

FIG. 1

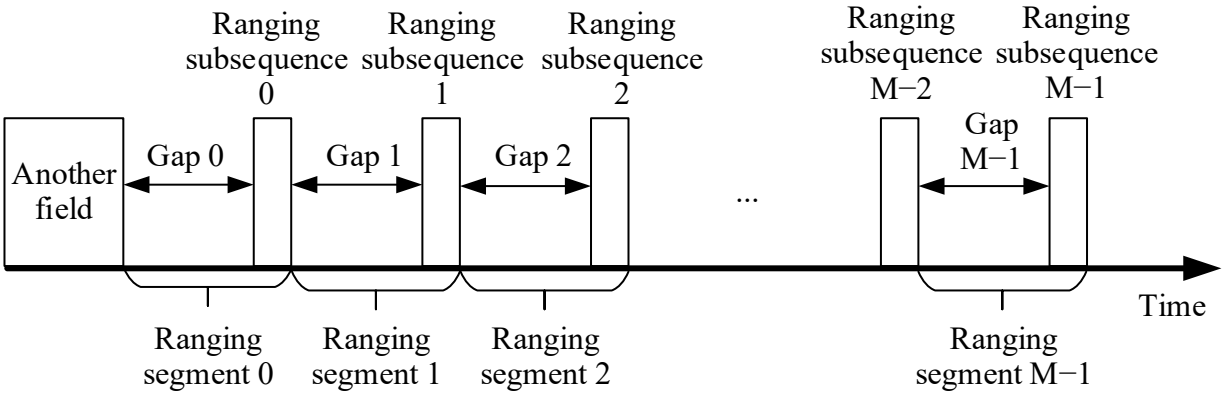


FIG. 2

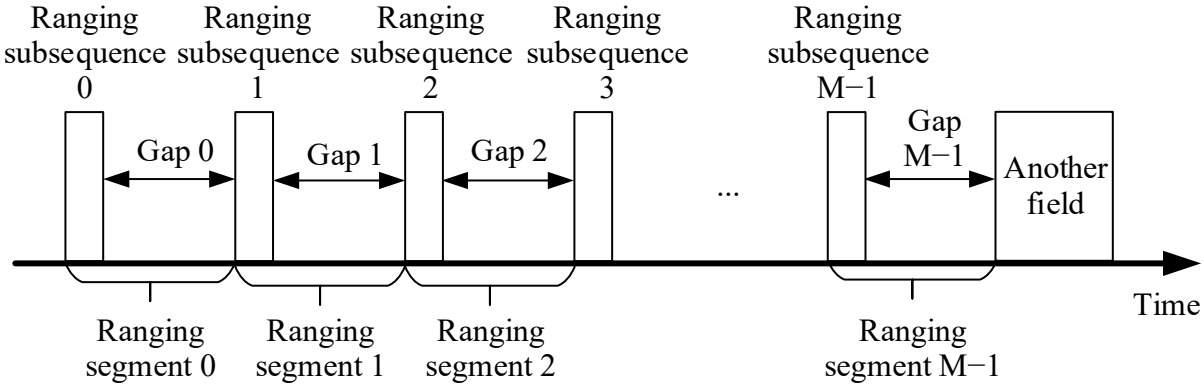


FIG. 3

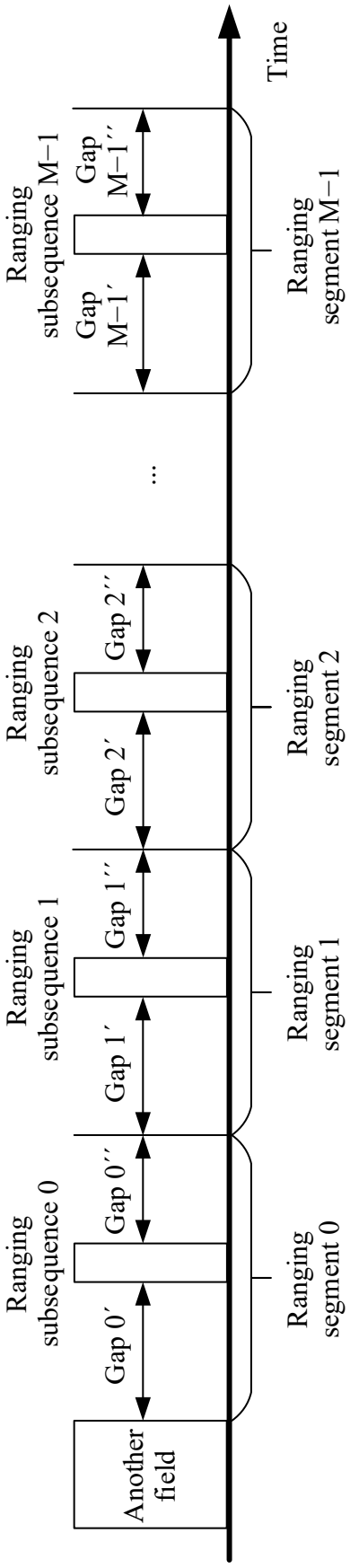

Another field
Gap 0′
Ranging subsequence 0
Gap 0″
Ranging segment 0
Gap 1′
Ranging subsequence 1
Gap 1″
Ranging segment 1
Gap 2′
Ranging subsequence 2
Gap 2″
Ranging segment 2
...
Gap M–1′
Ranging subsequence M–1
Gap M–1″
Ranging segment M–1
Time

