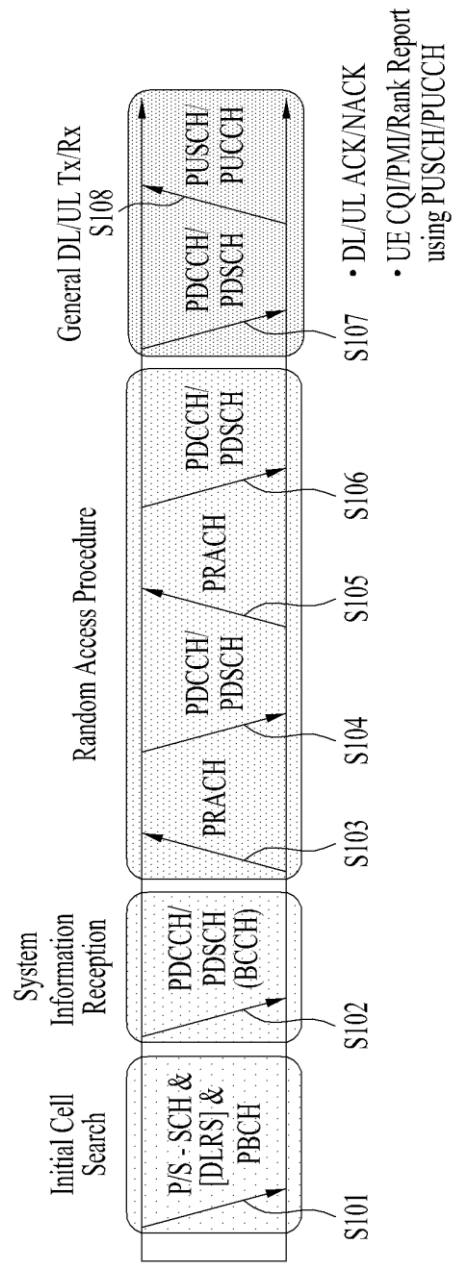
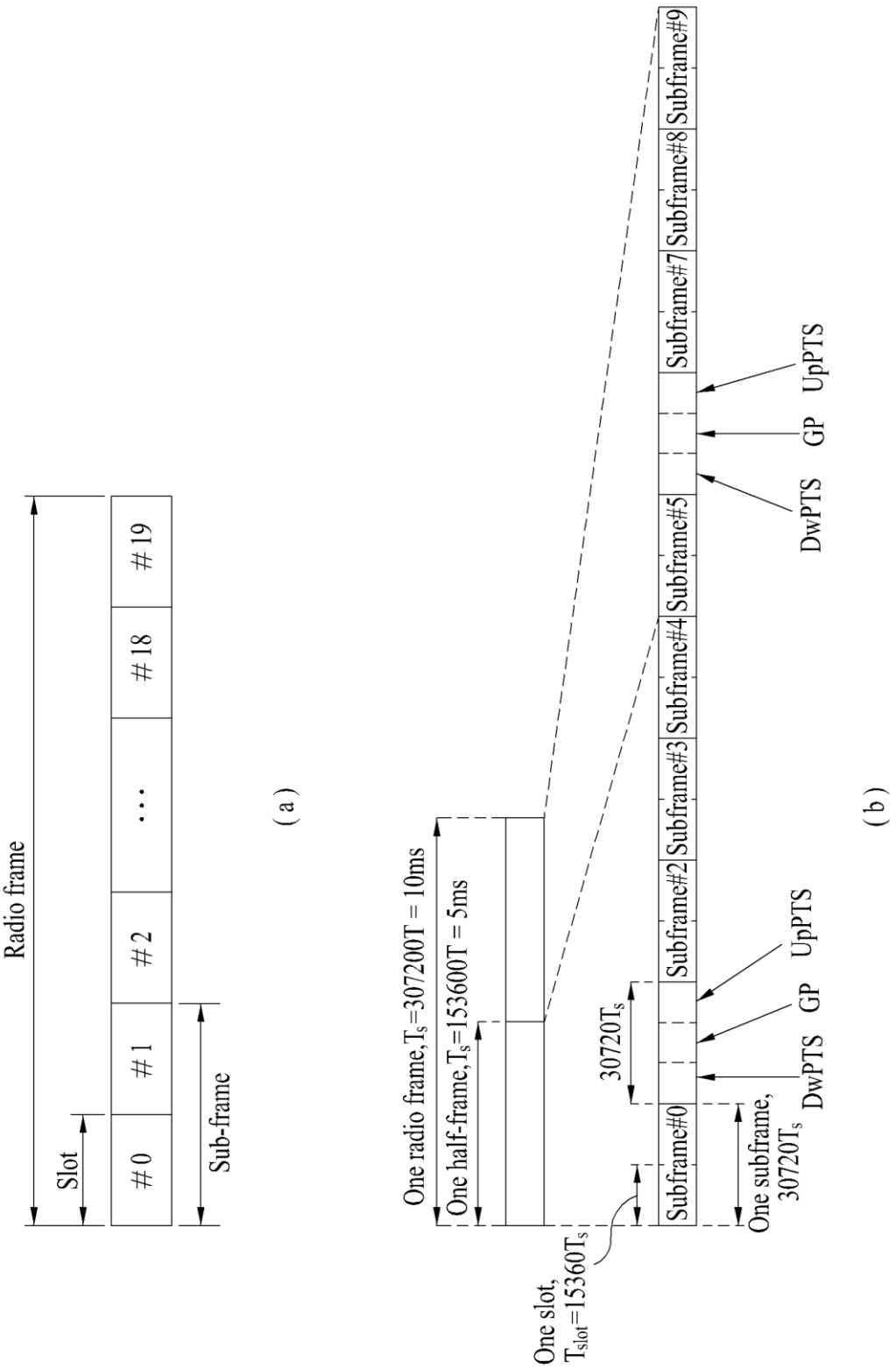
[DRAWINGS]

