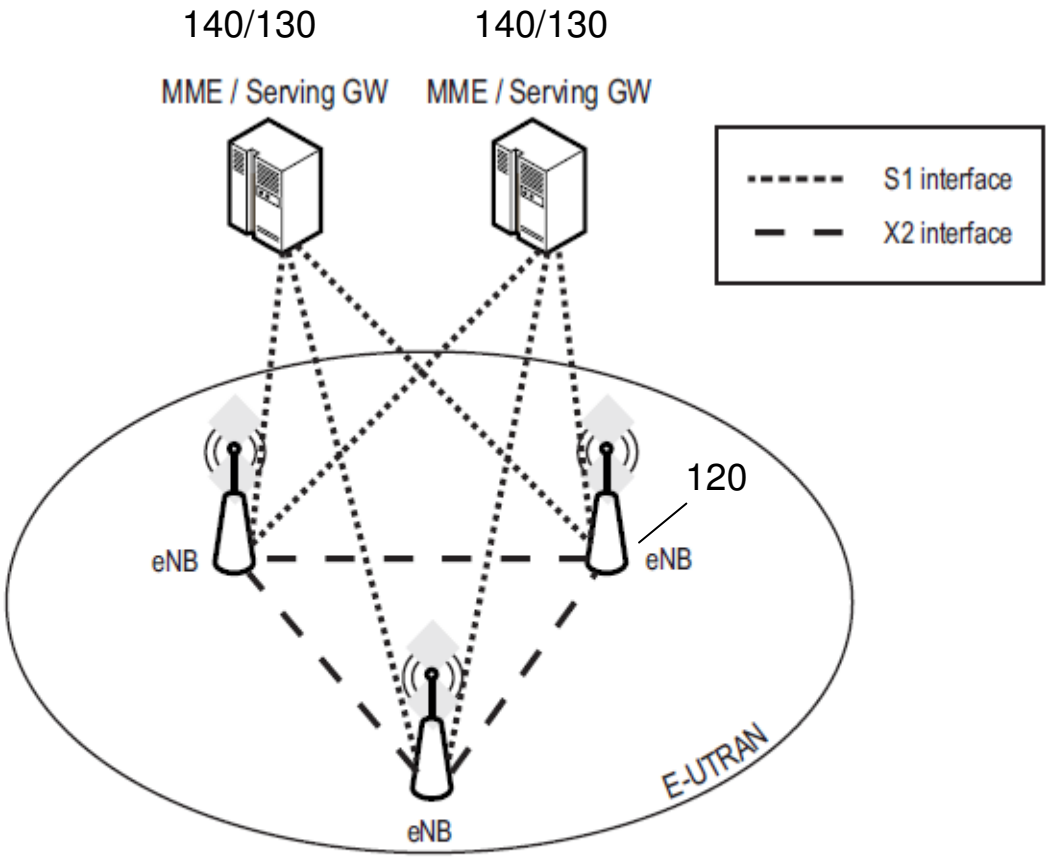
140/130
140/130
MME / Serving GW
MME / Serving GW
S1 interface
X2 interface
120
eNB
eNB
eNB
E-UTRAN

Fig. 2

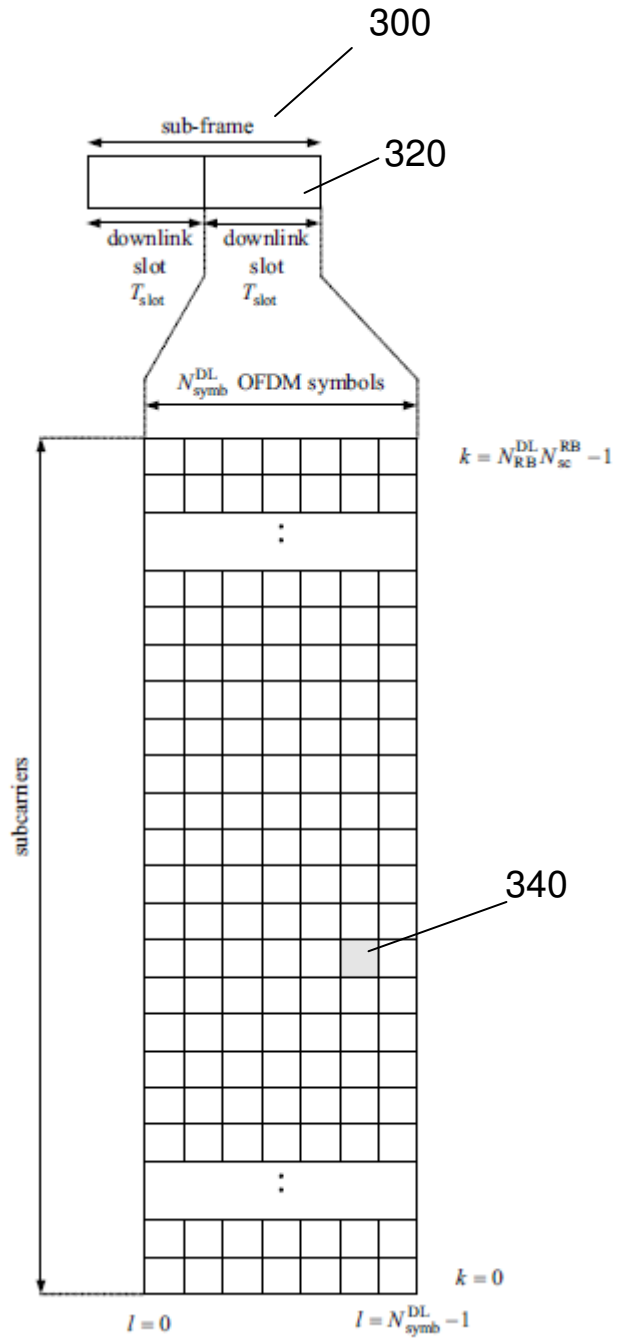
300
sub-frame
320
downlink slot T_{slot}
downlink slot T_{slot}
N_{symb}^{DL} OFDM symbols
$k = N_{RB}^{DL} N_{sc}^{RB} - 1$
subcarriers
340
$k = 0$
$l = 0$
$l = N_{symb}^{DL} - 1$

