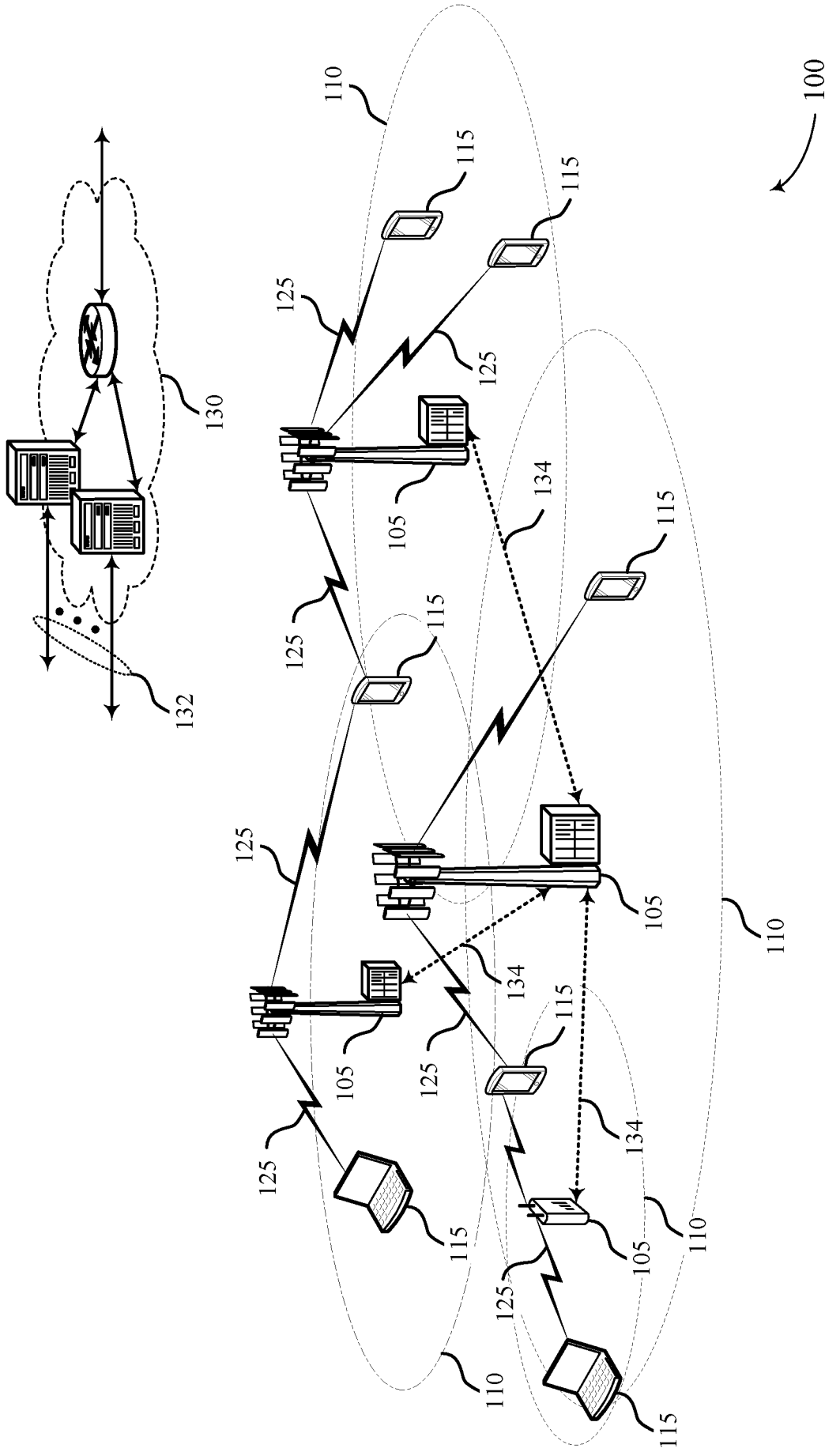


FIG. 1

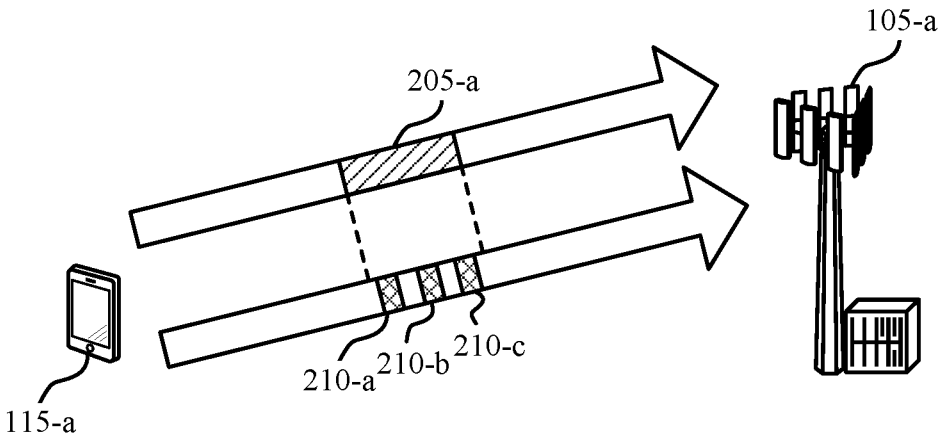

105-a
205-a
210-a
210-b
210-c
115-a
PUSCH Resource 205
PUCCH Resource 210
200

FIG. 2

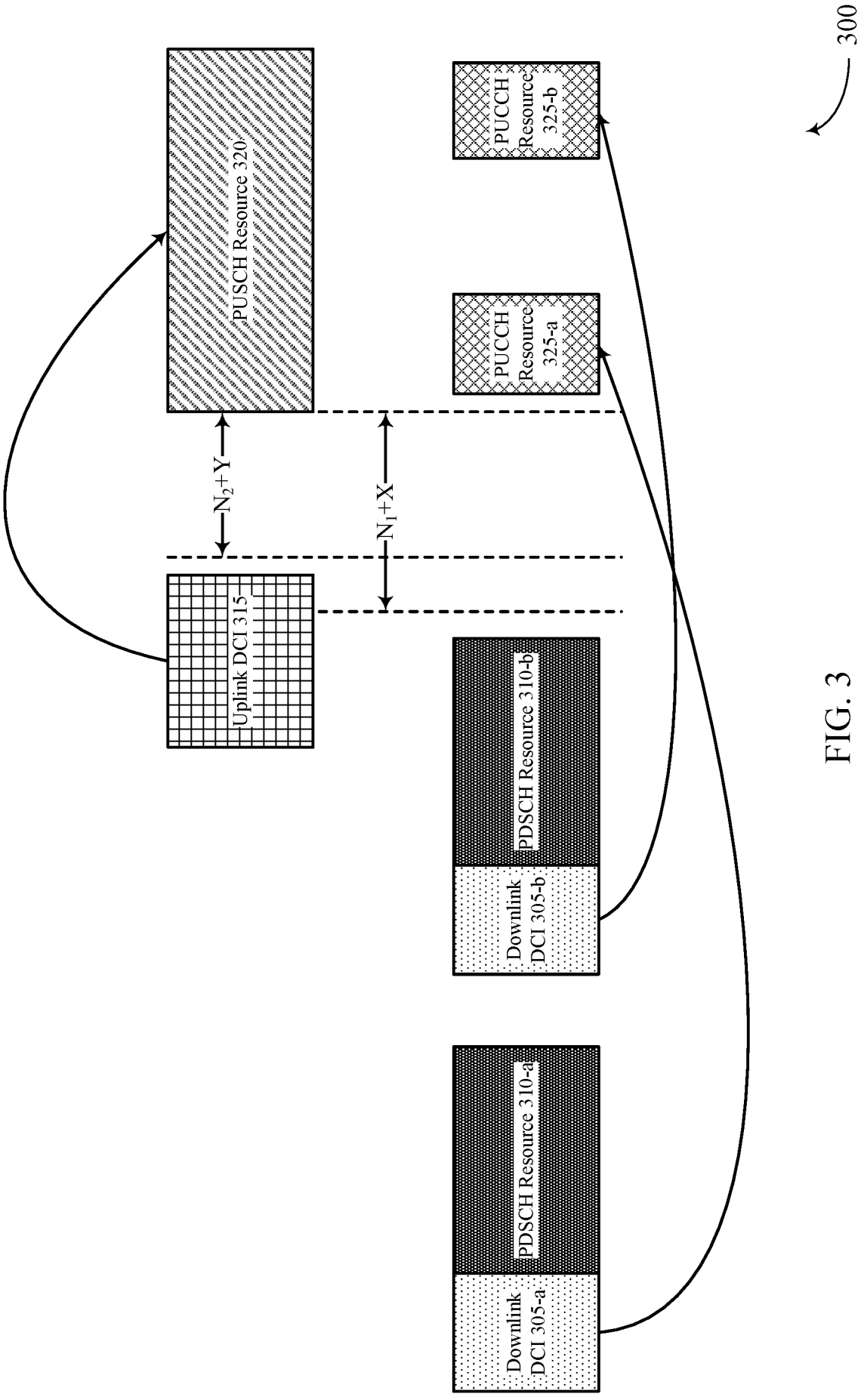

300
PUSCH Resource 320
PUCCH Resource 325-b
PUCCH Resource 325-a
N_2+Y
N_1+X
Uplink DCI 315
PDSCH Resource 310-b
Downlink DCI 305-b
PDSCH Resource 310-a
Downlink DCI 305-a

