FIG. 1

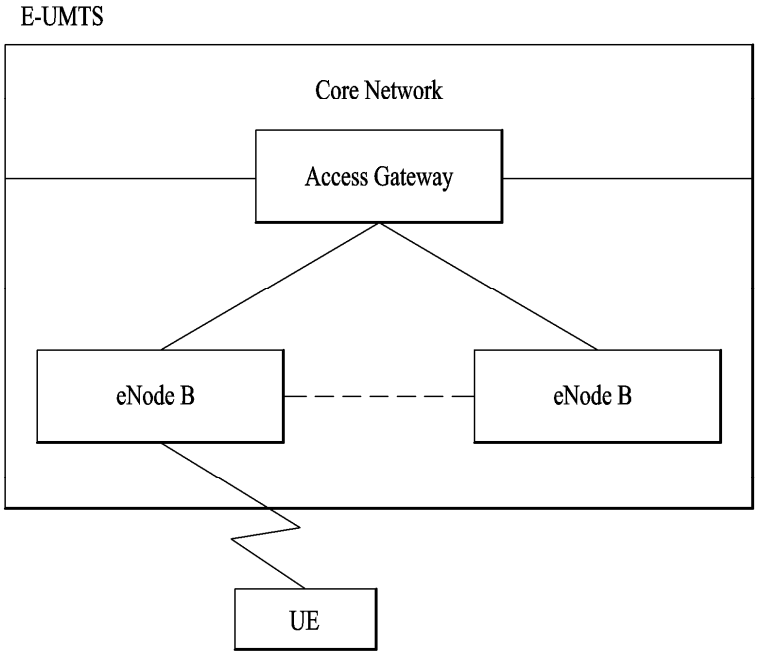
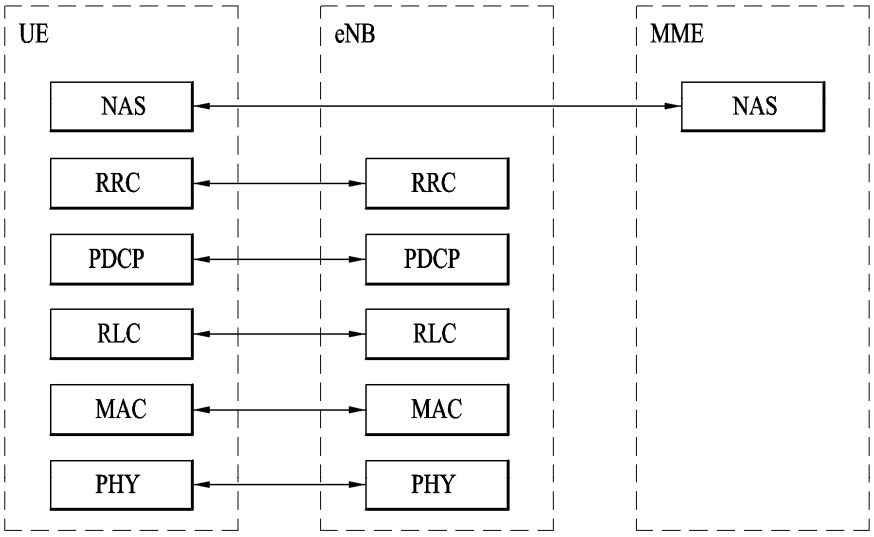
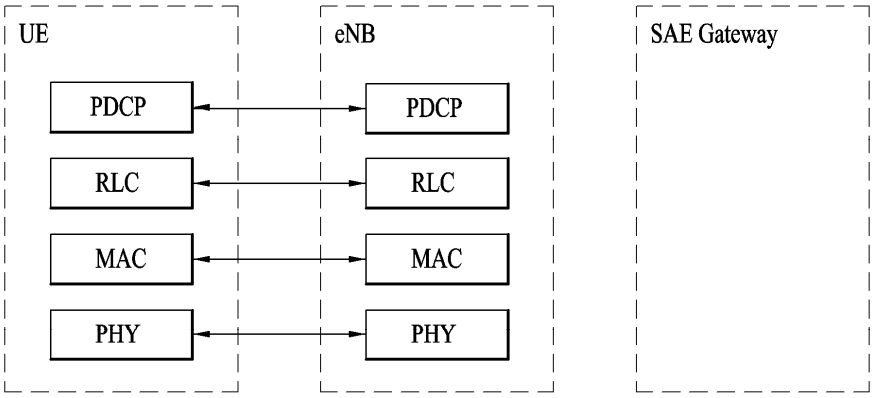


FIG. 2



(a) Control-Plane Protocol Stack



(b) User-Plane Protocol Stack

FIG. 3

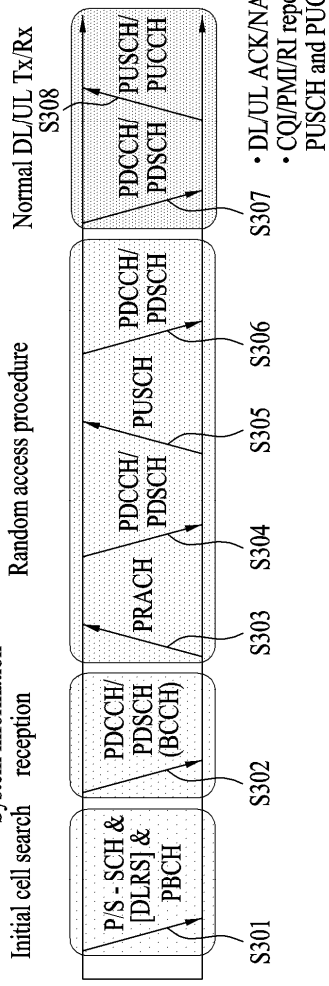

Initial cell search
System information reception
Random access procedure
Normal DL/UL Tx/Rx
S308
P/S - SCH & [DLRS] & PBCH
PDCCH/ PDSCH (BCCH)
PRACH
PDCCH/ PDSCH
PUSCH
PDCCH/ PDSCH
PDCCH/ PDSCH
PUSCH/ PUCCH
S301
S302
S303
S304
S305
S306
S307
• DL/UL ACK/NACK
• CQI/PMI/RI reporting of UE using PUSCH and PUCCH

