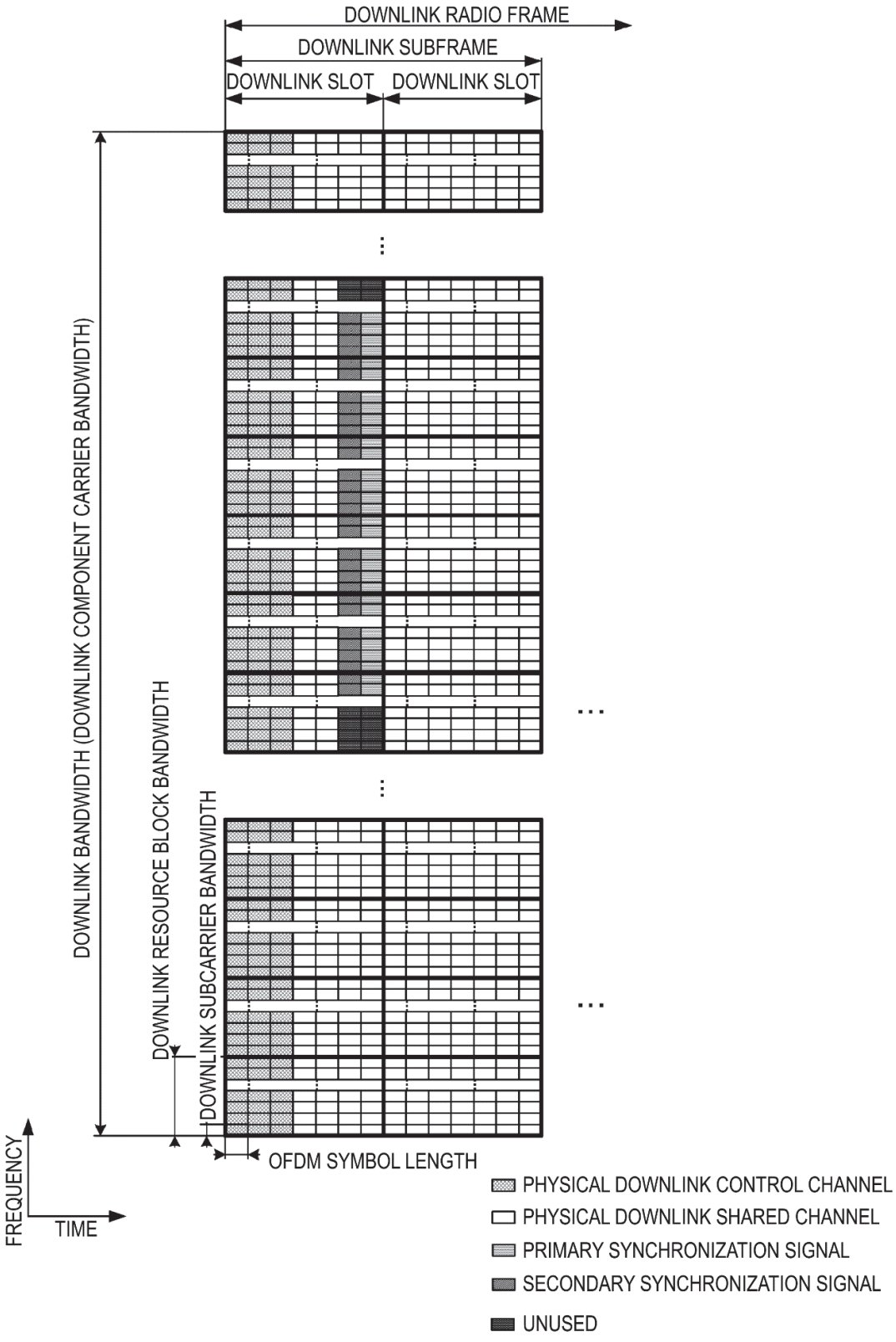
DOWNLINK RADIO FRAME
DOWNLINK SUBFRAME
DOWNLINK SLOT
DOWNLINK SLOT
DOWNLINK BANDWIDTH (DOWNLINK COMPONENT CARRIER BANDWIDTH)
DOWNLINK RESOURCE BLOCK BANDWIDTH
DOWNLINK SUBCARRIER BANDWIDTH
OFDM SYMBOL LENGTH
FREQUENCY
TIME
PHYSICAL DOWNLINK CONTROL CHANNEL
PHYSICAL DOWNLINK SHARED CHANNEL
PRIMARY SYNCHRONIZATION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

FIG. 1

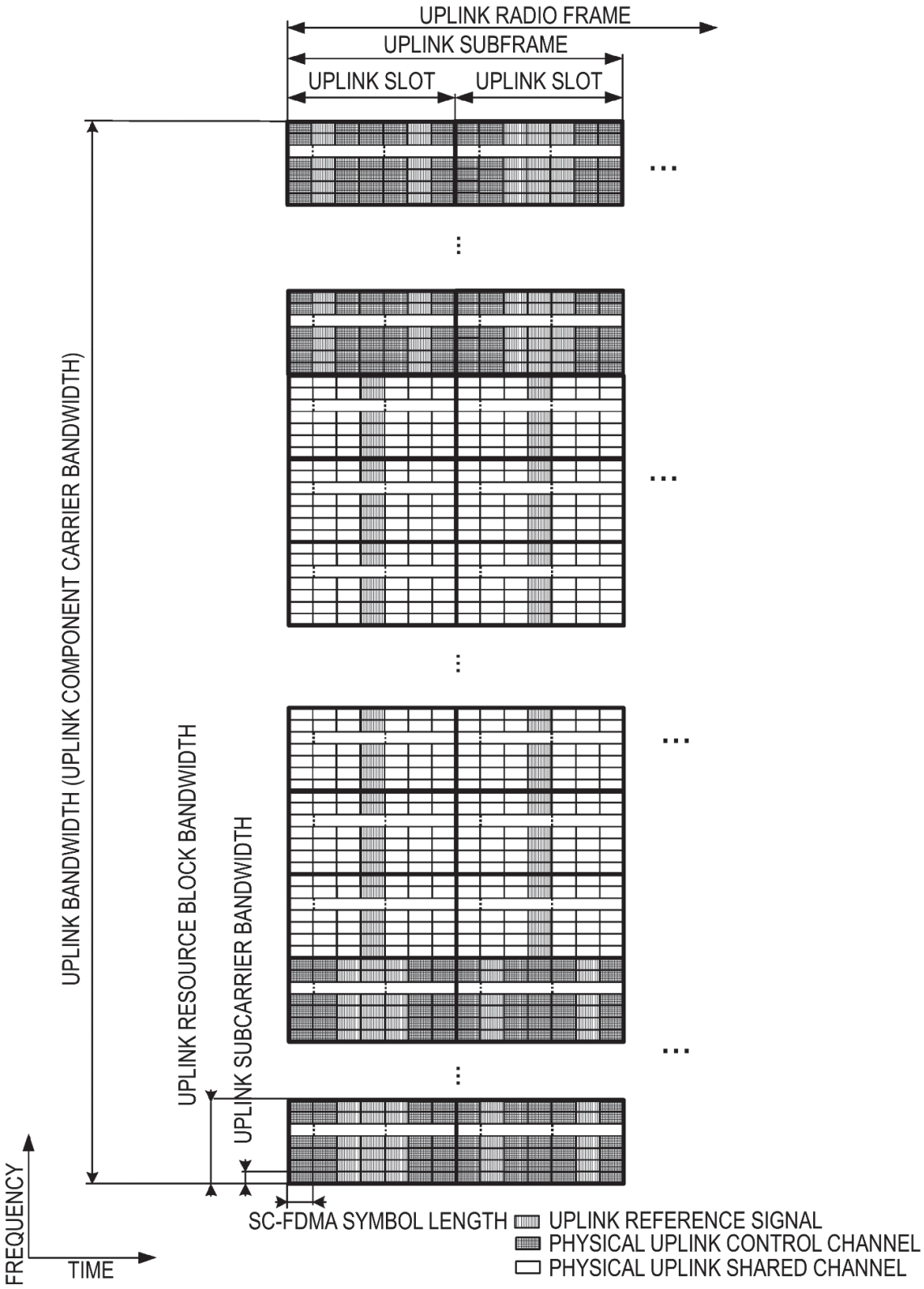
UPLINK RADIO FRAME
UPLINK SUBFRAME
UPLINK SLOT
UPLINK SLOT
UPLINK BANDWIDTH (UPLINK COMPONENT CARRIER BANDWIDTH)
UPLINK RESOURCE BLOCK BANDWIDTH
UPLINK SUBCARRIER BANDWIDTH
SC-FDMA SYMBOL LENGTH
FREQUENCY
TIME
UPLINK REFERENCE SIGNAL
PHYSICAL UPLINK CONTROL CHANNEL
PHYSICAL UPLINK SHARED CHANNEL