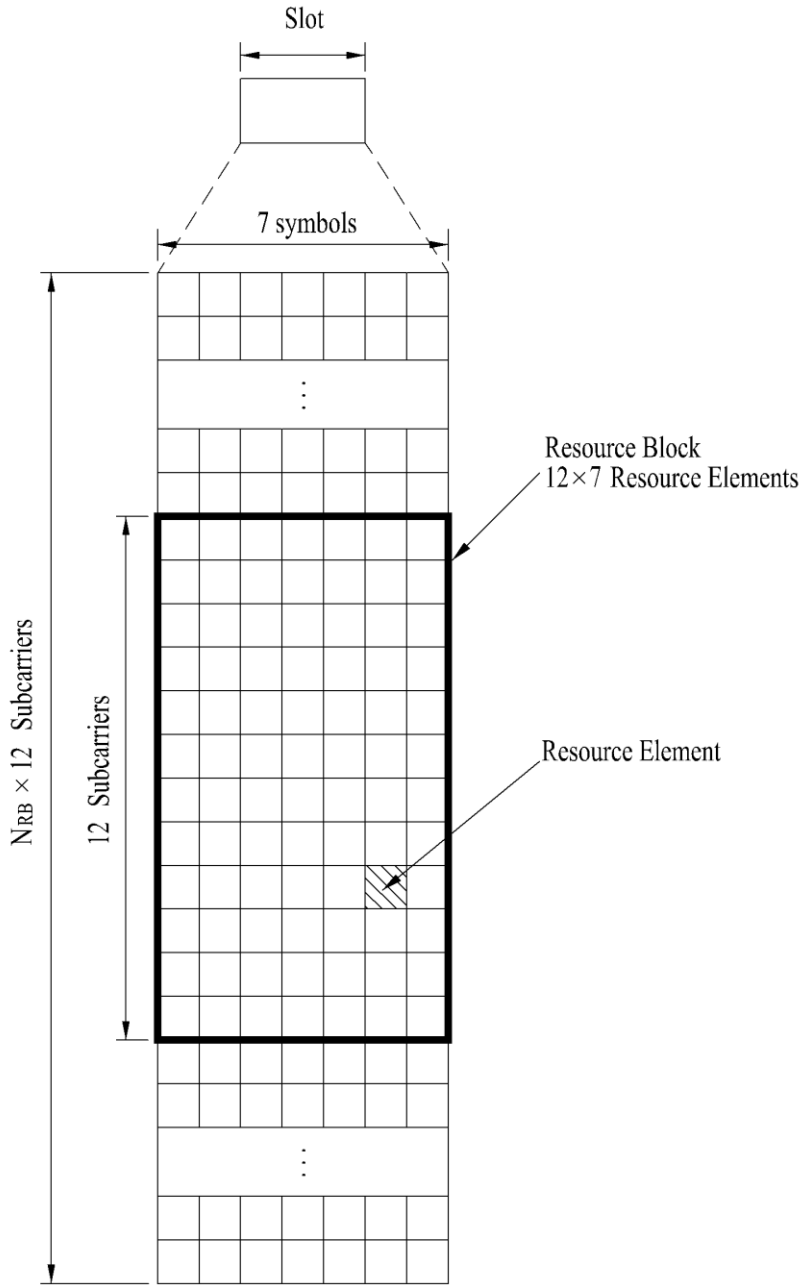
【FIG. 1】



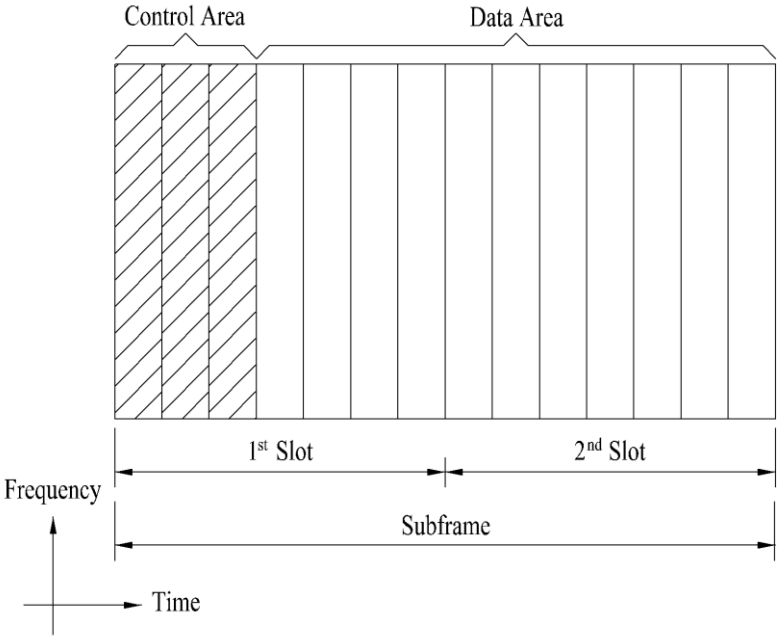
【FIG. 2】


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

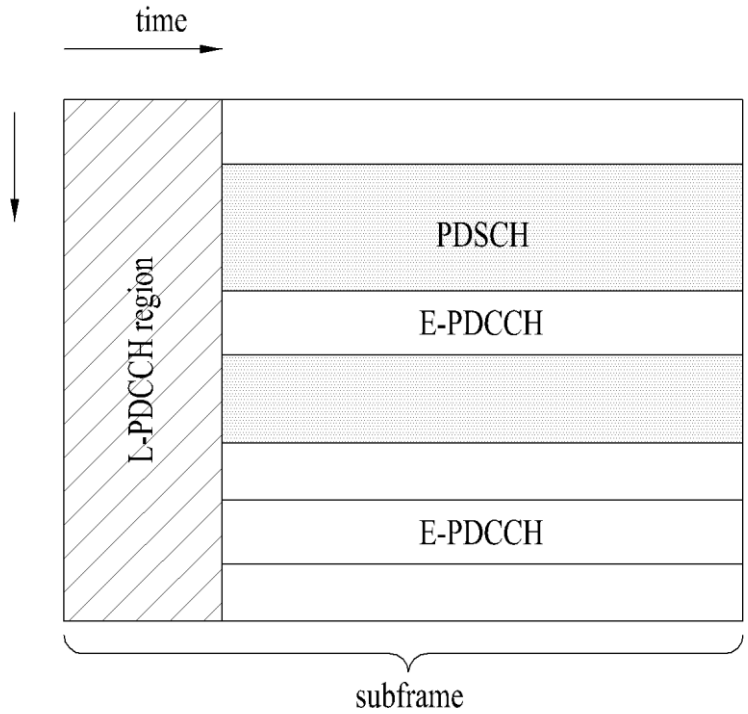
【FIG. 3】


Slot
7 symbols
Resource Block
12×7 Resource Elements
Resource Element
$N_{RB} \times 12$ Subcarriers
12 Subcarriers

