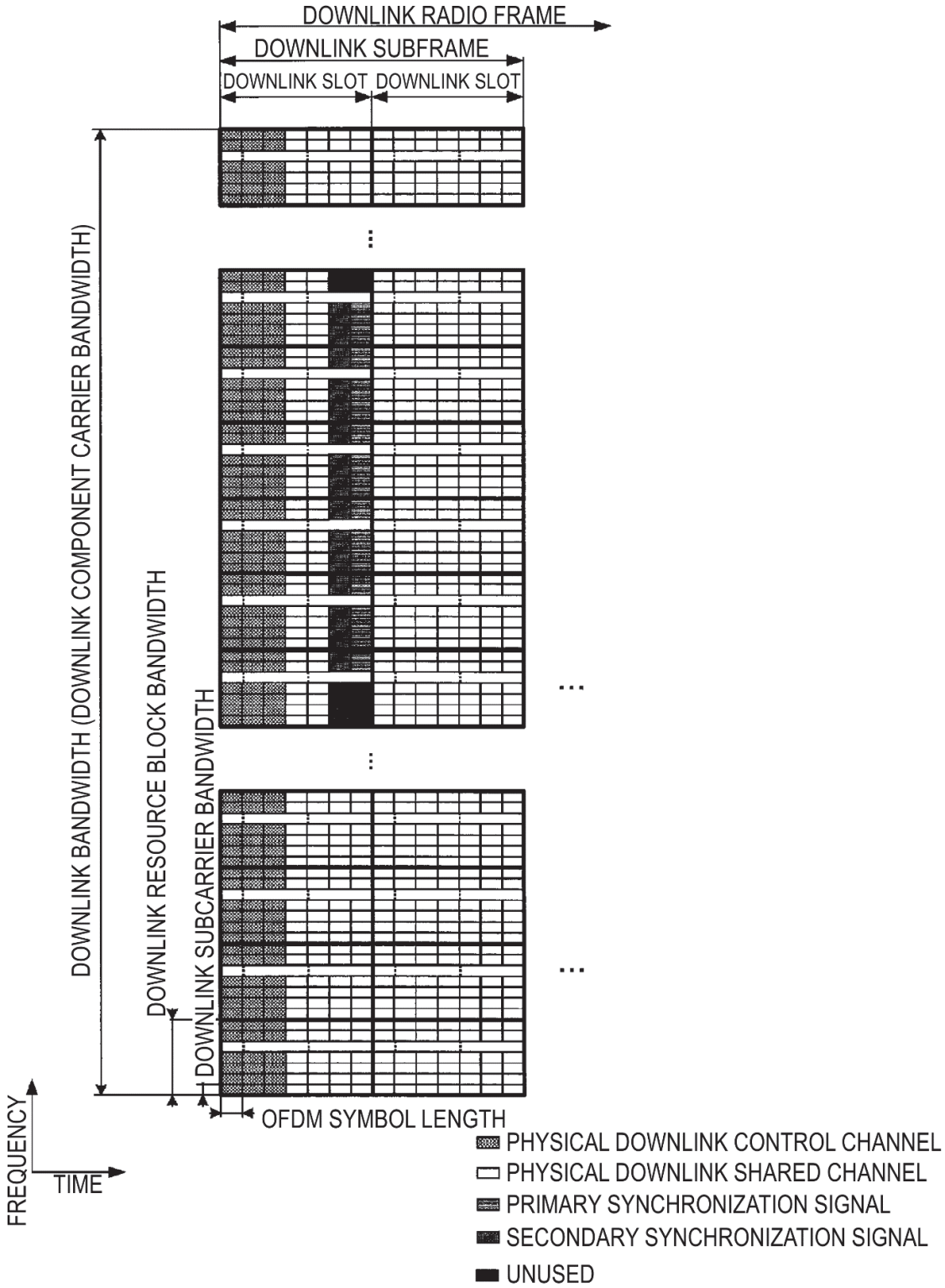
DOWNLINK RADIO FRAME
DOWNLINK SUBFRAME
DOWNLINK SLOT
DOWNLINK SLOT
DOWNLINK BANDWIDTH (DOWNLINK COMPONENT CARRIER BANDWIDTH)
DOWNLINK RESOURCE BLOCK BANDWIDTH
DOWNLINK SUBCARRIER BANDWIDTH
OFDM SYMBOL LENGTH
FREQUENCY
TIME
PHYSICAL DOWNLINK CONTROL CHANNEL
PHYSICAL DOWNLINK SHARED CHANNEL
PRIMARY SYNCHRONIZATION SIGNAL
SECONDARY SYNCHRONIZATION SIGNAL
UNUSED

FIG. 1

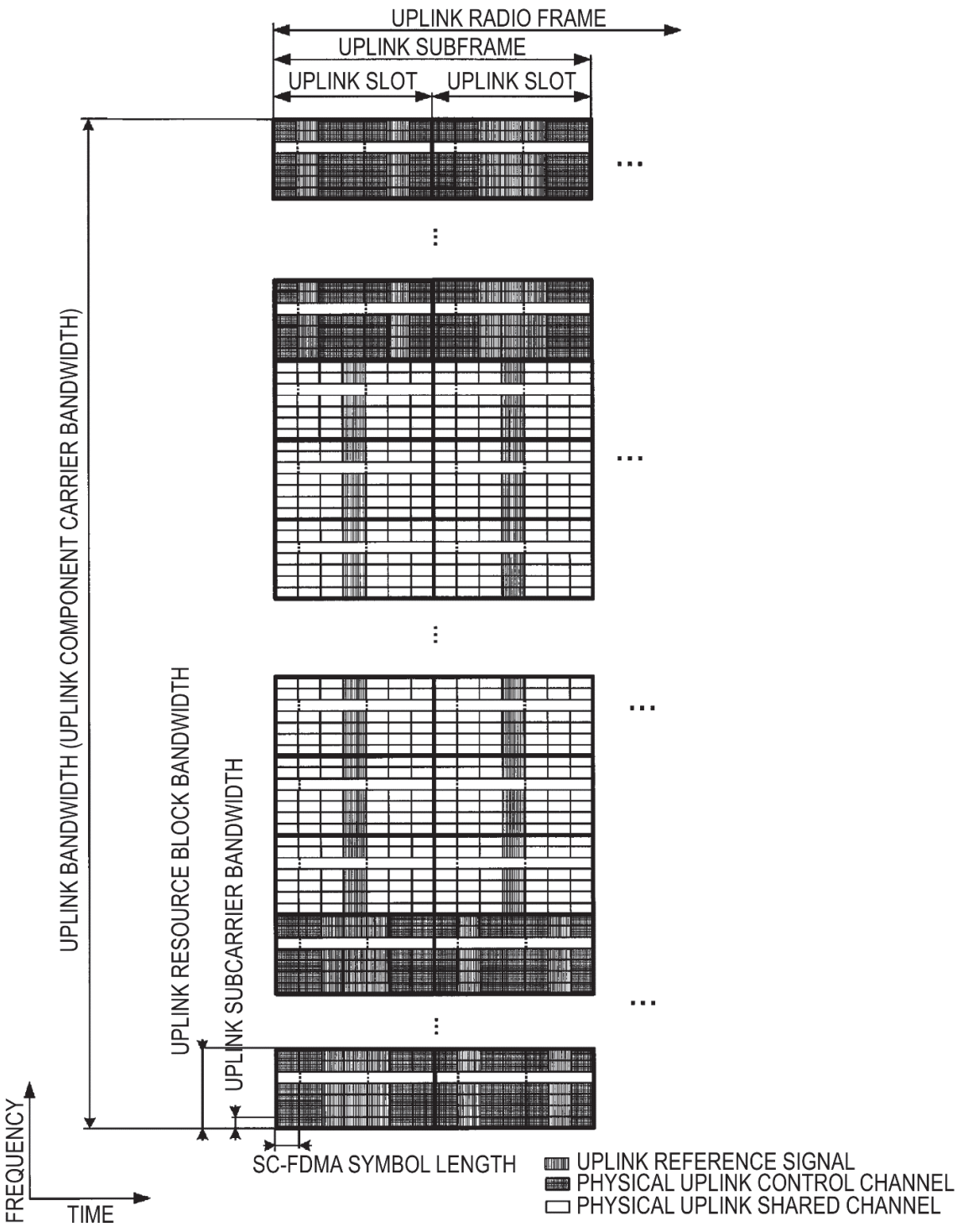
UPLINK RADIO FRAME
UPLINK SUBFRAME
UPLINK SLOT
UPLINK SLOT
UPLINK BANDWIDTH (UPLINK COMPONENT CARRIER BANDWIDTH)
UPLINK RESOURCE BLOCK BANDWIDTH
UPLINK SUBCARRIER BANDWIDTH
SC-FDMA SYMBOL LENGTH
FREQUENCY
TIME
UPLINK REFERENCE SIGNAL
PHYSICAL UPLINK CONTROL CHANNEL
PHYSICAL UPLINK SHARED CHANNEL