Fig. 3

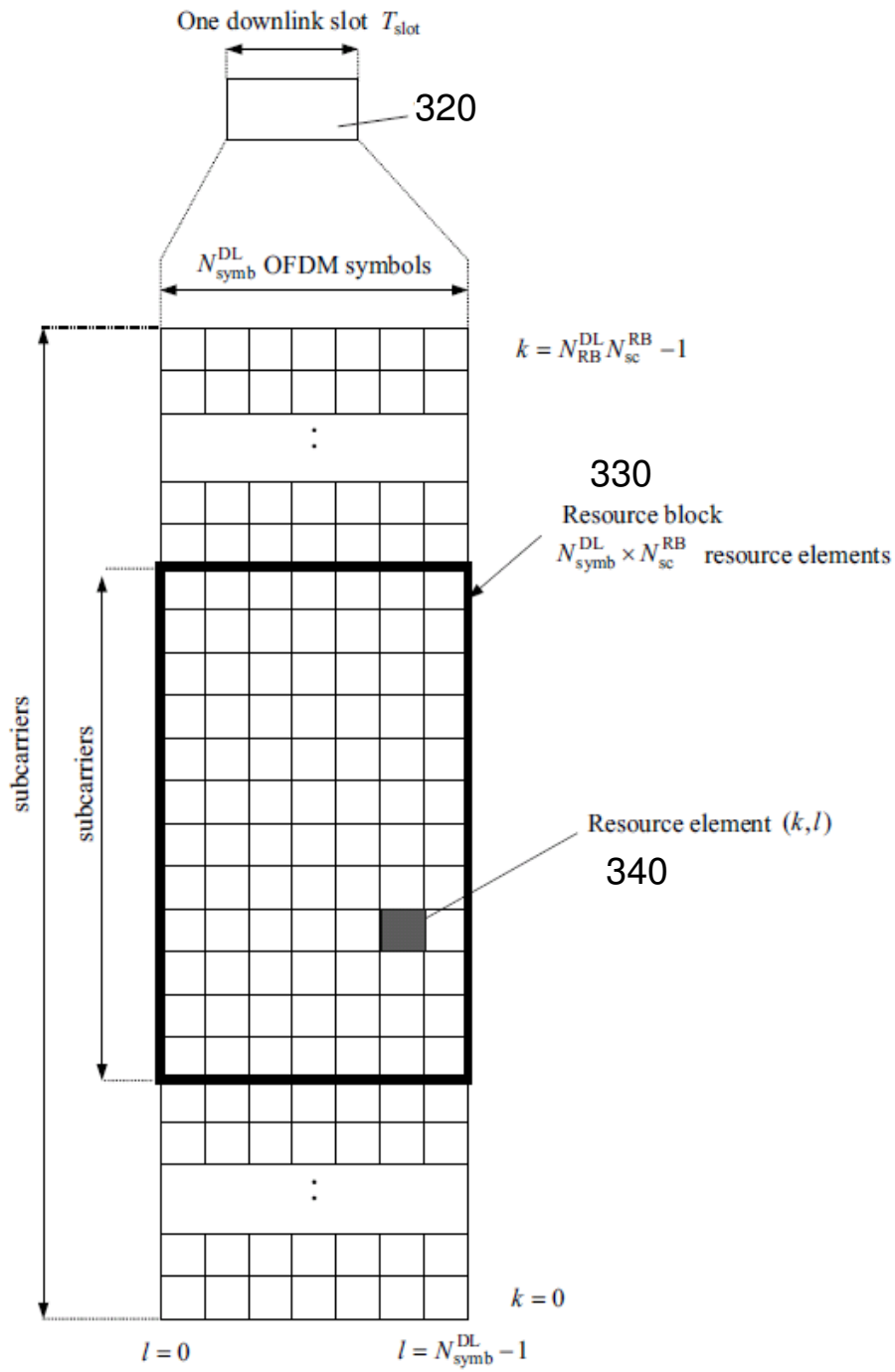
One downlink slot T_{slot}
320
N_{symb}^{DL} OFDM symbols
$k = N_{RB}^{DL} N_{sc}^{RB} - 1$
330
Resource block
$N_{symb}^{DL} \times N_{sc}^{RB}$ resource elements
subcarriers
subcarriers
Resource element (k,l)
340
$k = 0$
$l = 0$
$l = N_{symb}^{DL} - 1$