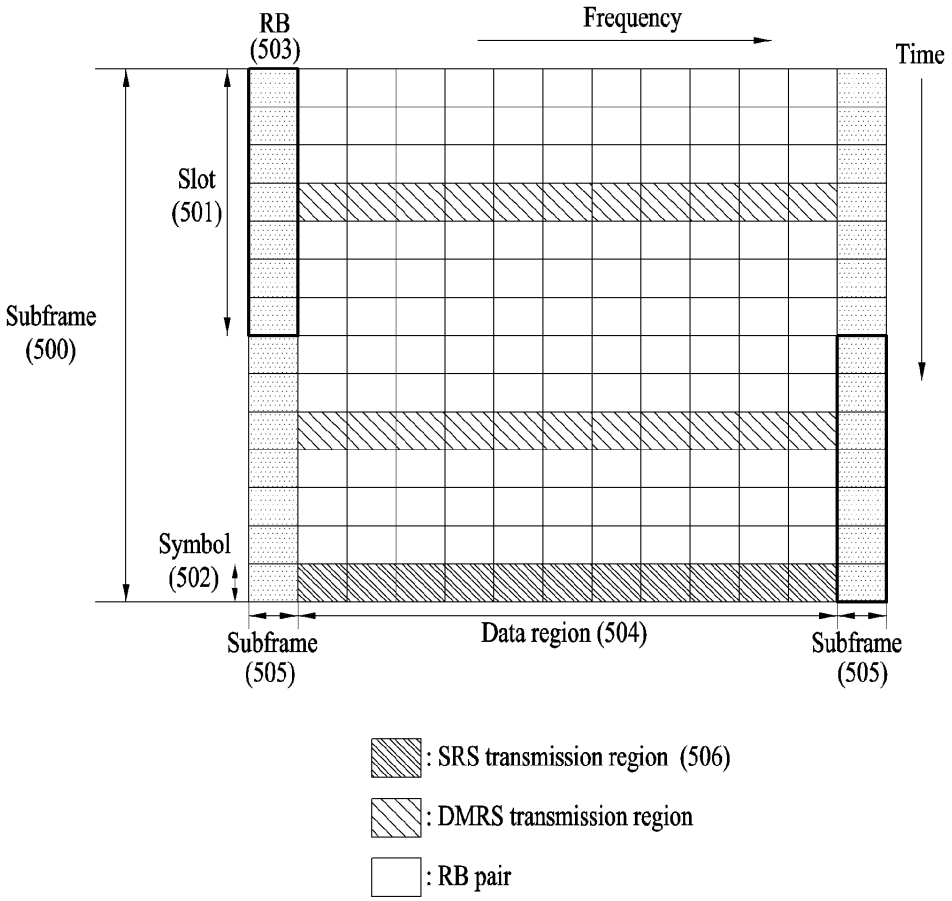
【FIG. 4】


Control Area
Data Area
1st Slot
2nd Slot
Frequency
Subframe
Time

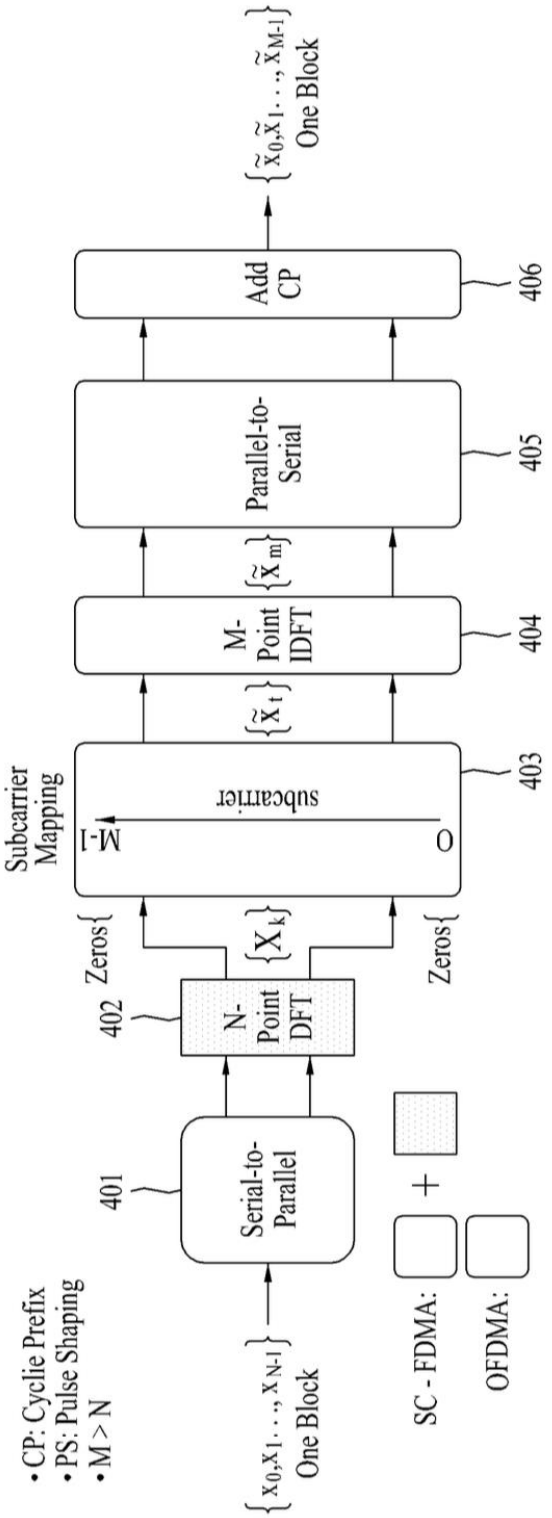
【FIG. 5】


time
L-PDCCH region
PDSCH
E-PDCCH
E-PDCCH
subframe

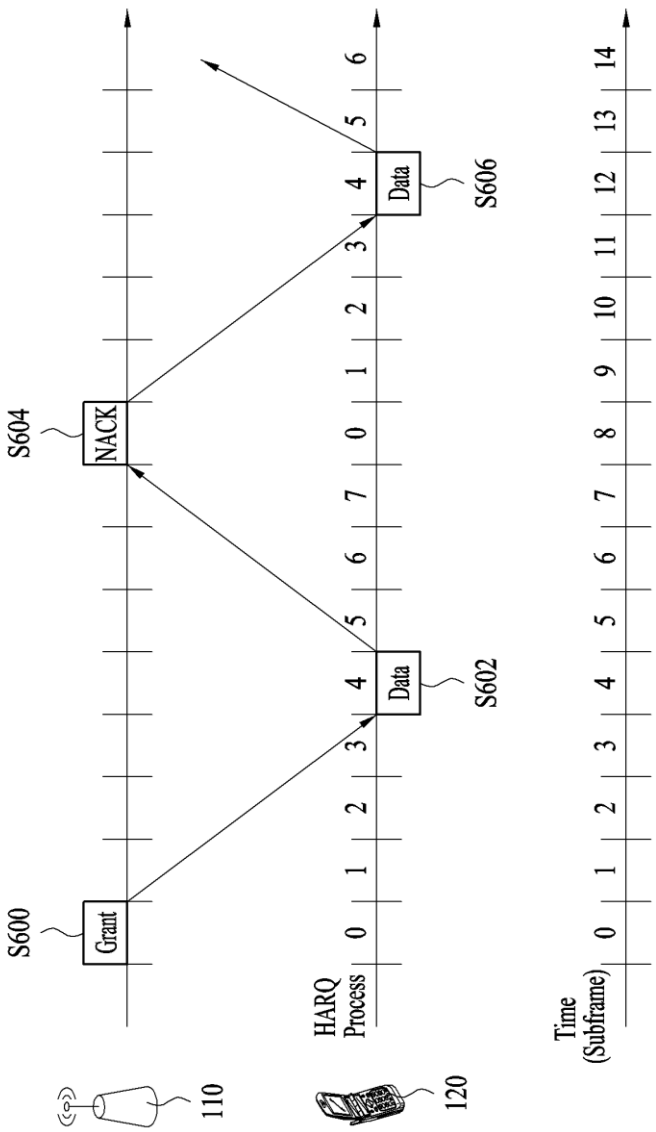
【FIG. 6】


RB
(503)
Frequency
Time
Slot
(501)
Subframe
(500)
Symbol
(502)
Subframe
(505)
Data region (504)
Subframe
(505)
: SRS transmission region (506)
: DMRS transmission region
: RB pair