FIG. 2

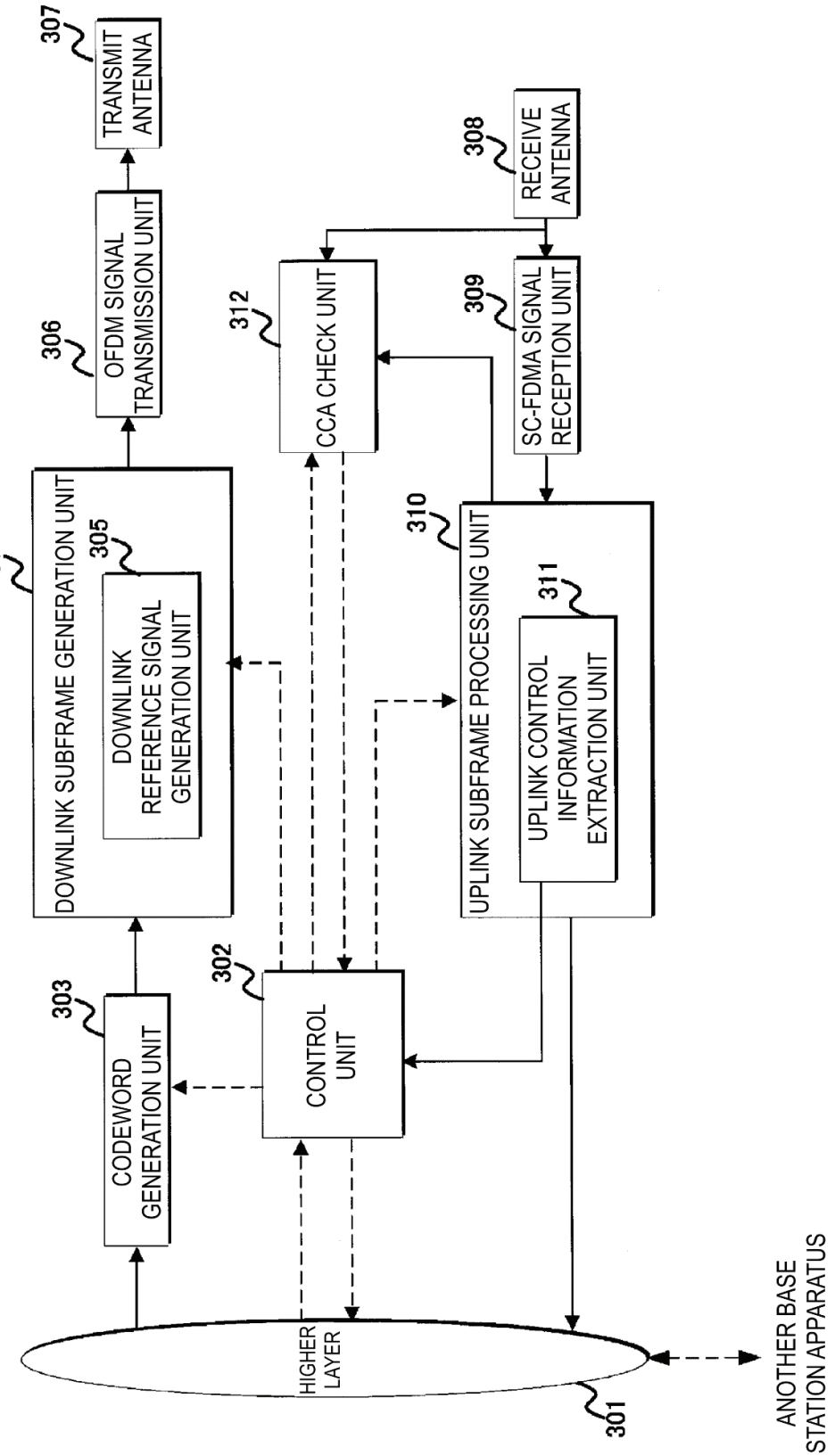
307
TRANSMIT ANTENNA
306
OFDM SIGNAL TRANSMISSION UNIT
304
DOWNLINK SUBFRAME GENERATION UNIT
305
DOWNLINK REFERENCE SIGNAL GENERATION UNIT
303
CODEWORD GENERATION UNIT
302
CONTROL UNIT
312
CCA CHECK UNIT
308
RECEIVE ANTENNA
309
SC-FDMA SIGNAL RECEPTION UNIT
310
UPLINK SUBFRAME PROCESSING UNIT
311
UPLINK CONTROL INFORMATION EXTRACTION UNIT
HIGHER LAYER
301
ANOTHER BASE STATION APPARATUS

FIG. 3

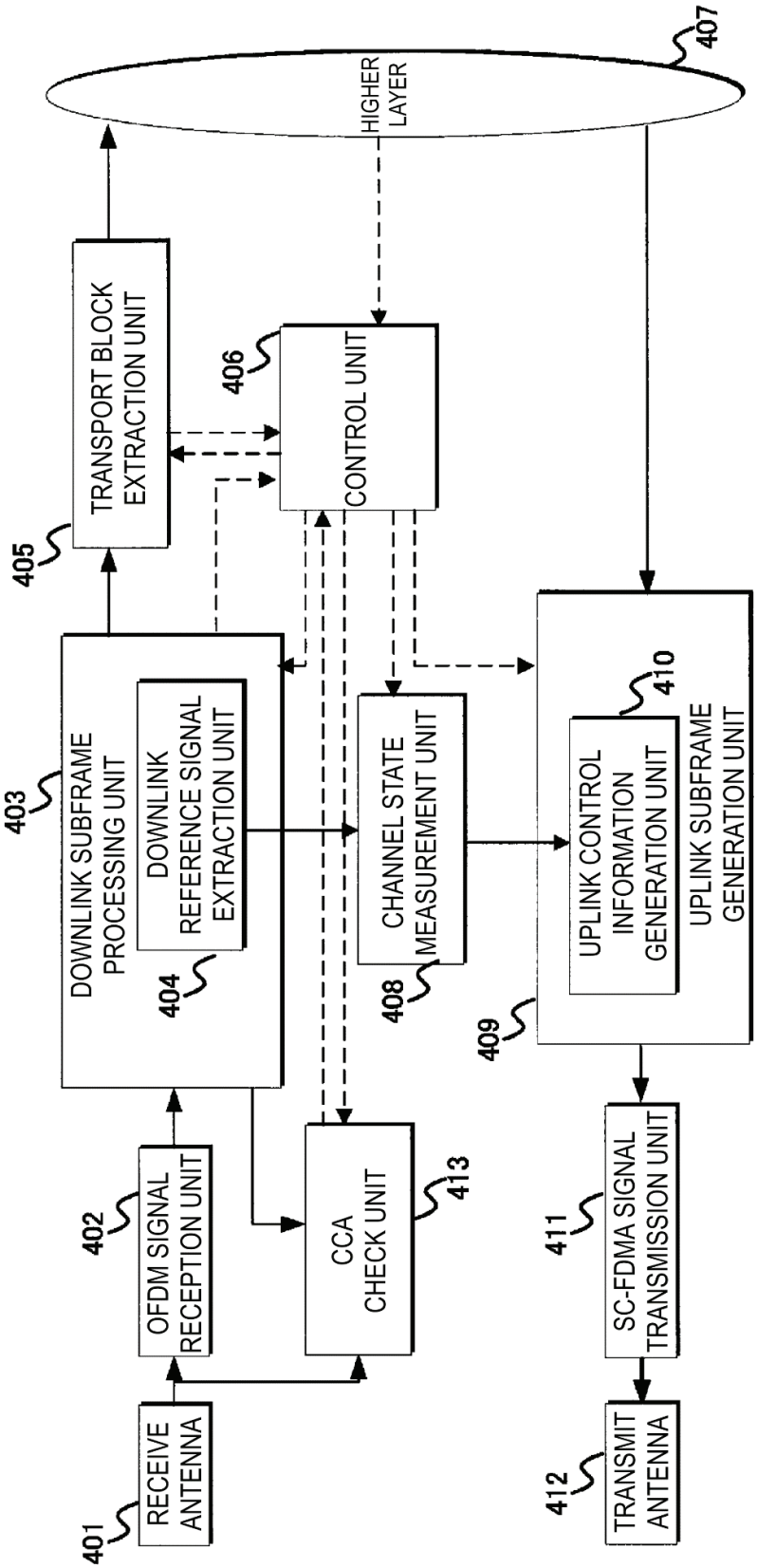
HIGHER LAYER
407
TRANSPORT BLOCK EXTRACTION UNIT
405
CONTROL UNIT
406
DOWNLINK SUBFRAME PROCESSING UNIT
403
DOWNLINK REFERENCE SIGNAL EXTRACTION UNIT
404
CHANNEL STATE MEASUREMENT UNIT
408
UPLINK SUBFRAME GENERATION UNIT
409
UPLINK CONTROL INFORMATION GENERATION UNIT
410
OFDM SIGNAL RECEPTION UNIT
402
CCA CHECK UNIT
413
SC-FDMA SIGNAL TRANSMISSION UNIT
411
RECEIVE ANTENNA
401
TRANSMIT ANTENNA
412