Fig. 4

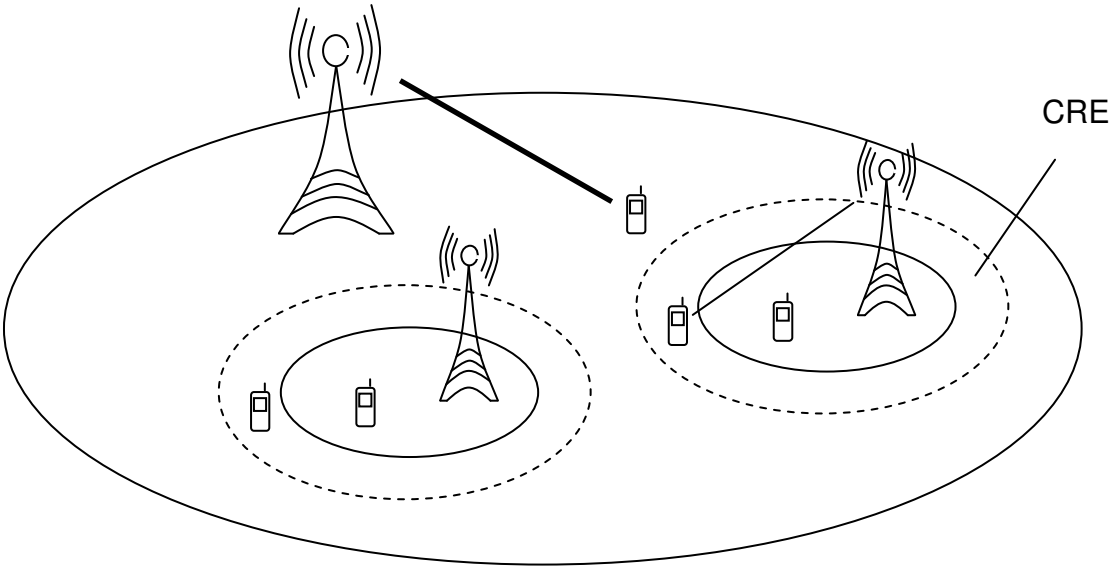
CRE

Fig. 5A

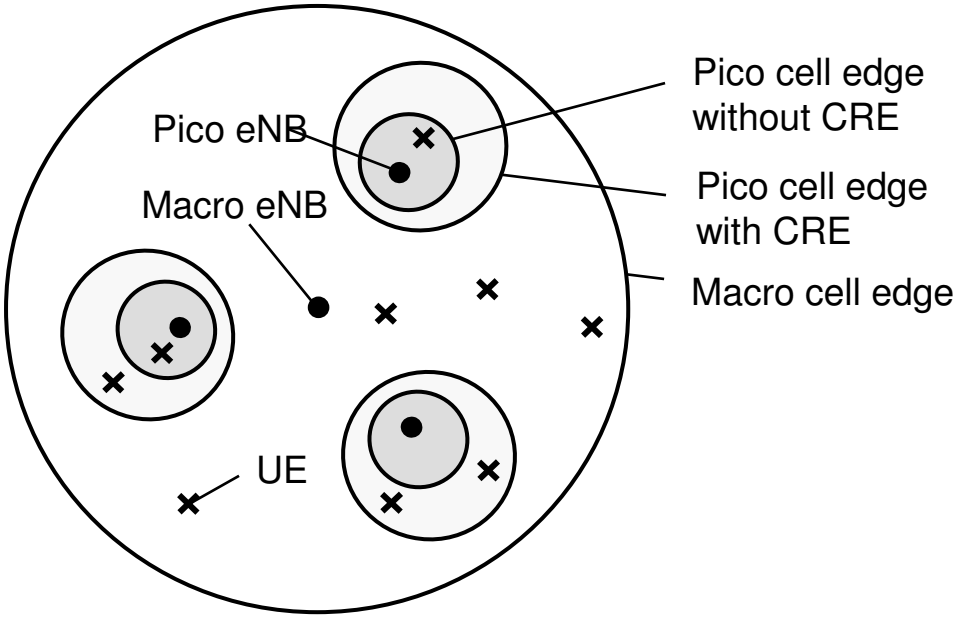
Pico eNB
Macro eNB
UE
Pico cell edge without CRE
Pico cell edge with CRE
Macro cell edge

Fig. 5B

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

Fig. 6

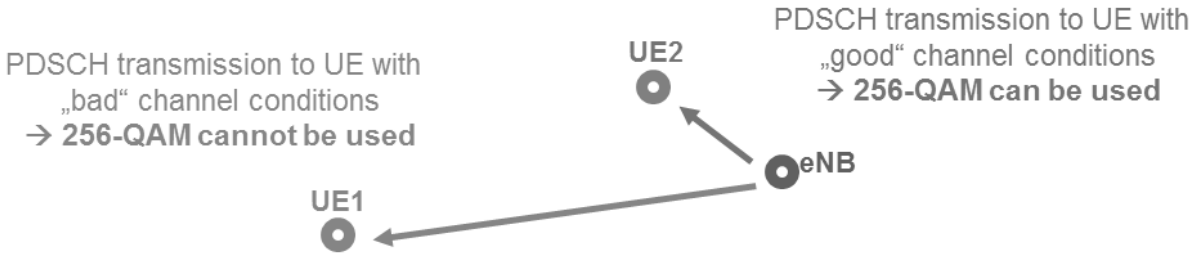
PDSCH transmission to UE with
„bad“ channel conditions
→ 256-QAM cannot be used
UE2
PDSCH transmission to UE with
„good“ channel conditions
→ 256-QAM can be used
eNB
UE1