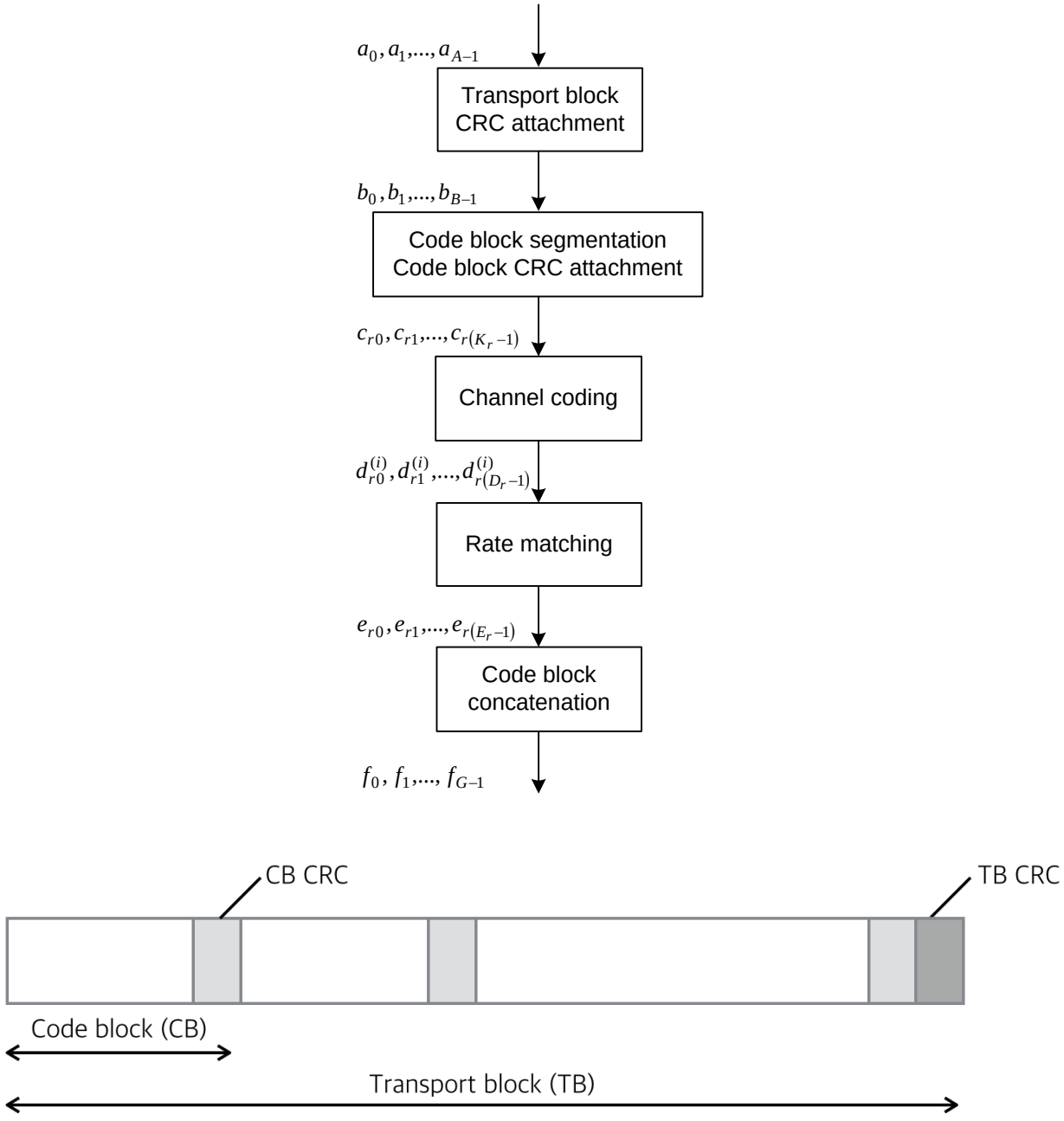
【FIG. 7】


• CP: Cyclie Prefix
• PS: Pulse Shaping
• M > N
{x0,x1, . . ., xN-1} One Block
401
Serial-to-Parallel
402
N-Point DFT
{Xk}
Zeros{
Zeros{
Subcarrier Mapping
M-1
0
subcarrier
403
{x̃t}
M-Point IDFT
404
{x̃m}
Parallel-to-Serial
405
Add CP
406
{x̃0,x̃1, . . ., x̃M-1} One Block
SC - FDMA:
OFDMA:

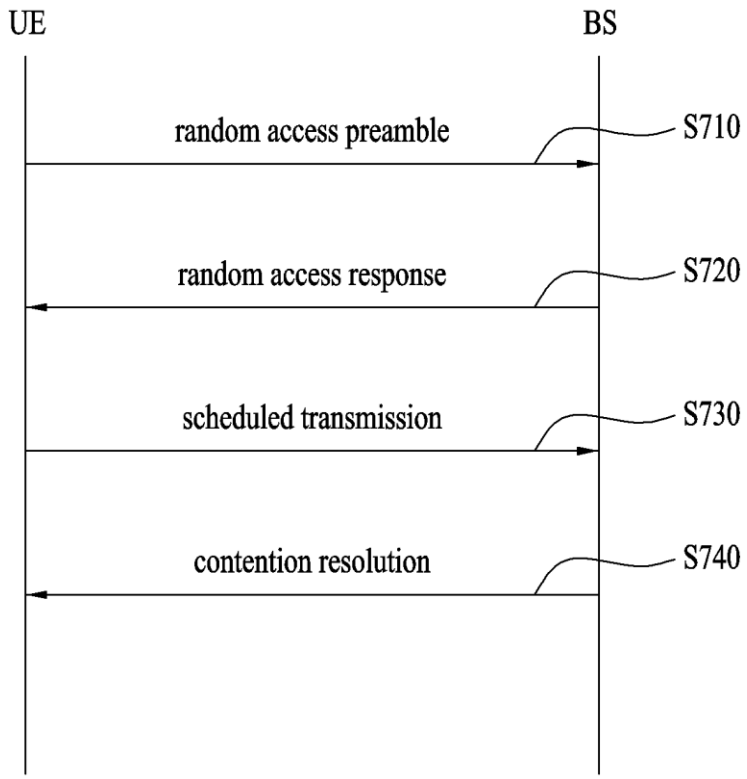
【FIG. 8】


S600
Grant
S604
NACK
S602
Data
S606
Data
HARQ Process
0 1 2 3 4 5 6 7 0 1 2 3 4 5 6