FIG. 4

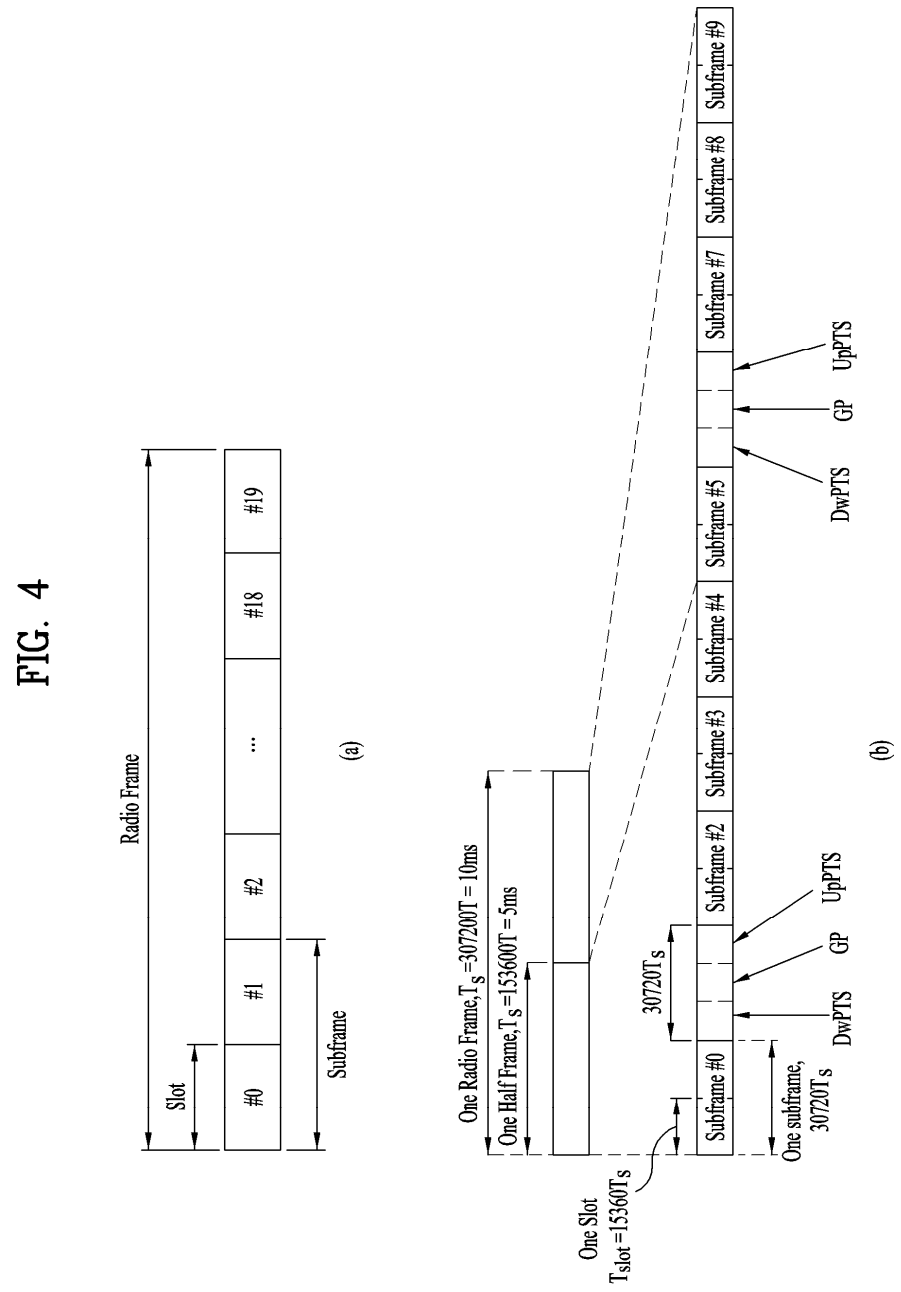

Radio Frame
Slot
#0
#1
#2
...
#18
#19
Subframe
(a)
One Radio Frame, T_S =307200T = 10ms
One Half Frame, T_S =153600T = 5ms
One Slot
T_{slot} =15360T_S
30720T_S
One subframe,
30720T_S
Subframe #0
Subframe #2
Subframe #3
Subframe #4
Subframe #5
Subframe #7
Subframe #8
Subframe #9
DwPTS
GP
UpPTS
DwPTS
GP
UpPTS
(b)