FIG. 3

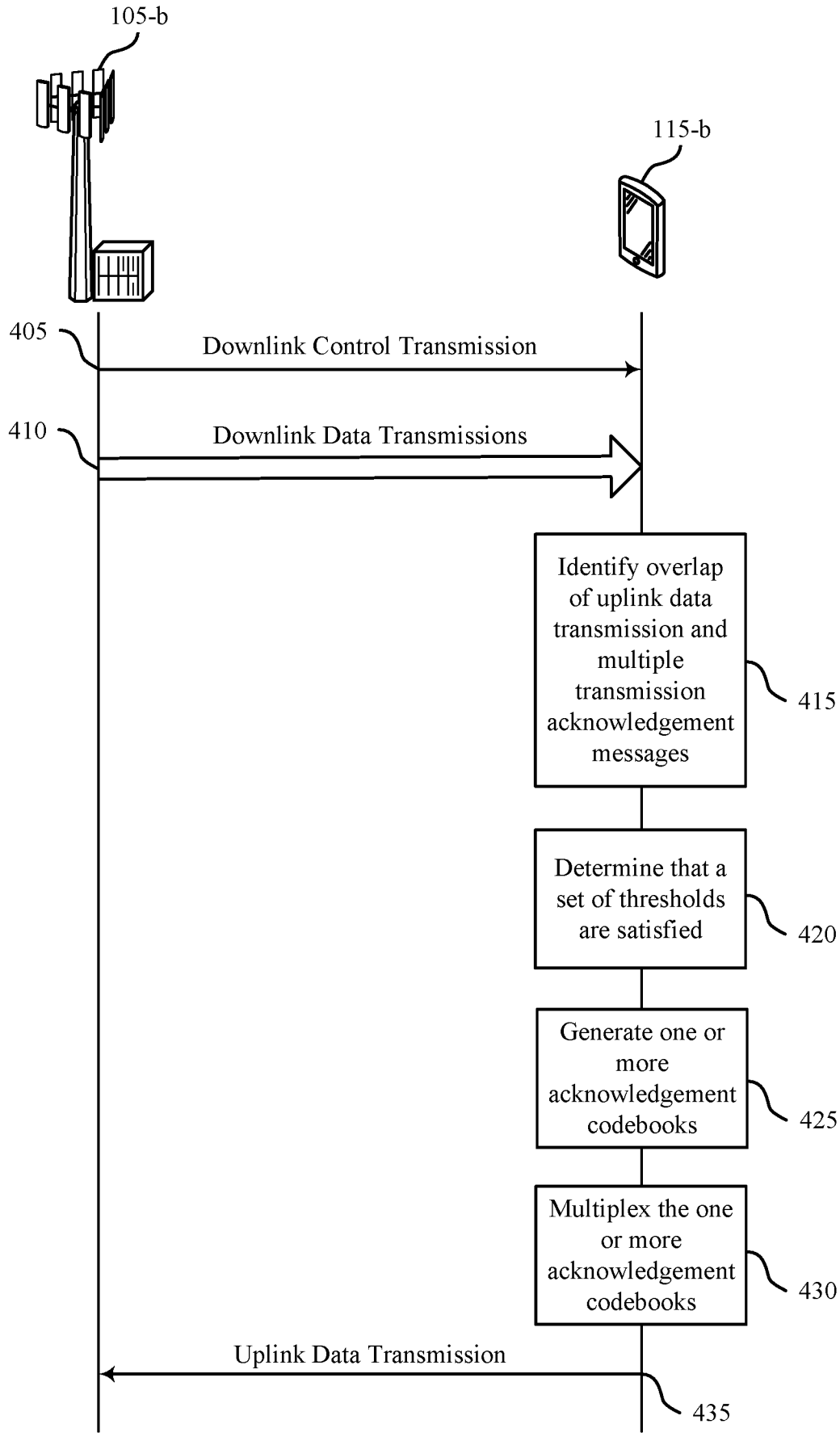

105-b
115-b
405
Downlink Control Transmission
410
Downlink Data Transmissions
Identify overlap of uplink data transmission and multiple transmission acknowledgement messages
415
Determine that a set of thresholds are satisfied
420
Generate one or more acknowledgement codebooks
425
Multiplex the one or more acknowledgement codebooks
430
Uplink Data Transmission
435
400

FIG. 4

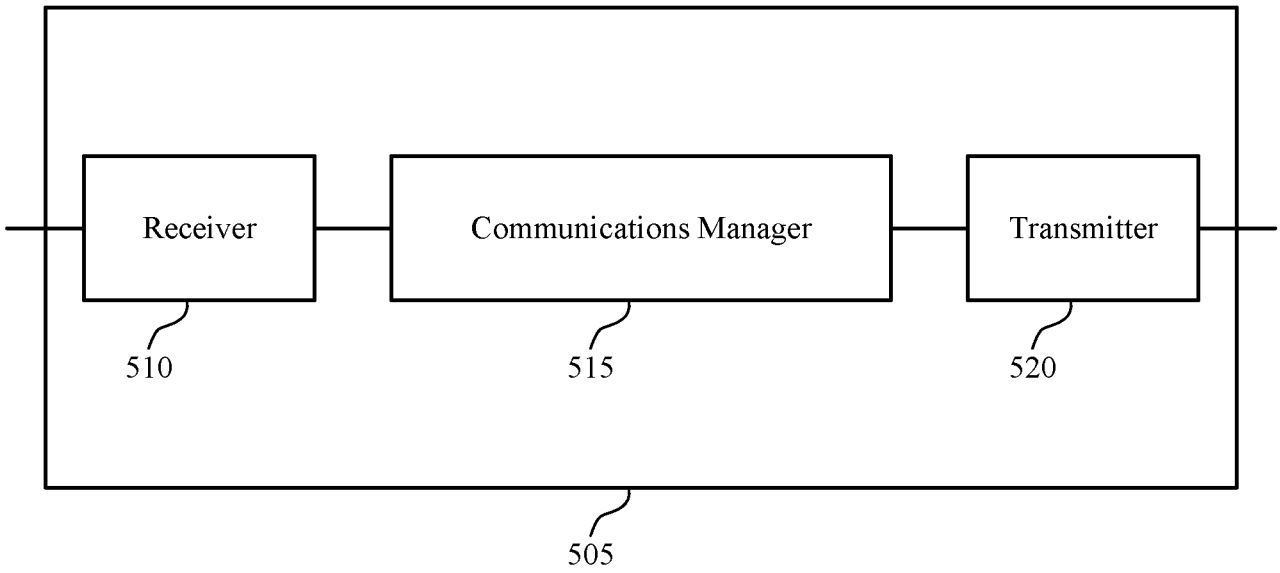

Receiver
Communications Manager
Transmitter
510
515
520
505
500

FIG. 5

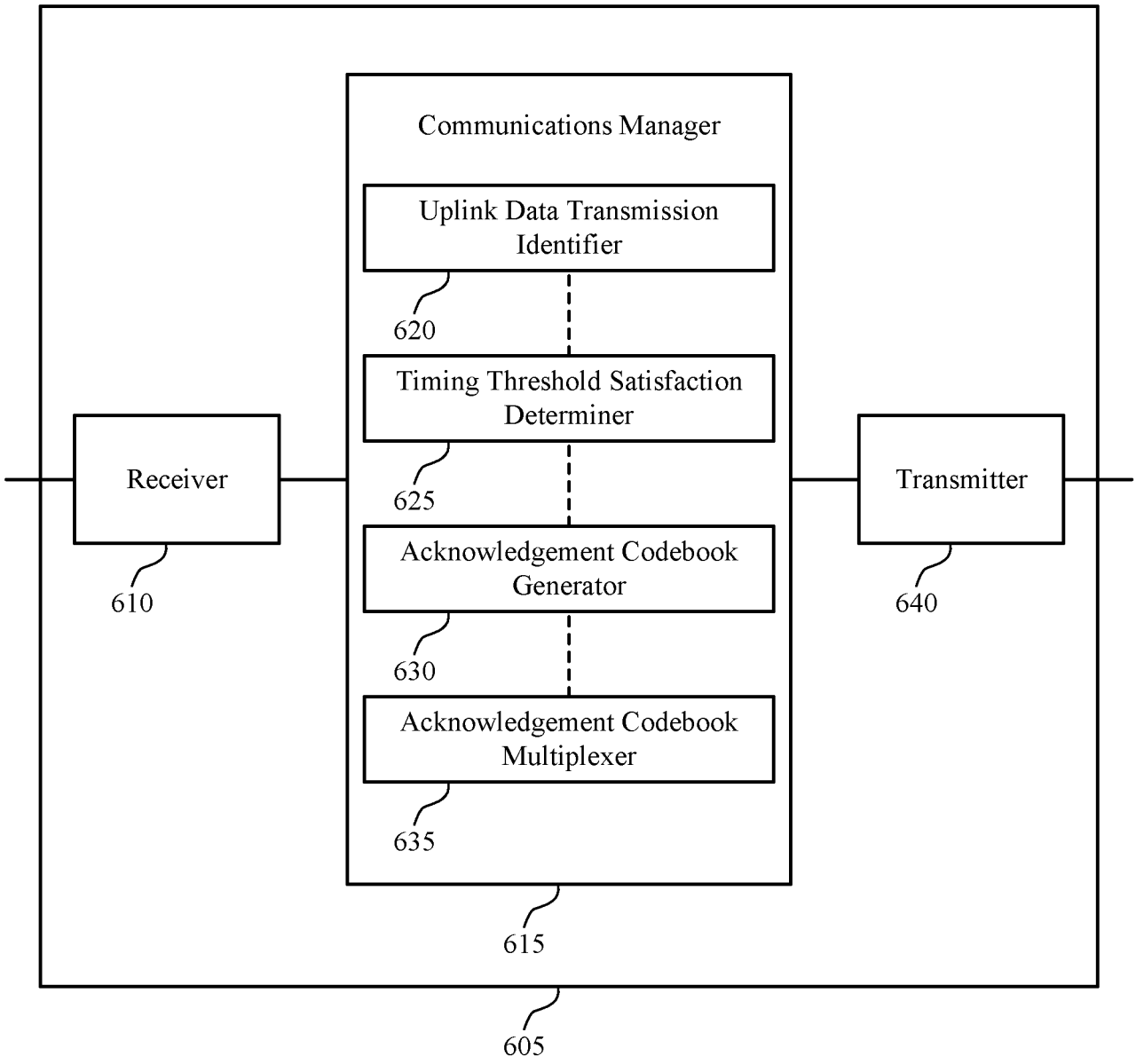

Communications Manager
Uplink Data Transmission Identifier
620
Timing Threshold Satisfaction Determiner
625
Acknowledgement Codebook Generator
630
Acknowledgement Codebook Multiplexer
635
615
Receiver
610
Transmitter
640
605
600