Fig. 7

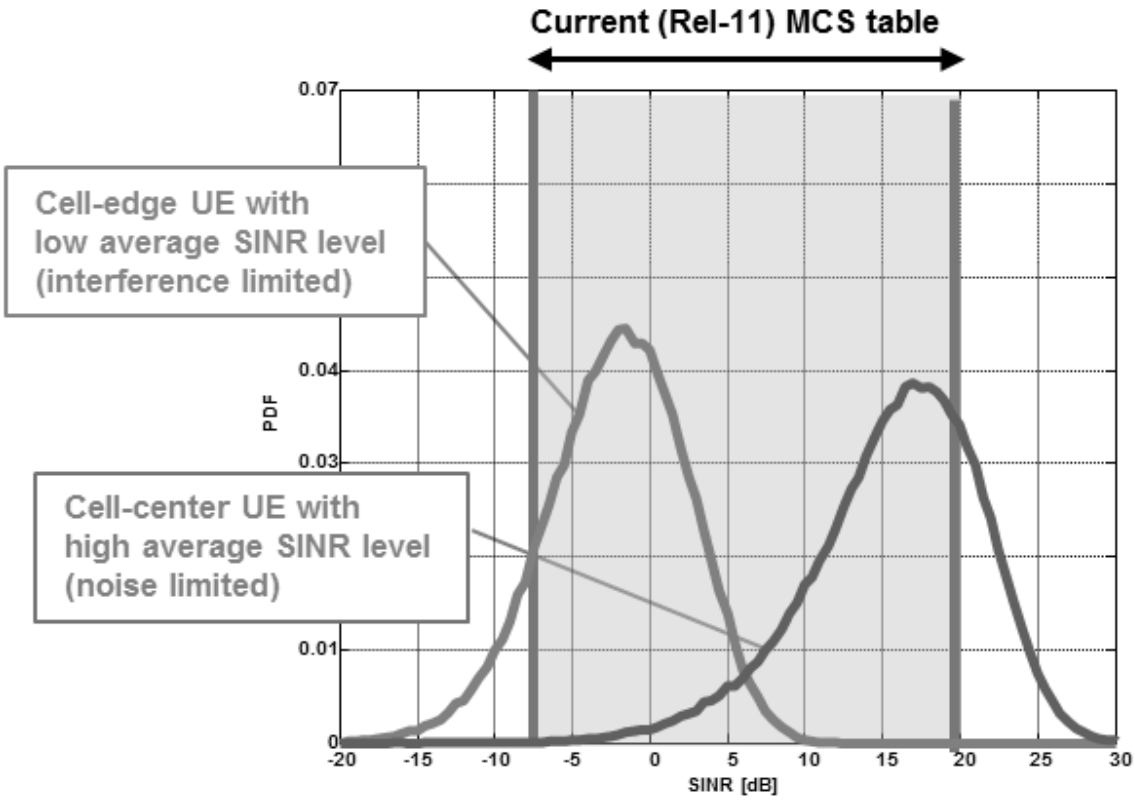
Current (Rel-11) MCS table
Cell-edge UE with
low average SINR level
(interference limited)
Cell-center UE with
high average SINR level
(noise limited)
PDF
0.07
0.04
0.03
0.01
0
-20
-15
-10
-5
0
5
10
15
20
25
30
SINR [dB]

Fig. 8

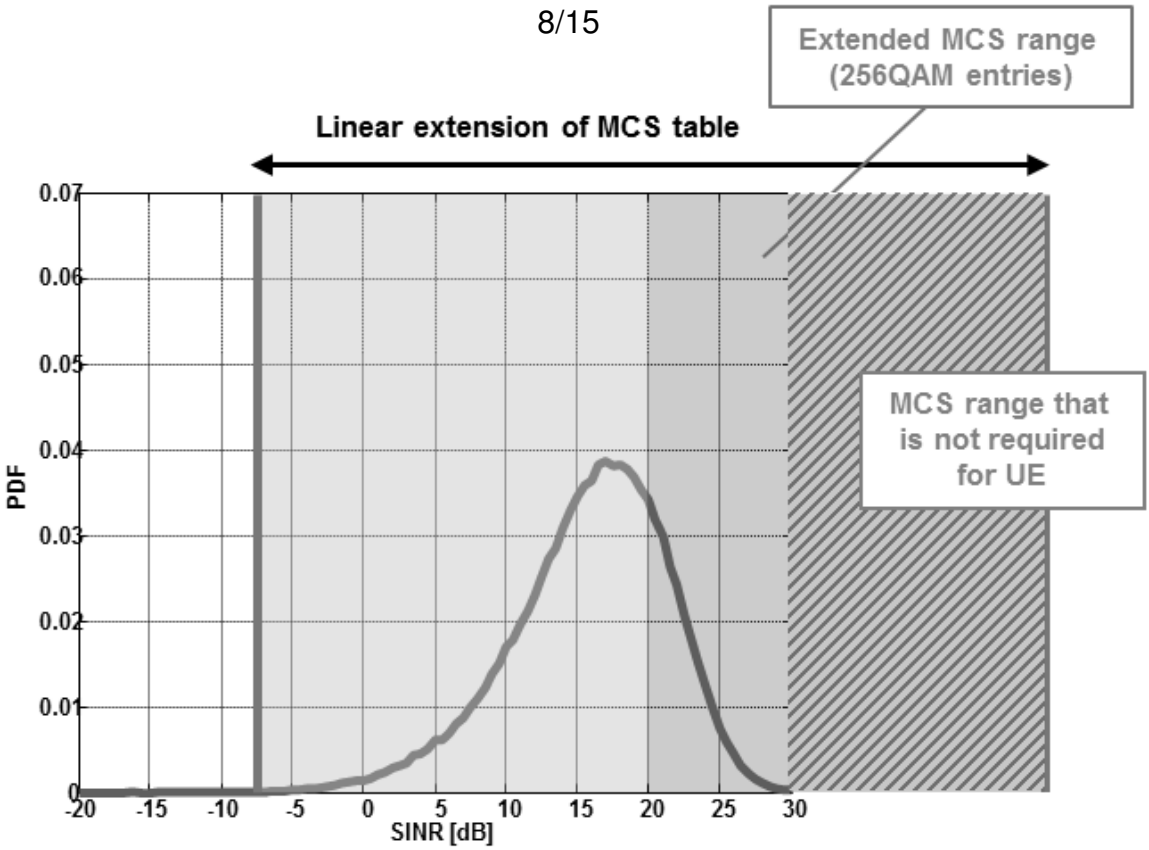
Extended MCS range
(256QAM entries)
Linear extension of MCS table
MCS range that
is not required
for UE
PDF
SINR [dB]
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-20
-15
-10
-5
0
5
10
15
20
25
30