FIG. 5

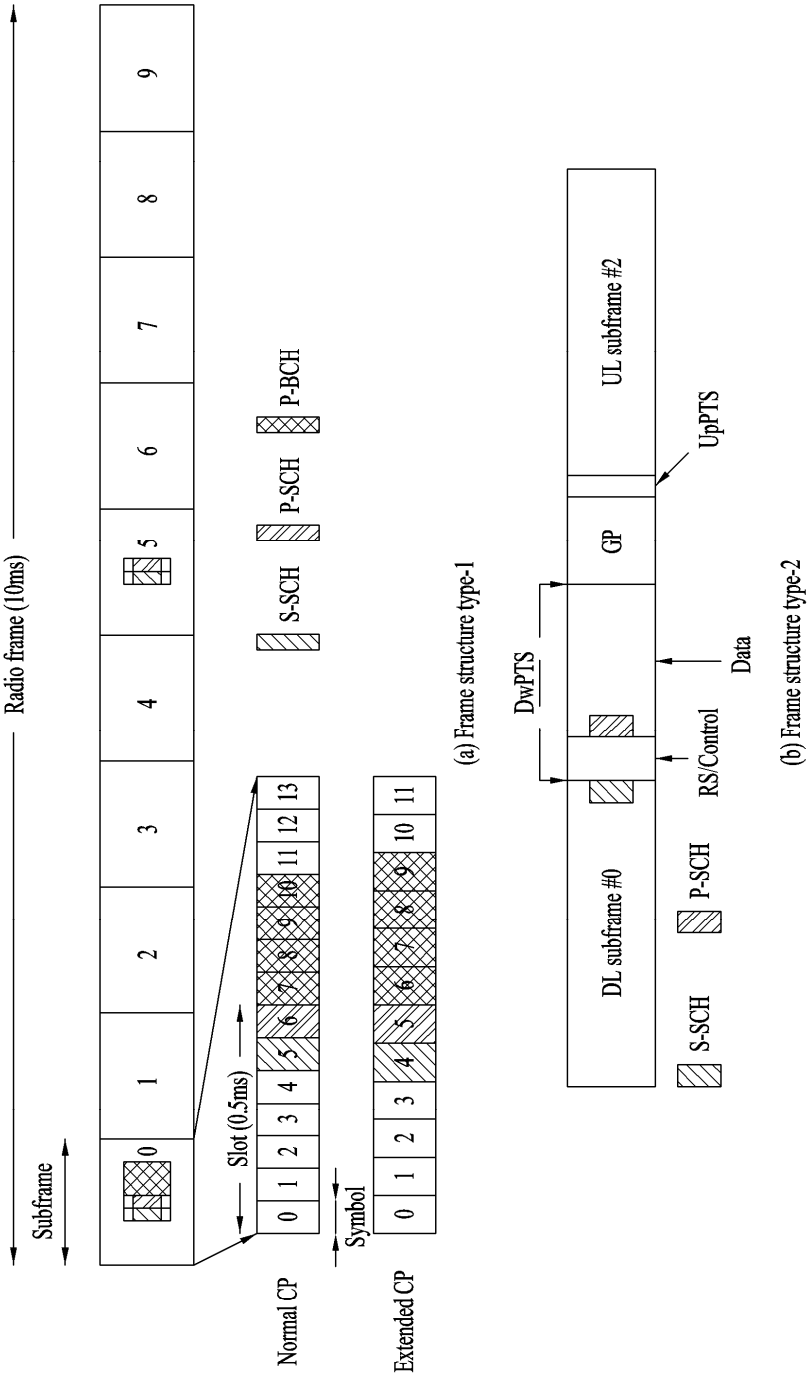

Radio frame (10ms)
Subframe
0
1
2
3
4
5
6
7
8
9
S-SCH
P-SCH
P-BCH
Slot (0.5ms)
Symbol
Normal CP
Extended CP
(a) Frame structure type-1
DwPTS
GP
UpPTS
UL subframe #2
DL subframe #0
S-SCH
P-SCH
RS/Control
Data
(b) Frame structure type-2