FIG. 6

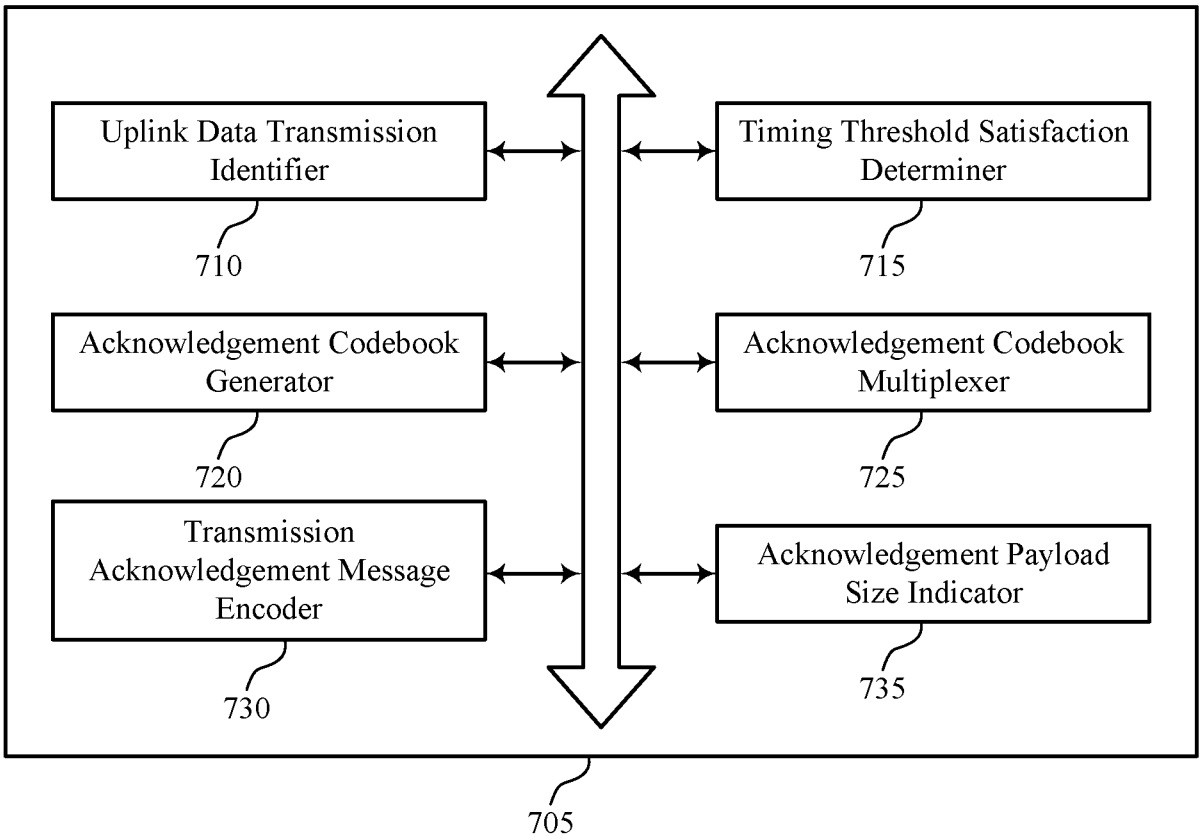

Uplink Data Transmission Identifier
710
Timing Threshold Satisfaction Determiner
715
Acknowledgement Codebook Generator
720
Acknowledgement Codebook Multiplexer
725
Transmission Acknowledgement Message Encoder
730
Acknowledgement Payload Size Indicator
735
705
700

FIG. 7

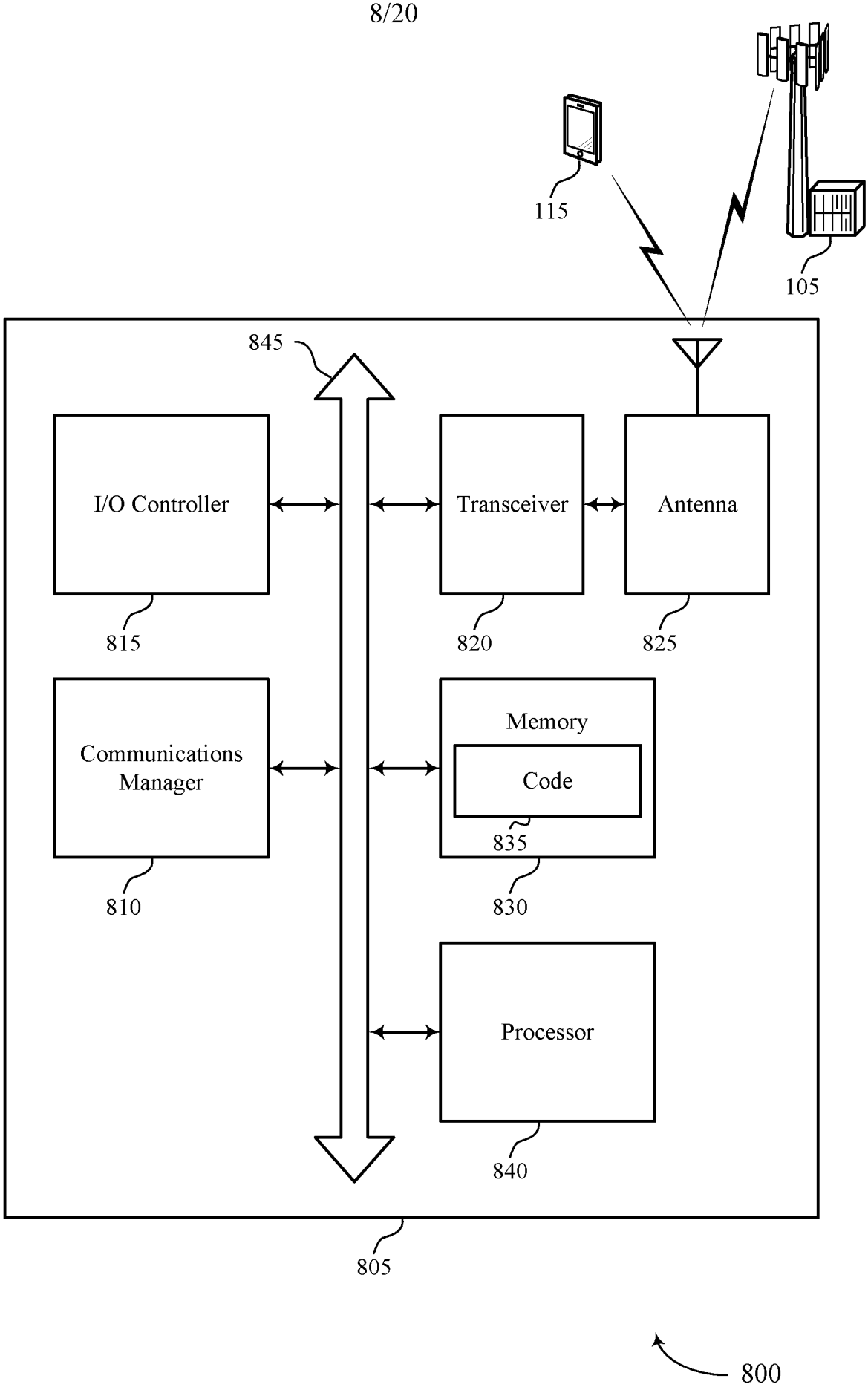

115
105
845
I/O Controller
Transceiver
Antenna
815
820
825
Communications Manager
Memory
Code
835
810
830
Processor
840
805
800