Fig. 9

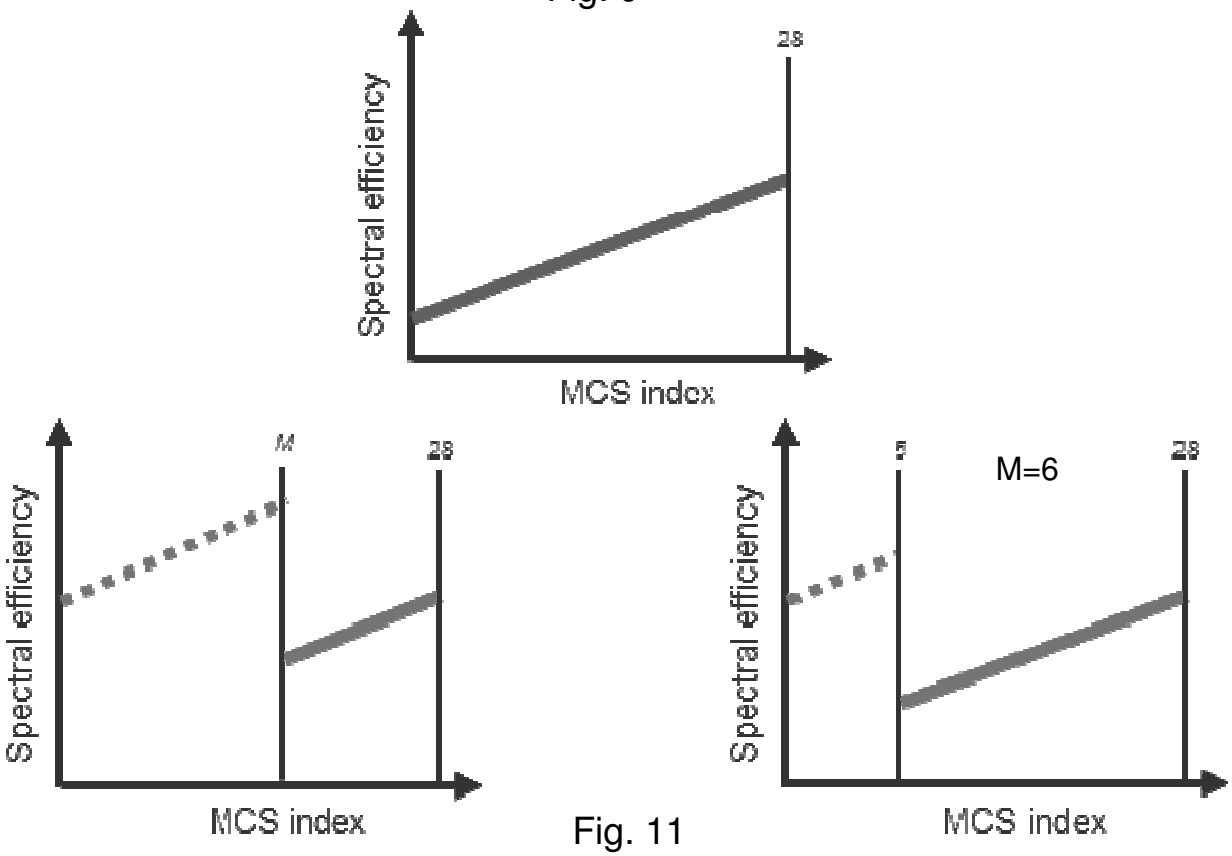
Spectral efficiency
MCS index
28
M
28
M=6
5
28

Fig. 11

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

Fig. 10A

MCS Index	Modulation Order	TBS Index
0	8	26
1	8	27
2	8	28
3	8	29
4	8	30
5	8	31
6	8	32
7	8	33
8	8	34
9	8	35
10	8	36
11	8	37
12	8	38
13	8	39
14	8	40
15	8	41
16	8	42
17	8	43
18	4	16
19	4	17
20	4	18
21	4	19
22	4	20
23	6	21
24	6	22
25	6	23
26	6	24
27	6	25
28	6	26
29	2	Reserved
30	4	
31	6	

Fig. 10B

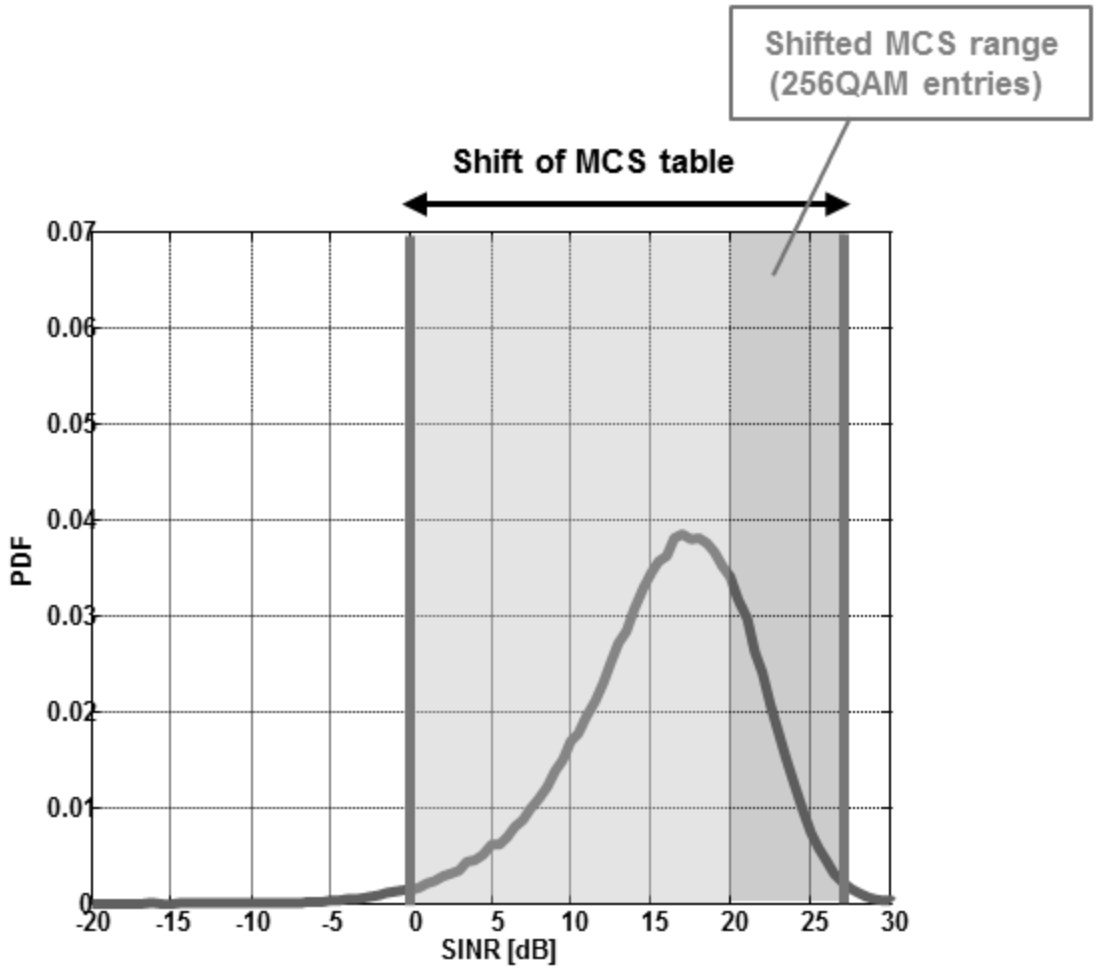
Shifted MCS range
(256QAM entries)
Shift of MCS table
PDF
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-20
-15
-10
-5
0
5
10
15
20
25
30
SINR [dB]