FIG. 6

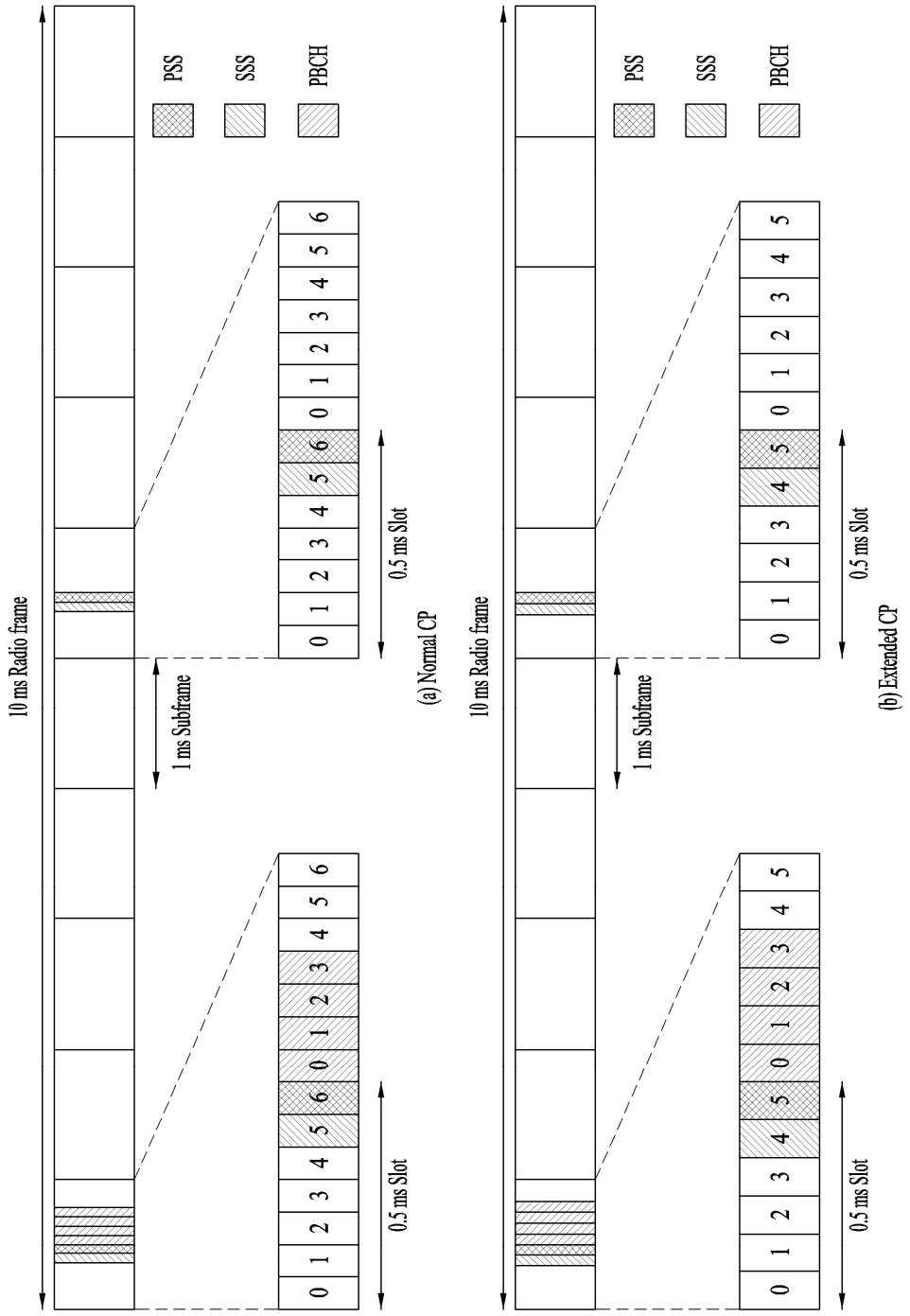

10 ms Radio frame
PSS
SSS
PBCH
1 ms Subframe
0.5 ms Slot
0 1 2 3 4 5 6
(a) Normal CP
10 ms Radio frame
PSS
SSS
PBCH
1 ms Subframe
0.5 ms Slot
0 1 2 3 4 5
(b) Extended CP

FIG. 7

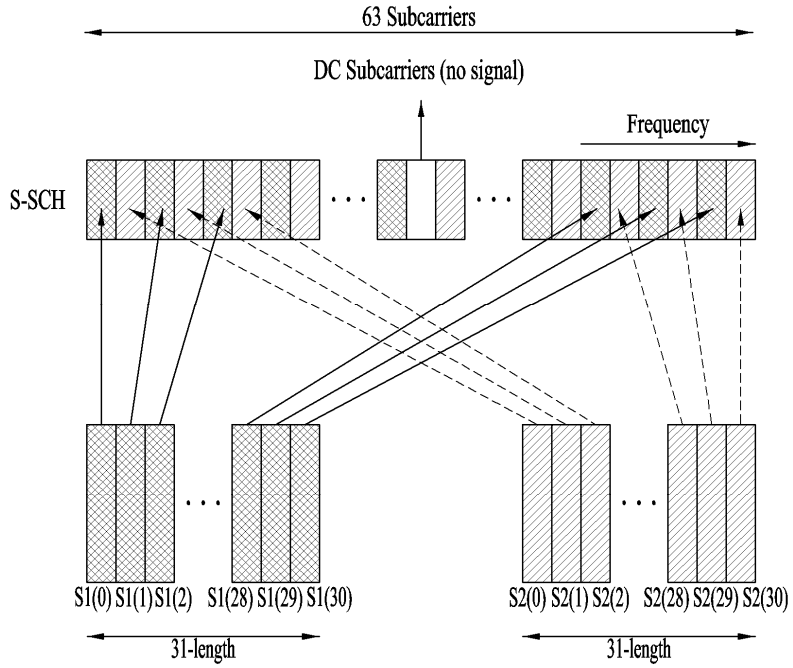

63 Subcarriers
DC Subcarriers (no signal)
Frequency
S-SCH
S1(0) S1(1) S1(2) S1(28) S1(29) S1(30)
S2(0) S2(1) S2(2) S2(28) S2(29) S2(30)
31-length
31-length