Time (Subframe)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
110
120

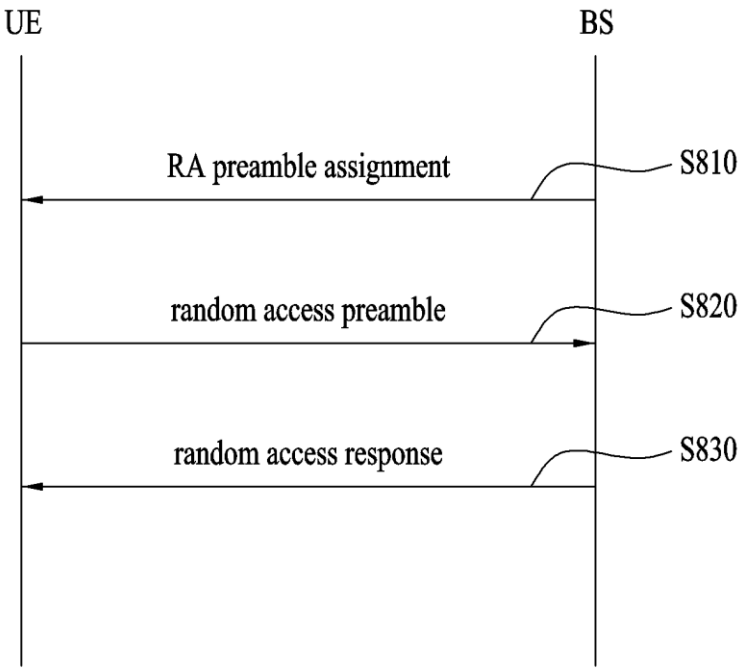
【FIG. 9】


$a_0, a_1, ..., a_{A-1}$
Transport block CRC attachment
$b_0, b_1, ..., b_{B-1}$
Code block segmentation Code block CRC attachment
$c_{r0}, c_{r1}, ..., c_{r(K_r-1)}$
Channel coding
$d_{r0}^{(i)}, d_{r1}^{(i)}, ..., d_{r(D_r-1)}^{(i)}$
Rate matching
$e_{r0}, e_{r1}, ..., e_{r(E_r-1)}$
Code block concatenation
$f_0, f_1, ..., f_{G-1}$
CB CRC
TB CRC
Code block (CB)
Transport block (TB)