FIG. 2

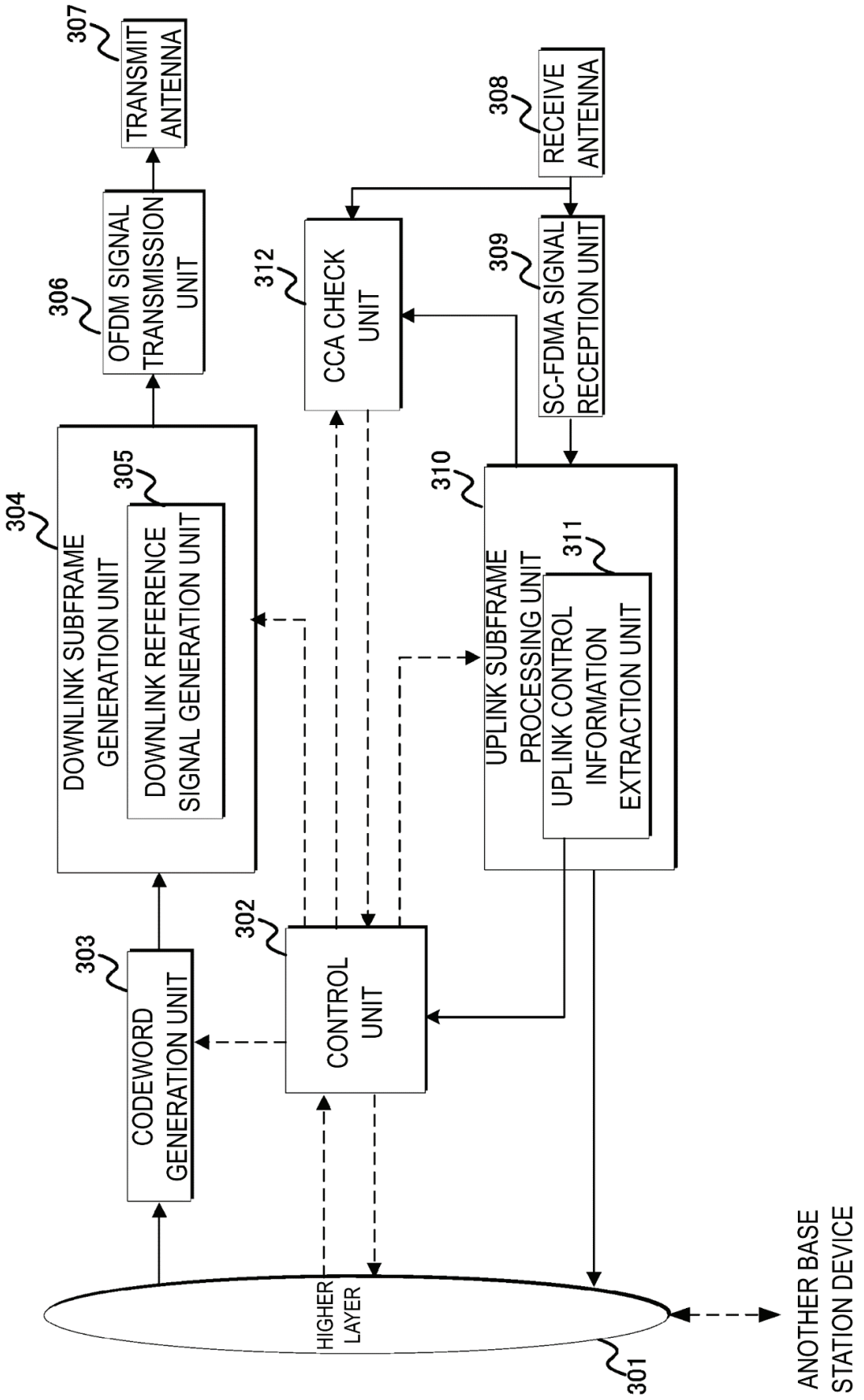
307
TRANSMIT ANTENNA
308
RECEIVE ANTENNA
306
OFDM SIGNAL TRANSMISSION UNIT
312
CCA CHECK UNIT
309
SC-FDMA SIGNAL RECEPTION UNIT
304
DOWNLINK SUBFRAME GENERATION UNIT
305
DOWNLINK REFERENCE SIGNAL GENERATION UNIT
310
UPLINK SUBFRAME PROCESSING UNIT
311
UPLINK CONTROL INFORMATION EXTRACTION UNIT
303
CODEWORD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

FIG. 3

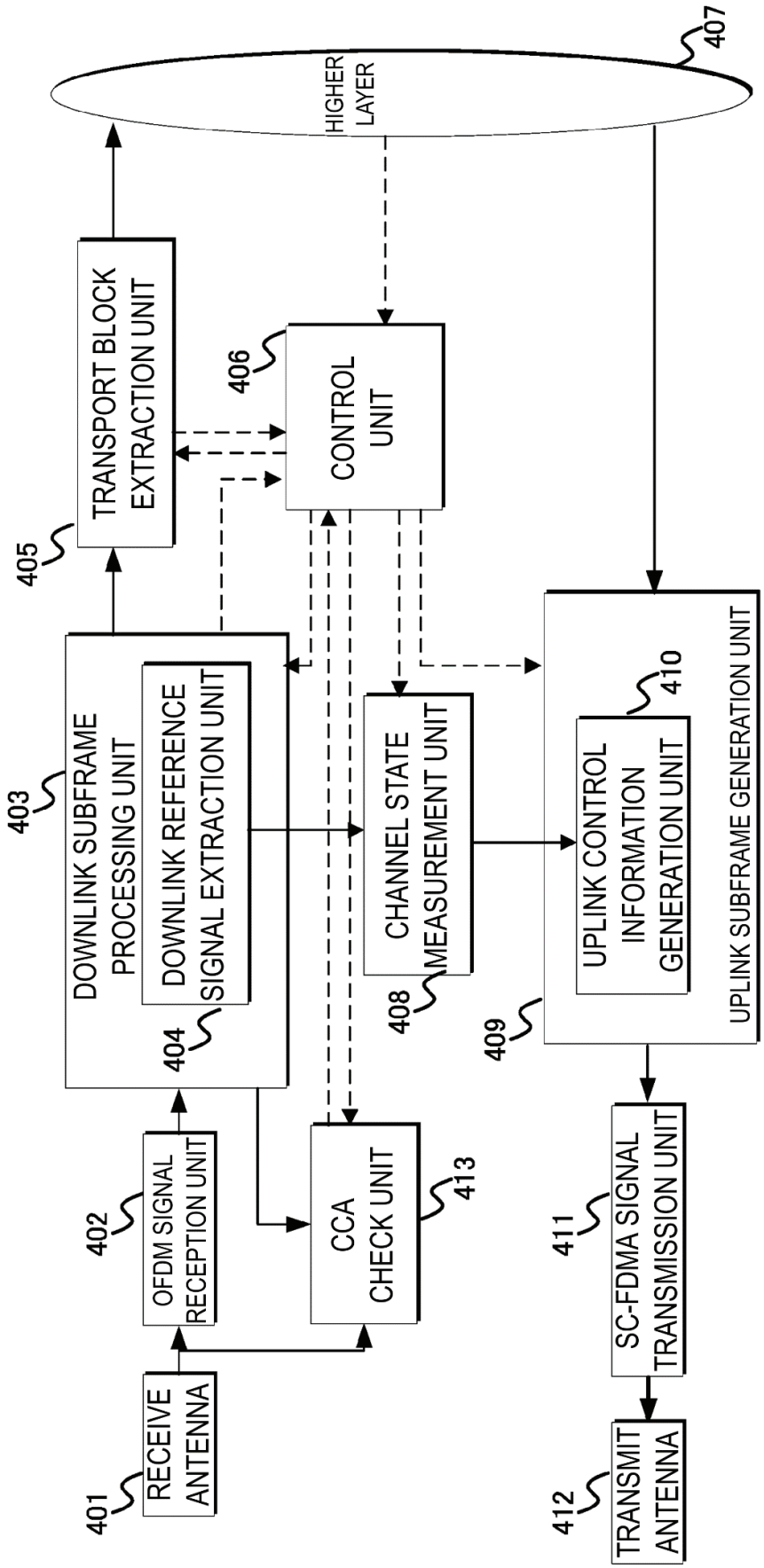
HIGHER LAYER
407
TRANSPORT BLOCK EXTRACTION UNIT
405
CONTROL UNIT
406
DOWNLINK SUBFRAME PROCESSING UNIT
403
DOWNLINK REFERENCE SIGNAL EXTRACTION UNIT
404
CHANNEL STATE MEASUREMENT UNIT
408
UPLINK SUBFRAME GENERATION UNIT
409
UPLINK CONTROL INFORMATION GENERATION UNIT
410
OFDM SIGNAL RECEPTION UNIT
402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