FIG. 4

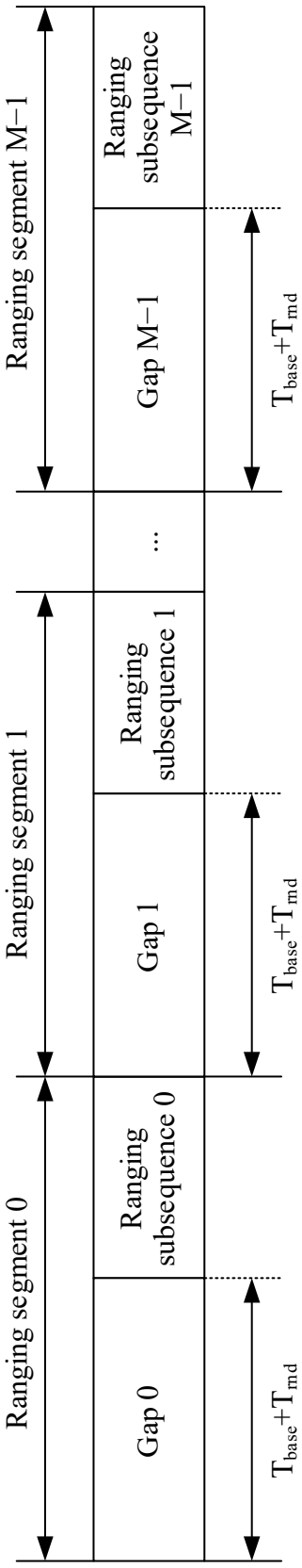

Ranging segment 0
Gap 0
Ranging subsequence 0
$T_{base}+T_{md}$
Ranging segment 1
Gap 1
Ranging subsequence 1
$T_{base}+T_{md}$
...
Ranging segment M−1
Gap M−1
Ranging subsequence M−1
$T_{base}+T_{md}$

FIG. 5

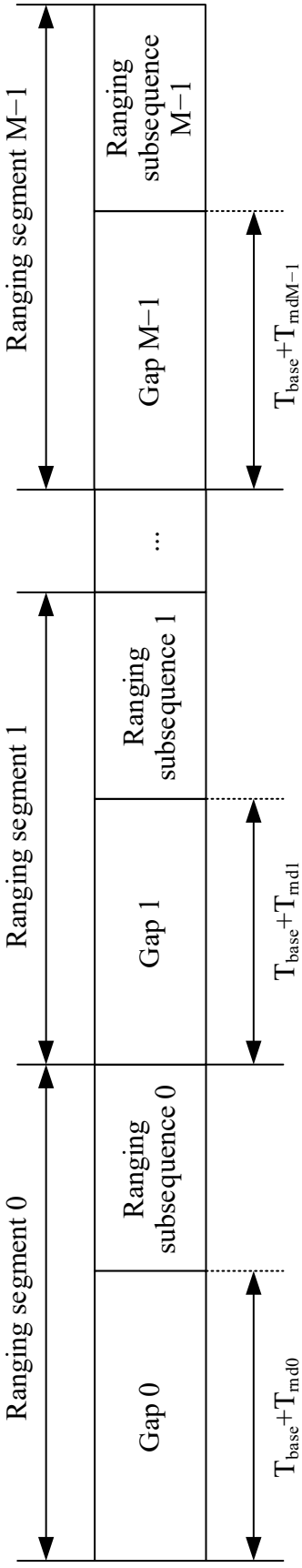

Ranging segment 0
Gap 0
Ranging subsequence 0
$T_{base}+T_{md0}$
Ranging segment 1
Gap 1
Ranging subsequence 1
$T_{base}+T_{md1}$
...
Ranging segment M−1
Gap M−1
Ranging subsequence M−1
$T_{base}+T_{mdM-1}$

FIG. 6

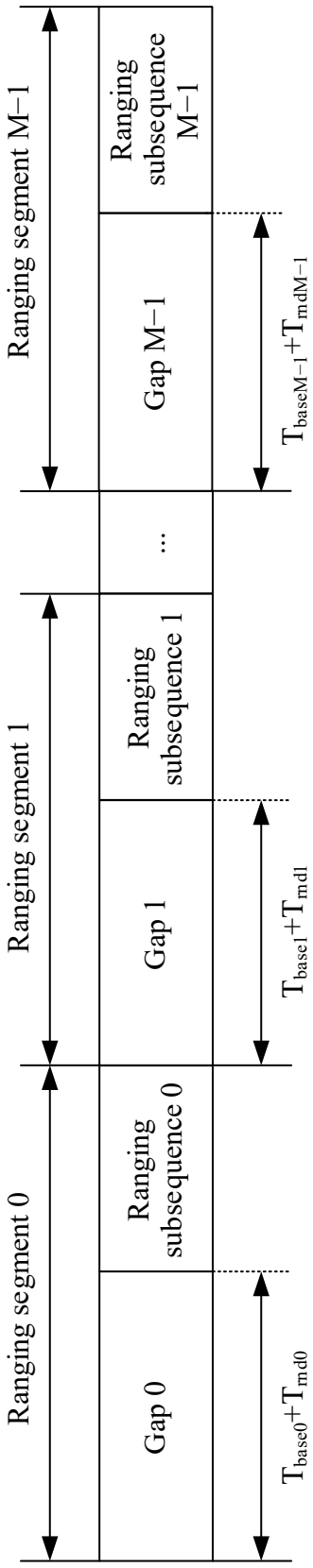

Ranging segment 0
Gap 0
Ranging subsequence 0
$T_{base0}+T_{md0}$
Ranging segment 1
Gap 1
Ranging subsequence 1
$T_{base1}+T_{md1}$
...
Ranging segment M−1
Gap M−1
Ranging subsequence M−1
$T_{baseM-1}+T_{mdM-1}$