FIG. 8

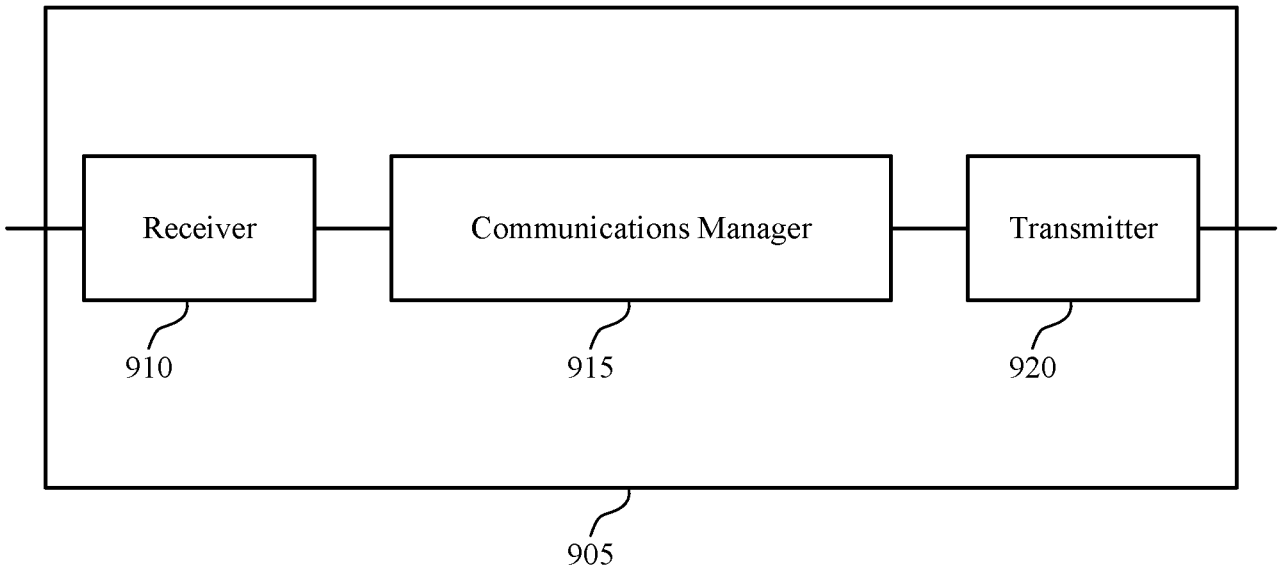

Receiver
Communications Manager
Transmitter
910
915
920
905
900

FIG. 9

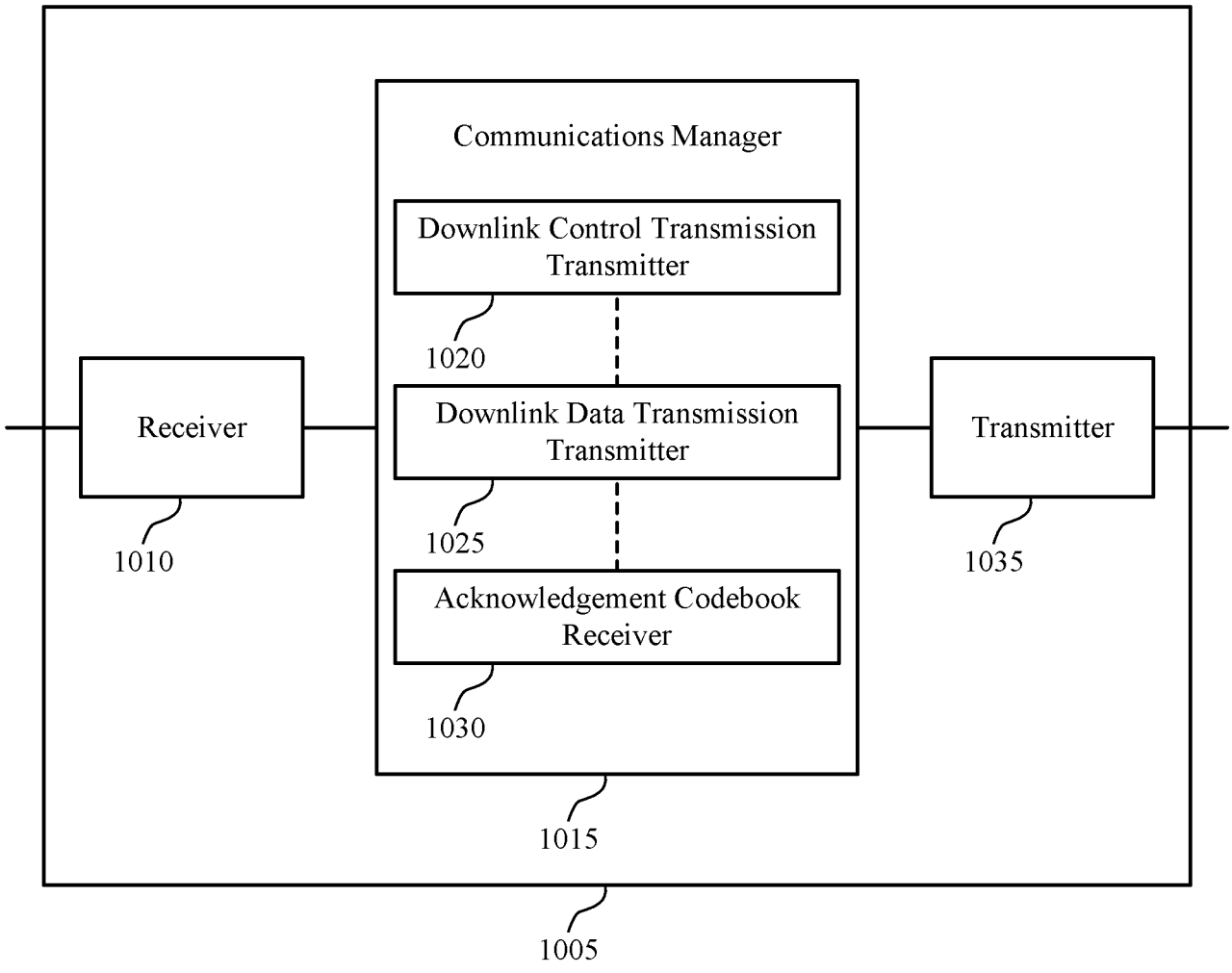

Communications Manager
Downlink Control Transmission Transmitter
1020
Downlink Data Transmission Transmitter
1025
Acknowledgement Codebook Receiver
1030
Receiver
1010
Transmitter
1035
1015
1005
1000

FIG. 10

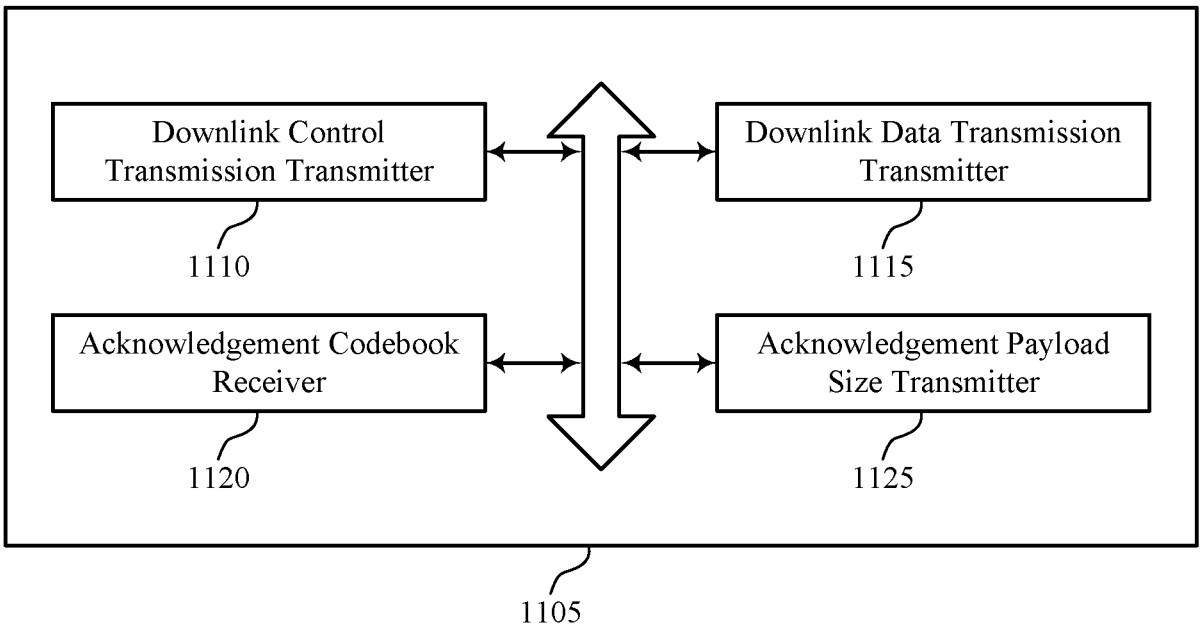

Downlink Control Transmission Transmitter
1110
Downlink Data Transmission Transmitter
1115
Acknowledgement Codebook Receiver
1120
Acknowledgement Payload Size Transmitter
1125
1105
1100