FIG. 4

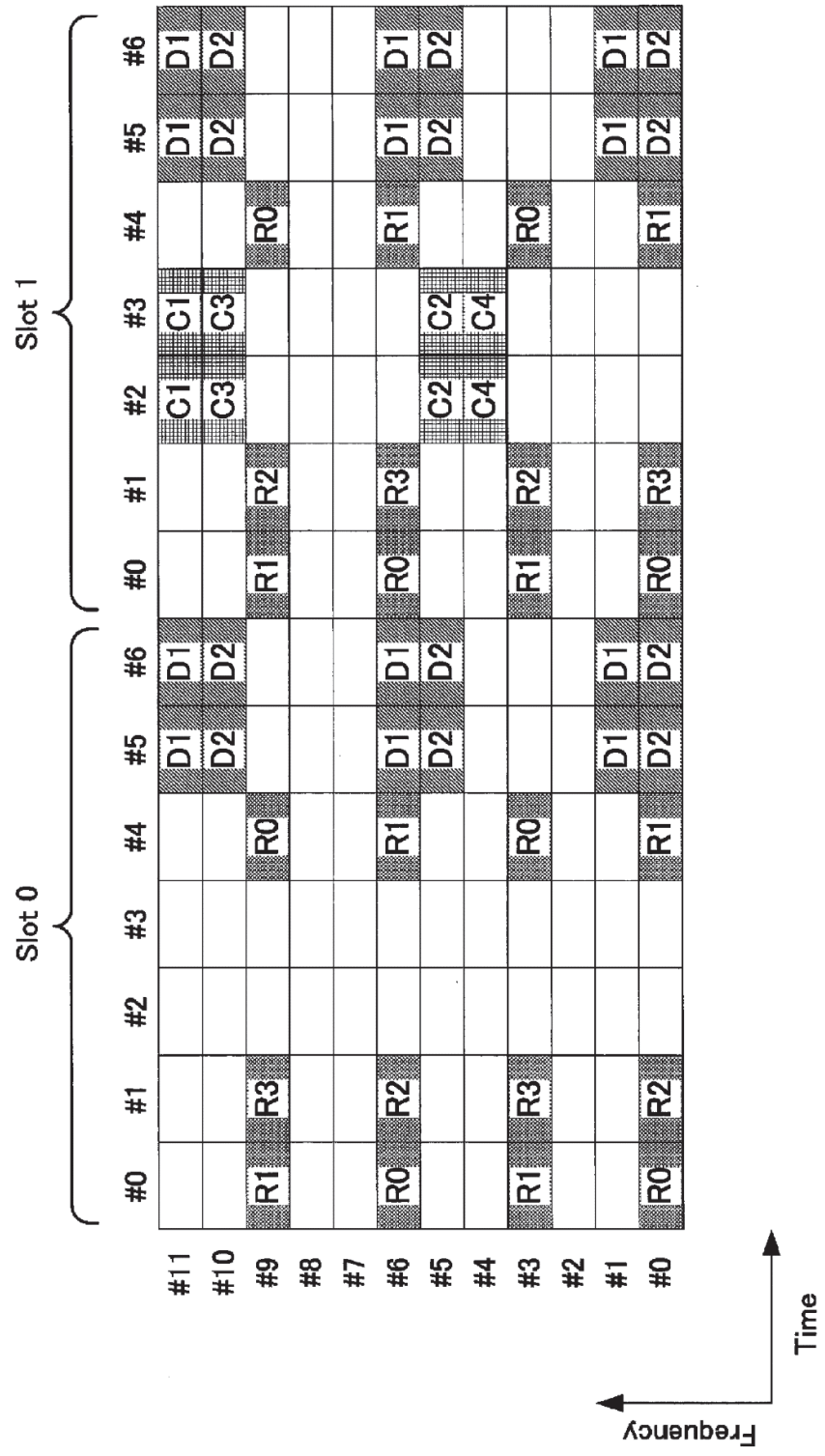

FIG. 5

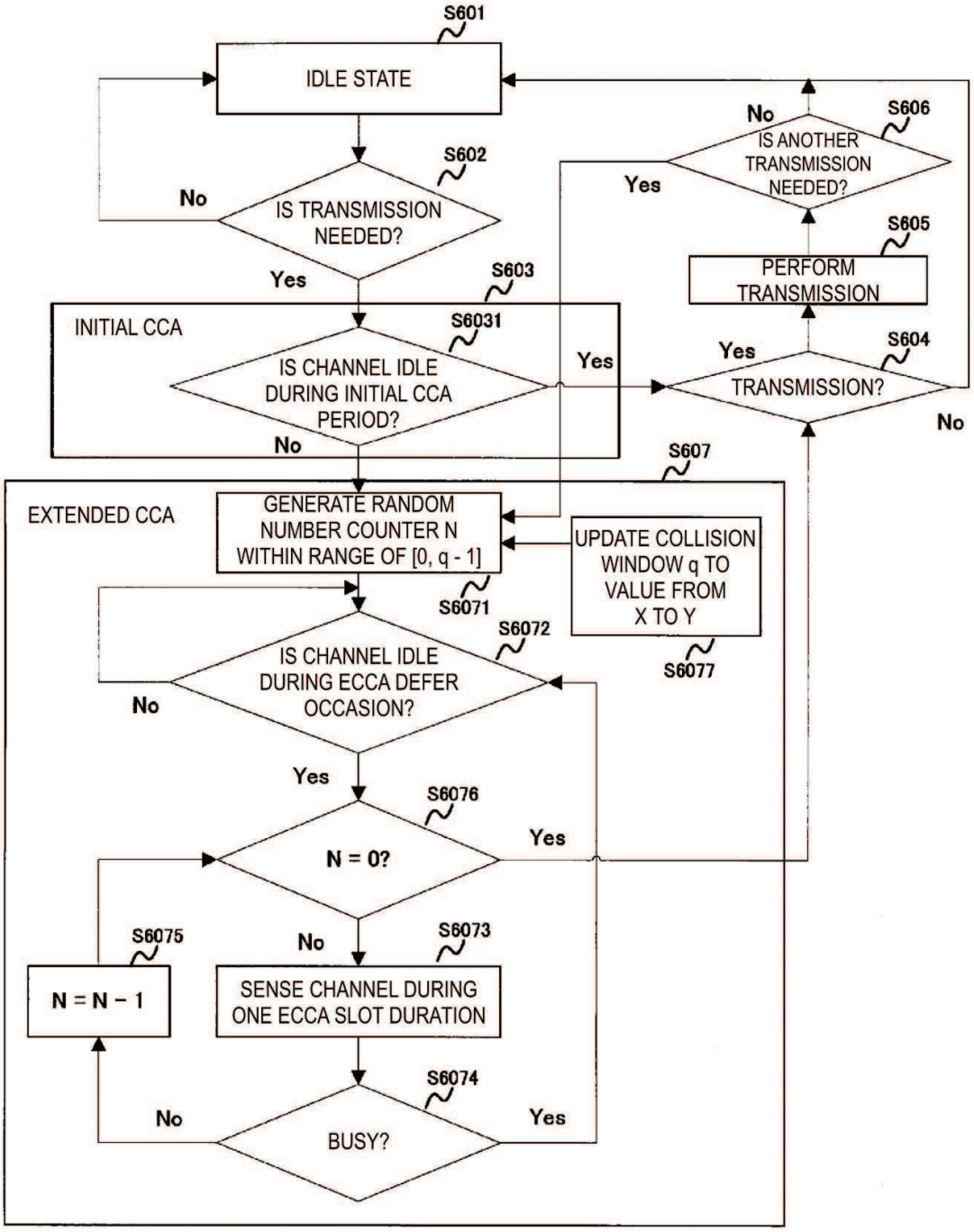
S601
IDLE STATE
S602
IS TRANSMISSION NEEDED?
No
Yes
S603
INITIAL CCA
S6031
IS CHANNEL IDLE DURING INITIAL CCA PERIOD?
Yes
No
S604
TRANSMISSION?
Yes
No
S605
PERFORM TRANSMISSION
S606
IS ANOTHER TRANSMISSION NEEDED?
No
Yes
S607
EXTENDED CCA
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
S6071
UPDATE COLLISION WINDOW q TO VALUE FROM X TO Y
S6077
S6072
IS CHANNEL IDLE DURING ECCA DEFER OCCASION?
No
Yes
S6076
N = 0?
Yes
No
S6073
SENSE CHANNEL DURING ONE ECCA SLOT DURATION
S6074
BUSY?
No
Yes
S6075
N = N − 1

FIG. 6

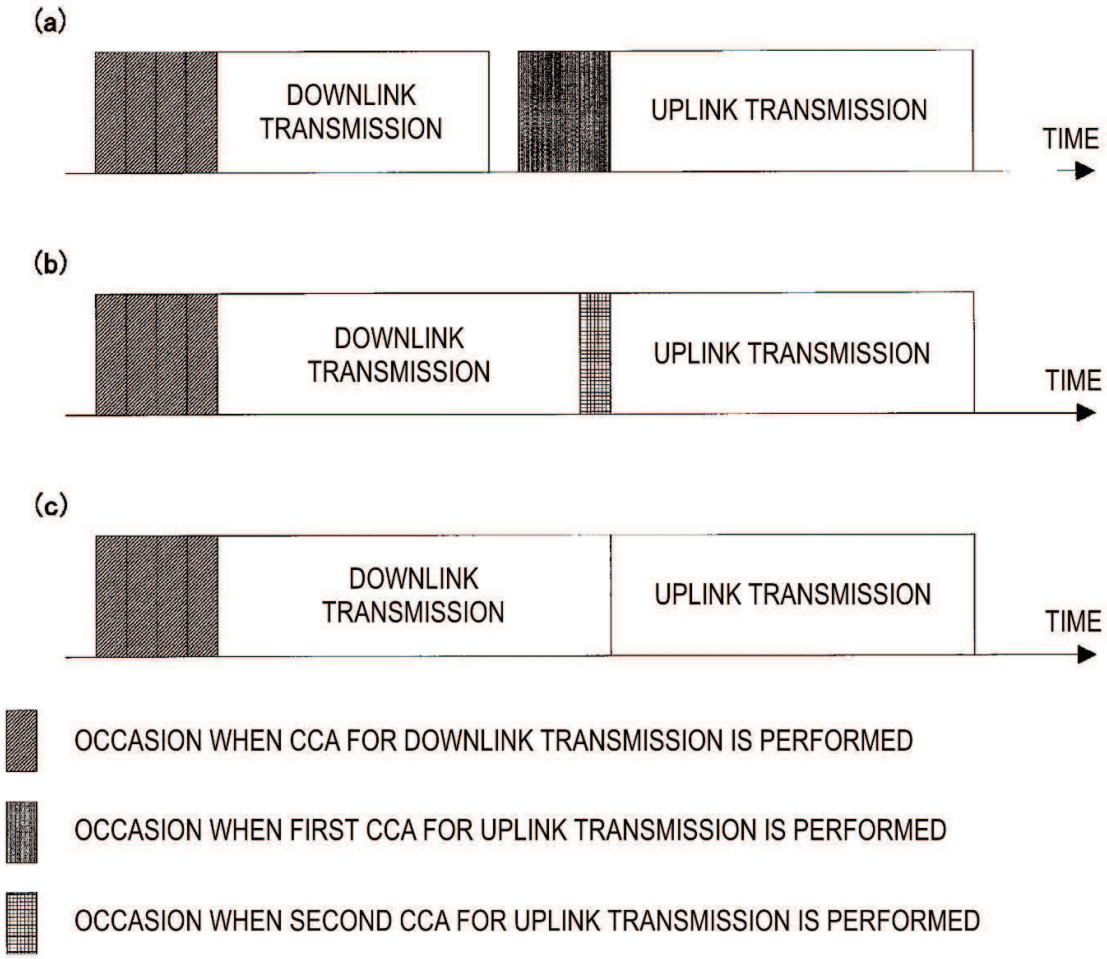
(a)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
(b)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
(c)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
OCCASION WHEN CCA FOR DOWNLINK TRANSMISSION IS PERFORMED
OCCASION WHEN FIRST CCA FOR UPLINK TRANSMISSION IS PERFORMED
OCCASION WHEN SECOND CCA FOR UPLINK TRANSMISSION IS PERFORMED