FIG. 7

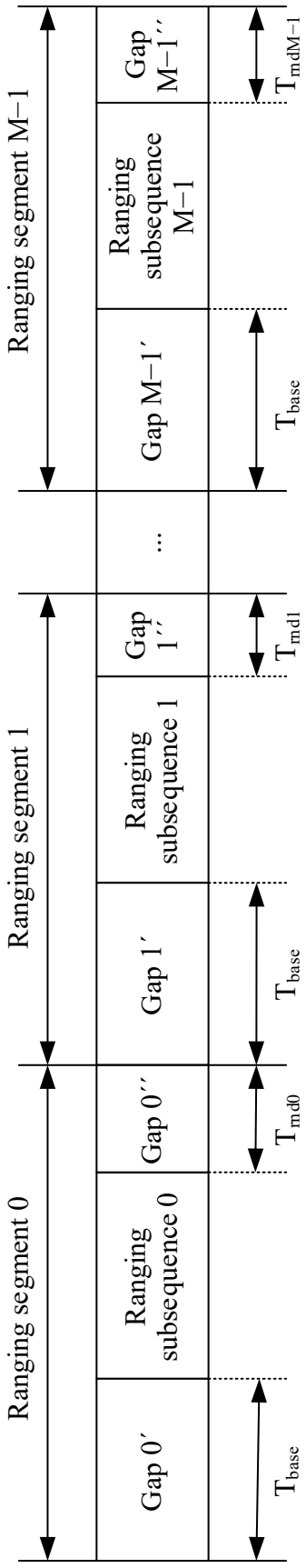

Ranging segment 0
Gap 0′
Ranging subsequence 0
Gap 0″
T_base
T_md0
Ranging segment 1
Gap 1′
Ranging subsequence 1
Gap 1″
T_base
T_md1
...
Ranging segment M–1
Gap M–1′
Ranging subsequence M–1
Gap M–1″
T_base
T_mdM–1

FIG. 8

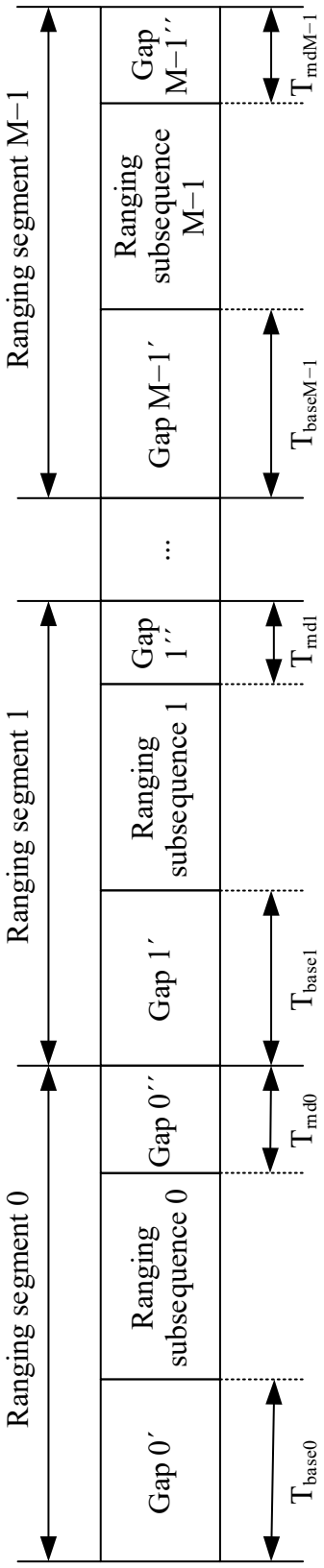

Ranging segment 0
Gap 0′
Ranging subsequence 0
Gap 0″
Ranging segment 1
Gap 1′
Ranging subsequence 1
Gap 1″
...
Ranging segment M−1
Gap M−1′
Ranging subsequence M−1
Gap M−1″
T_{base0}
T_{md0}
T_{base1}
T_{md1}
$T_{baseM-1}$
T_{mdM-1}