FIG. 4

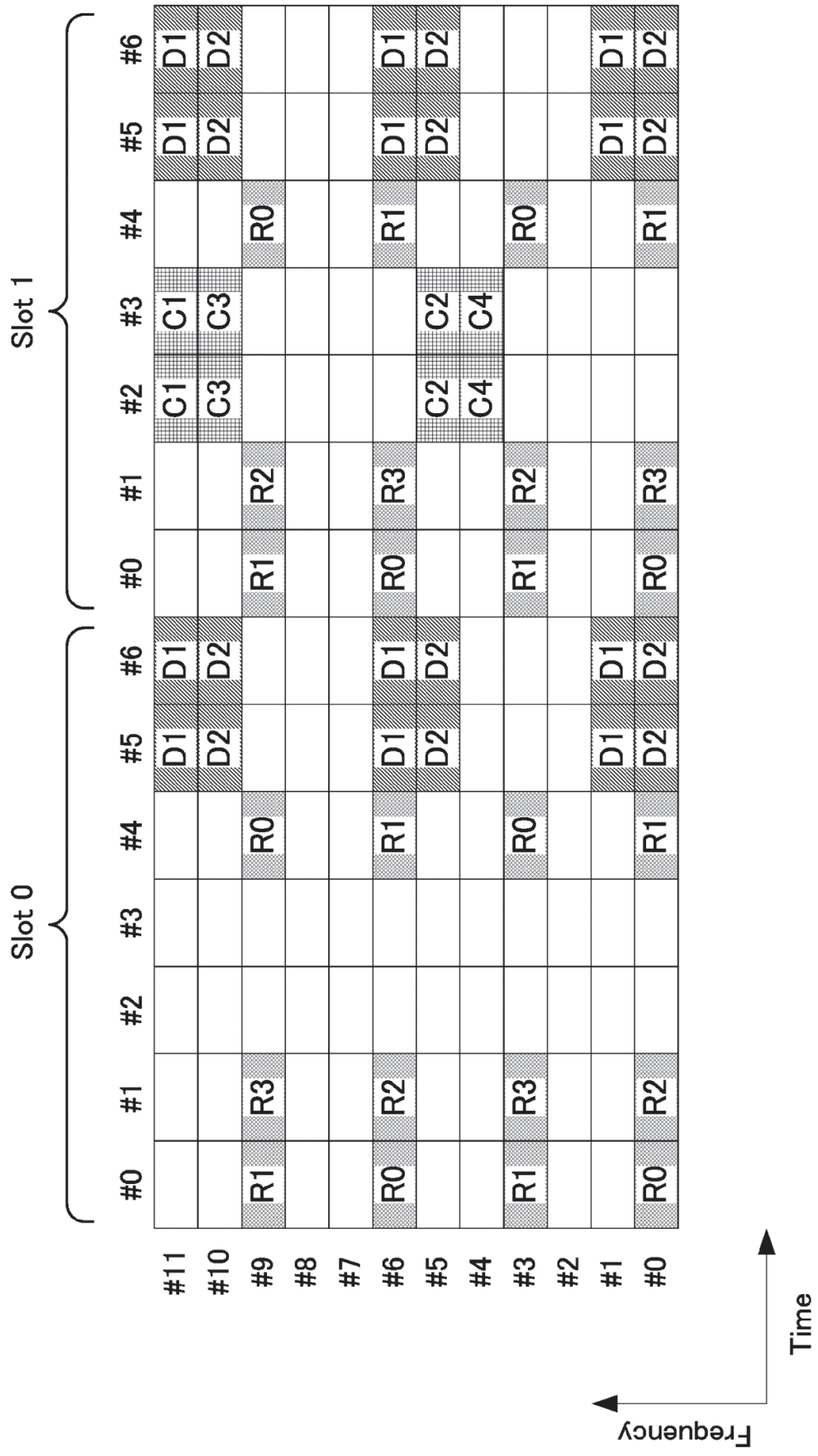

FIG. 5

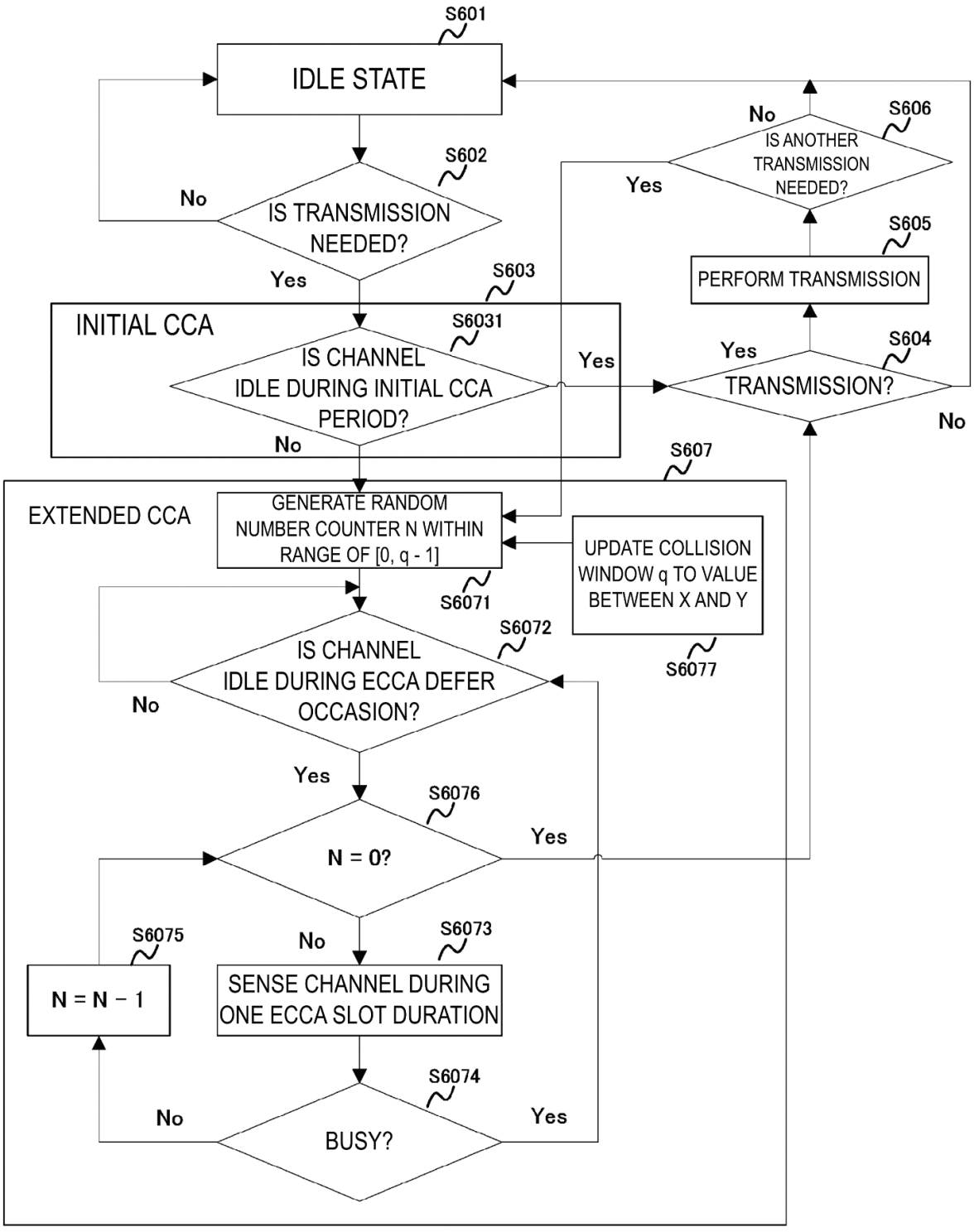
S601
IDLE STATE
S602
IS TRANSMISSION NEEDED?
No
Yes
S603
INITIAL CCA
S6031
IS CHANNEL IDLE DURING INITIAL CCA PERIOD?
Yes
No
S604
TRANSMISSION?
Yes
No
S605
PERFORM TRANSMISSION
S606
IS ANOTHER TRANSMISSION NEEDED?
No
Yes
S607
EXTENDED CCA
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
S6071
UPDATE COLLISION WINDOW q TO VALUE BETWEEN X AND 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