FIG. 8

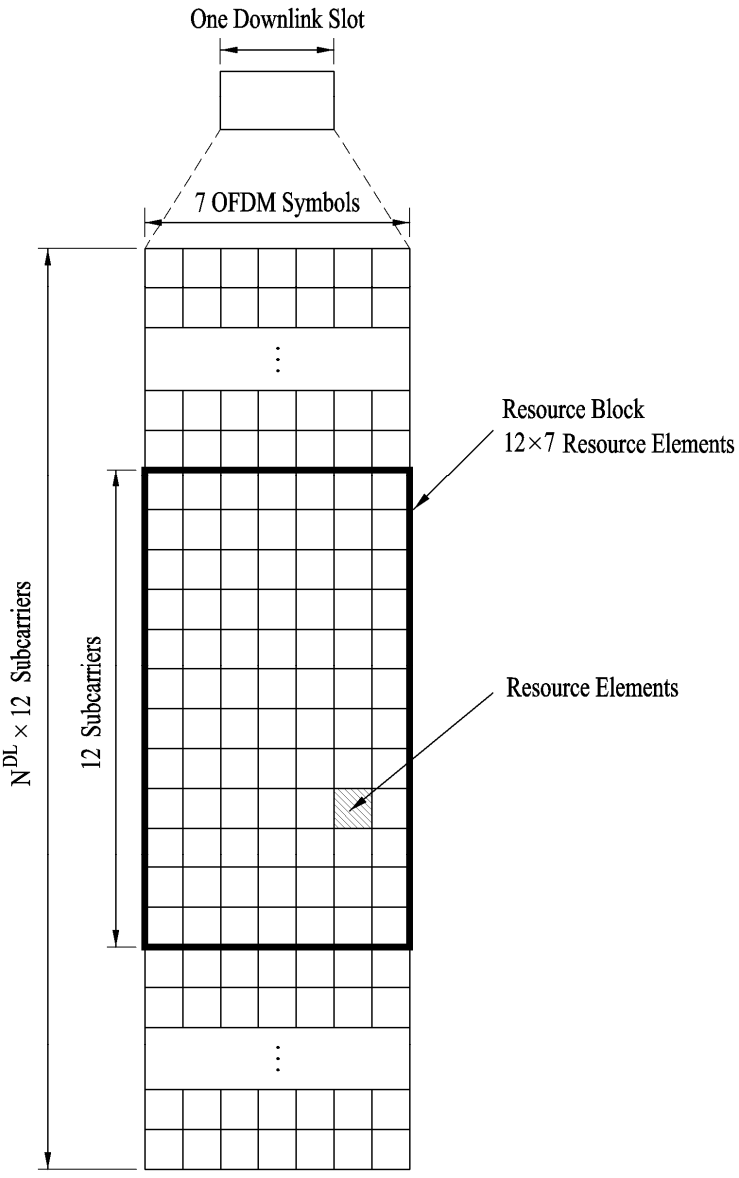

One Downlink Slot
7 OFDM Symbols
Resource Block
12×7 Resource Elements
Resource Elements
$N^{DL} \times 12$ Subcarriers
12 Subcarriers

FIG. 9

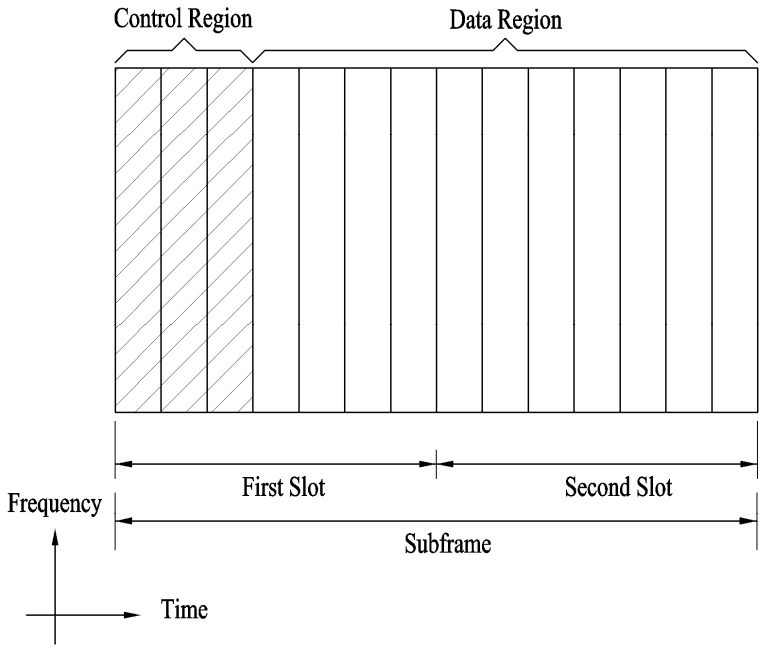

Control Region
Data Region
First Slot
Second Slot
Frequency
Subframe
Time

FIG. 10

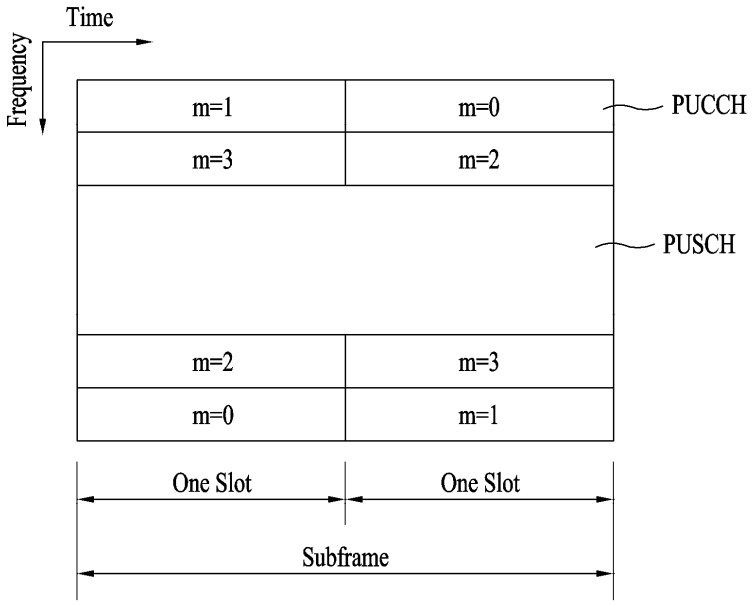

Time
Frequency
m=1
m=0
PUCCH
m=3
m=2
PUSCH
m=2
m=3
m=0
m=1
One Slot
One Slot
Subframe