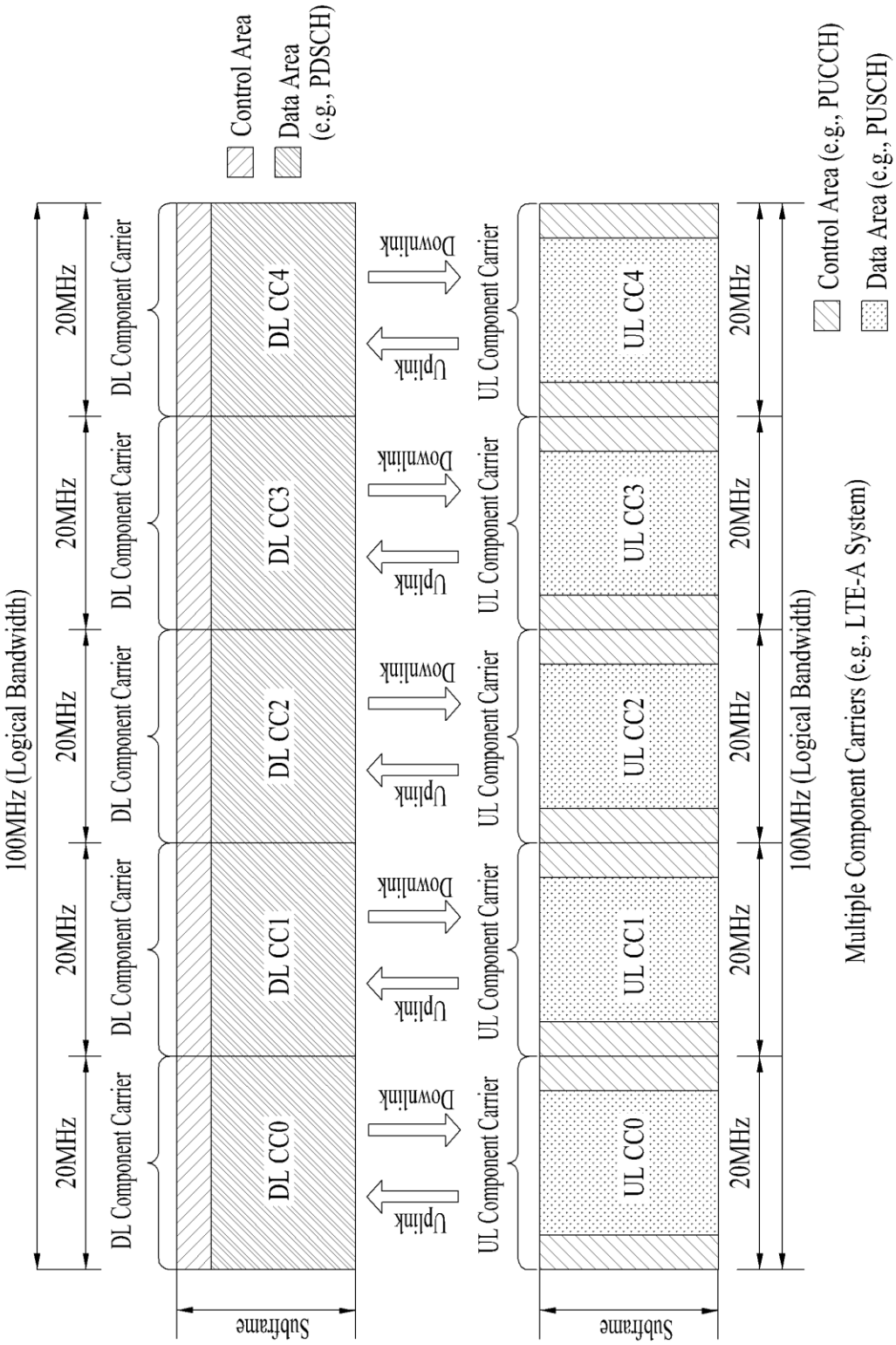
【FIG. 10】


UE
BS
random access preamble
S710
random access response
S720
scheduled transmission
S730
contention resolution
S740

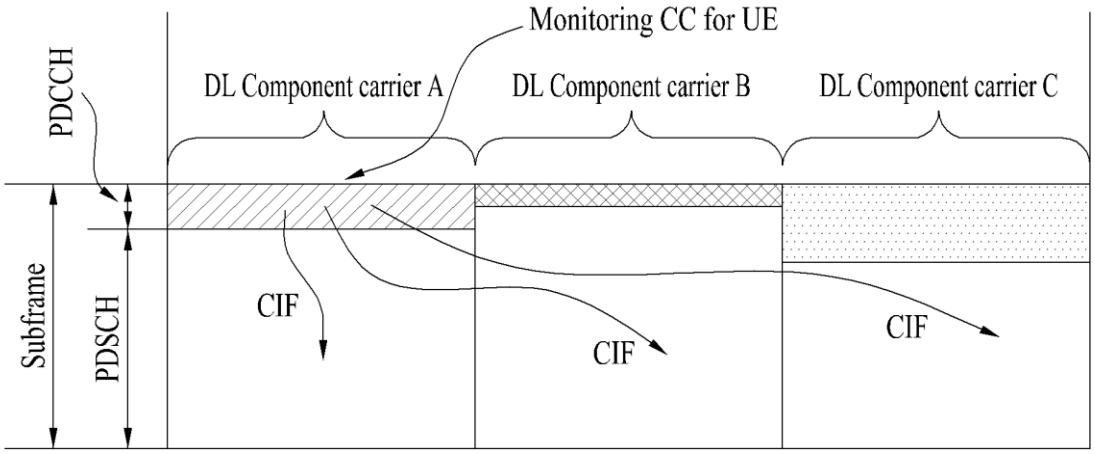
【FIG. 11】


UE
BS
RA preamble assignment
S810
random access preamble
S820
random access response
S830