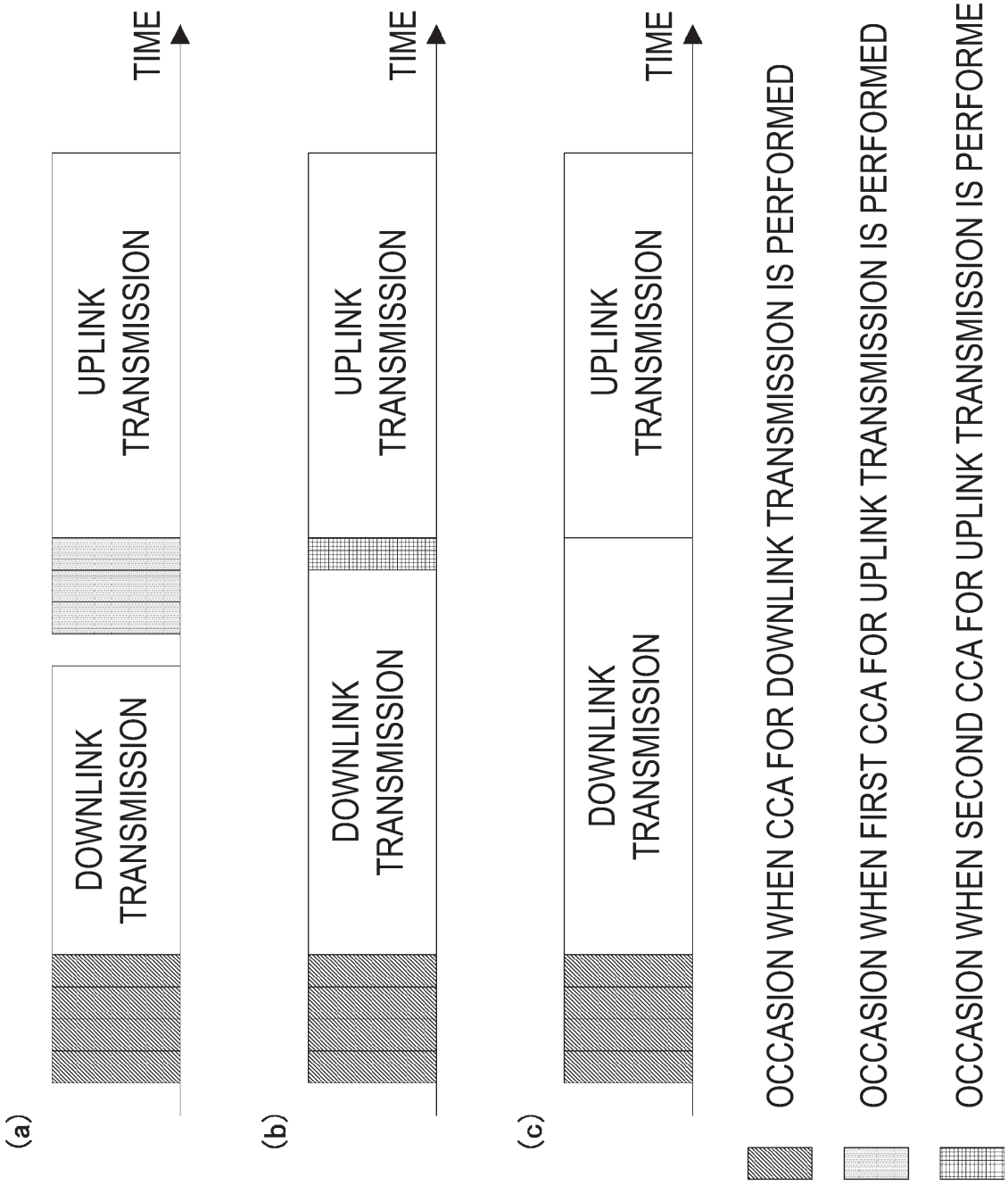
(a)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
(b)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
(c)
DOWNLINK TRANSMISSION
UPLINK TRANSMISSION
TIME
OCCASION WHEN CCA FOR DOWNLINK TRANSMISSION IS PERFORMED
OCCASION WHEN FIRST CCA FOR UPLINK TRANSMISSION IS PERFORMED
OCCASION WHEN SECOND CCA FOR UPLINK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