Fig. 12

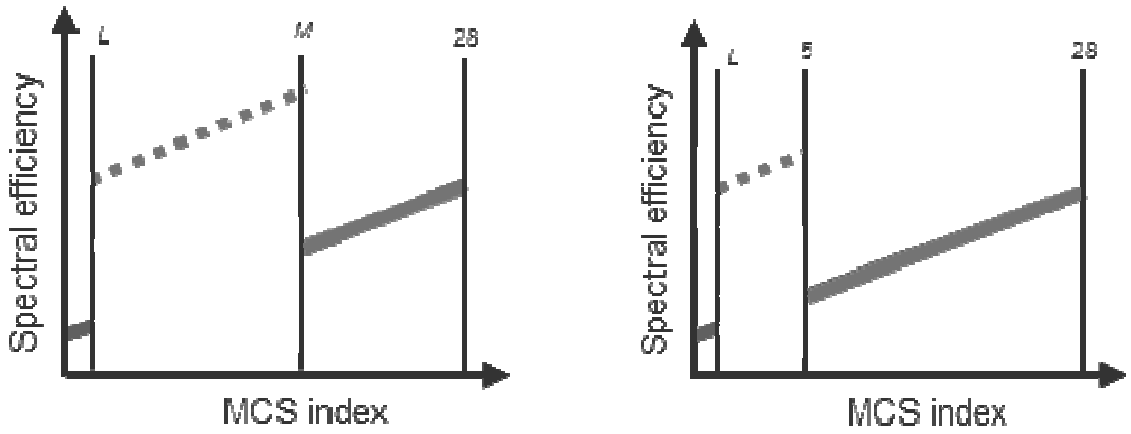
Spectral efficiency
MCS index
Spectral efficiency
MCS index

Fig. 14

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

Fig. 13A

MCS Index	Modulation Order	TBS Index
0	2	0
1	2	1
2	8	26
3	8	27
4	8	28
5	8	29
6	8	30
7	8	31
8	8	32
9	8	33
10	8	34
11	8	35
12	8	36
13	8	37
14	8	38
15	8	39
16	8	40
17	8	41
18	4	16
19	4	17
20	4	18
21	4	19
22	4	20
23	6	21
24	6	22
25	6	23
26	6	24
27	6	25
28	6	26
29	2	Reserved
30	4	
31	6	

Fig. 13B

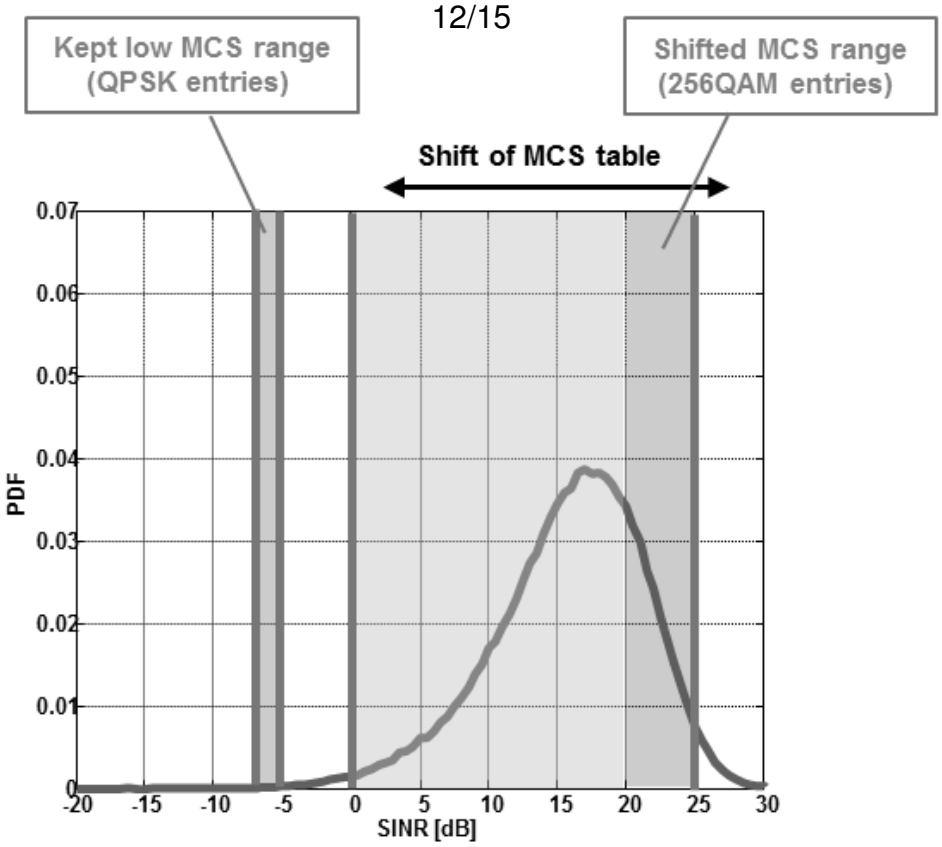
Kept low MCS range
(QPSK entries)
Shifted MCS range
(256QAM entries)
Shift of MCS table
PDF
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-20
-15
-10
-5
0
5
10
15
20
25
30
SINR [dB]