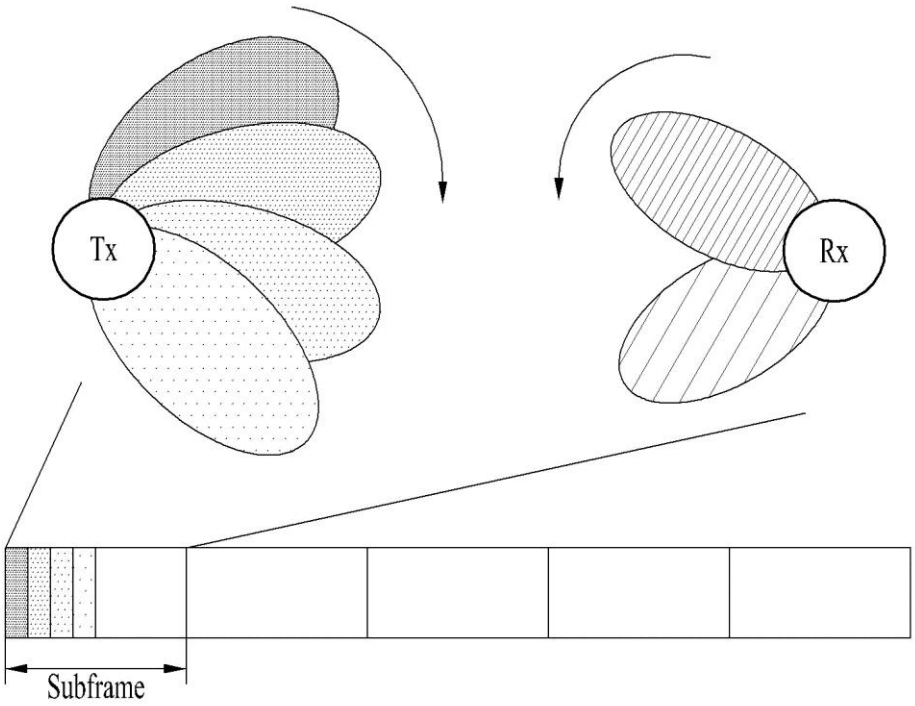
【FIG. 12】


100MHz (Logical Bandwidth)
20MHz
20MHz
20MHz
20MHz
20MHz
DL Component Carrier
DL Component Carrier
DL Component Carrier
DL Component Carrier
DL Component Carrier
DL CC0
DL CC1
DL CC2
DL CC3
DL CC4
Subframe
Downlink
Uplink
Control Area
Data Area
(e.g., PDSCH)
UL Component Carrier
UL CC0
UL CC1
UL CC2
UL CC3
UL CC4
100MHz (Logical Bandwidth)
Control Area (e.g., PUCCH)
Data Area (e.g., PUSCH)
Multiple Component Carriers (e.g., LTE-A System)

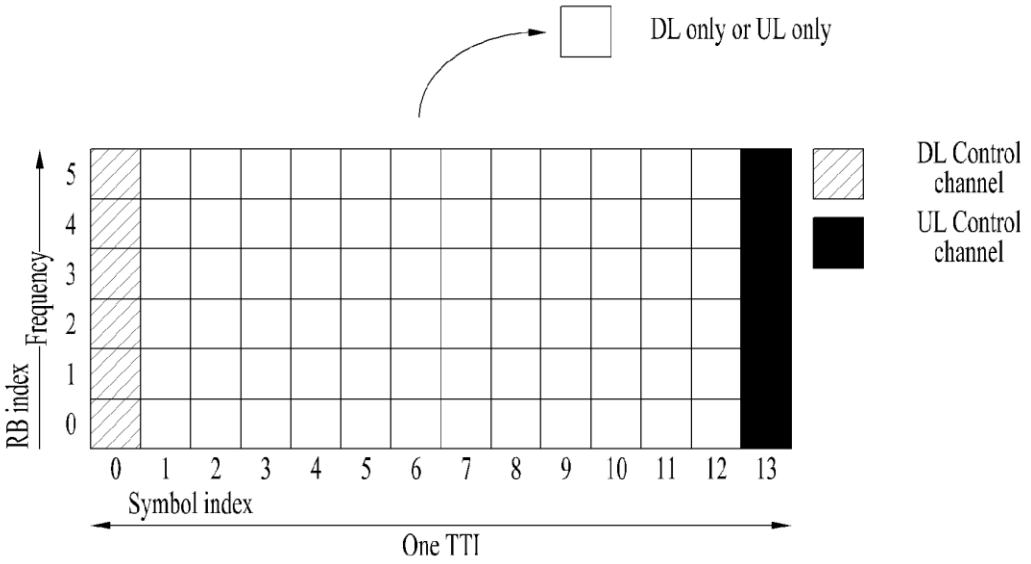
【FIG. 13】


Monitoring CC for UE
PDCCH
DL Component carrier A
DL Component carrier B
DL Component carrier C
Subframe
PDSCH
CIF
CIF
CIF