FIG. 9

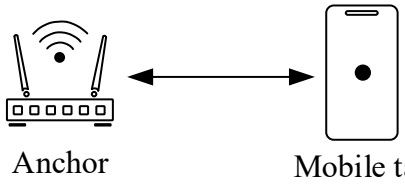


FIG. 10

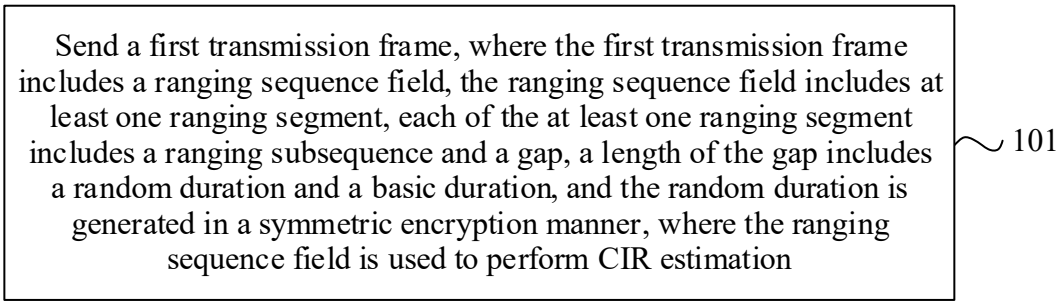


FIG. 11

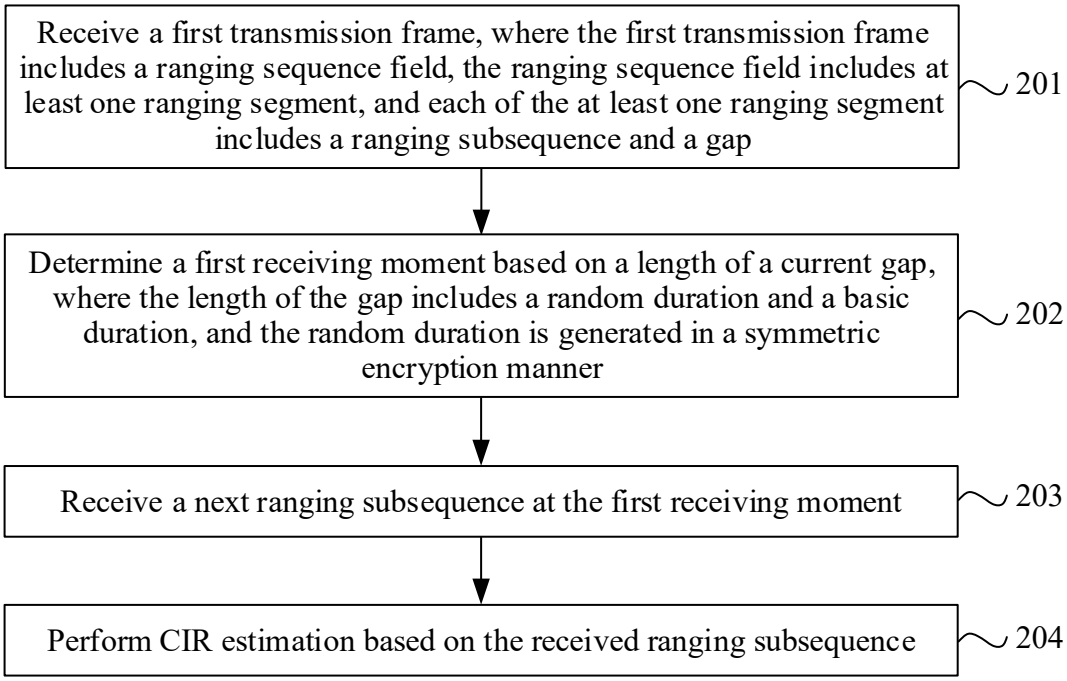


FIG. 12

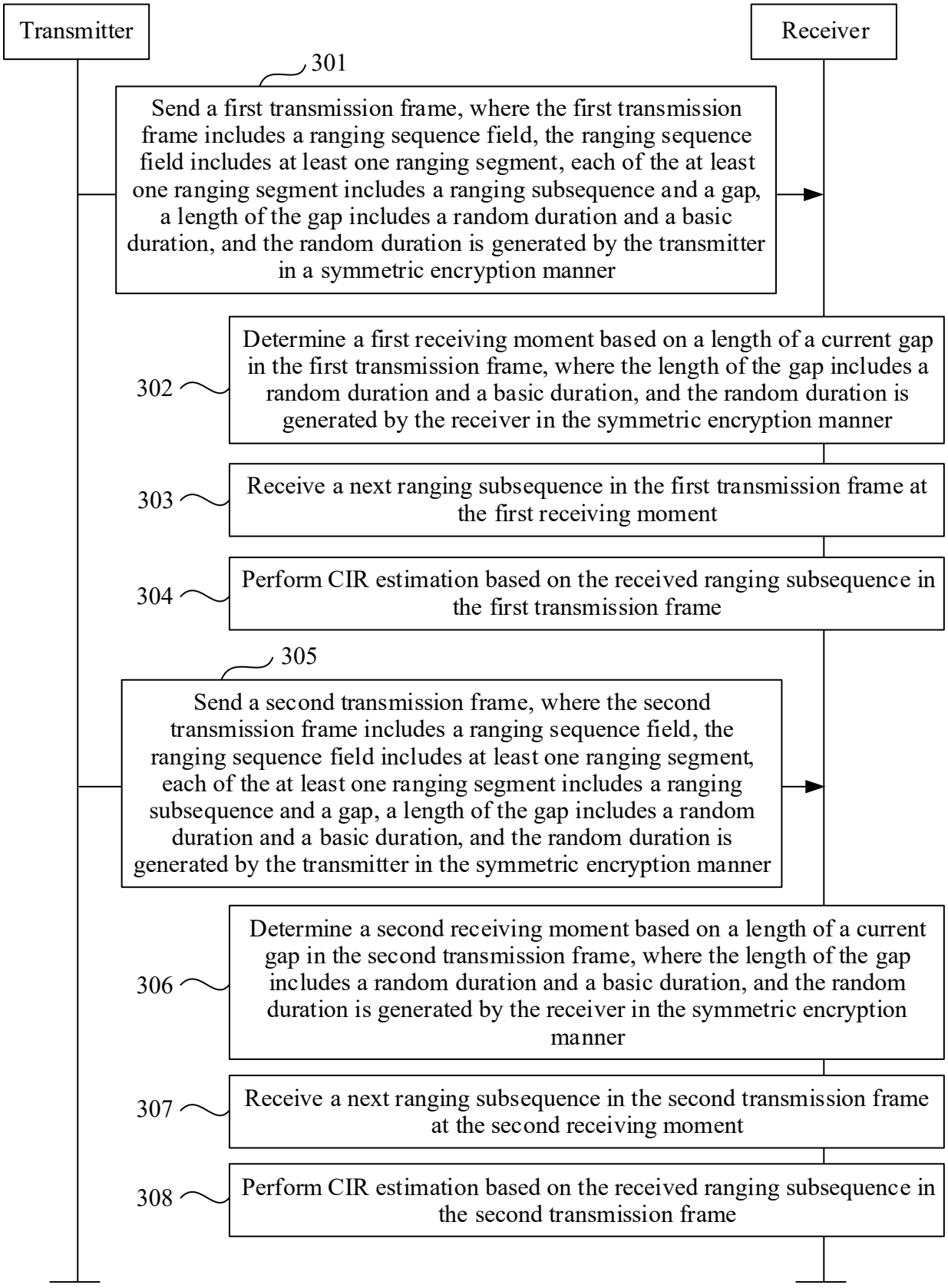

Transmitter
Receiver
301
Send a first transmission frame, where the first transmission frame includes a ranging sequence field, the ranging sequence field includes at least one ranging segment, each of the at least one ranging segment includes a ranging subsequence and a gap, a length of the gap includes a random duration and a basic duration, and the random duration is generated by the transmitter in a symmetric encryption manner
302
Determine a first receiving moment based on a length of a current gap in the first transmission frame, where the length of the gap includes a random duration and a basic duration, and the random duration is generated by the receiver in the symmetric encryption manner
303
Receive a next ranging subsequence in the first transmission frame at the first receiving moment
304
Perform CIR estimation based on the received ranging subsequence in the first transmission frame
305
Send a second transmission frame, where the second transmission frame includes a ranging sequence field, the ranging sequence field includes at least one ranging segment, each of the at least one ranging segment includes a ranging subsequence and a gap, a length of the gap includes a random duration and a basic duration, and the random duration is generated by the transmitter in the symmetric encryption manner
306
Determine a second receiving moment based on a length of a current gap in the second transmission frame, where the length of the gap includes a random duration and a basic duration, and the random duration is generated by the receiver in the symmetric encryption manner
307
Receive a next ranging subsequence in the second transmission frame at the second receiving moment
308
Perform CIR estimation based on the received ranging subsequence in the second transmission frame