FIG. 7

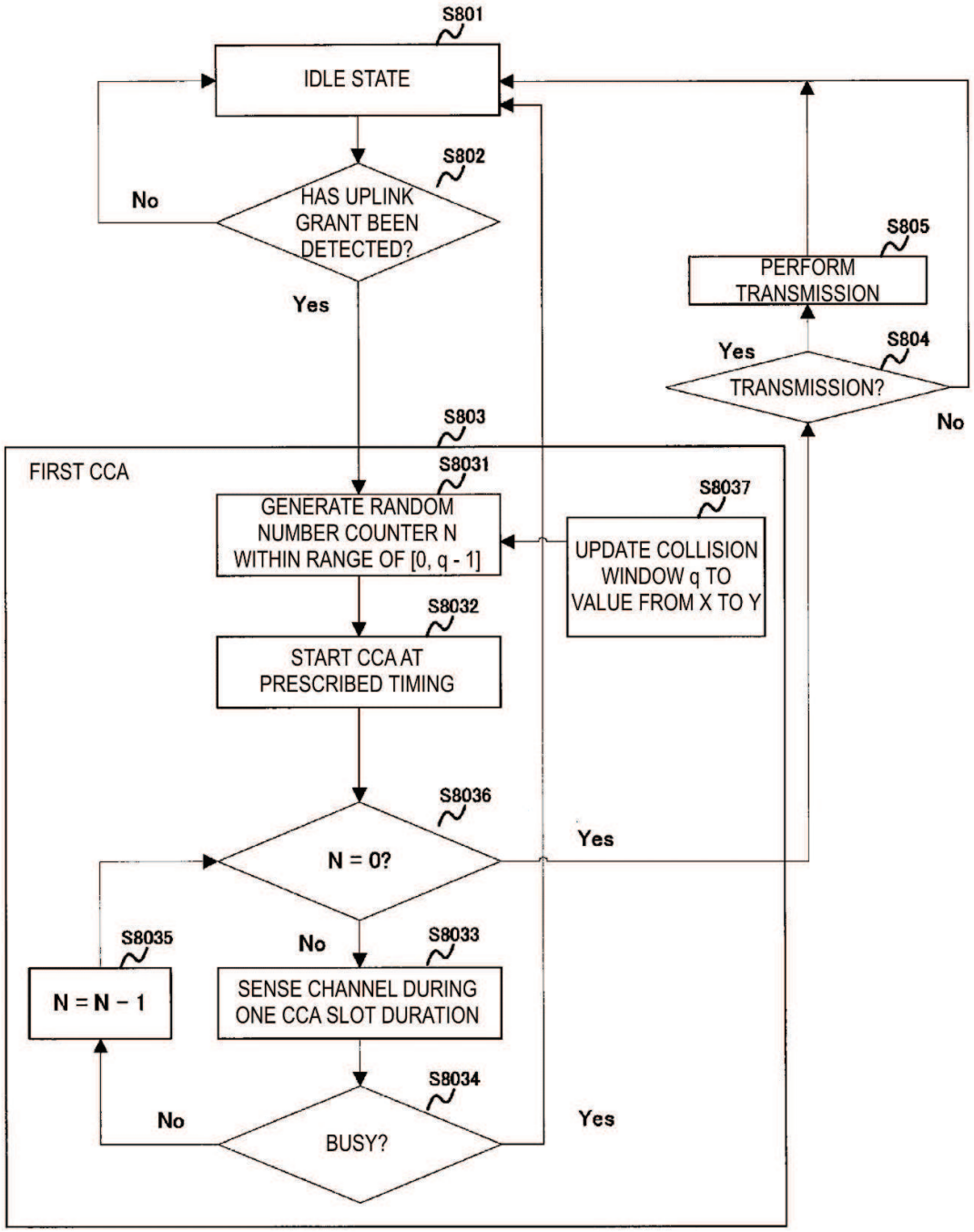
S801
IDLE STATE
S802
HAS UPLINK GRANT BEEN DETECTED?
No
Yes
S805
PERFORM TRANSMISSION
Yes
S804
TRANSMISSION?
No
S803
FIRST CCA
S8031
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
S8037
UPDATE COLLISION WINDOW q TO VALUE FROM X TO Y
S8032
START CCA AT PRESCRIBED TIMING
S8036
N = 0?
Yes
No
S8035
N = N − 1
S8033
SENSE CHANNEL DURING ONE CCA SLOT DURATION
S8034
BUSY?
No
Yes

FIG. 8

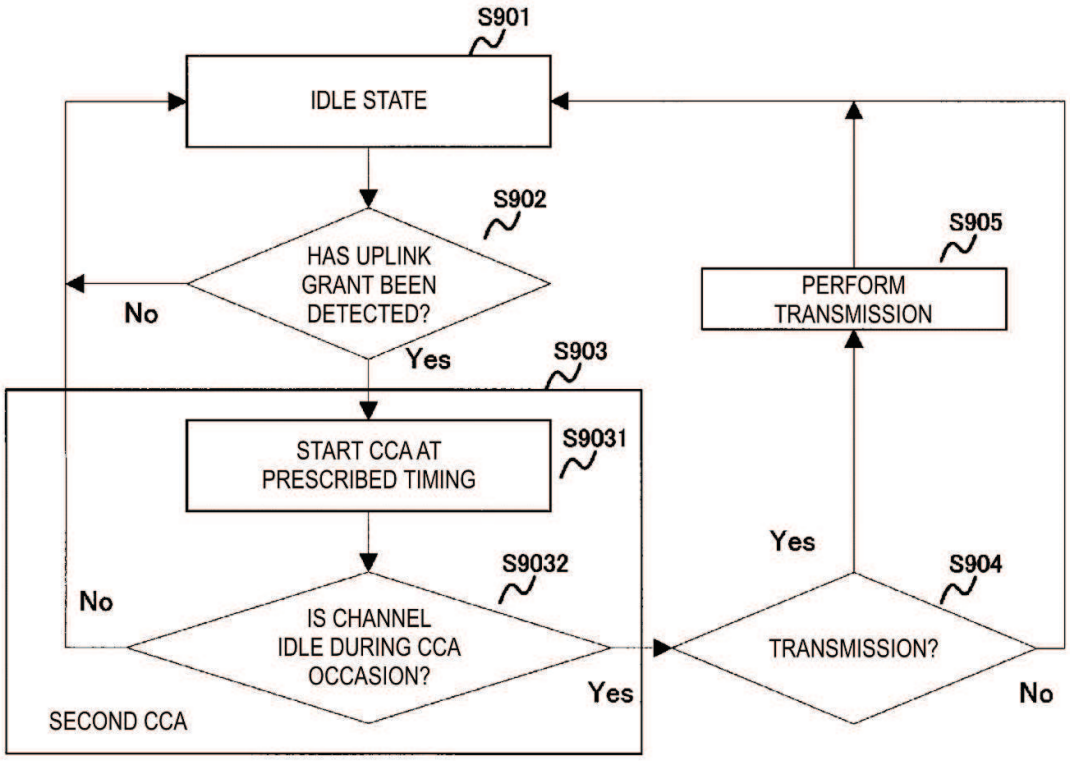
S901
IDLE STATE
S902
HAS UPLINK GRANT BEEN DETECTED?
No
Yes
S903
START CCA AT PRESCRIBED TIMING
S9031
S9032
IS CHANNEL IDLE DURING CCA OCCASION?
No
Yes
SECOND CCA
S905
PERFORM TRANSMISSION
Yes
S904
TRANSMISSION?
No