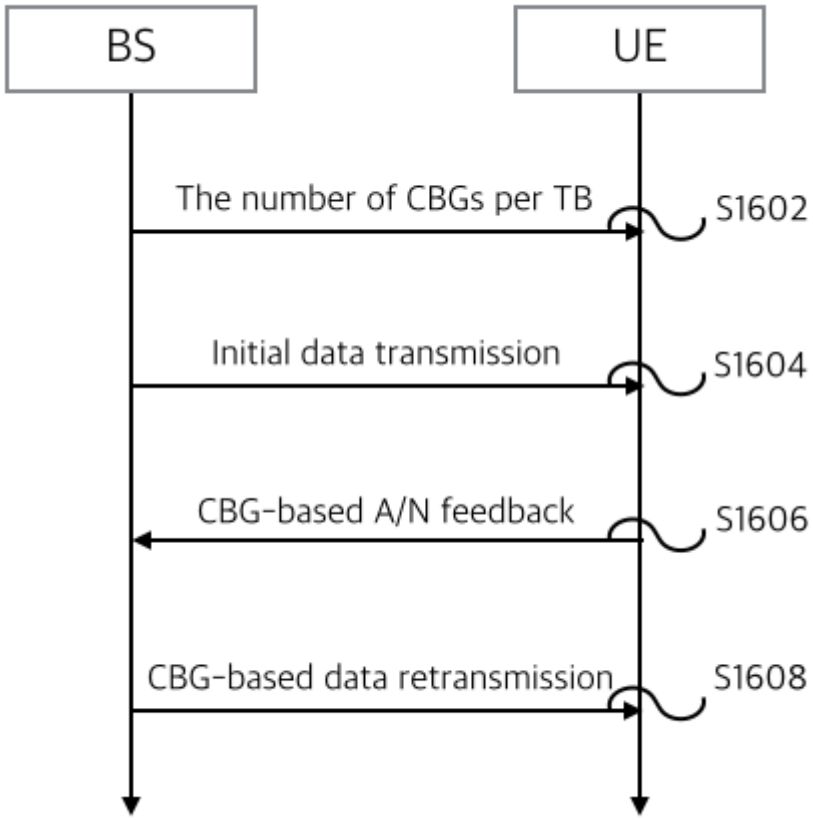
【FIG. 14】

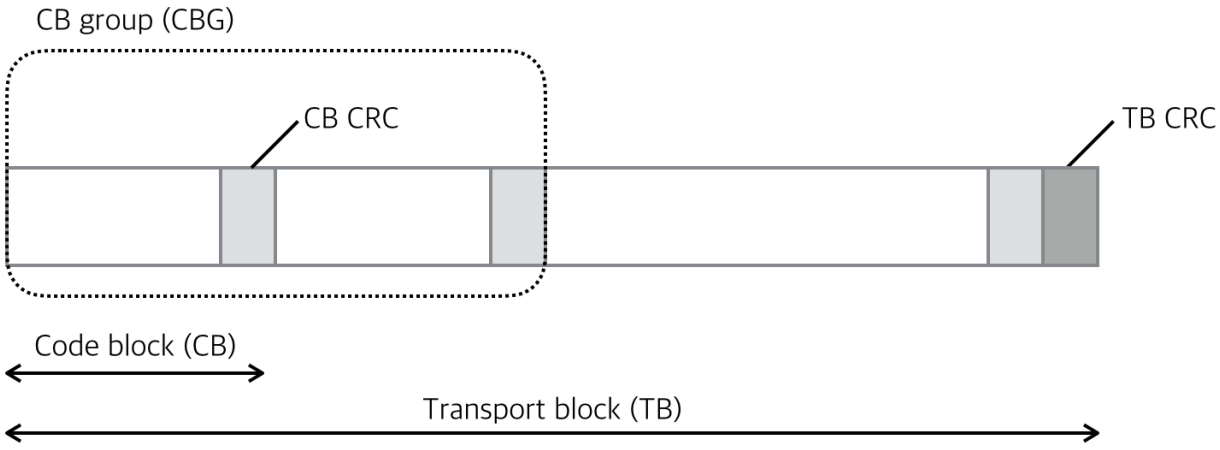

Tx
Rx
Subframe

【FIG. 15】

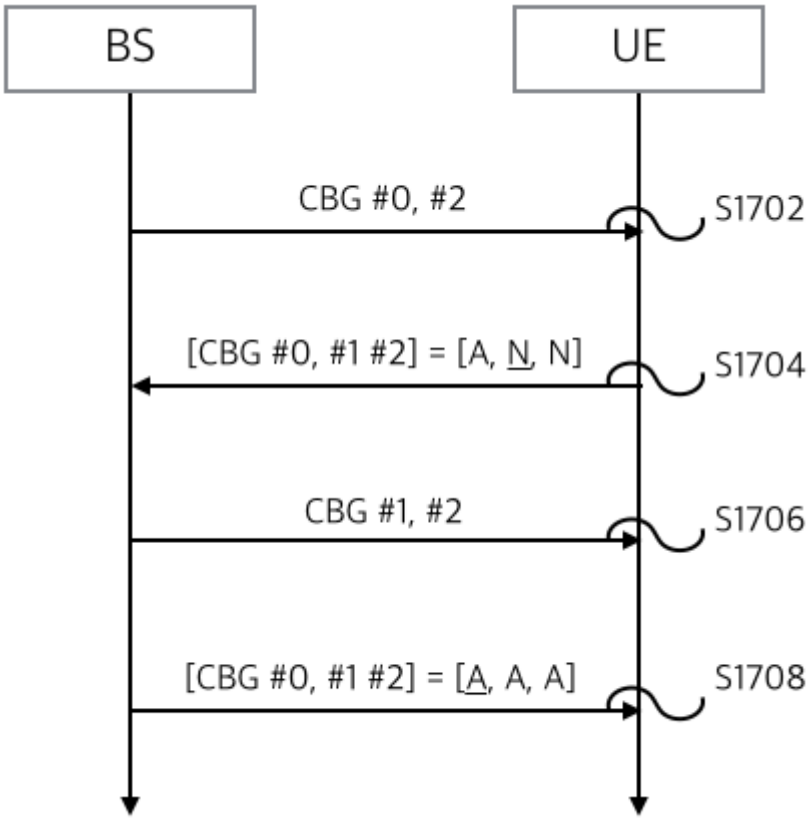

DL only or UL only
DL Control channel
UL Control channel
RB index
Frequency
5
4
3
2
1
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13
Symbol index
One TTI

【FIG. 16】

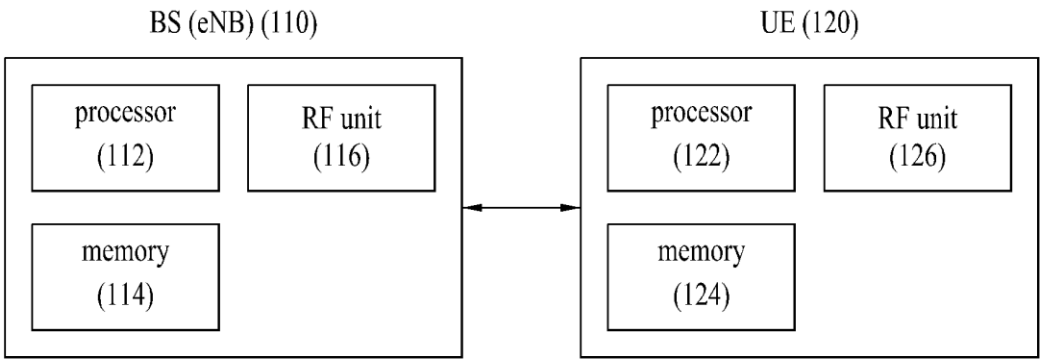

BS
UE
The number of CBGs per TB
S1602
Initial data transmission
S1604
CBG-based A/N feedback
S1606
CBG-based data retransmission
S1608


CB group (CBG)
CB CRC
TB CRC
Code block (CB)
Transport block (TB)

【FIG. 17】


BS
UE
CBG #0, #2
S1702
[CBG #0, #1 #2] = [A, N, N]
S1704
CBG #1, #2
S1706
[CBG #0, #1 #2] = [A, A, A]
S1708

【FIG. 18】


BS (eNB) (110)
processor (112)
RF unit (116)
memory (114)
UE (120)
processor (122)
RF unit (126)
memory (124)