FIG. 11

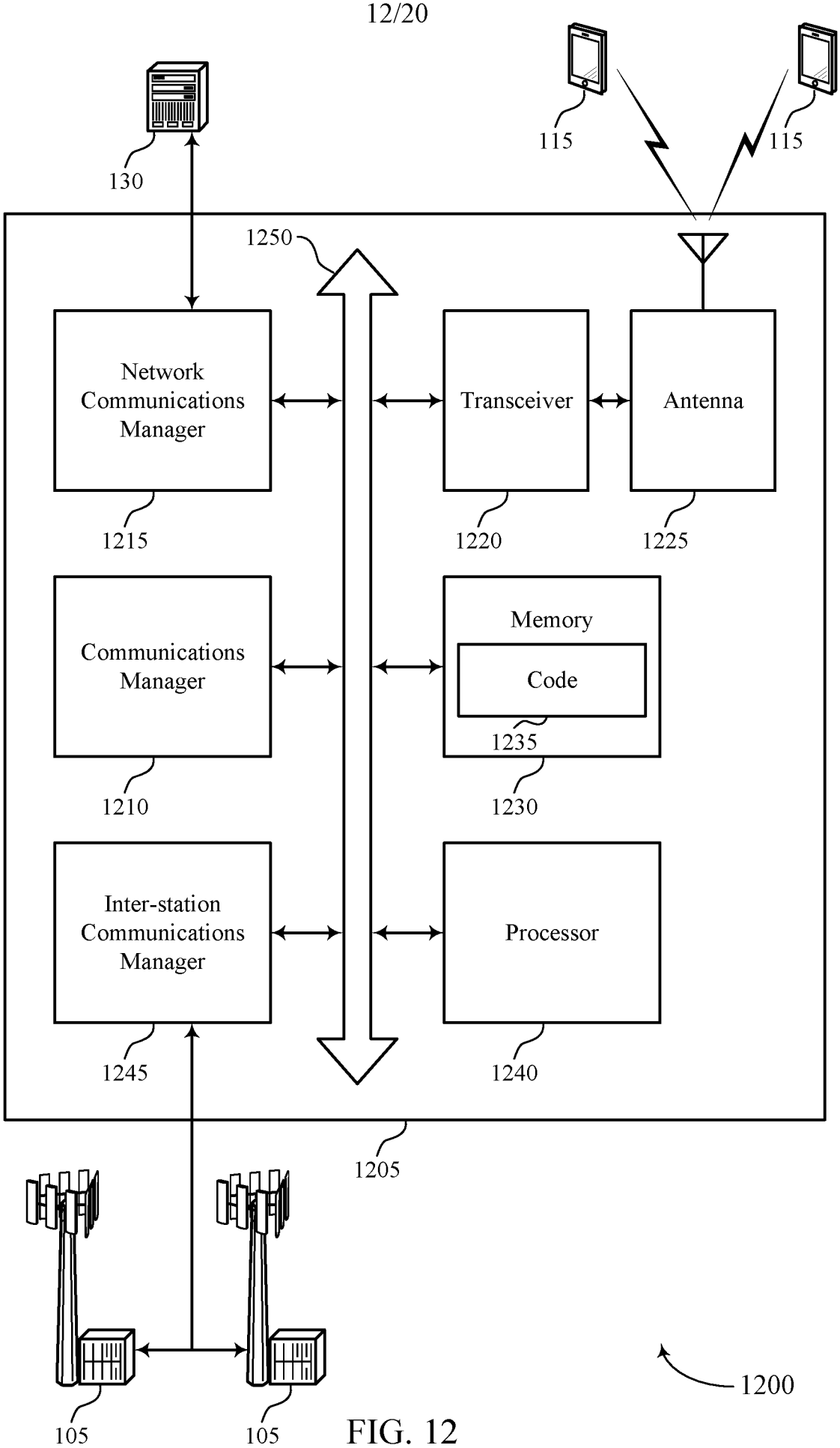

130
115
115
1250
Network Communications Manager
Transceiver
Antenna
1215
1220
1225
Communications Manager
Memory
Code
1235
1210
1230
Inter-station Communications Manager
Processor
1245
1240
1205
105
105
1200

FIG. 12

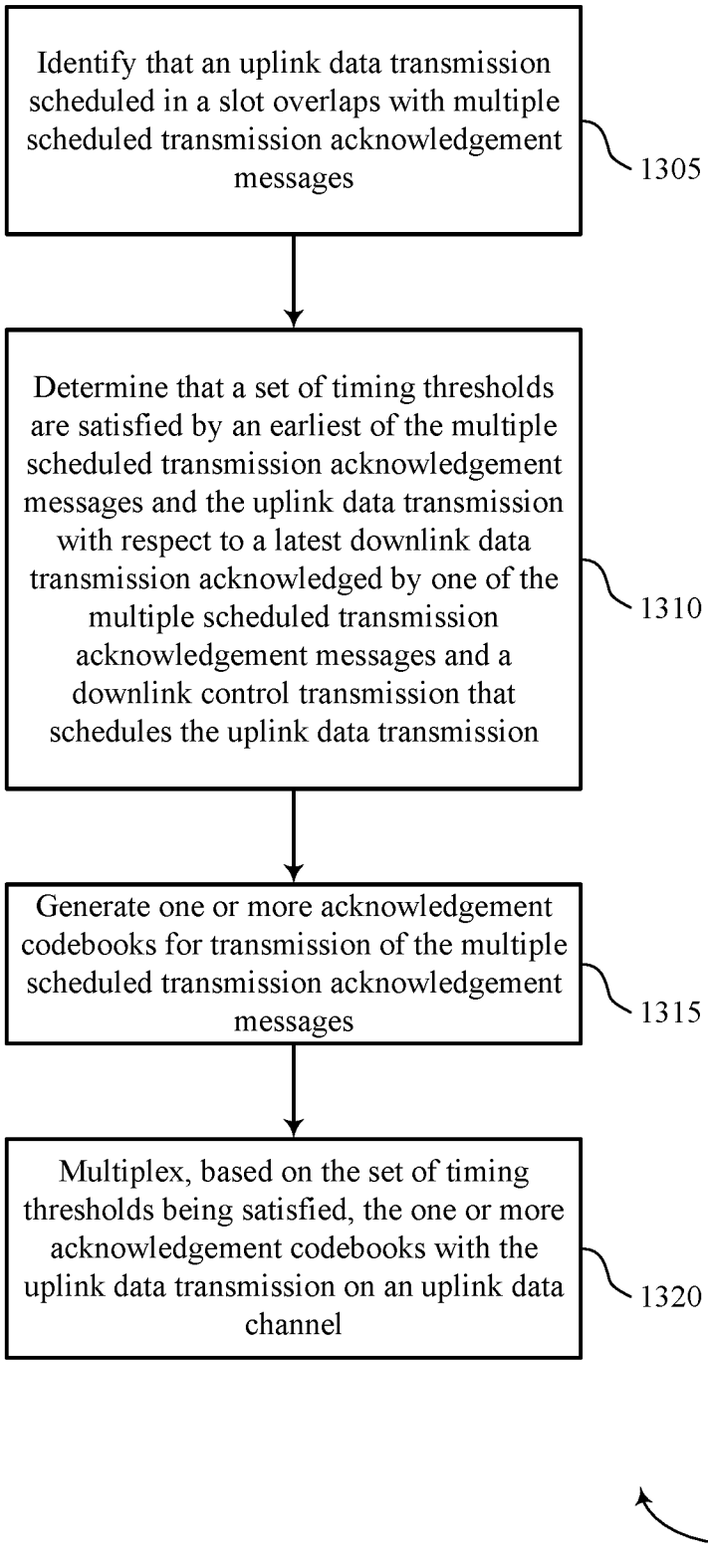

Identify that an uplink data transmission scheduled in a slot overlaps with multiple scheduled transmission acknowledgement messages
1305
Determine that a set of timing thresholds are satisfied by an earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission acknowledged by one of the multiple scheduled transmission acknowledgement messages and a downlink control transmission that schedules the uplink data transmission
1310
Generate one or more acknowledgement codebooks for transmission of the multiple scheduled transmission acknowledgement messages
1315
Multiplex, based on the set of timing thresholds being satisfied, the one or more acknowledgement codebooks with the uplink data transmission on an uplink data channel
1320
1300