FIG. 7

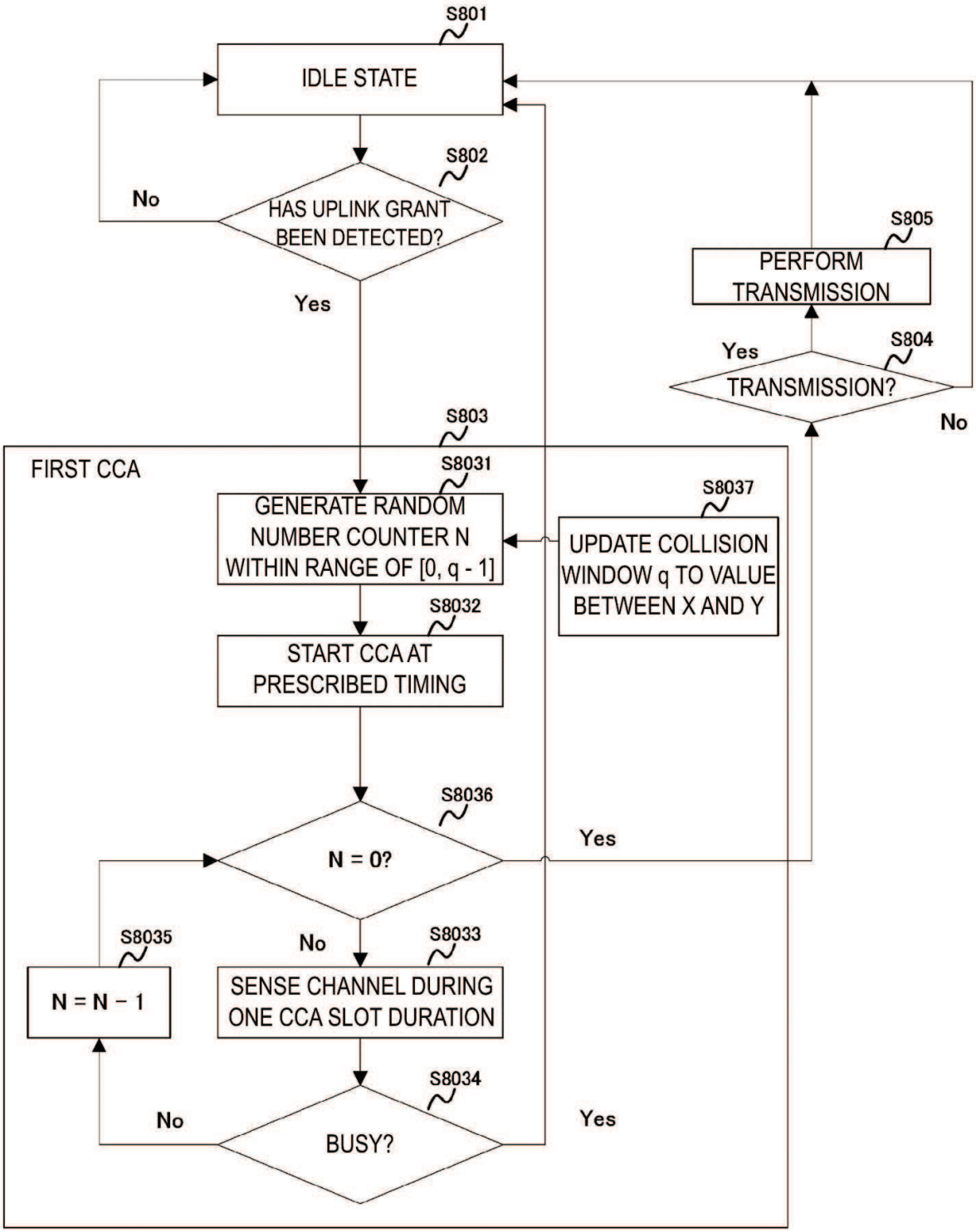
S801
IDLE STATE
S802
HAS UPLINK GRANT BEEN DETECTED?
No
Yes
S805
PERFORM TRANSMISSION
S804
TRANSMISSION?
Yes
No
S803
FIRST CCA
S8031
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
S8037
UPDATE COLLISION WINDOW q TO VALUE BETWEEN X AND Y
S8032
START CCA AT PRESCRIBED TIMING
S8036
N = 0?
Yes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

FIG. 8

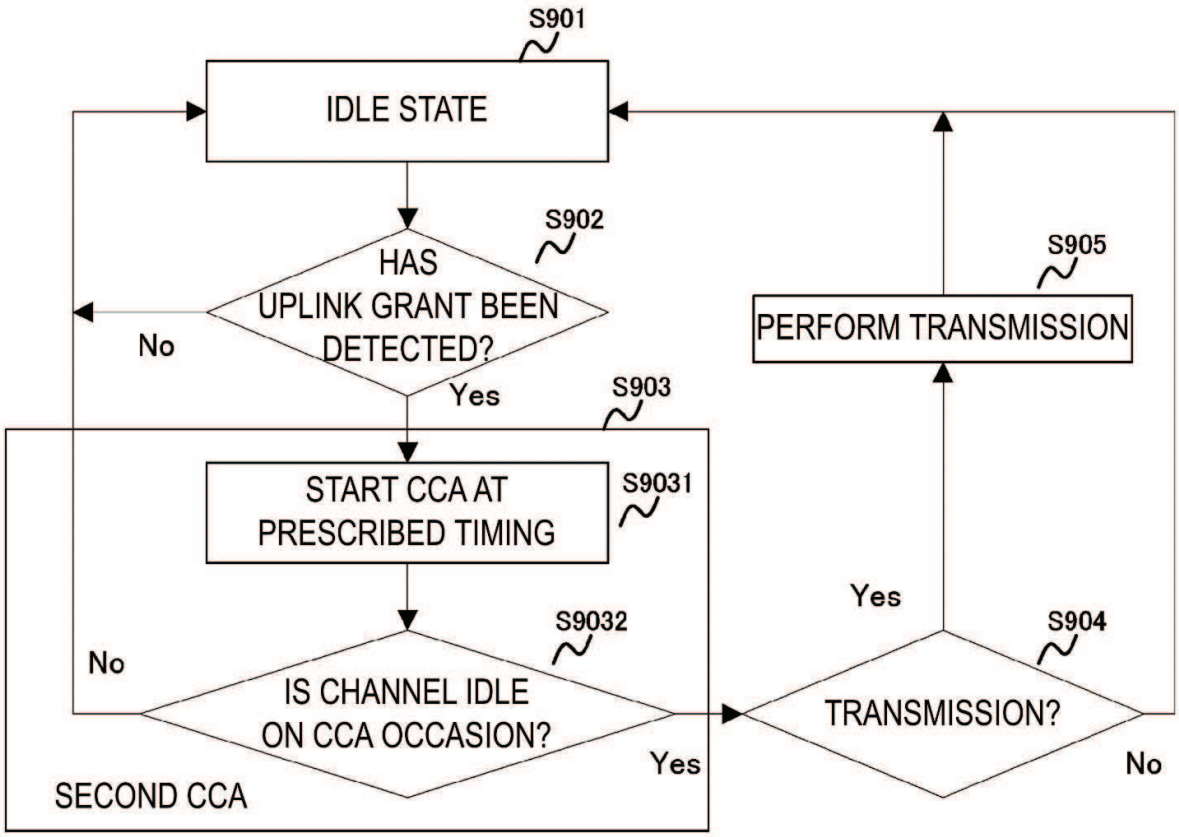
S901
IDLE STATE
S902
HAS UPLINK GRANT BEEN DETECTED?
No
Yes
S903
START CCA AT PRESCRIBED TIMING
S9031
S9032
No
IS CHANNEL IDLE ON CCA OCCASION?
Yes
SECOND CCA
Yes
S904
TRANSMISSION?
No
S905
PERFORM TRANSMISSION