FIG. 9

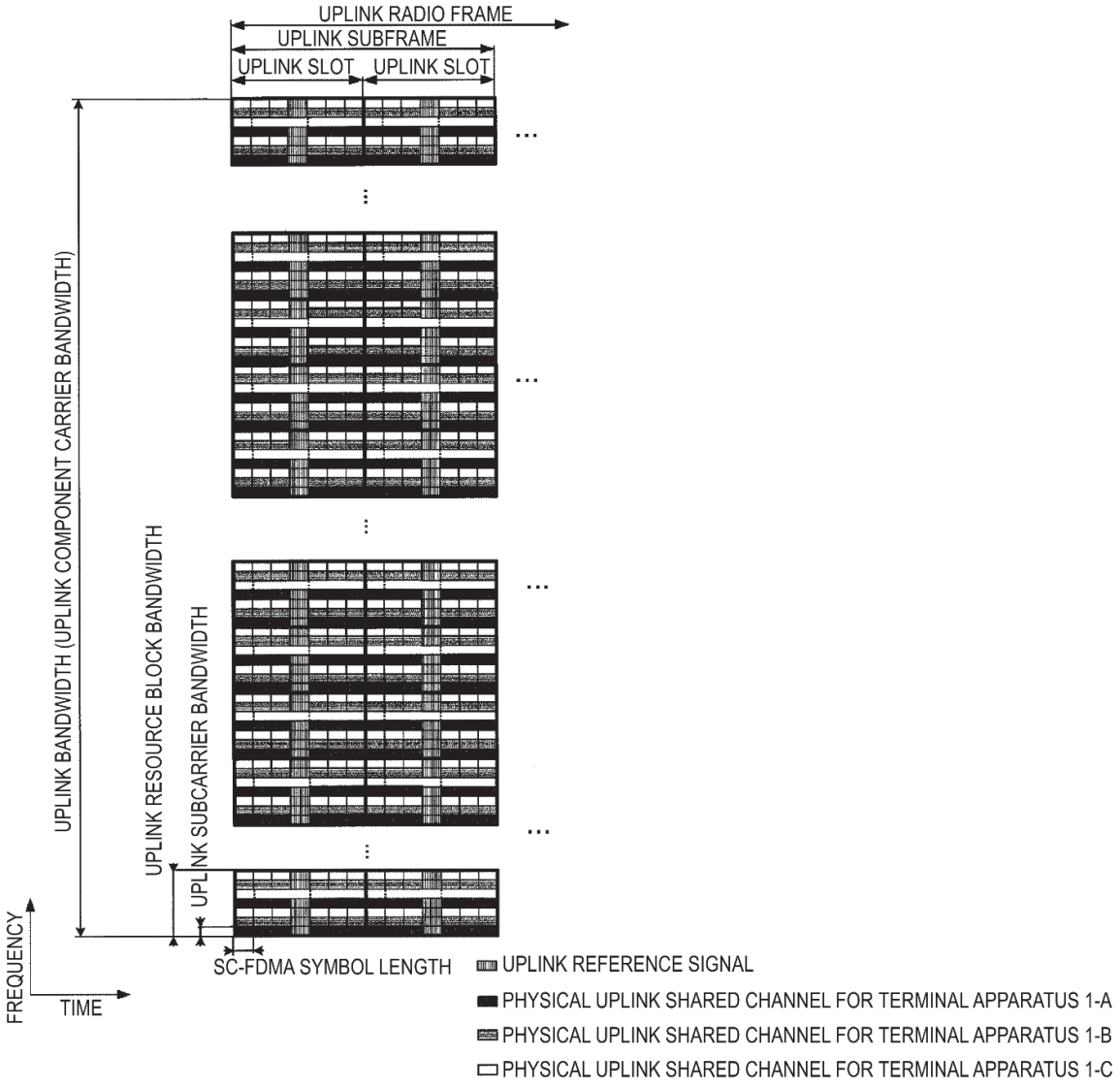
UPLINK RADIO FRAME
UPLINK SUBFRAME
UPLINK SLOT
UPLINK SLOT
UPLINK BANDWIDTH (UPLINK COMPONENT CARRIER BANDWIDTH)
UPLINK RESOURCE BLOCK BANDWIDTH
UPLINK SUBCARRIER BANDWIDTH
SC-FDMA SYMBOL LENGTH
FREQUENCY
TIME
UPLINK REFERENCE SIGNAL
PHYSICAL UPLINK SHARED CHANNEL FOR TERMINAL APPARATUS 1-A
PHYSICAL UPLINK SHARED CHANNEL FOR TERMINAL APPARATUS 1-B
PHYSICAL UPLINK SHARED CHANNEL FOR TERMINAL APPARATUS 1-C

FIG. 10

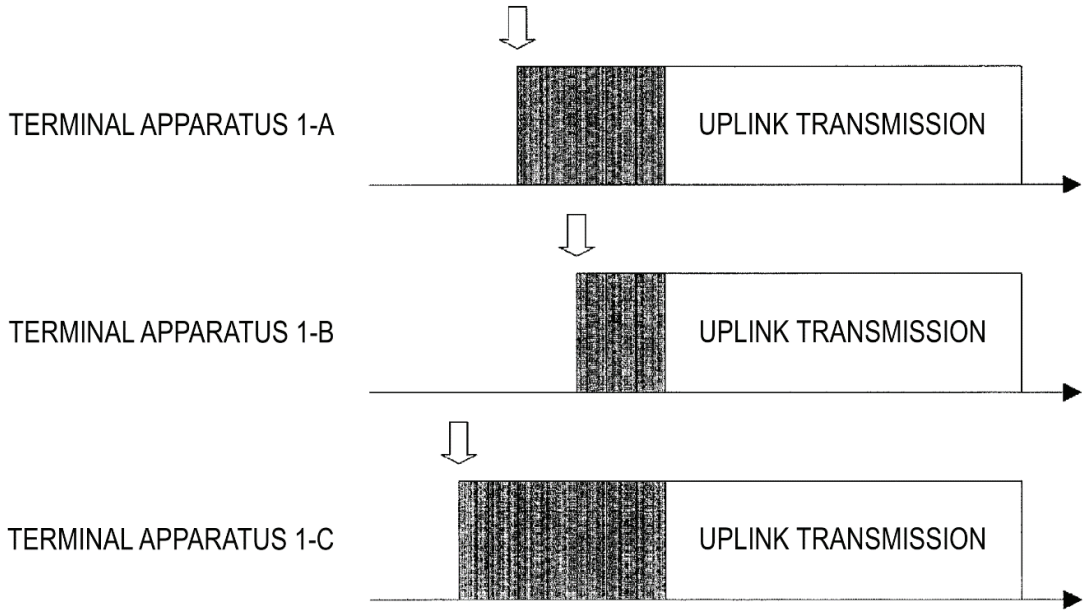
TERMINAL APPARATUS 1-A
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-B
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-C
UPLINK TRANSMISSION
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR FIRST UPLINK LBT

FIG. 11

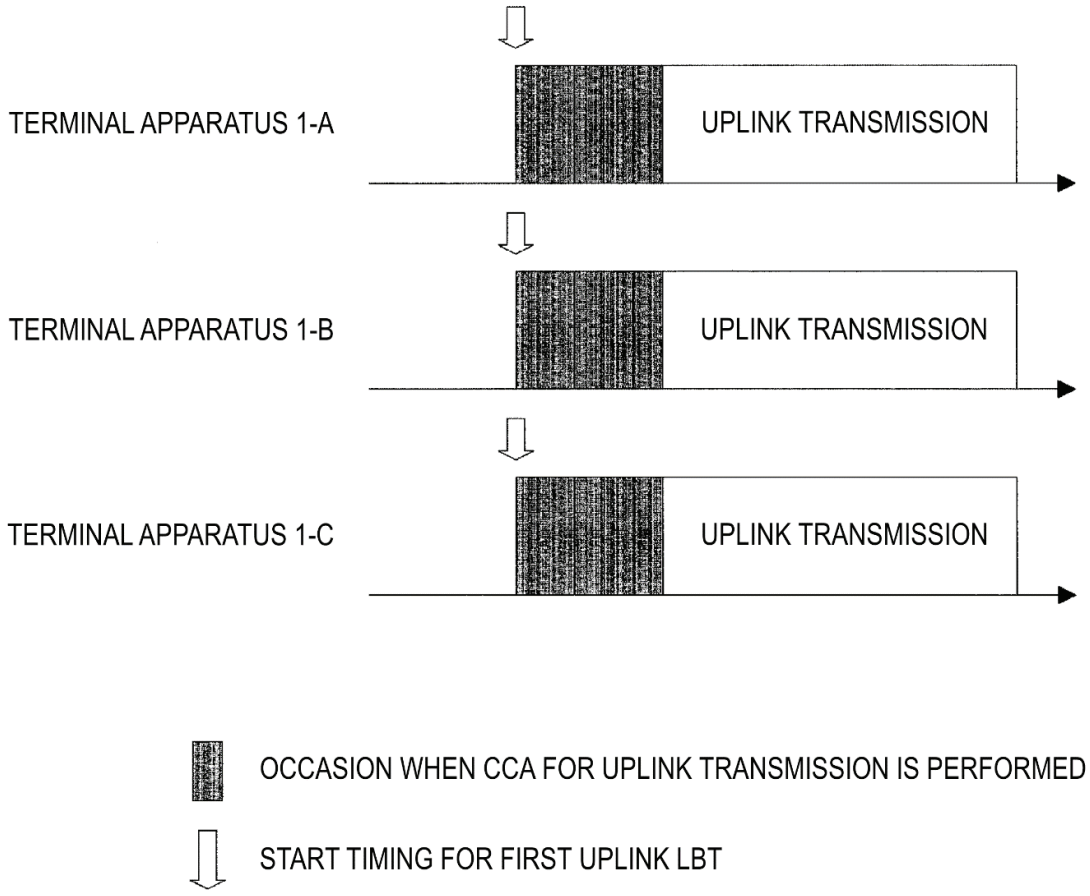
TERMINAL APPARATUS 1-A
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-B
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-C
UPLINK TRANSMISSION
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR FIRST UPLINK LBT

FIG. 12

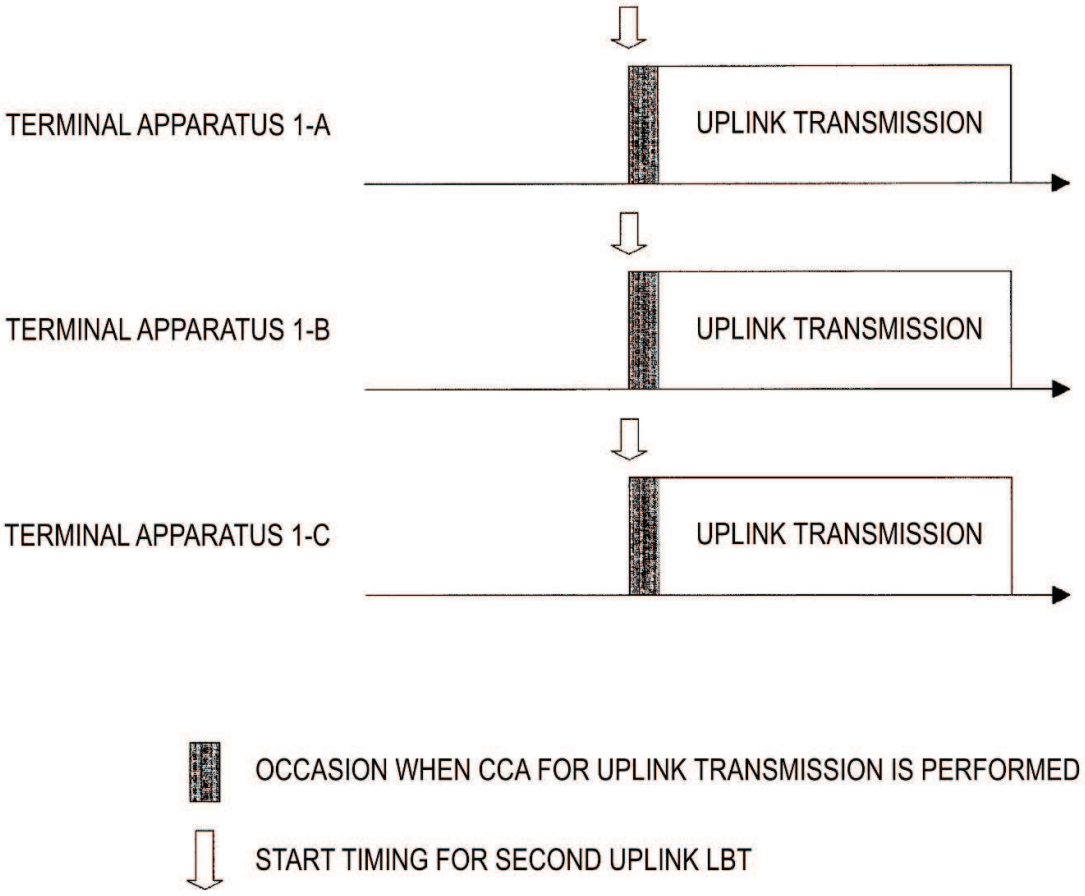
TERMINAL APPARATUS 1-A
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-B
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-C
UPLINK TRANSMISSION
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR SECOND UPLINK LBT