FIG. 13

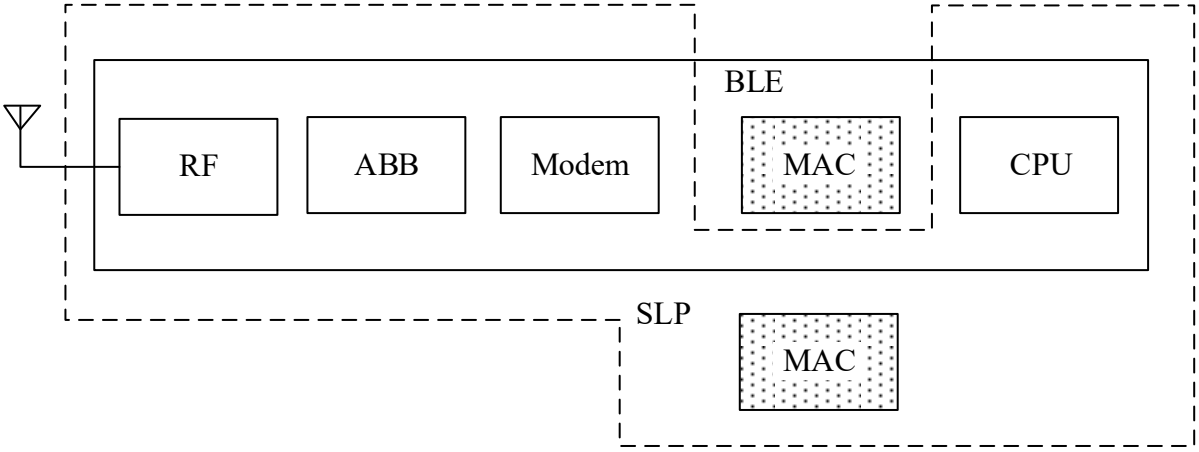


FIG. 14

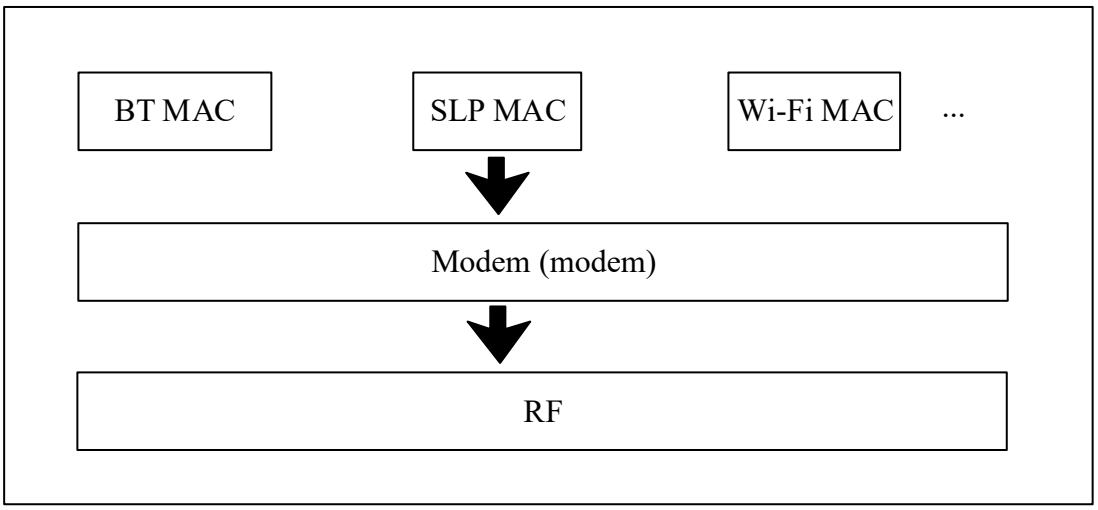


FIG. 15

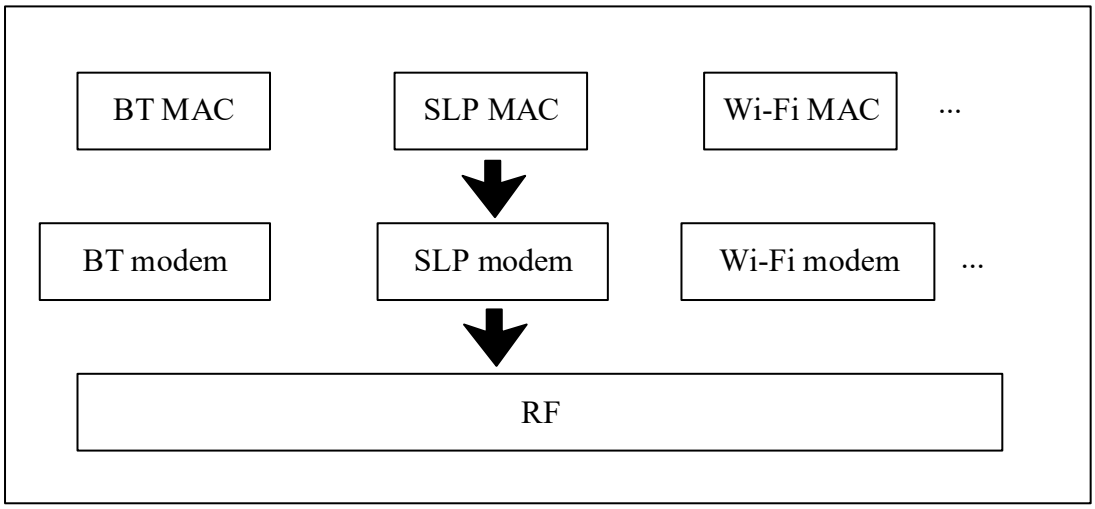


FIG. 16

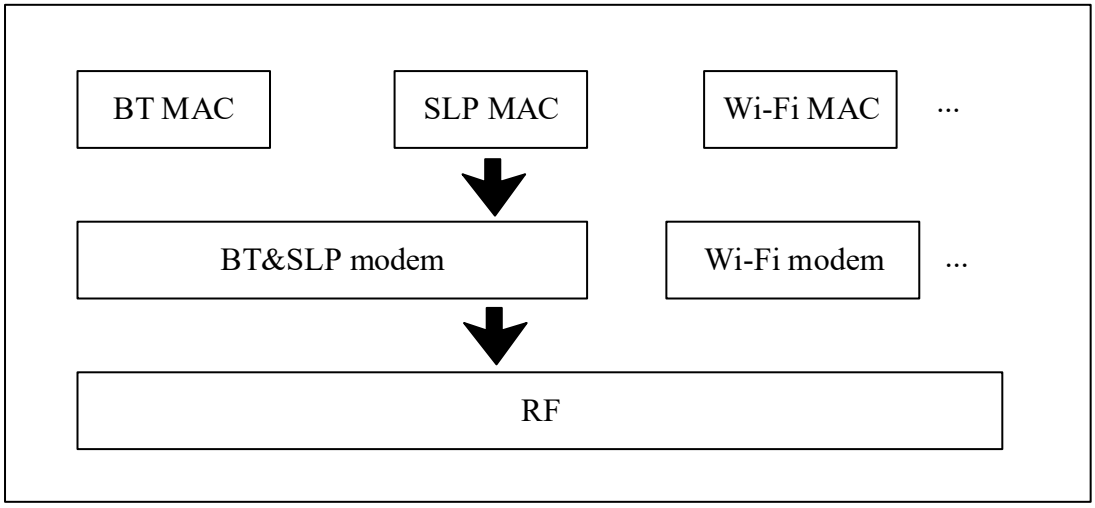


FIG. 17

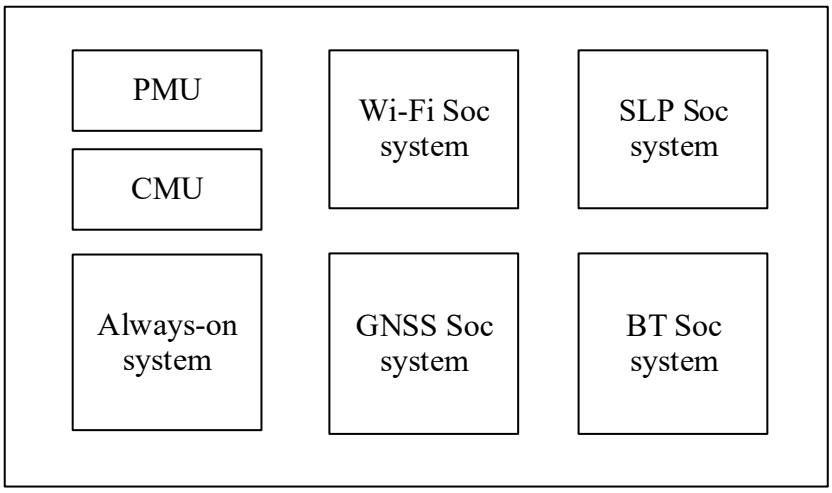


