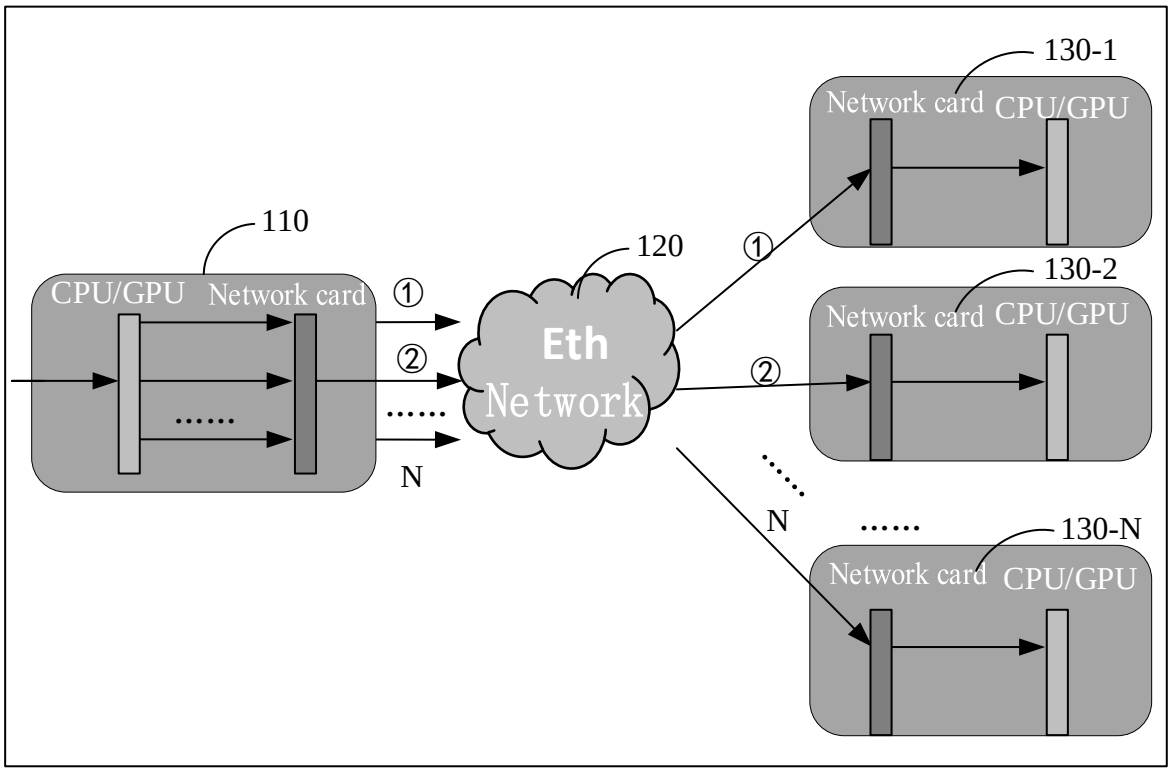

130-1
Network card
CPU/GPU
110
120
CPU/GPU
Network card
①
②
.....
N
Eth
Network
①
②
130-2
Network card
CPU/GPU
.....
N
.....
130-N
Network card
CPU/GPU