Fig. 15

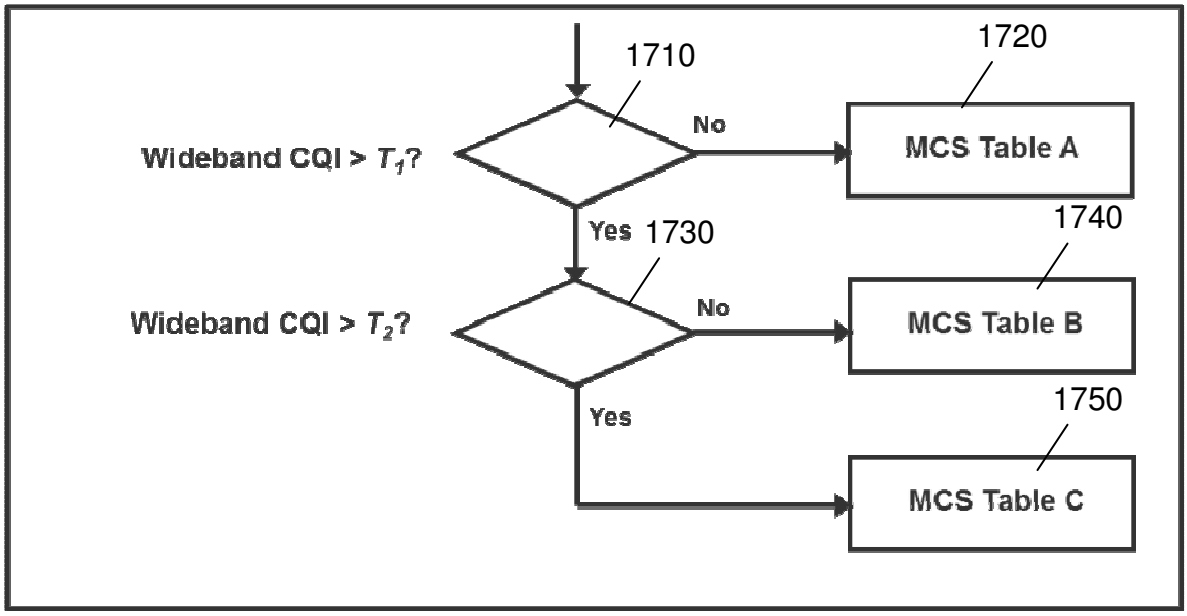
1710
1720
Wideband CQI > T_1?
No
MCS Table A
Yes
1730
1740
Wideband CQI > T_2?
No
MCS Table B
Yes
1750
MCS Table C

Fig. 17

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

Fig. 16A

MCS Index	Modulation Order	TBS Index
0	8	reserved
1	8	26
2	8	27
3	8	28
4	8	29
5	8	30
6	8	31
7	8	32
8	8	33
9	8	34
10	8	35
11	8	36
12	8	37
13	8	38
14	8	39
15	8	40
16	8	41
17	8	42
18	4	16
19	4	17
20	4	18
21	4	19
22	4	20
23	6	21
24	6	22
25	6	23
26	6	24
27	6	25
28	6	26
29	2	Reserved
30	4	
31	6	

Fig. 16B

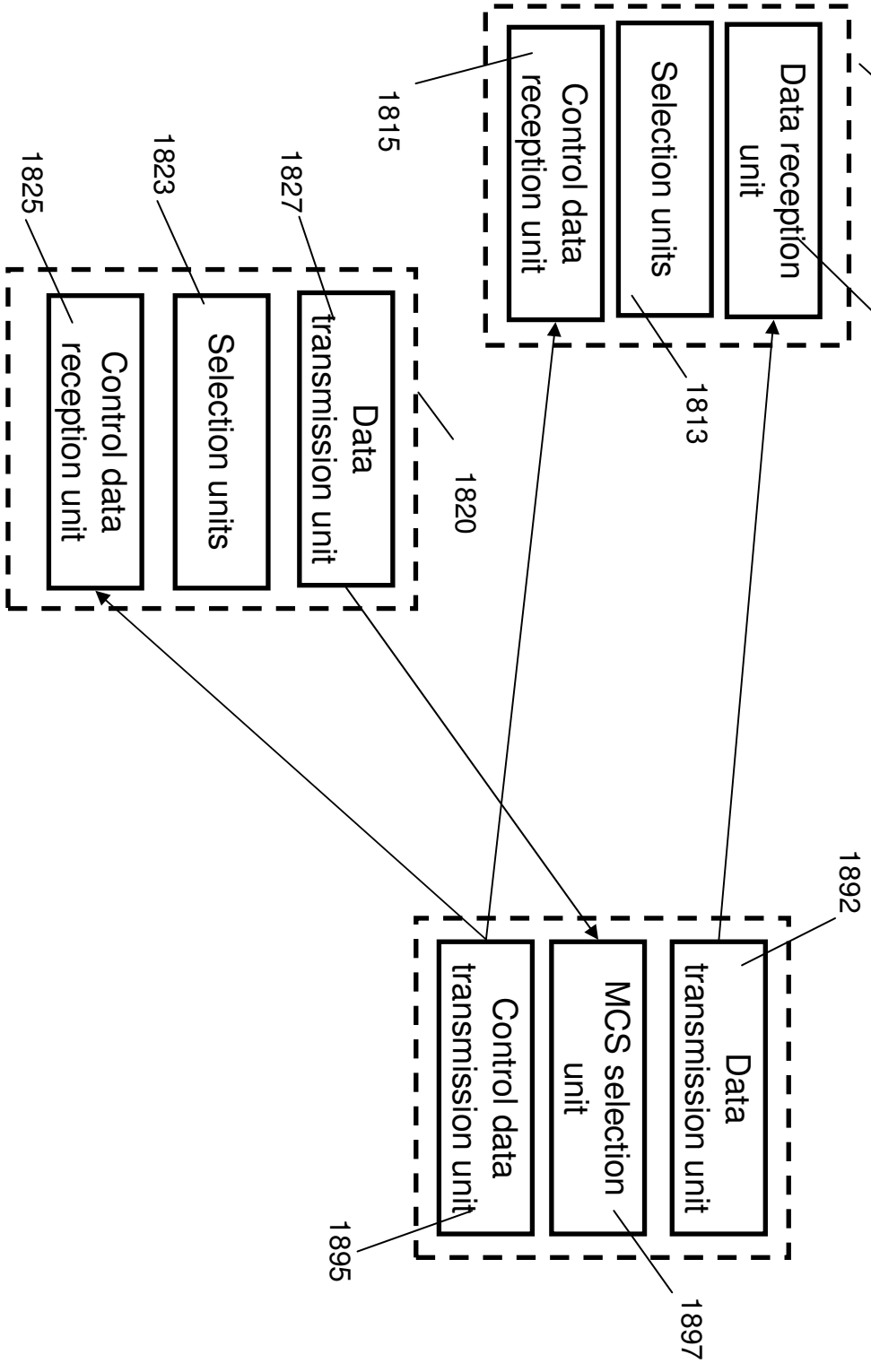
1810
Data reception unit
1812
Selection units
1813
Control data reception unit
1815
1820
Data transmission unit
1827
Selection units
1823
Control data reception unit
1825
1892
Data transmission unit
MCS selection unit
1897
Control data transmission unit
1895