FIG. 11

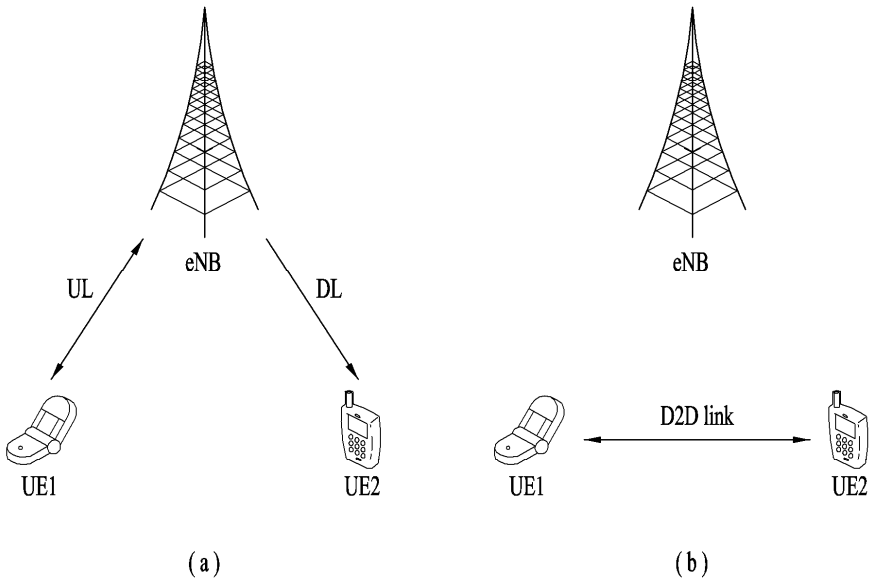

eNB
UL
DL
UE1
UE2
(a)
eNB
D2D link
UE1
UE2
(b)

FIG. 12

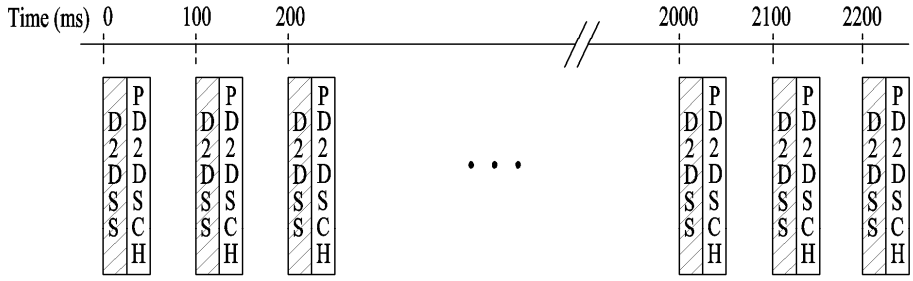

Time (ms)
0
100
200
2000
2100
2200
D2DSS
PD2DSCH

FIG. 13

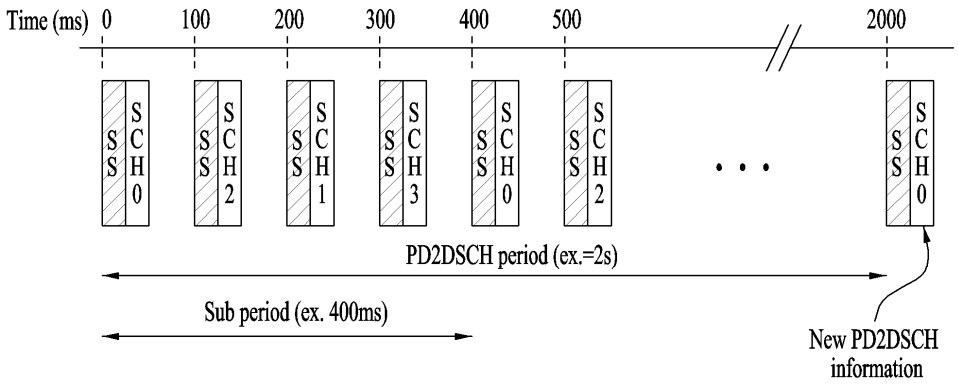

Time (ms)
0
100
200
300
400
500
2000
SS
SCH0
SS
SCH2
SS
SCH1
SS
SCH3
SS
SCH0
SS
SCH2
SS
SCH0
PD2DSCH period (ex.=2s)
Sub period (ex. 400ms)
New PD2DSCH information