FIG. 1

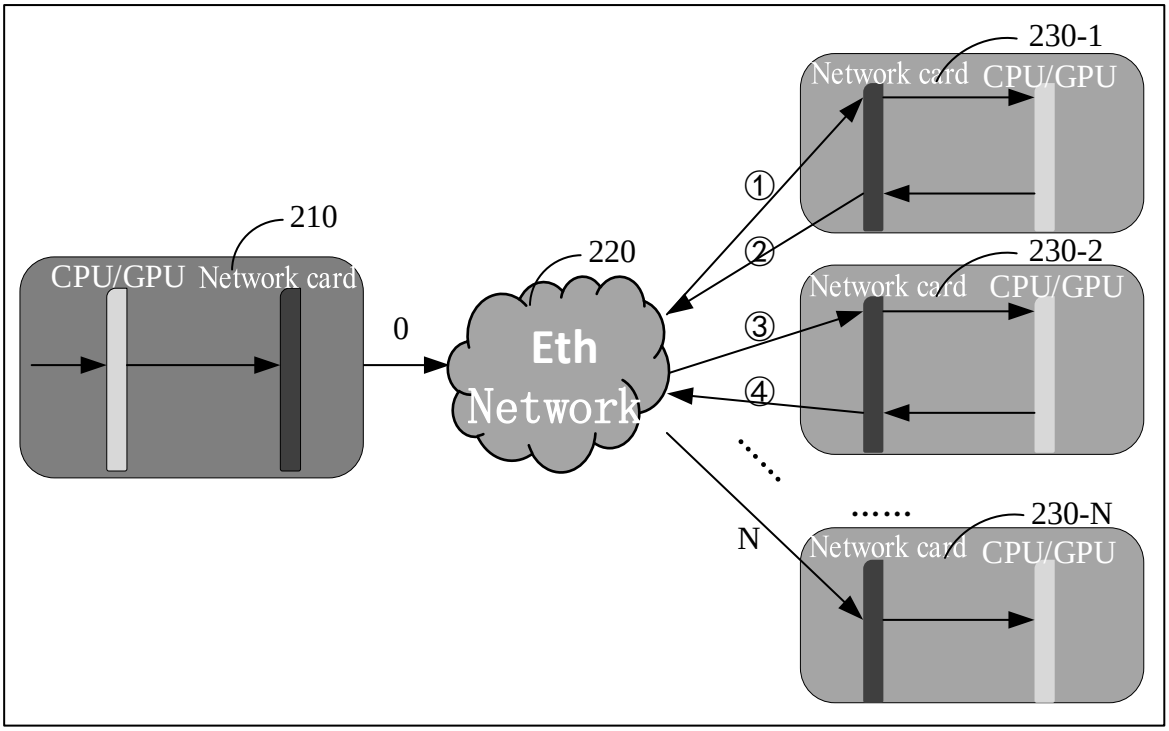

230-1
Network card
CPU/GPU
210
220
CPU/GPU
Network card
0
Eth
Network
①
②
③
④
230-2
Network card
CPU/GPU
.....
N
.....
230-N
Network card
CPU/GPU