FIG. 13

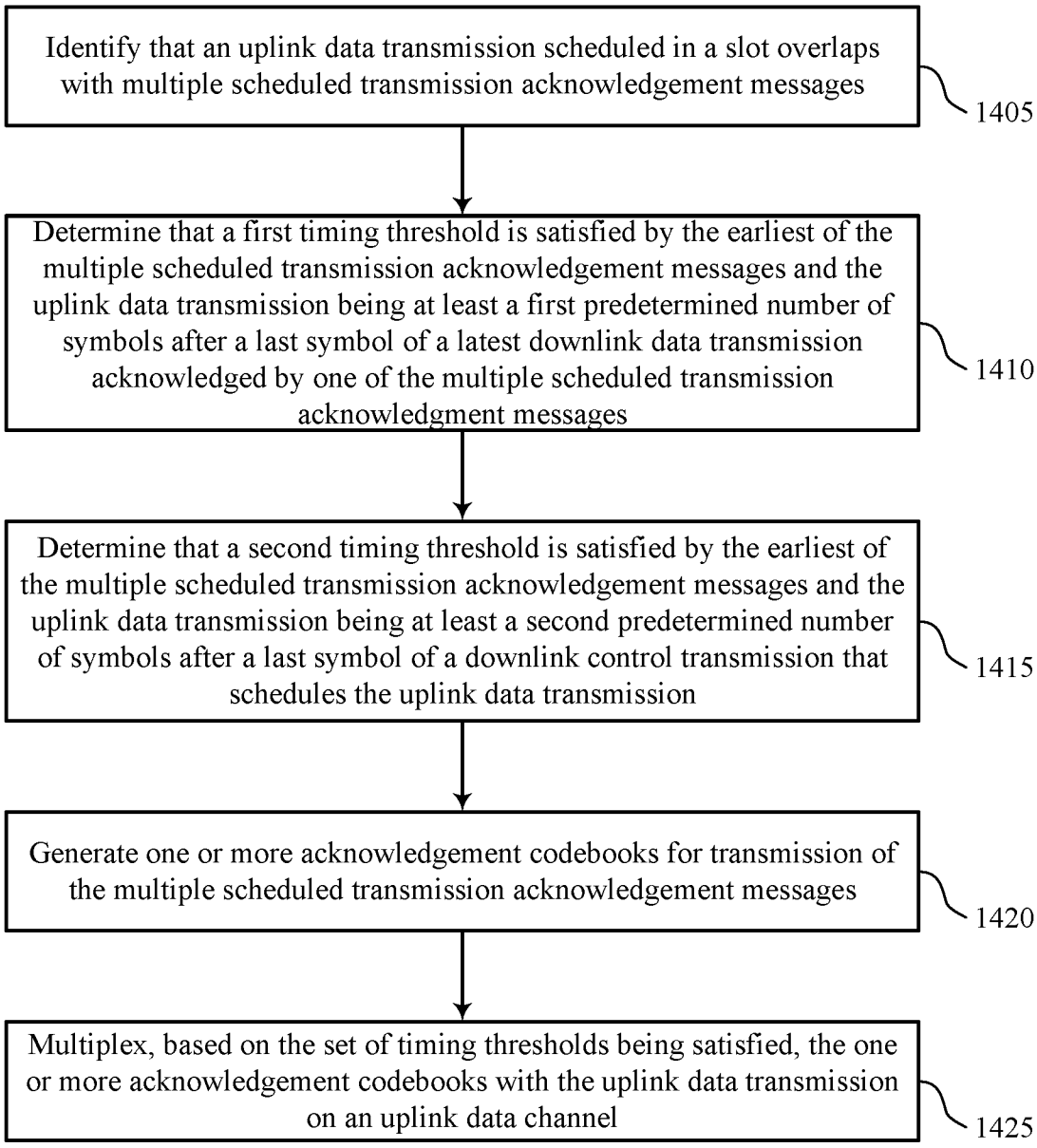

Identify that an uplink data transmission scheduled in a slot overlaps with multiple scheduled transmission acknowledgement messages
1405
Determine that a first timing threshold is satisfied by the earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission being at least a first predetermined number of symbols after a last symbol of a latest downlink data transmission acknowledged by one of the multiple scheduled transmission acknowledgment messages
1410
Determine that a second timing threshold is satisfied by the earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission being at least a second predetermined number of symbols after a last symbol of a downlink control transmission that schedules the uplink data transmission
1415
Generate one or more acknowledgement codebooks for transmission of the multiple scheduled transmission acknowledgement messages
1420
Multiplex, based on the set of timing thresholds being satisfied, the one or more acknowledgement codebooks with the uplink data transmission on an uplink data channel
1425
1400

FIG. 14

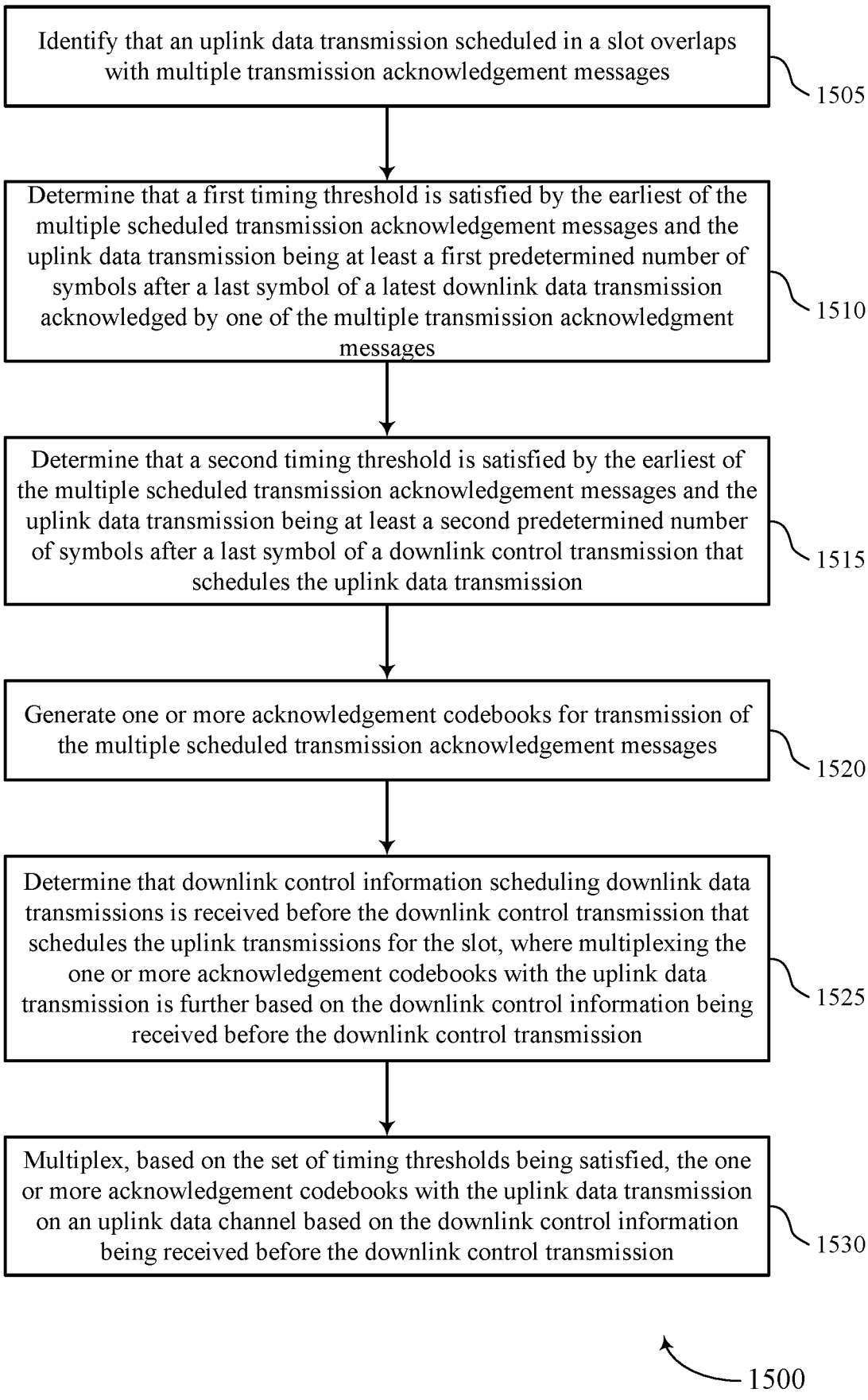

Identify that an uplink data transmission scheduled in a slot overlaps with multiple transmission acknowledgement messages
1505
Determine that a first timing threshold is satisfied by the earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission being at least a first predetermined number of symbols after a last symbol of a latest downlink data transmission acknowledged by one of the multiple transmission acknowledgment messages
1510
Determine that a second timing threshold is satisfied by the earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission being at least a second predetermined number of symbols after a last symbol of a downlink control transmission that schedules the uplink data transmission
1515
Generate one or more acknowledgement codebooks for transmission of the multiple scheduled transmission acknowledgement messages
1520
Determine that downlink control information scheduling downlink data transmissions is received before the downlink control transmission that schedules the uplink transmissions for the slot, where multiplexing the one or more acknowledgement codebooks with the uplink data transmission is further based on the downlink control information being received before the downlink control transmission
1525
Multiplex, based on the set of timing thresholds being satisfied, the one or more acknowledgement codebooks with the uplink data transmission on an uplink data channel based on the downlink control information being received before the downlink control transmission
1530
1500