FIG. 13

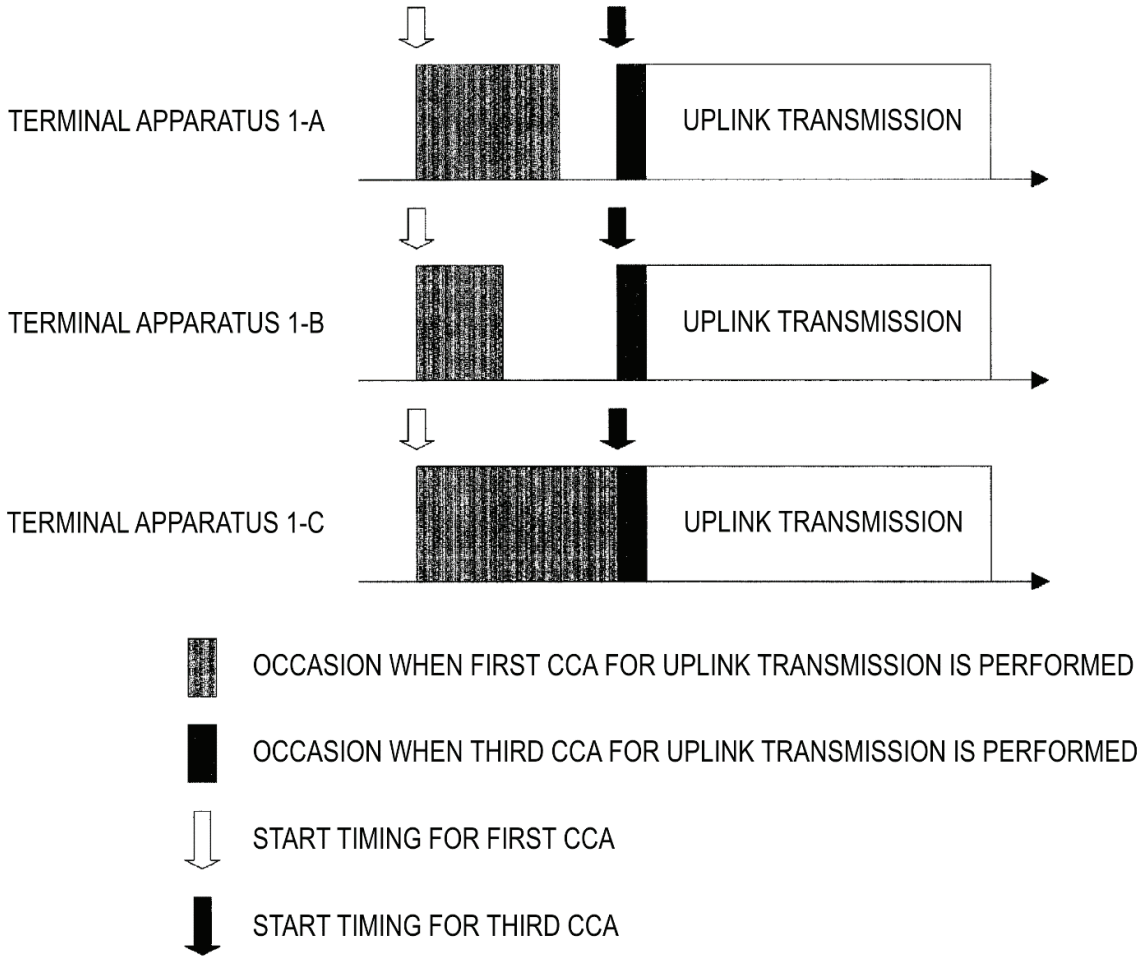
TERMINAL APPARATUS 1-A
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-B
UPLINK TRANSMISSION
TERMINAL APPARATUS 1-C
UPLINK TRANSMISSION
OCCASION WHEN FIRST CCA FOR UPLINK TRANSMISSION IS PERFORMED
OCCASION WHEN THIRD CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR FIRST CCA
START TIMING FOR THIRD CCA

FIG. 14

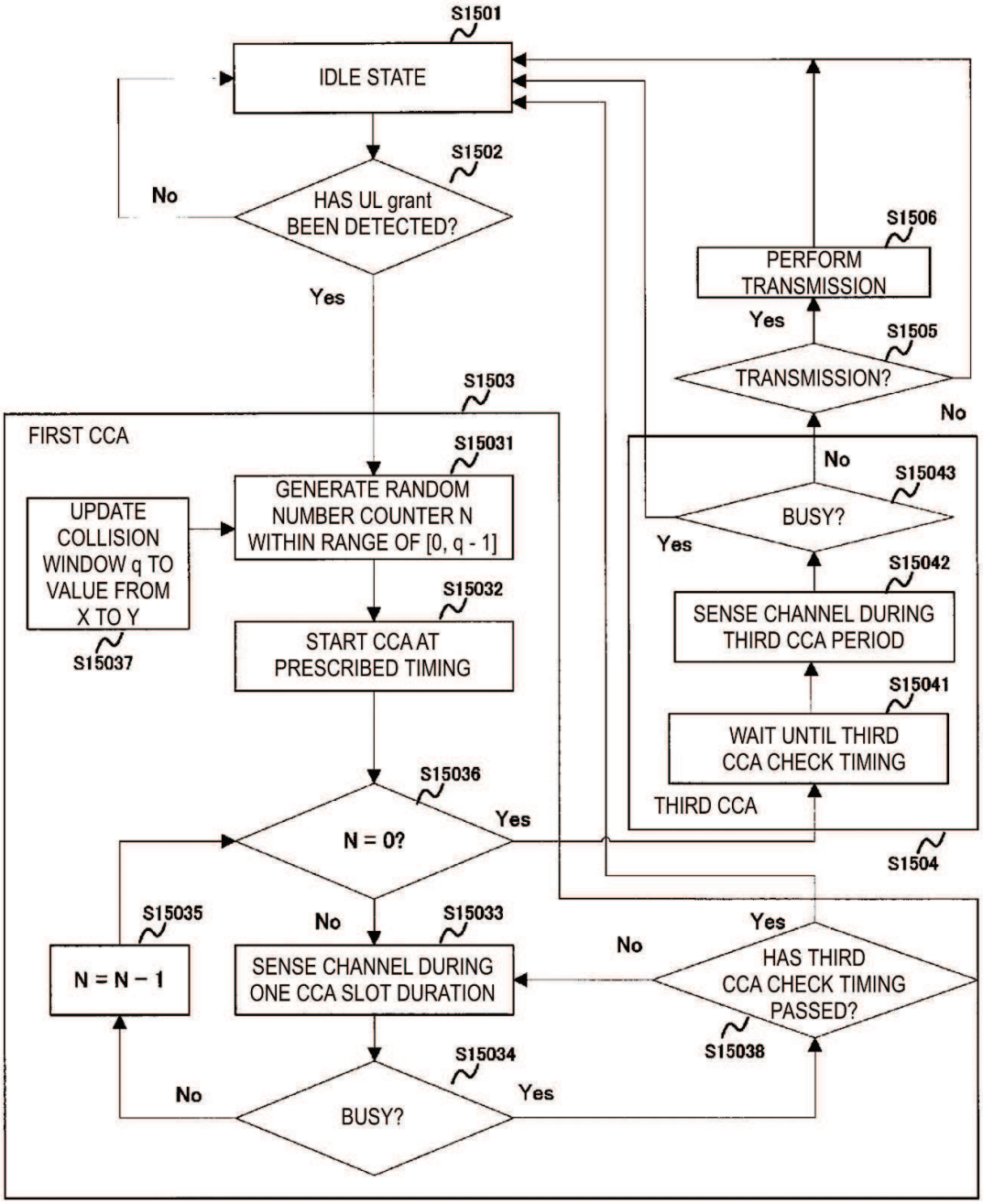
S1501
IDLE STATE
S1502
HAS UL grant BEEN DETECTED?
No
Yes
S1503
FIRST CCA
S15031
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
UPDATE COLLISION WINDOW q TO VALUE FROM X TO Y
S15037
S15032
START CCA AT PRESCRIBED TIMING
S15036
N = 0?
Yes
No
S15035
N = N - 1
S15033
SENSE CHANNEL DURING ONE CCA SLOT DURATION
S15034
BUSY?
No
Yes
S1504
THIRD CCA
S15041
WAIT UNTIL THIRD CCA CHECK TIMING
S15042
SENSE CHANNEL DURING THIRD CCA PERIOD
S15043
BUSY?
No
Yes
S15038
HAS THIRD CCA CHECK TIMING PASSED?
No
Yes
S1505
TRANSMISSION?
No
Yes
S1506
PERFORM TRANSMISSION