FIG. 9

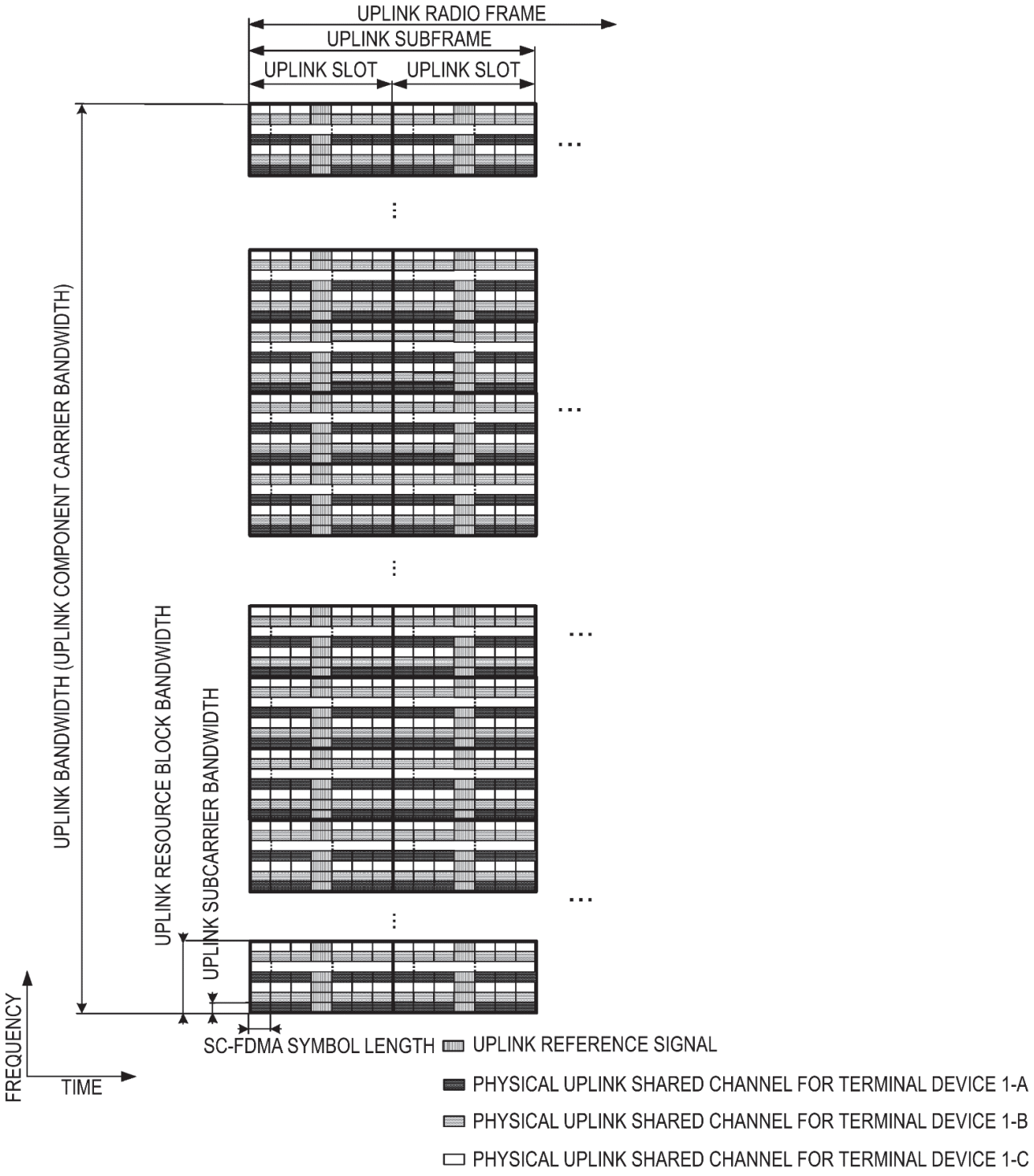
UPLINK RADIO FRAME
UPLINK SUBFRAME
UPLINK SLOT
UPLINK SLOT
UPLINK BANDWIDTH (UPLINK COMPONENT CARRIER BANDWIDTH)
UPLINK RESOURCE BLOCK BANDWIDTH
UPLINK SUBCARRIER BANDWIDTH
SC-FDMA SYMBOL LENGTH
FREQUENCY
TIME
UPLINK REFERENCE SIGNAL
PHYSICAL UPLINK SHARED CHANNEL FOR TERMINAL DEVICE 1-A
PHYSICAL UPLINK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

FIG. 10

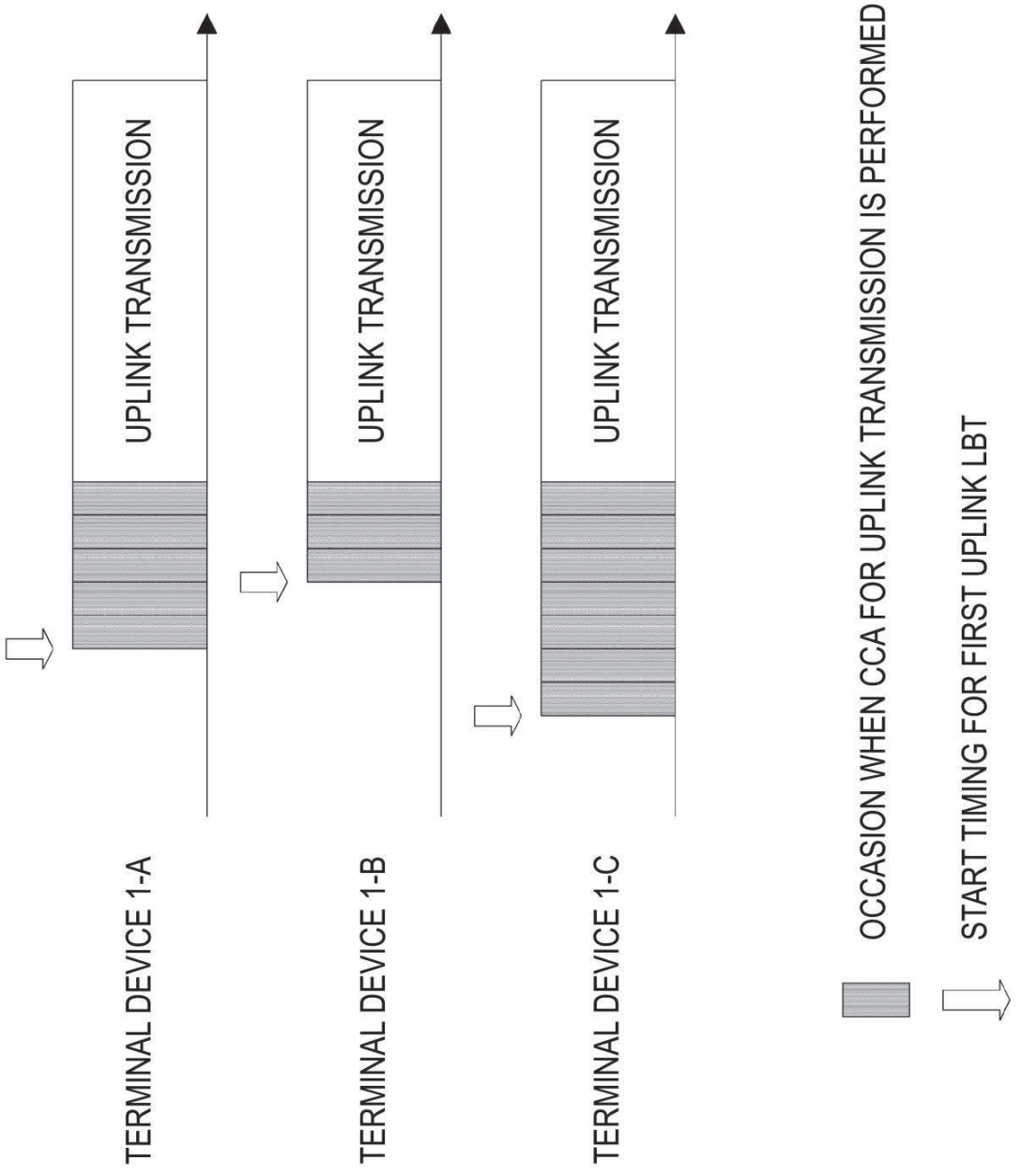
UPLINK TRANSMISSION
UPLINK TRANSMISSION
UPLINK TRANSMISSION
TERMINAL DEVICE 1-A
TERMINAL DEVICE 1-B
TERMINAL DEVICE 1-C
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR FIRST UPLINK LBT