FIG. 2

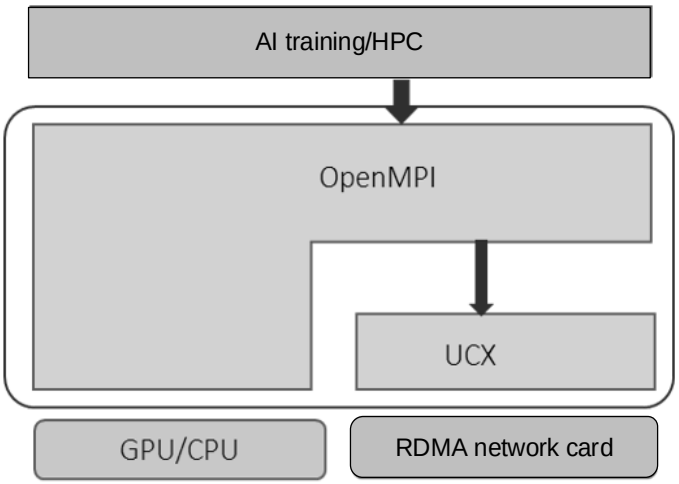


FIG. 3A

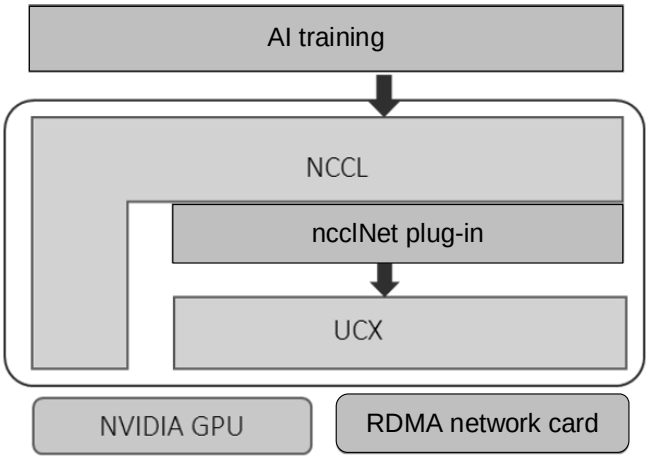


FIG. 3B

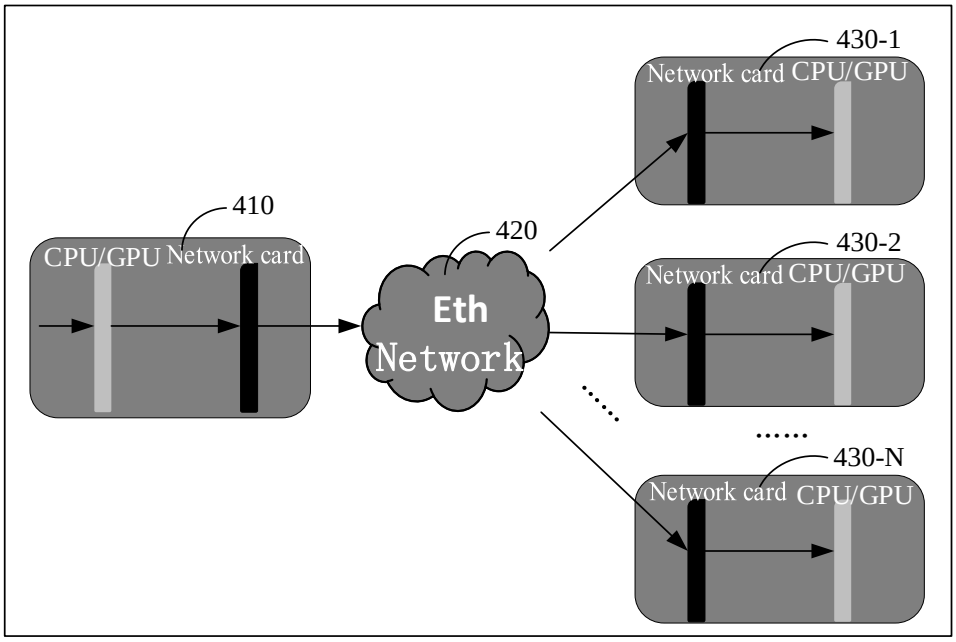


FIG. 4

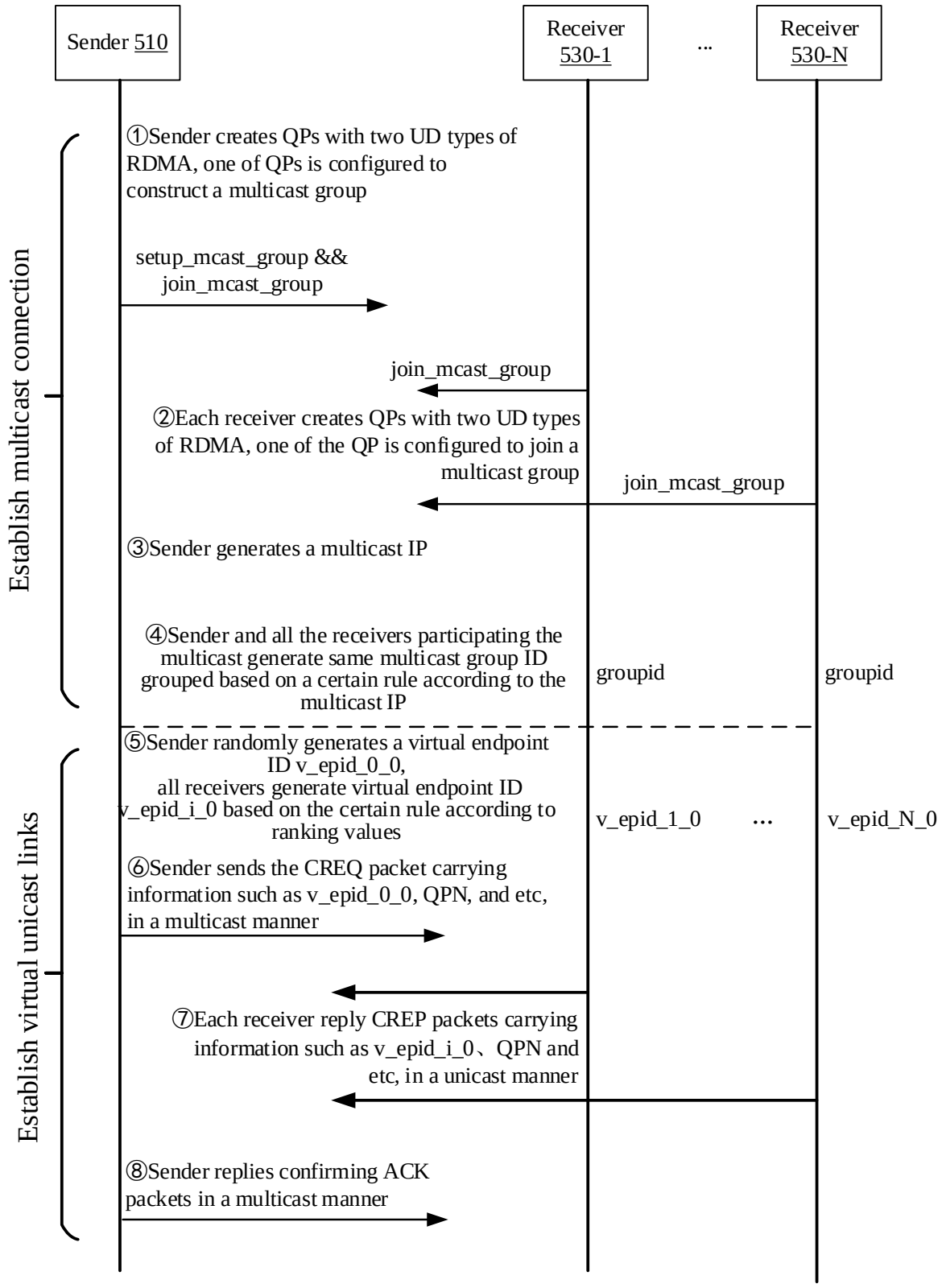

Sender 510
Receiver 530-1
...
Receiver 530-N
①Sender creates QPs with two UD types of RDMA, one of QPs is configured to construct a multicast group
setup_mcast_group && join_mcast_group
join_mcast_group
②Each receiver creates QPs with two UD types of RDMA, one of the QP is configured to join a multicast group
join_mcast_group
③Sender generates a multicast IP
④Sender and all the receivers participating the multicast generate same multicast group ID grouped based on a certain rule according to the multicast IP
groupid
groupid
Establish multicast connection
⑤Sender randomly generates a virtual endpoint ID v_epid_0_0, all receivers generate virtual endpoint ID v_epid_i_0 based on the certain rule according to ranking values
v_epid_1_0
...
v_epid_N_0
⑥Sender sends the CREQ packet carrying information such as v_epid_0_0, QPN, and etc, in a multicast manner
⑦Each receiver reply CREP packets carrying information such as v_epid_i_0、QPN and etc, in a unicast manner
⑧Sender replies confirming ACK packets in a multicast manner
Establish virtual unicast links