FIG. 15

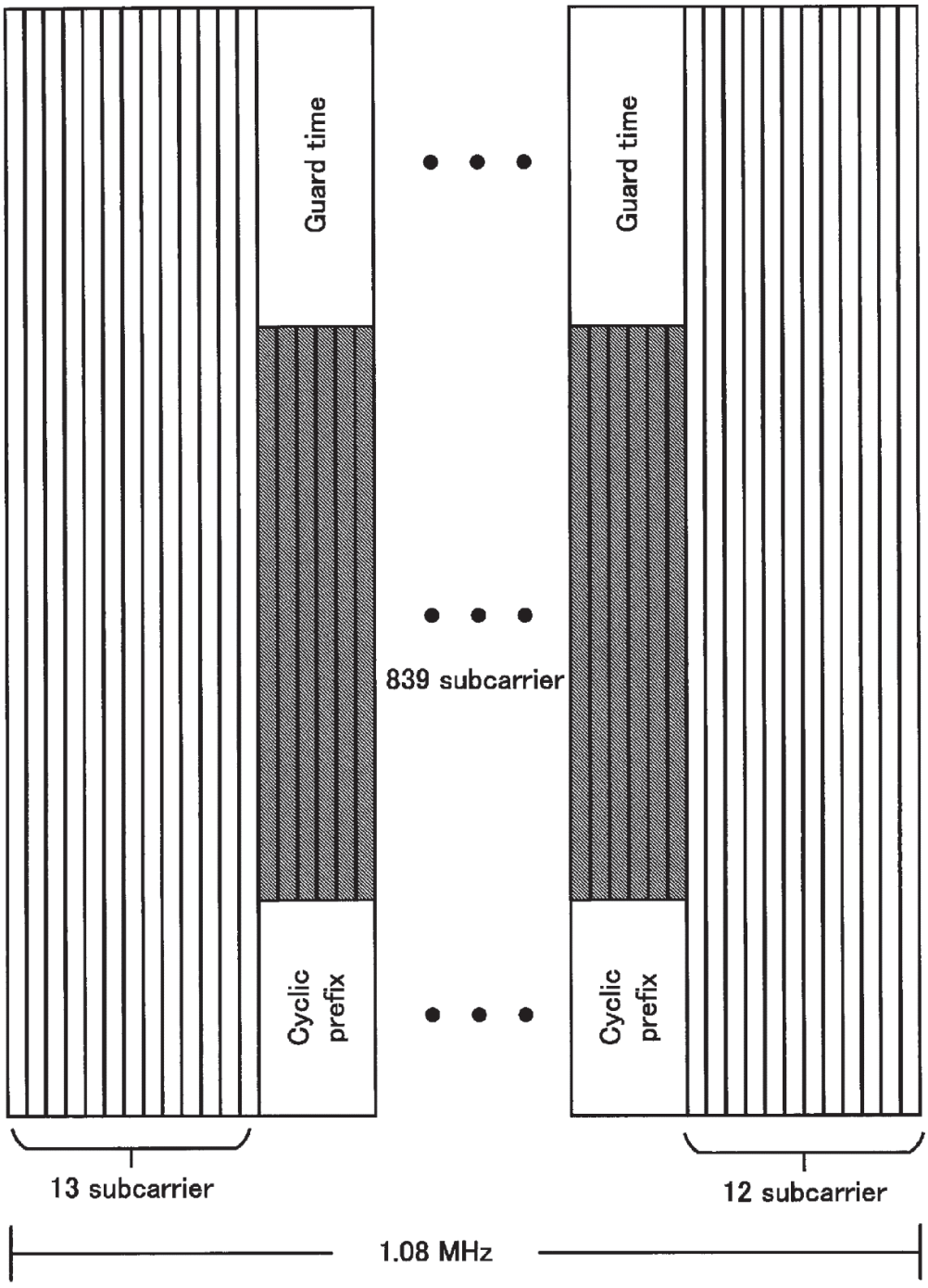
Guard time
Guard time
839 subcarrier
Cyclic prefix
Cyclic prefix
13 subcarrier
12 subcarrier
1.08 MHz

FIG. 16

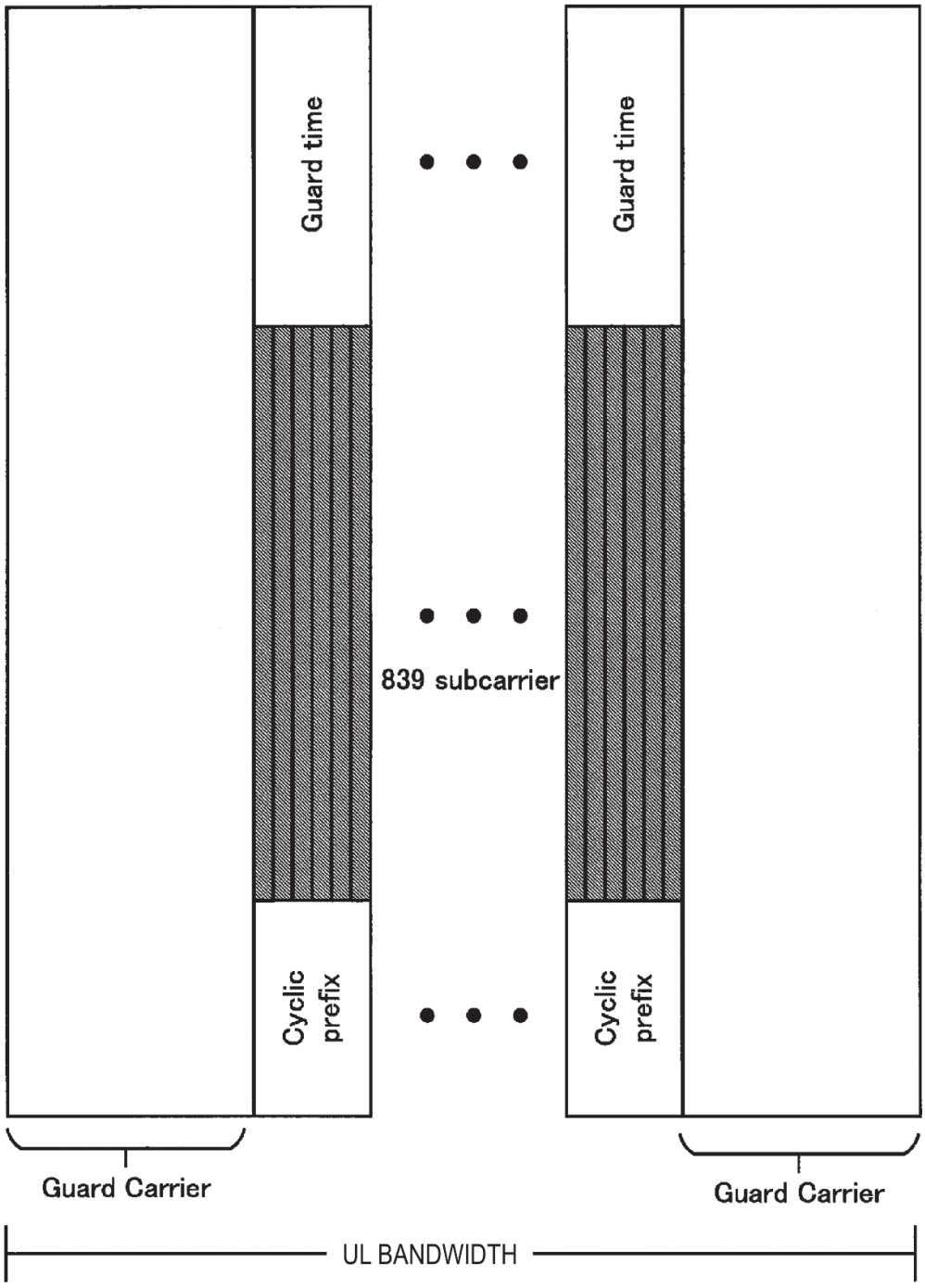
Guard time
Guard time
839 subcarrier
Cyclic prefix
Cyclic prefix
Guard Carrier
Guard Carrier
UL BANDWIDTH

FIG. 17

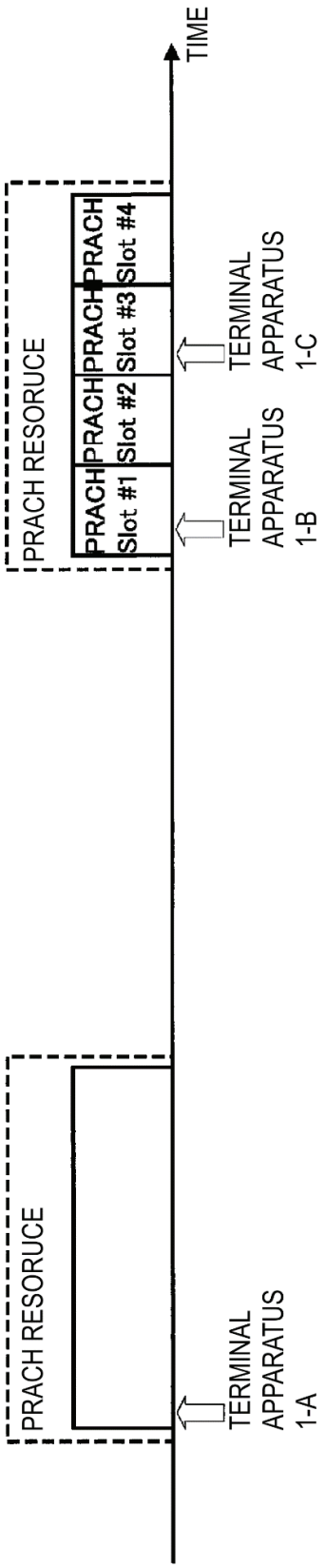
TIME
PRACH RESORUCE
PRACH Slot #1
PRACH Slot #2
PRACH Slot #3
PRACH Slot #4
TERMINAL APPARATUS 1-A
TERMINAL APPARATUS 1-B
TERMINAL APPARATUS 1-C