FIG. 14

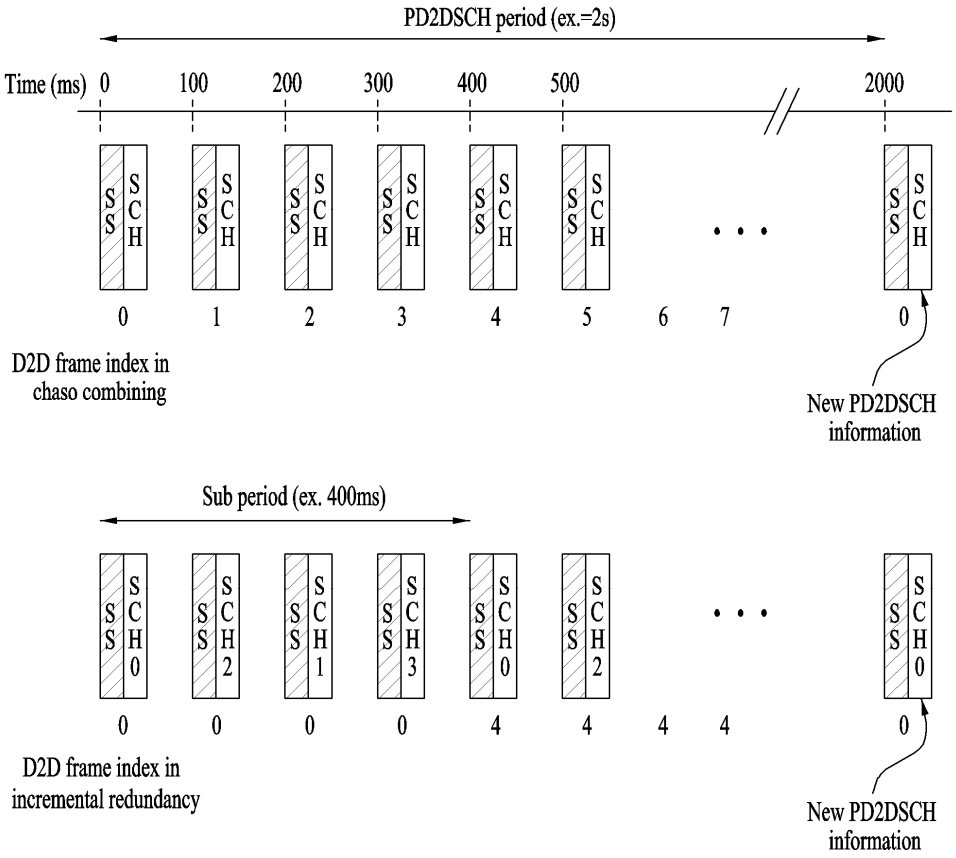

PD2DSCH period (ex.=2s)
Time (ms)
0
100
200
300
400
500
2000
SS
SCH
0
1
2
3
4
5
6
7
0
D2D frame index in chaso combining
New PD2DSCH information
Sub period (ex. 400ms)
SS
SCH0
SCH2
SCH1
SCH3
SCH0
SCH2
SCH0
0
0
0
0
4
4
4
4
0
D2D frame index in incremental redundancy
New PD2DSCH information

FIG. 15

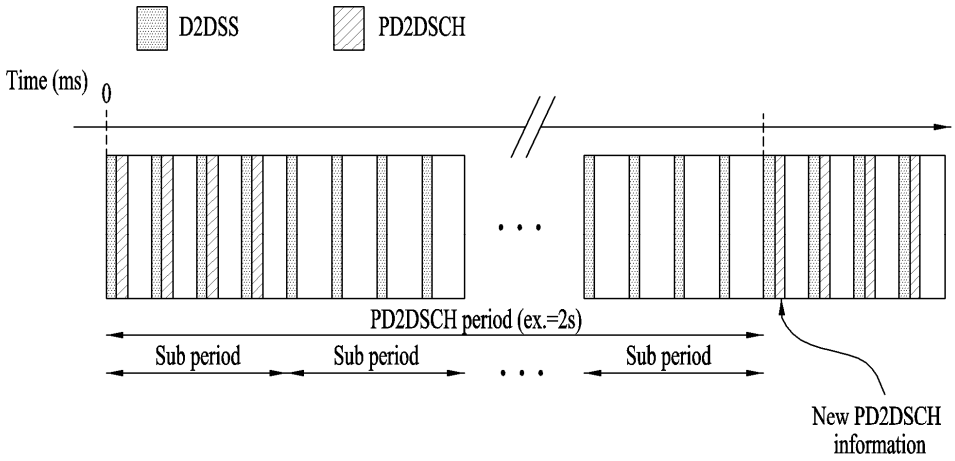

D2DSS
PD2DSCH
Time (ms)
0
PD2DSCH period (ex.=2s)
Sub period
Sub period
Sub period
New PD2DSCH information

FIG. 16

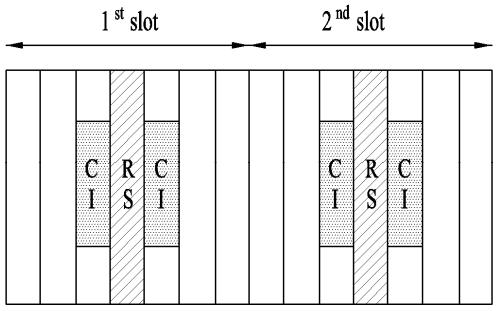

1st slot
2nd slot
CI
RS
CI
CI
RS
CI

FIG. 17

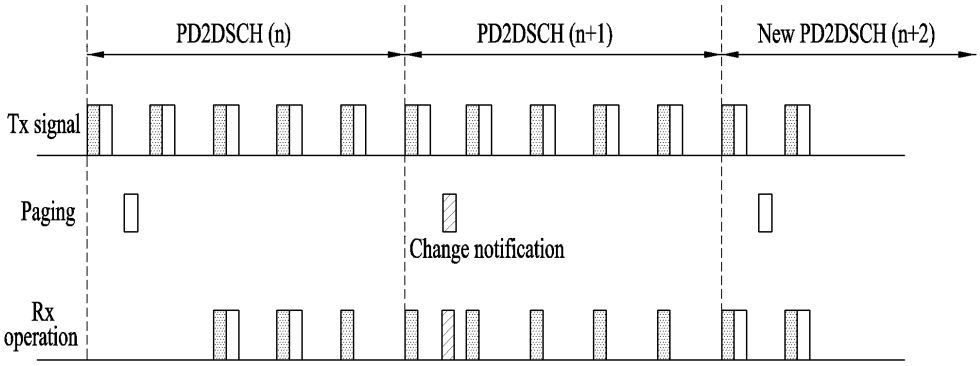

PD2DSCH (n)
PD2DSCH (n+1)
New PD2DSCH (n+2)
Tx signal
Paging
Change notification
Rx operation