FIG. 5A

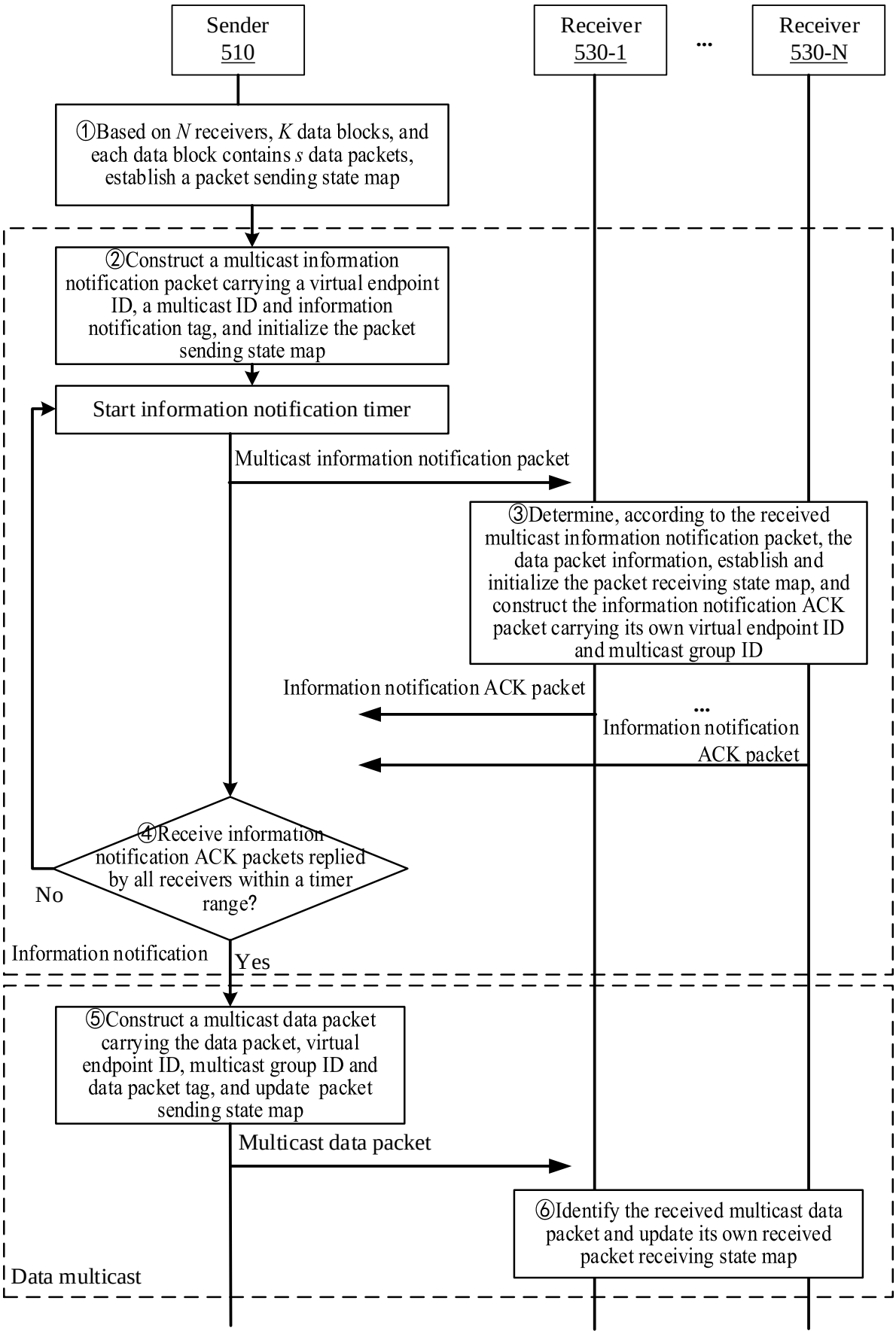

Sender
510
Receiver
530-1
...
Receiver
530-N
①Based on N receivers, K data blocks, and each data block contains s data packets, establish a packet sending state map
②Construct a multicast information notification packet carrying a virtual endpoint ID, a multicast ID and information notification tag, and initialize the packet sending state map
Start information notification timer
Multicast information notification packet
③Determine, according to the received multicast information notification packet, the data packet information, establish and initialize the packet receiving state map, and construct the information notification ACK packet carrying its own virtual endpoint ID and multicast group ID
Information notification ACK packet
...
Information notification ACK packet
④Receive information notification ACK packets replied by all receivers within a timer range?
No
Yes
Information notification
⑤Construct a multicast data packet carrying the data packet, virtual endpoint ID, multicast group ID and data packet tag, and update packet sending state map
Multicast data packet
⑥Identify the received multicast data packet and update its own received packet receiving state map
Data multicast