FIG. 15

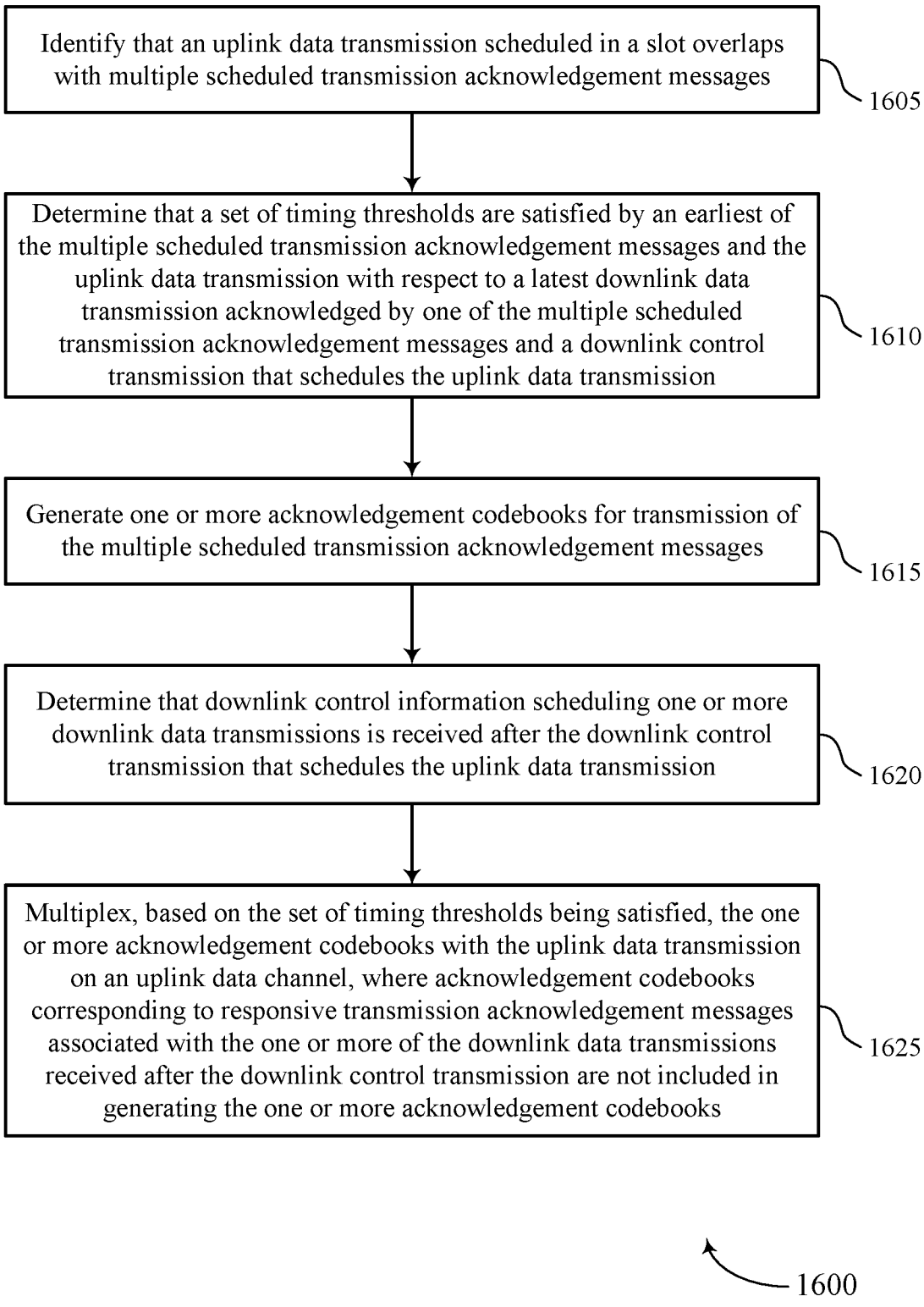

Identify that an uplink data transmission scheduled in a slot overlaps with multiple scheduled transmission acknowledgement messages
1605
Determine that a set of timing thresholds are satisfied by an earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission acknowledged by one of the multiple scheduled transmission acknowledgement messages and a downlink control transmission that schedules the uplink data transmission
1610
Generate one or more acknowledgement codebooks for transmission of the multiple scheduled transmission acknowledgement messages
1615
Determine that downlink control information scheduling one or more downlink data transmissions is received after the downlink control transmission that schedules the uplink data transmission
1620
Multiplex, based on the set of timing thresholds being satisfied, the one or more acknowledgement codebooks with the uplink data transmission on an uplink data channel, where acknowledgement codebooks corresponding to responsive transmission acknowledgement messages associated with the one or more of the downlink data transmissions received after the downlink control transmission are not included in generating the one or more acknowledgement codebooks
1625
1600

FIG. 16

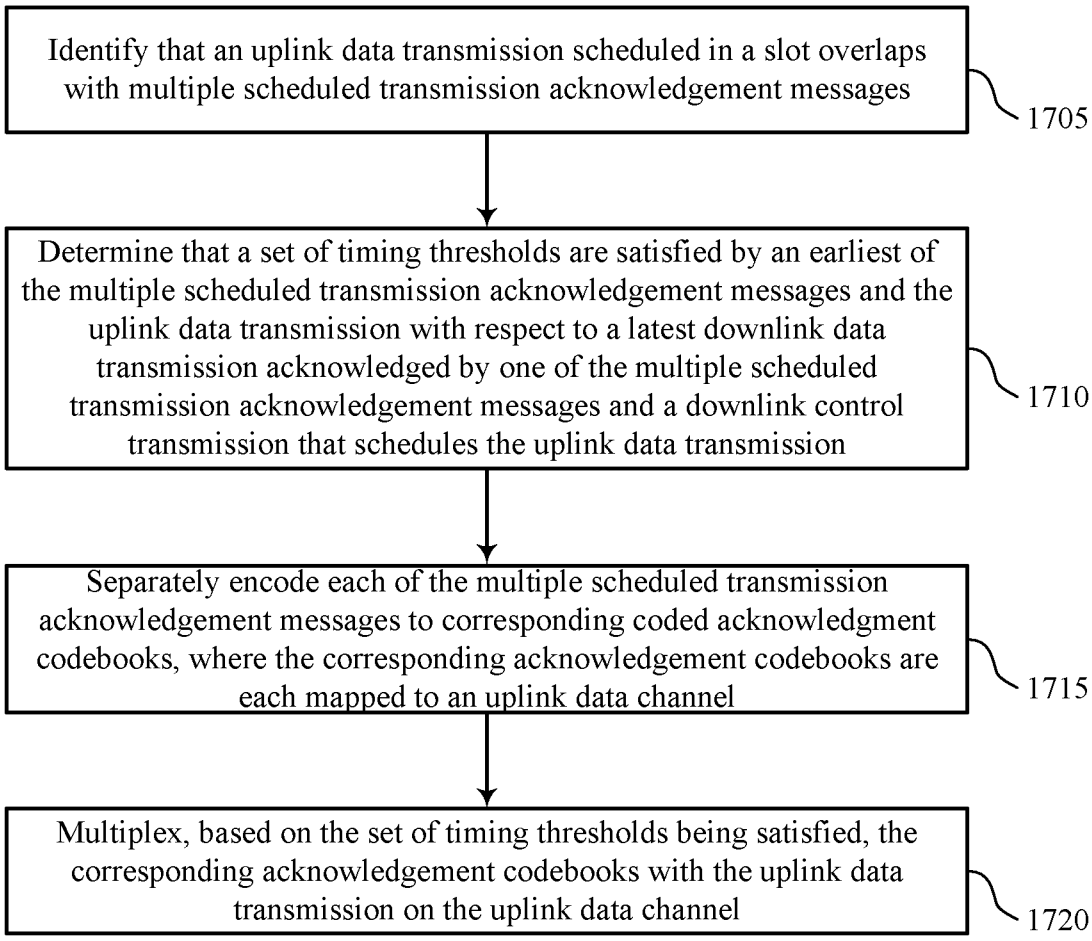

Identify that an uplink data transmission scheduled in a slot overlaps with multiple scheduled transmission acknowledgement messages
1705
Determine that a set of timing thresholds are satisfied by an earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission acknowledged by one of the multiple scheduled transmission acknowledgement messages and a downlink control transmission that schedules the uplink data transmission
1710
Separately encode each of the multiple scheduled transmission acknowledgement messages to corresponding coded acknowledgment codebooks, where the corresponding acknowledgement codebooks are each mapped to an uplink data channel
1715
Multiplex, based on the set of timing thresholds being satisfied, the corresponding acknowledgement codebooks with the uplink data transmission on the uplink data channel
1720
1700

FIG. 17

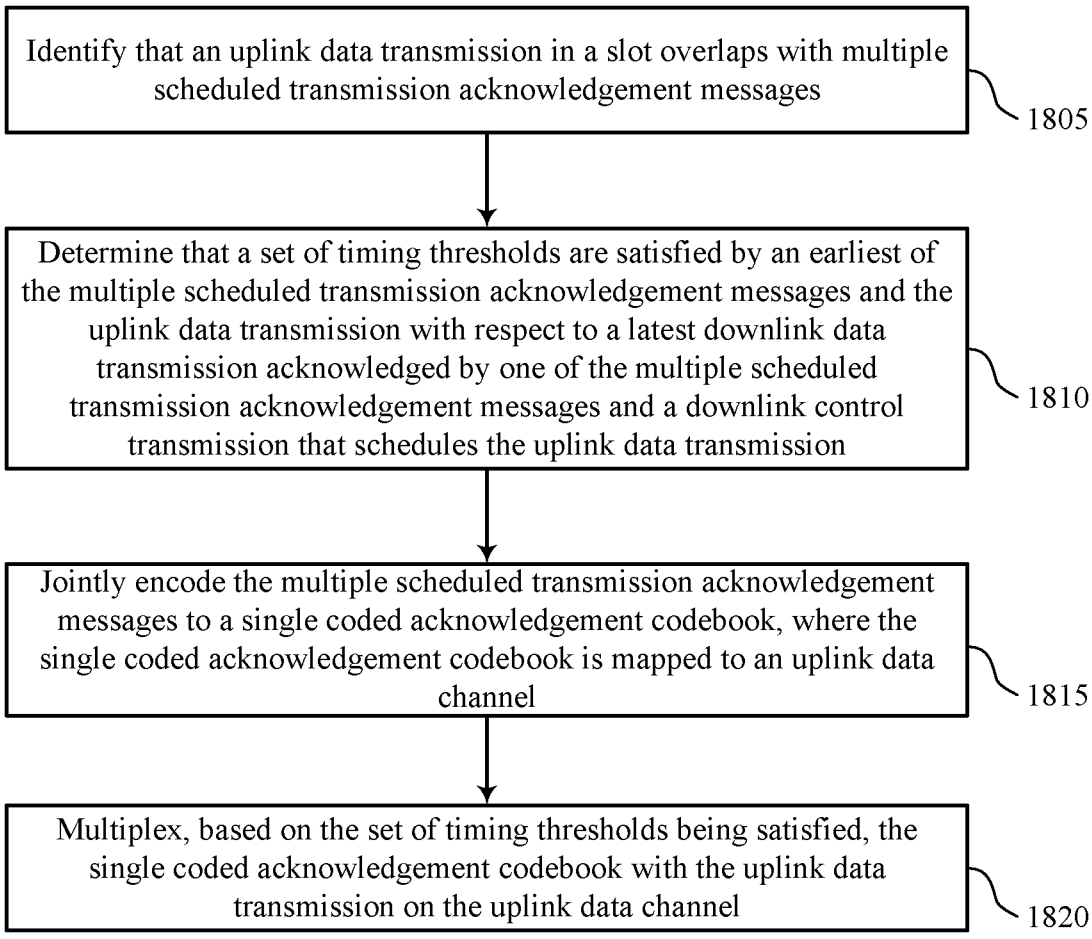

Identify that an uplink data transmission in a slot overlaps with multiple scheduled transmission acknowledgement messages
1805
Determine that a set of timing thresholds are satisfied by an earliest of the multiple scheduled transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission acknowledged by one of the multiple scheduled transmission acknowledgement messages and a downlink control transmission that schedules the uplink data transmission
1810
Jointly encode the multiple scheduled transmission acknowledgement messages to a single coded acknowledgement codebook, where the single coded acknowledgement codebook is mapped to an uplink data channel
1815
Multiplex, based on the set of timing thresholds being satisfied, the single coded acknowledgement codebook with the uplink data transmission on the uplink data channel
1820
1800