FIG. 18

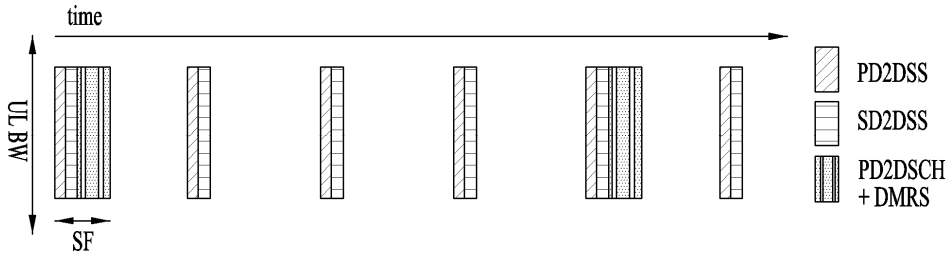

time
UL BW
SF
PD2DSS
SD2DSS
PD2DSCH + DMRS

FIG. 19

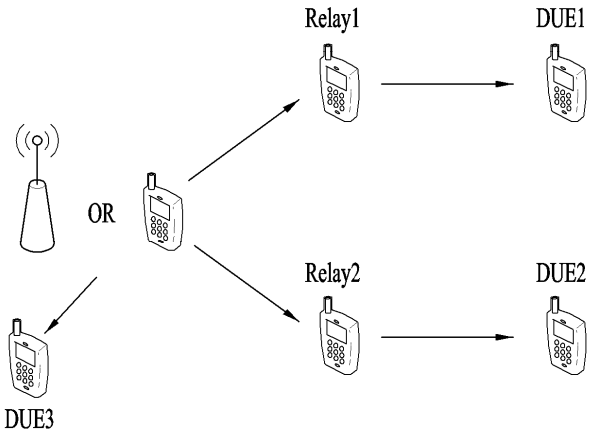

Relay1
DUE1
OR
Relay2
DUE2
DUE3

FIG. 20

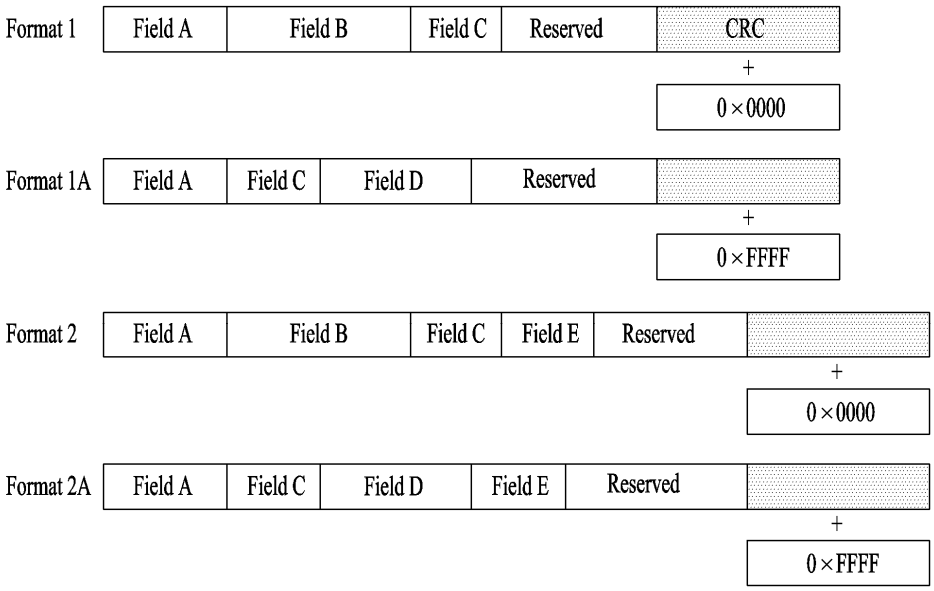

Format 1
Field A
Field B
Field C
Reserved
CRC
+
0×0000
Format 1A
Field A
Field C
Field D
Reserved
+
0×FFFF
Format 2
Field A
Field B
Field C
Field E
Reserved
+
0×0000
Format 2A
Field A
Field C
Field D
Field E
Reserved
+
0×FFFF

FIG. 21

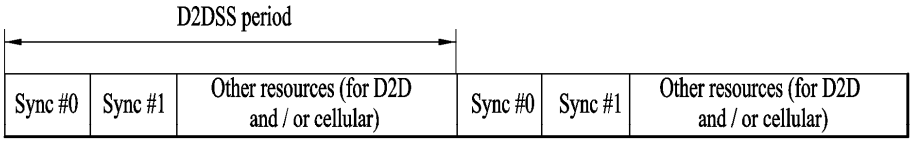
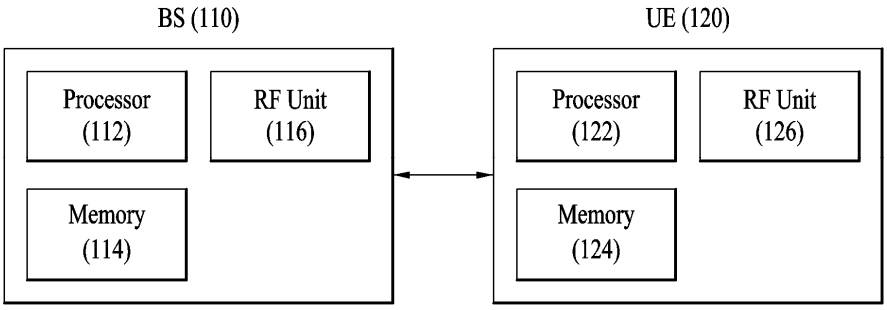

D2DSS period
Sync #0
Sync #1
Other resources (for D2D and / or cellular)
Sync #0
Sync #1
Other resources (for D2D and / or cellular)

FIG. 22


BS (110)
Processor (112)
RF Unit (116)
Memory (114)
UE (120)
Processor (122)
RF Unit (126)
Memory (124)