FIG. 5B

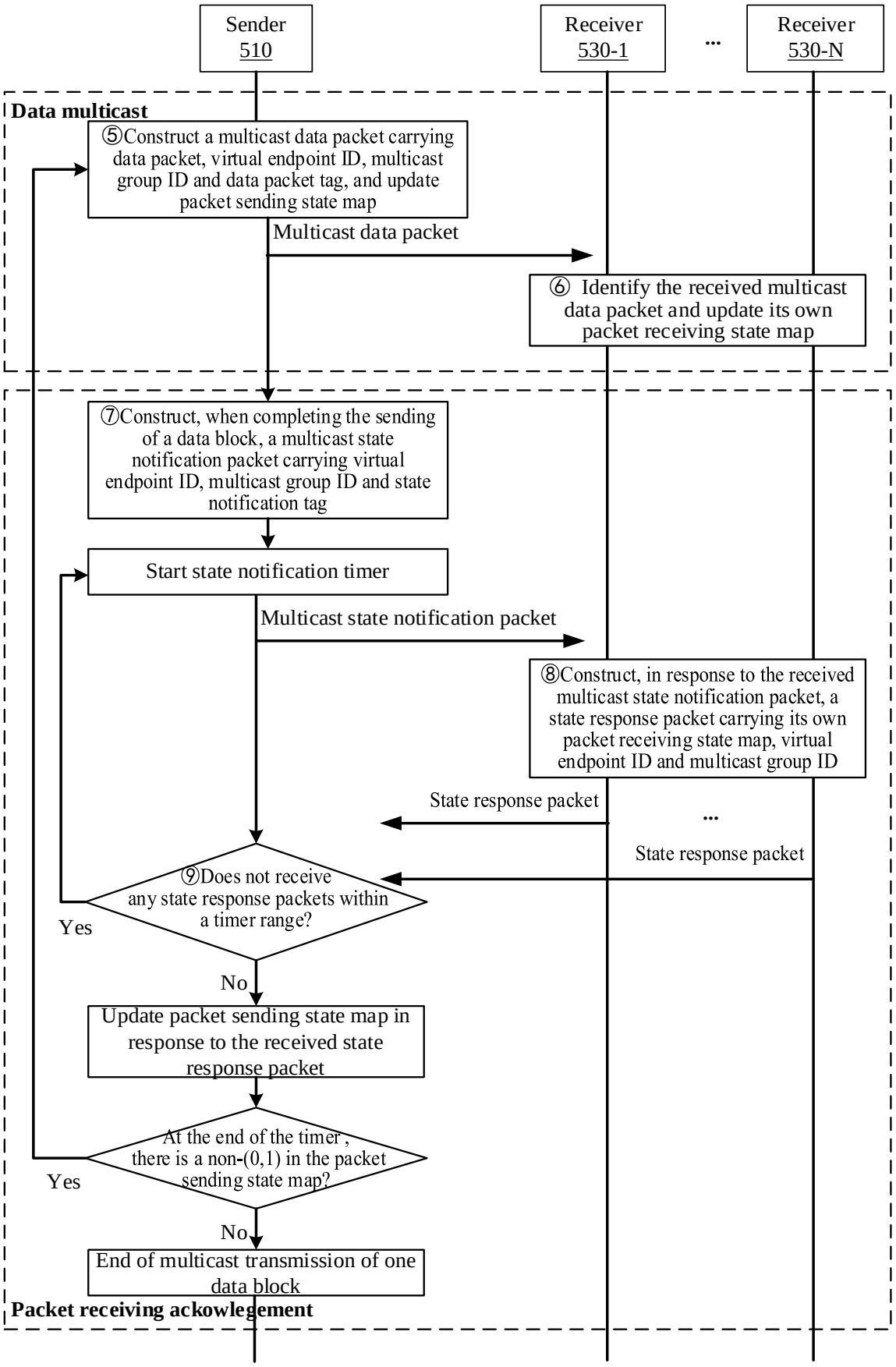


FIG. 5B（continued）

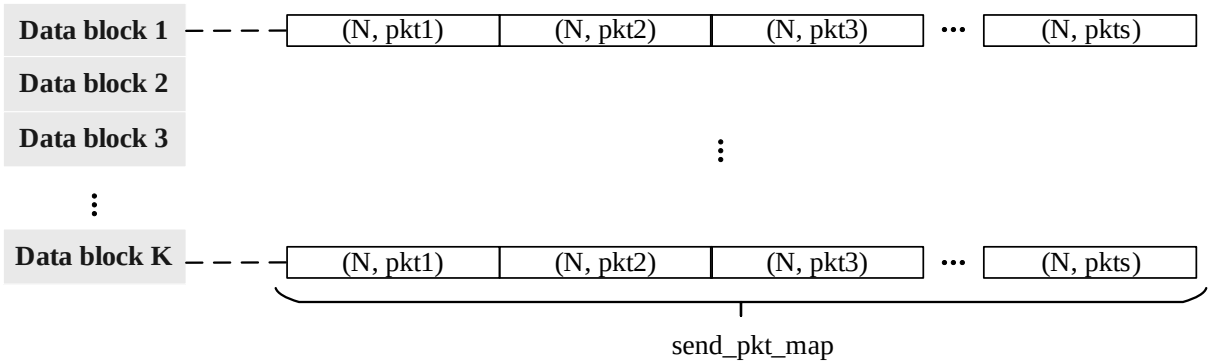


FIG. 6

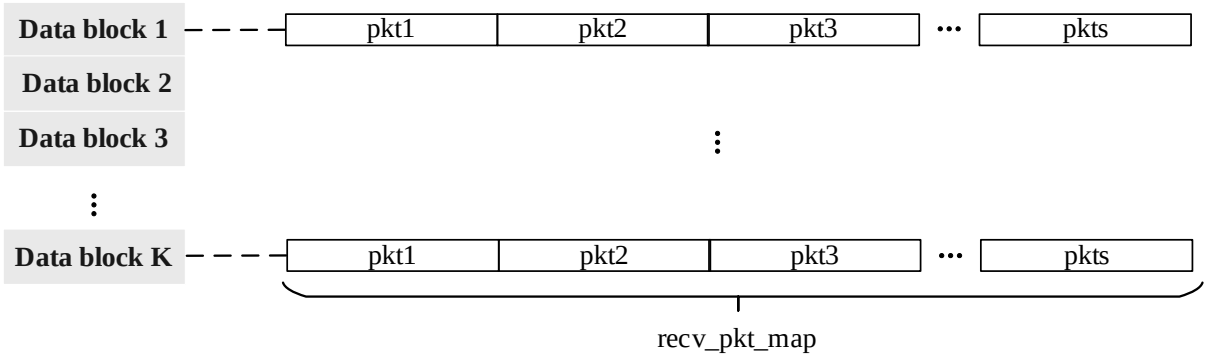


FIG. 7

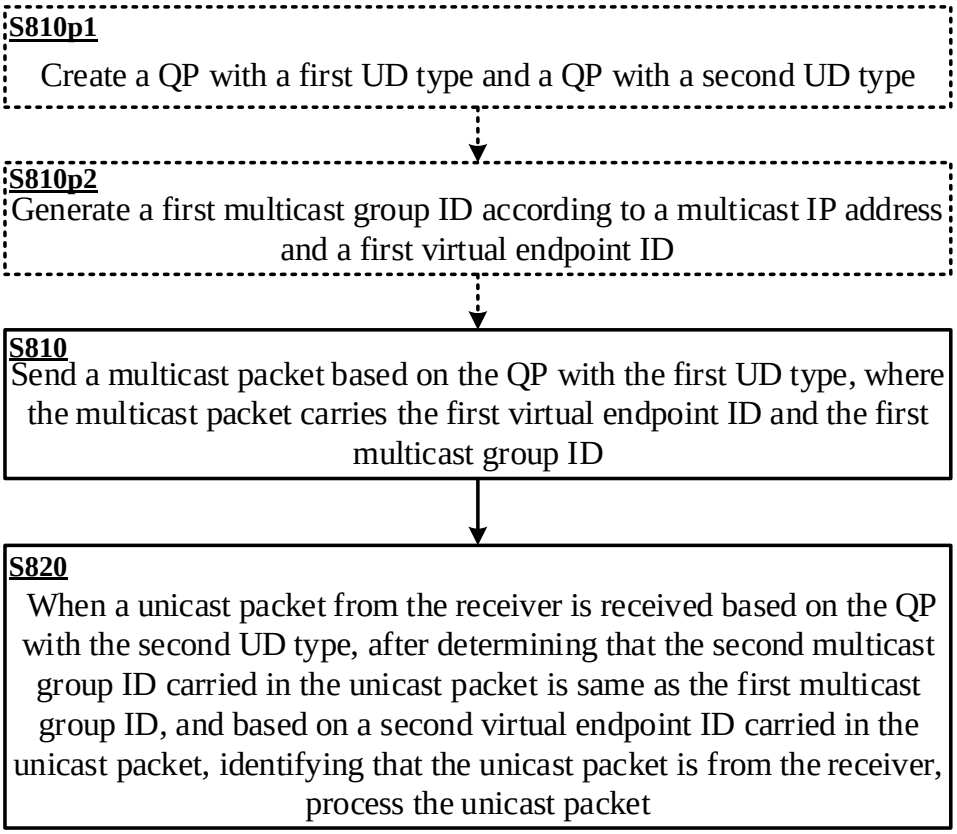


FIG. 8

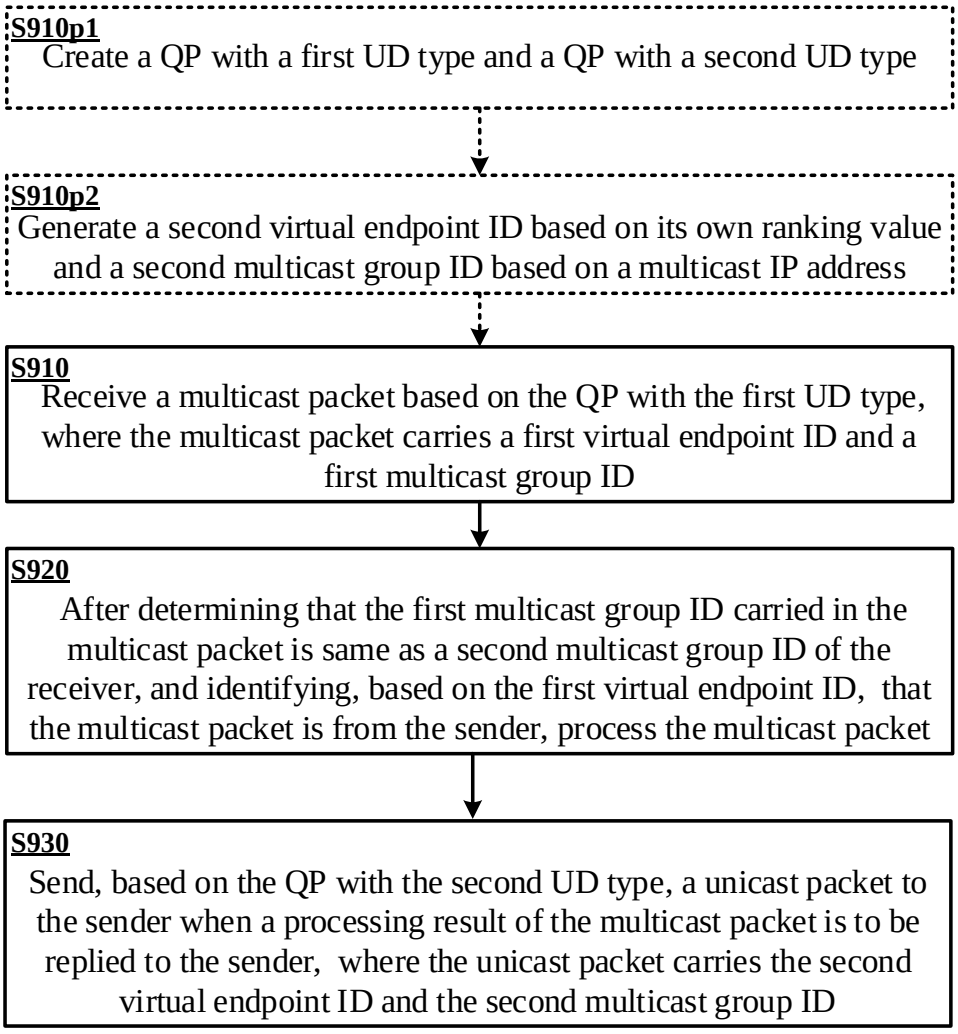

S910p1
Create a QP with a first UD type and a QP with a second UD type
S910p2
Generate a second virtual endpoint ID based on its own ranking value and a second multicast group ID based on a multicast IP address