Fig. 18

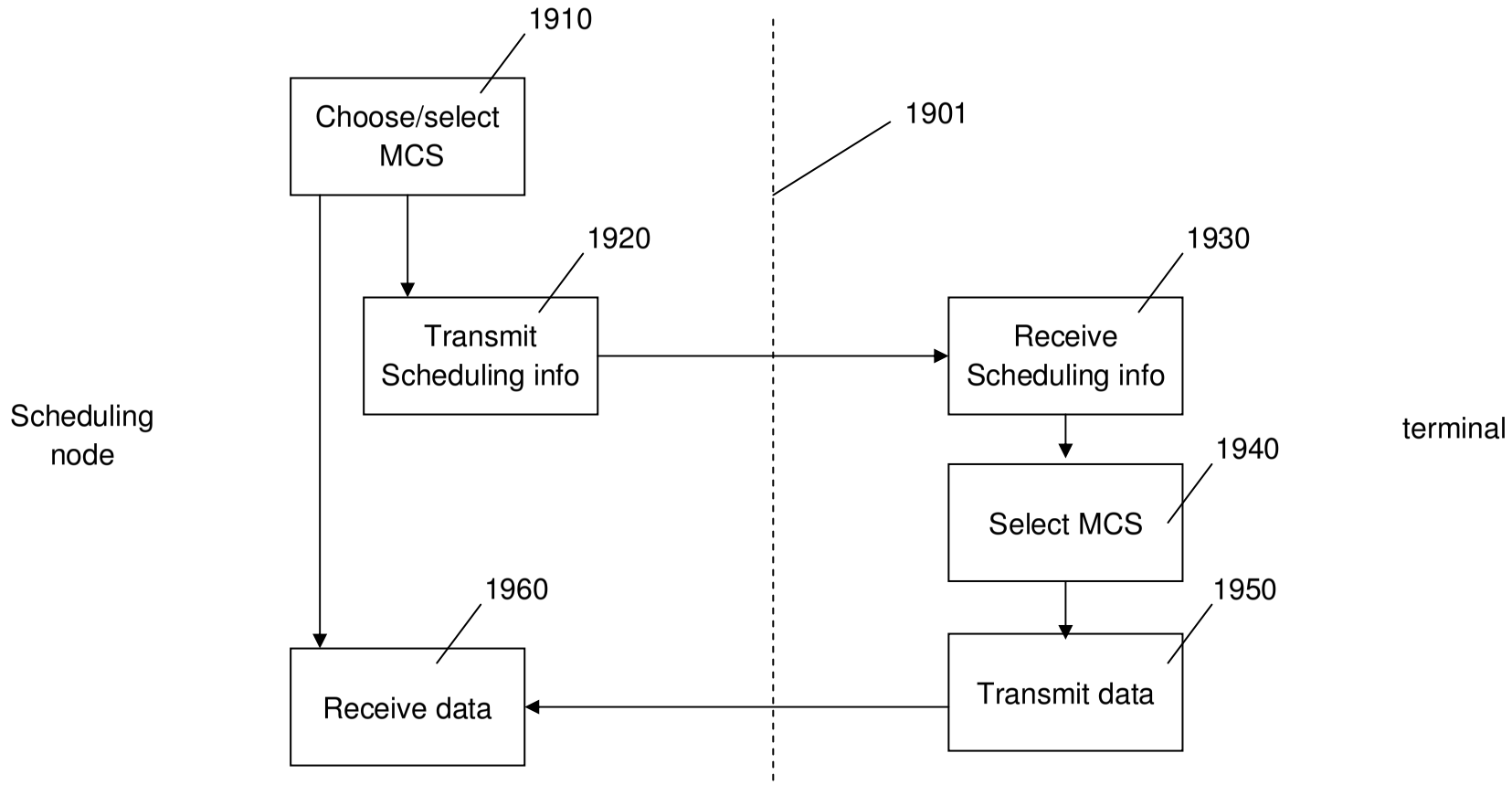
Scheduling node
terminal
1910
Choose/select MCS
1901
1920
Transmit Scheduling info
1930
Receive Scheduling info
1940
Select MCS
1960
Receive data
1950
Transmit data

Fig. 19