FIG. 18

PRACH Mask Index	Allowed PRACH (FDD)	Allowed PRACH (TDD)
0	All	All
1	PRACH Resource Index 0	PRACH Resource Index 0
2	PRACH Resource Index 1	PRACH Resource Index 1
3	PRACH Resource Index 2	PRACH Resource Index 2
4	PRACH Resource Index 3	PRACH Resource Index 3
5	PRACH Resource Index 4	PRACH Resource Index 4
6	PRACH Resource Index 5	PRACH Resource Index 5
7	PRACH Resource Index 6	Reserved
8	PRACH Resource Index 7	Reserved
9	PRACH Resource Index 8	Reserved
10	PRACH Resource Index 9	Reserved
11	Every, in the time domain, even PRACH opportunity fitst PRACH resource index in subframe	Every, in the time domain, even PRACH opportunity fitst PRACH resource index in subframe
12	Every, in the time domain, odd PRACH opportunity fitst PRACH resource index in subframe	Every, in the time domain, odd PRACH opportunity fitst PRACH resource index in subframe
13	Reserved	First PRACH resource index in subframe
14	Reserved	Second PRACH resource index in subframe
15	Reserved	Third PRACH resource index in subframe

FIG. 19

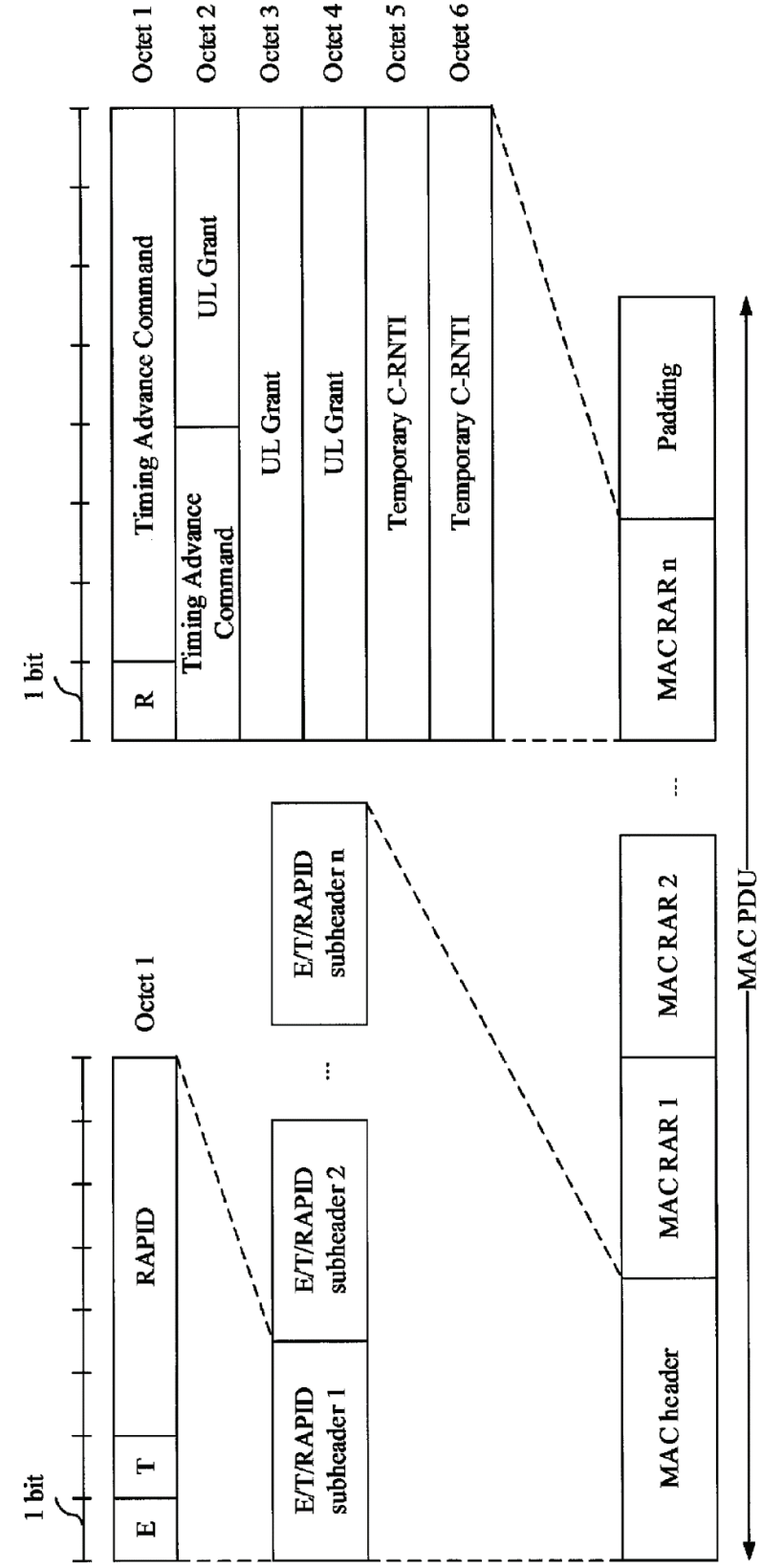
1 bit
E
T
RAPID
Octet 1
E/T/RAPID subheader 1
E/T/RAPID subheader 2
...
E/T/RAPID subheader n
MAC header
MAC RAR 1
MAC RAR 2
...
MAC RAR n
Padding
MAC PDU
1 bit
R
Timing Advance Command
Octet 1
Timing Advance Command
UL Grant
Octet 2
UL Grant
Octet 3
UL Grant
Octet 4
Temporary C-RNTI
Octet 5
Temporary C-RNTI
Octet 6

FIG. 20

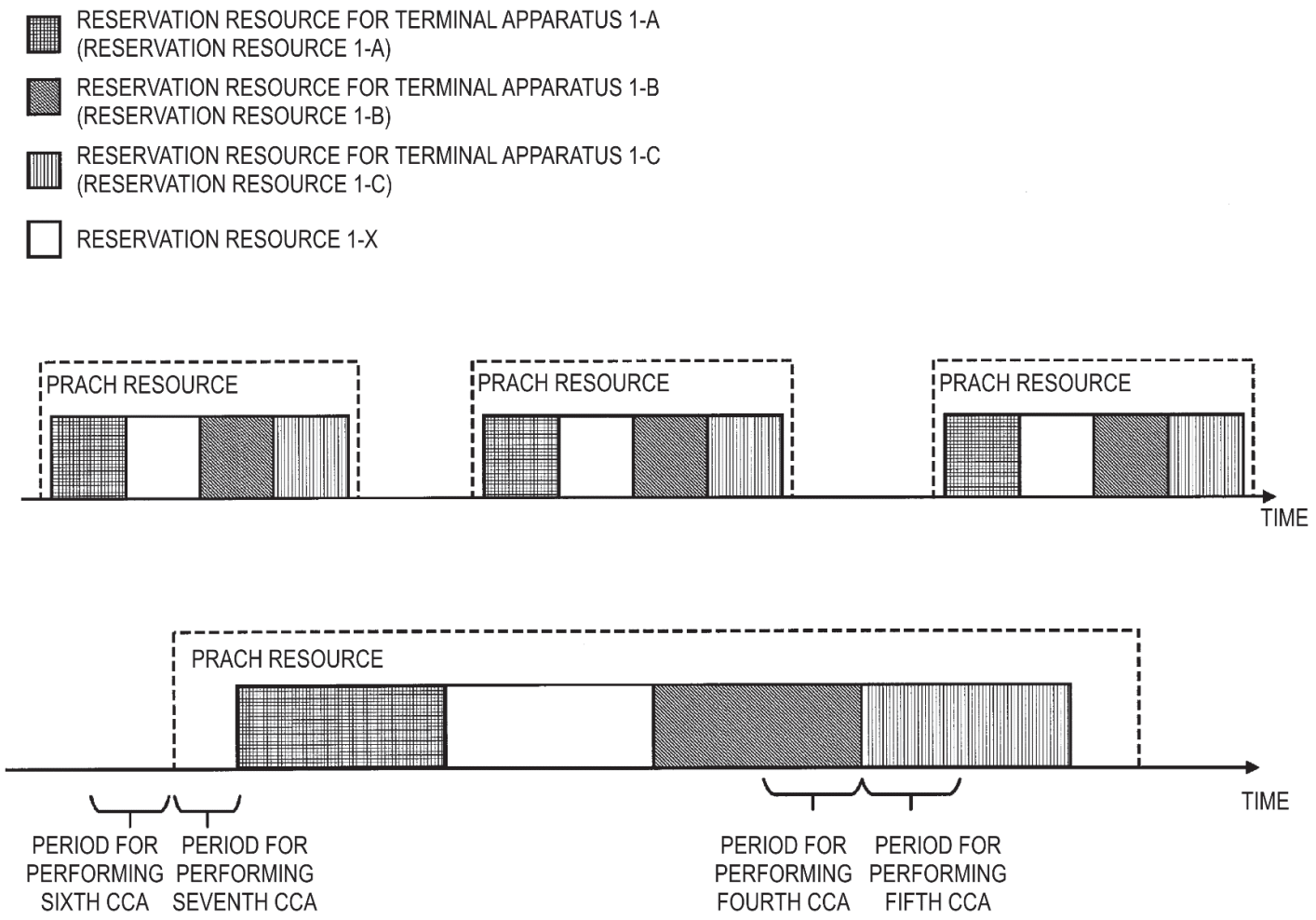
RESERVATION RESOURCE FOR TERMINAL APPARATUS 1-A
(RESERVATION RESOURCE 1-A)
RESERVATION RESOURCE FOR TERMINAL APPARATUS 1-B
(RESERVATION RESOURCE 1-B)
RESERVATION RESOURCE FOR TERMINAL APPARATUS 1-C
(RESERVATION RESOURCE 1-C)
RESERVATION RESOURCE 1-X
PRACH RESOURCE
PRACH RESOURCE
PRACH RESOURCE
TIME
PRACH RESOURCE
TIME
PERIOD FOR PERFORMING SIXTH CCA
PERIOD FOR PERFORMING SEVENTH CCA
PERIOD FOR PERFORMING FOURTH CCA
PERIOD FOR PERFORMING FIFTH CCA

FIG. 21