FIG. 18

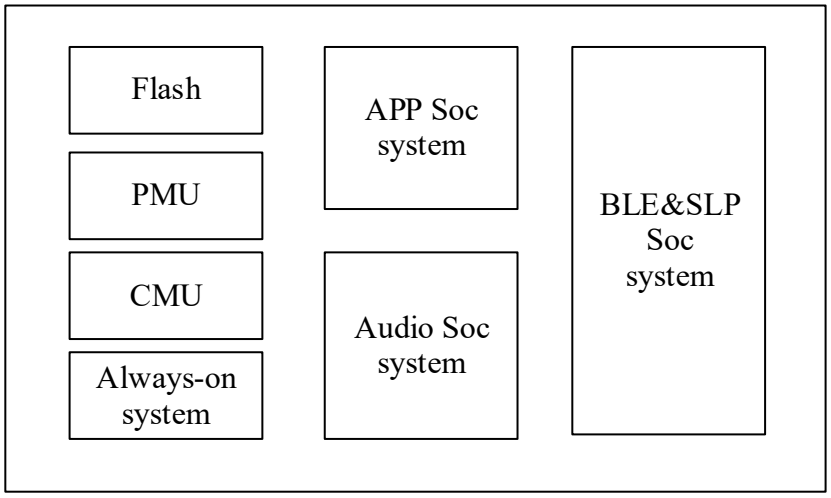


FIG. 19

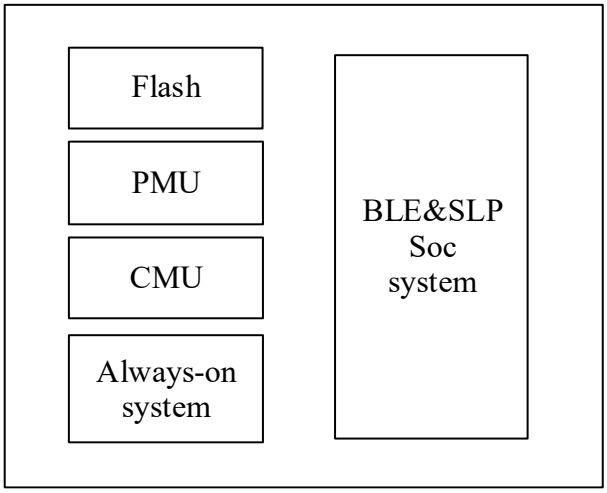


FIG. 20

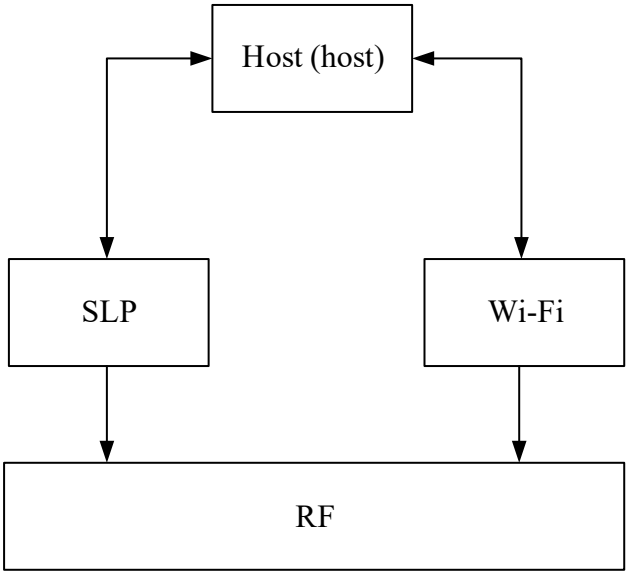


FIG. 21

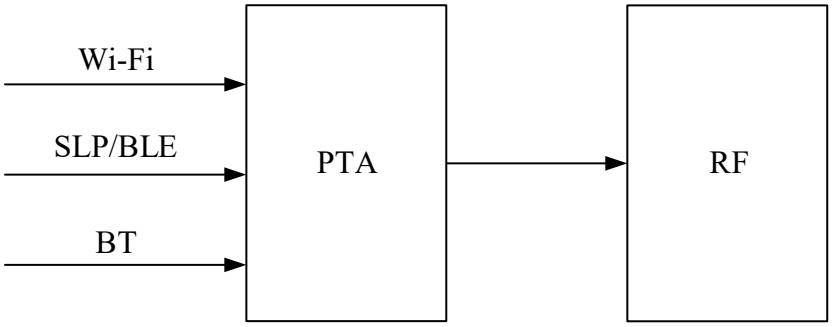


FIG. 22

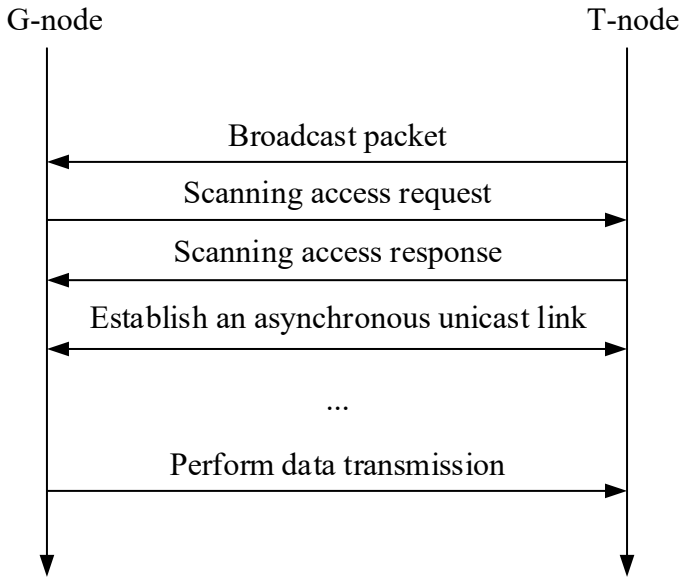