FIG. 11

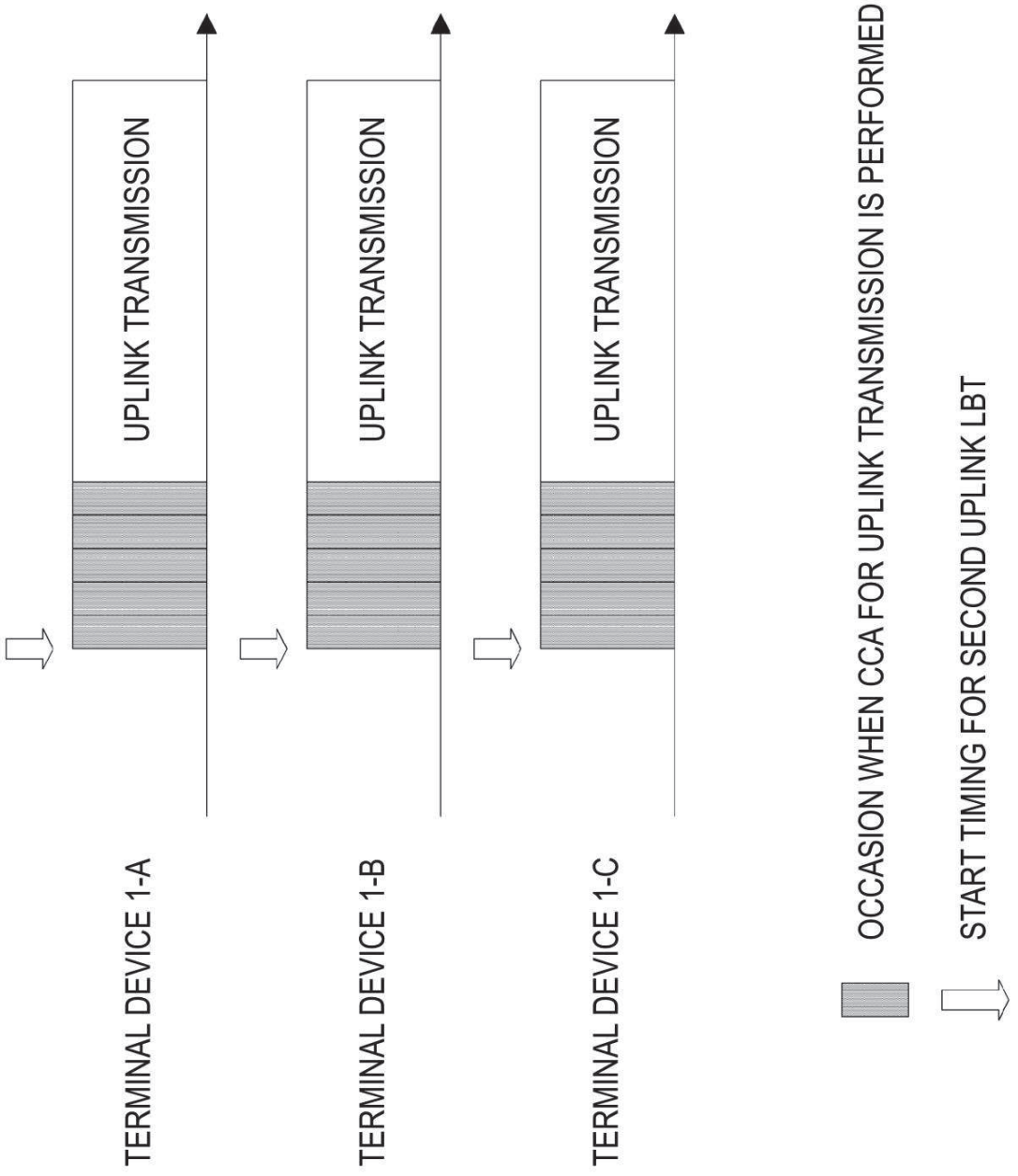
TERMINAL DEVICE 1-A
TERMINAL DEVICE 1-B
TERMINAL DEVICE 1-C
UPLINK TRANSMISSION
UPLINK TRANSMISSION
UPLINK TRANSMISSION
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR SECOND UPLINK LBT

FIG. 12

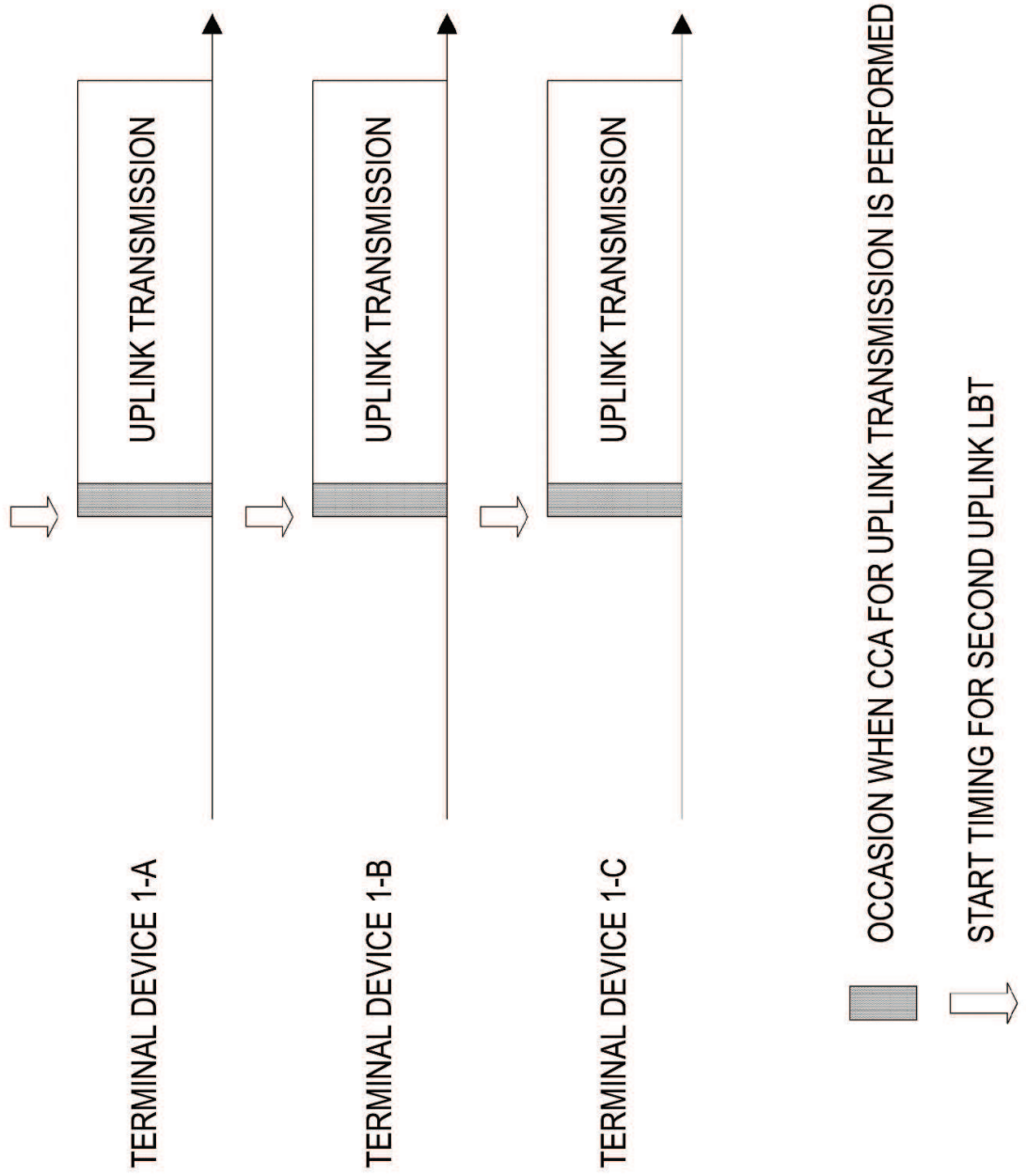
UPLINK TRANSMISSION
UPLINK TRANSMISSION
UPLINK TRANSMISSION
TERMINAL DEVICE 1-A
TERMINAL DEVICE 1-B
TERMINAL DEVICE 1-C
OCCASION WHEN CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR SECOND UPLINK LBT