S910
Receive a multicast packet based on the QP with the first UD type, where the multicast packet carries a first virtual endpoint ID and a first multicast group ID
S920
After determining that the first multicast group ID carried in the multicast packet is same as a second multicast group ID of the receiver, and identifying, based on the first virtual endpoint ID, that the multicast packet is from the sender, process the multicast packet
S930
Send, based on the QP with the second UD type, a unicast packet to the sender when a processing result of the multicast packet is to be replied to the sender, where the unicast packet carries the second virtual endpoint ID and the second multicast group ID

FIG. 9

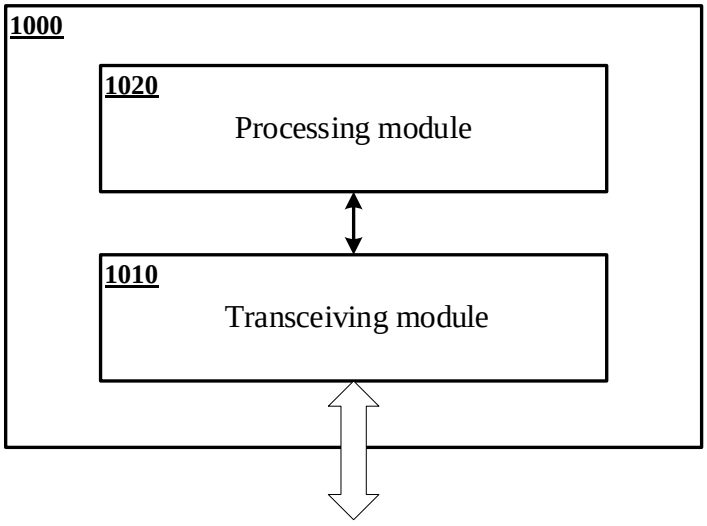

1000
1020
Processing module
1010
Transceiving module

FIG. 10