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous unicast link
...
Perform data transmission

FIG. 23

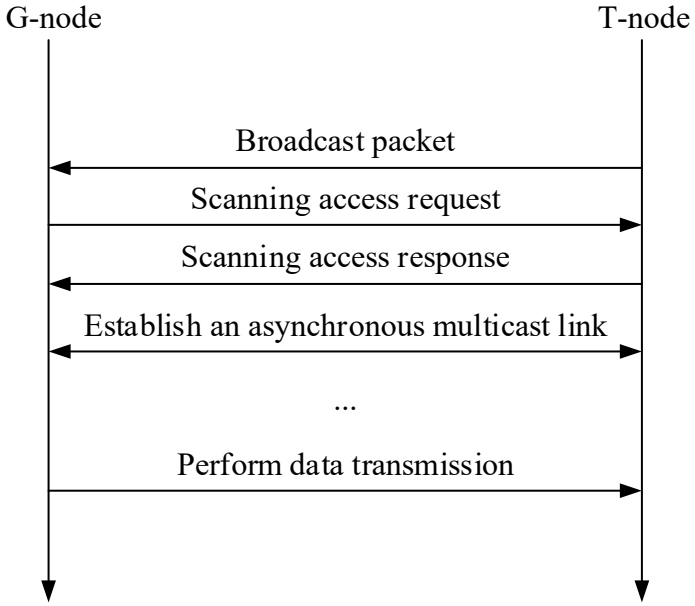

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous multicast link
...
Perform data transmission