FIG. 18

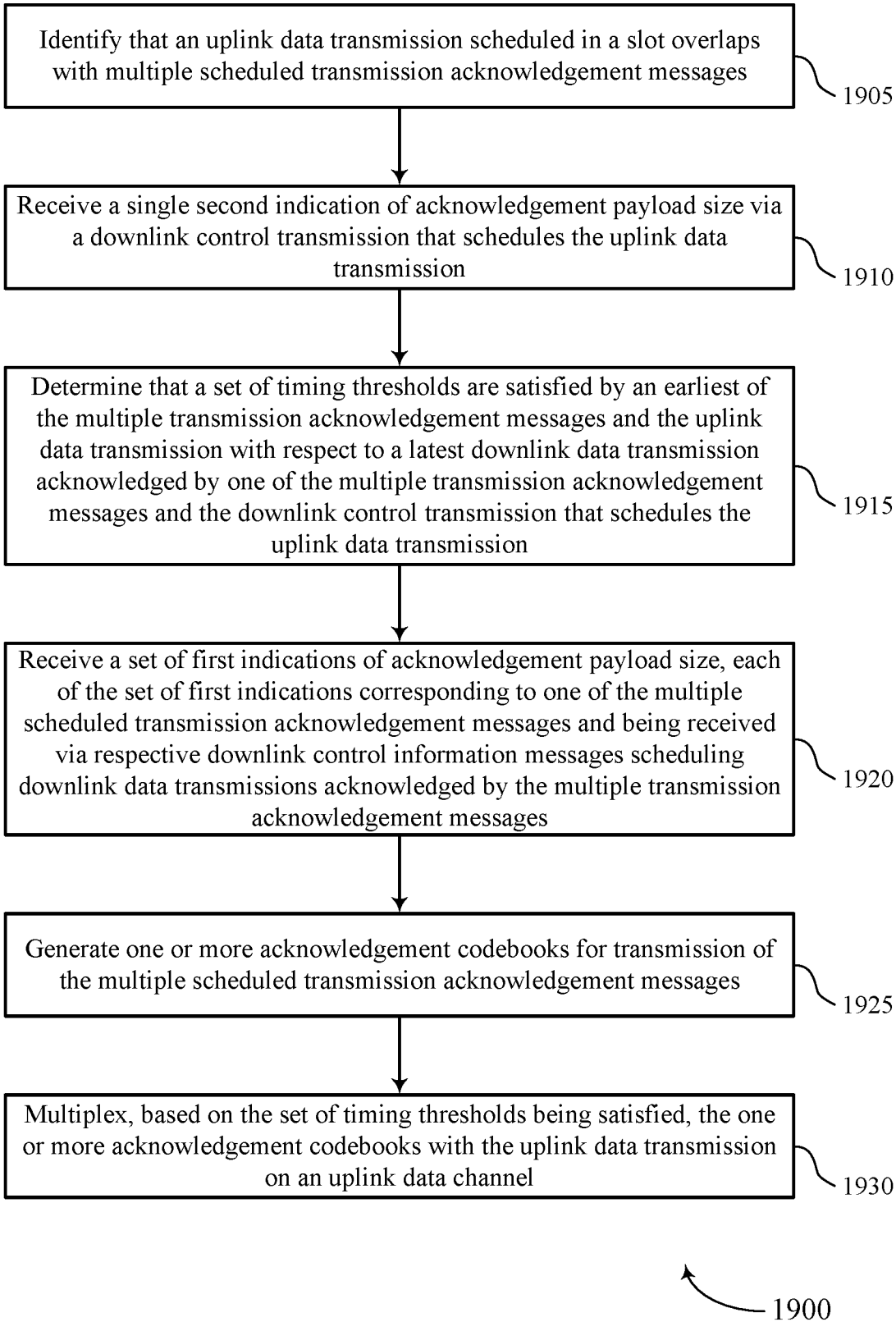

Identify that an uplink data transmission scheduled in a slot overlaps with multiple scheduled transmission acknowledgement messages
1905
Receive a single second indication of acknowledgement payload size via a downlink control transmission that schedules the uplink data transmission
1910
Determine that a set of timing thresholds are satisfied by an earliest of the multiple transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission acknowledged by one of the multiple transmission acknowledgement messages and the downlink control transmission that schedules the uplink data transmission
1915
Receive a set of first indications of acknowledgement payload size, each of the set of first indications corresponding to one of the multiple scheduled transmission acknowledgement messages and being received via respective downlink control information messages scheduling downlink data transmissions acknowledged by the multiple transmission acknowledgement messages
1920
Generate one or more acknowledgement codebooks for transmission of the multiple scheduled transmission acknowledgement messages
1925
Multiplex, based on the set of timing thresholds being satisfied, the one or more acknowledgement codebooks with the uplink data transmission on an uplink data channel
1930
1900

FIG. 19

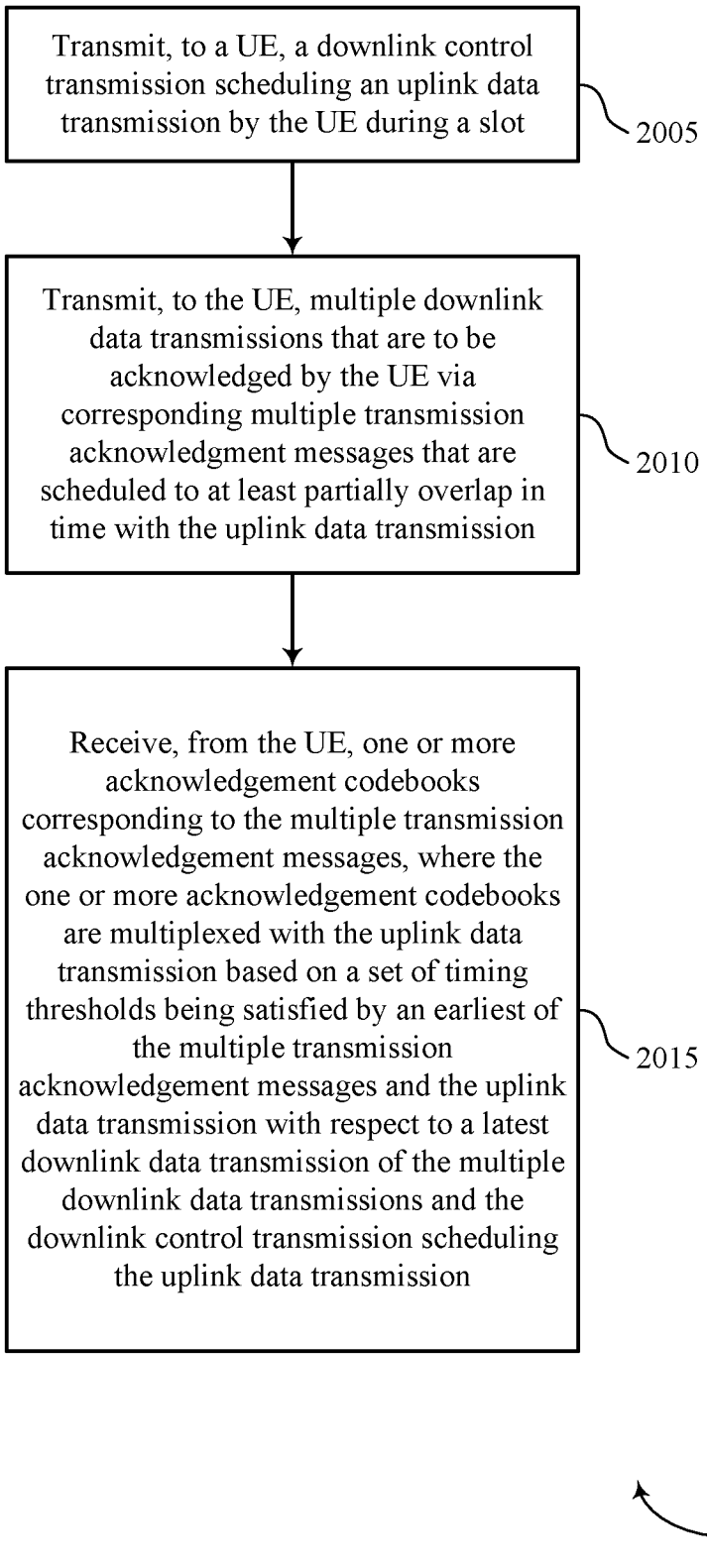

Transmit, to a UE, a downlink control transmission scheduling an uplink data transmission by the UE during a slot
2005
Transmit, to the UE, multiple downlink data transmissions that are to be acknowledged by the UE via corresponding multiple transmission acknowledgment messages that are scheduled to at least partially overlap in time with the uplink data transmission
2010
Receive, from the UE, one or more acknowledgement codebooks corresponding to the multiple transmission acknowledgement messages, where the one or more acknowledgement codebooks are multiplexed with the uplink data transmission based on a set of timing thresholds being satisfied by an earliest of the multiple transmission acknowledgement messages and the uplink data transmission with respect to a latest downlink data transmission of the multiple downlink data transmissions and the downlink control transmission scheduling the uplink data transmission
2015
2000

FIG. 20