FIG. 13

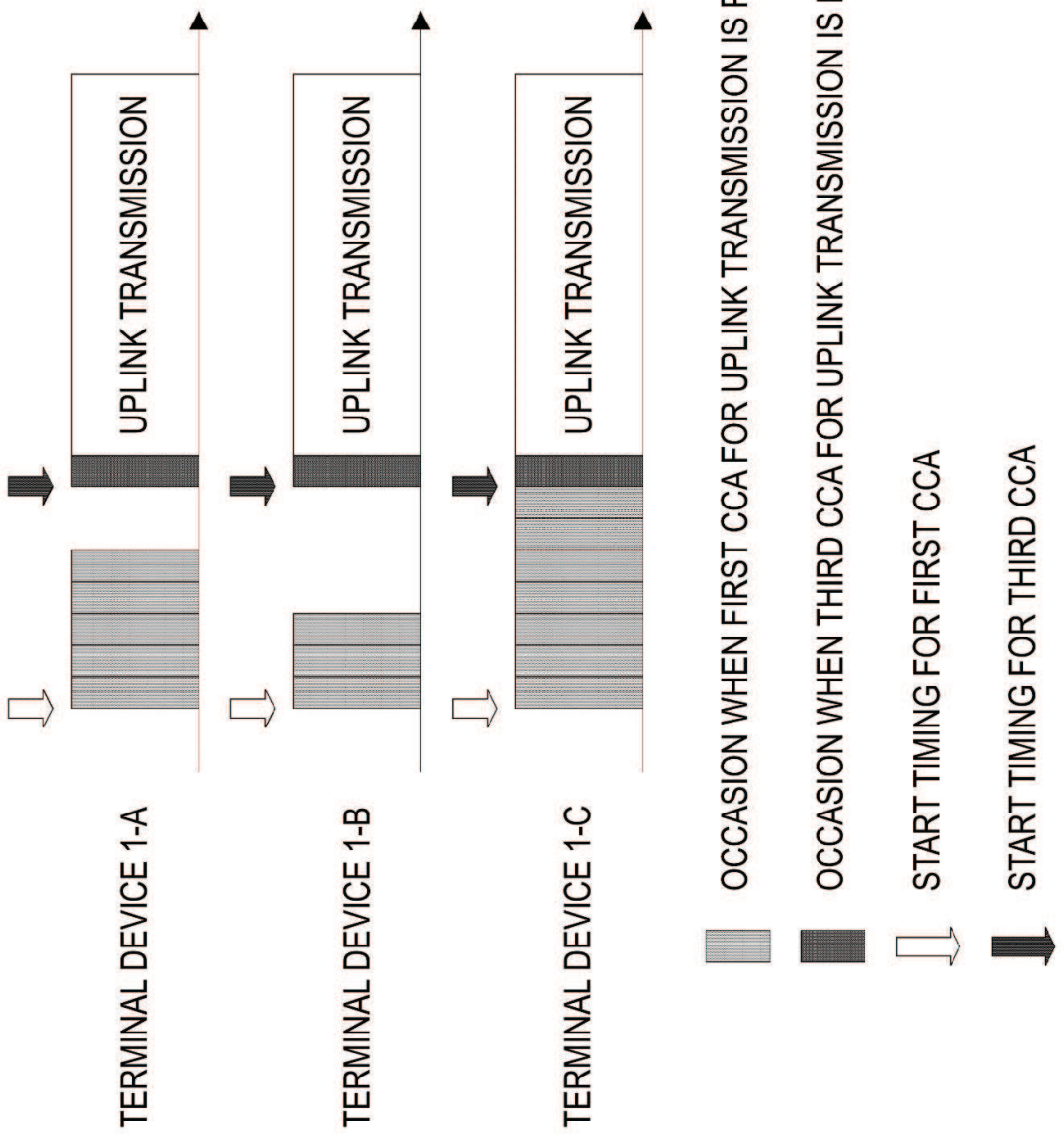
TERMINAL DEVICE 1-A
TERMINAL DEVICE 1-B
TERMINAL DEVICE 1-C
UPLINK TRANSMISSION
UPLINK TRANSMISSION
UPLINK TRANSMISSION
OCCASION WHEN FIRST CCA FOR UPLINK TRANSMISSION IS PERFORMED
OCCASION WHEN THIRD CCA FOR UPLINK TRANSMISSION IS PERFORMED
START TIMING FOR FIRST CCA
START TIMING FOR THIRD CCA

FIG. 14

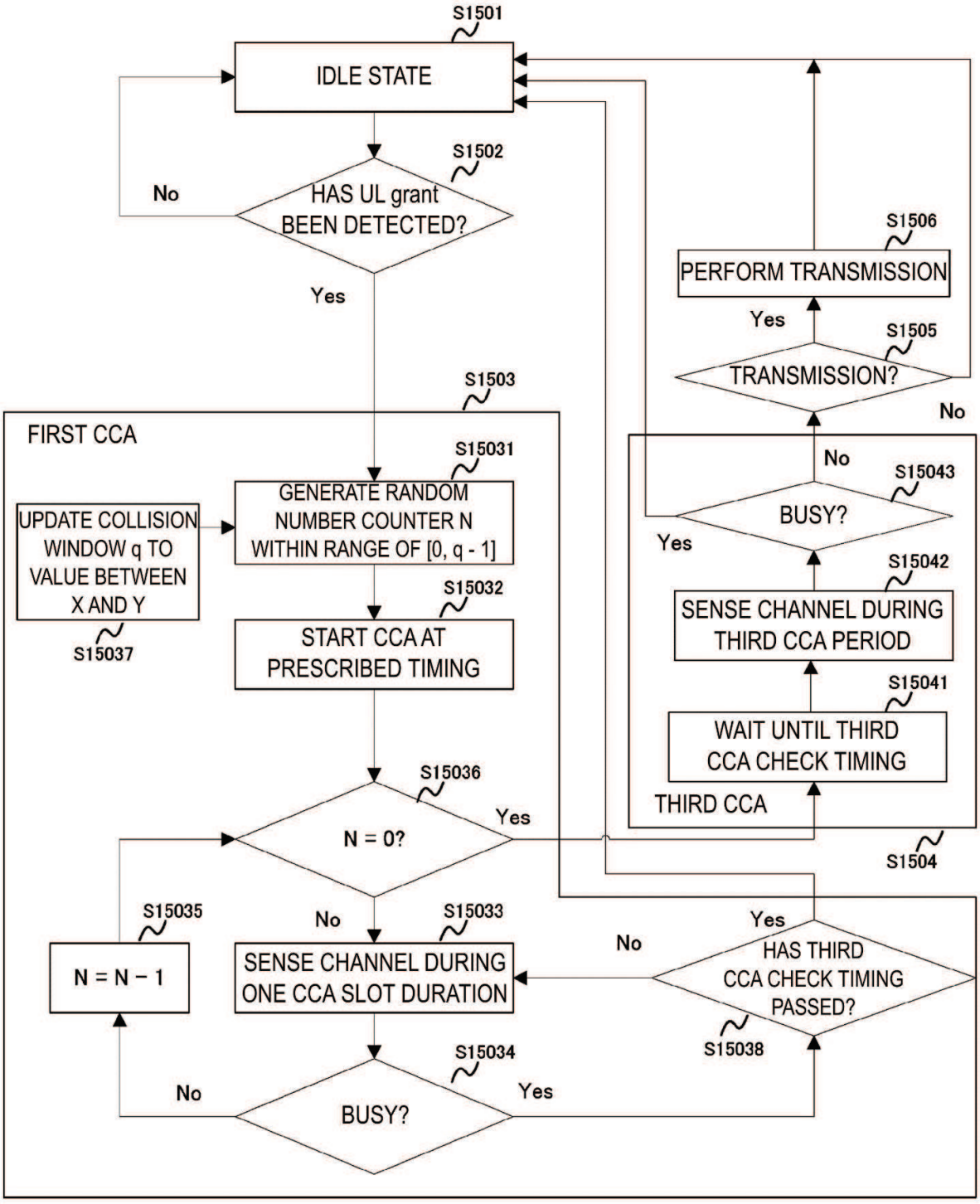
S1501
IDLE STATE
S1502
HAS UL grant BEEN DETECTED?
No
Yes
S1503
FIRST CCA
S15031
GENERATE RANDOM NUMBER COUNTER N WITHIN RANGE OF [0, q - 1]
UPDATE COLLISION WINDOW q TO VALUE BETWEEN X AND Y
S15037
S15032
START CCA AT PRESCRIBED TIMING
S15036
N = 0?
Yes
No
S15035
N = N − 1
S15033
SENSE CHANNEL DURING 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?
Yes
No
S15038
HAS THIRD CCA CHECK TIMING PASSED?
No
Yes
S1505
TRANSMISSION?
Yes
No
S1506
PERFORM TRANSMISSION

FIG. 15