FIG. 24

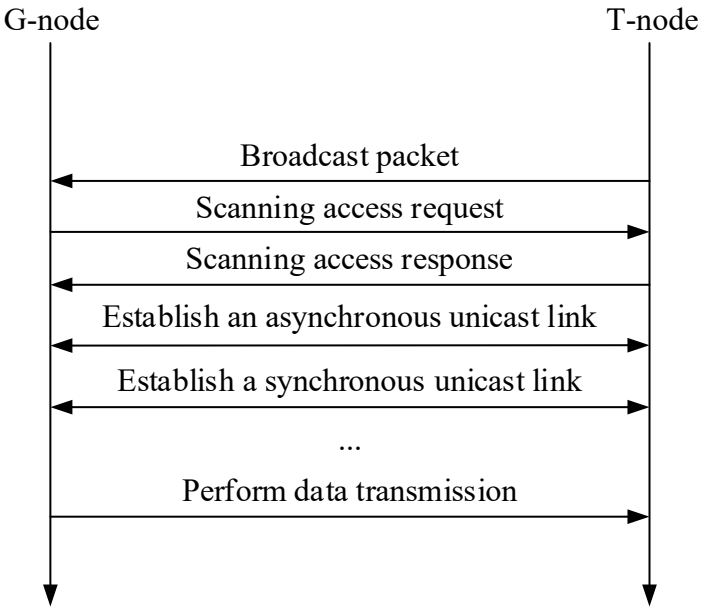

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous unicast link
Establish a synchronous unicast link
...
Perform data transmission

FIG. 25

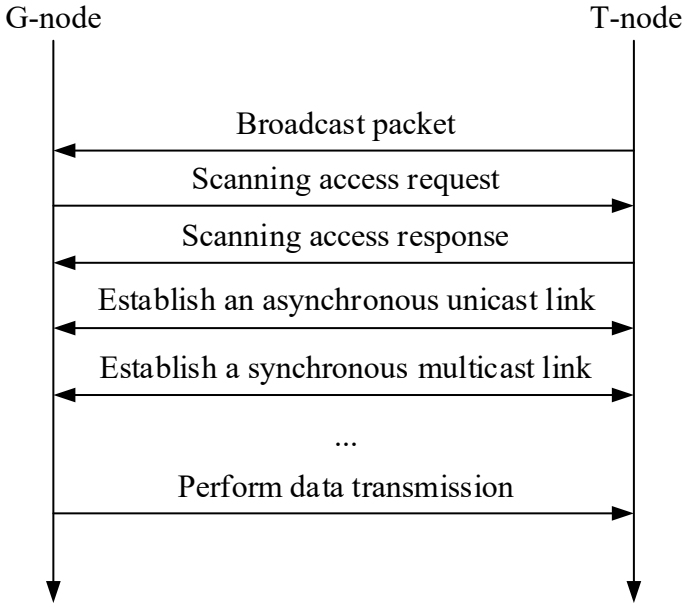

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous unicast link
Establish a synchronous multicast link
...
Perform data transmission

FIG. 26

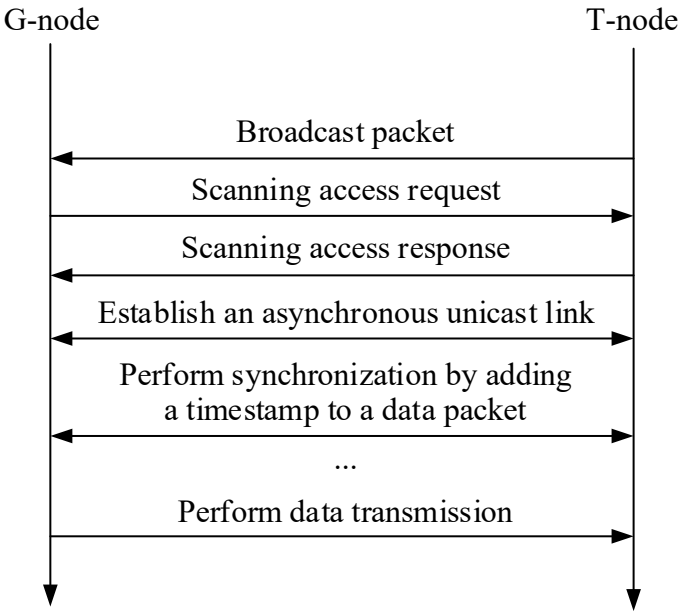

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous unicast link
Perform synchronization by adding a timestamp to a data packet
...
Perform data transmission

FIG. 27

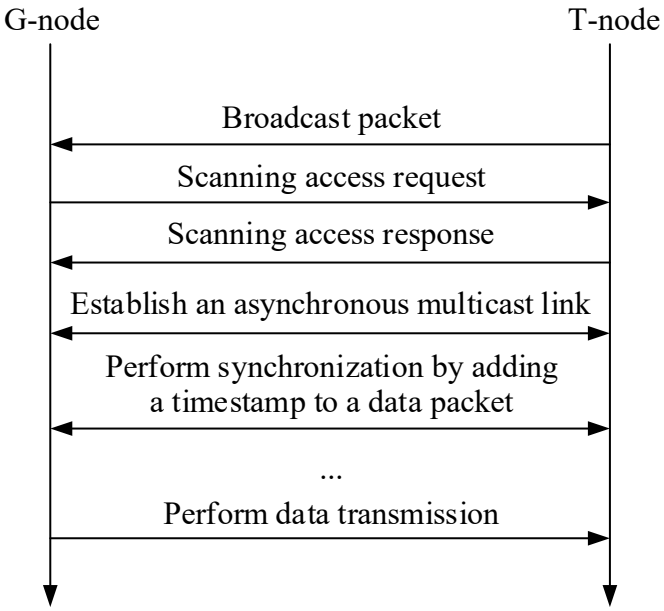

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Establish an asynchronous multicast link
Perform synchronization by adding a timestamp to a data packet
...
Perform data transmission

FIG. 28

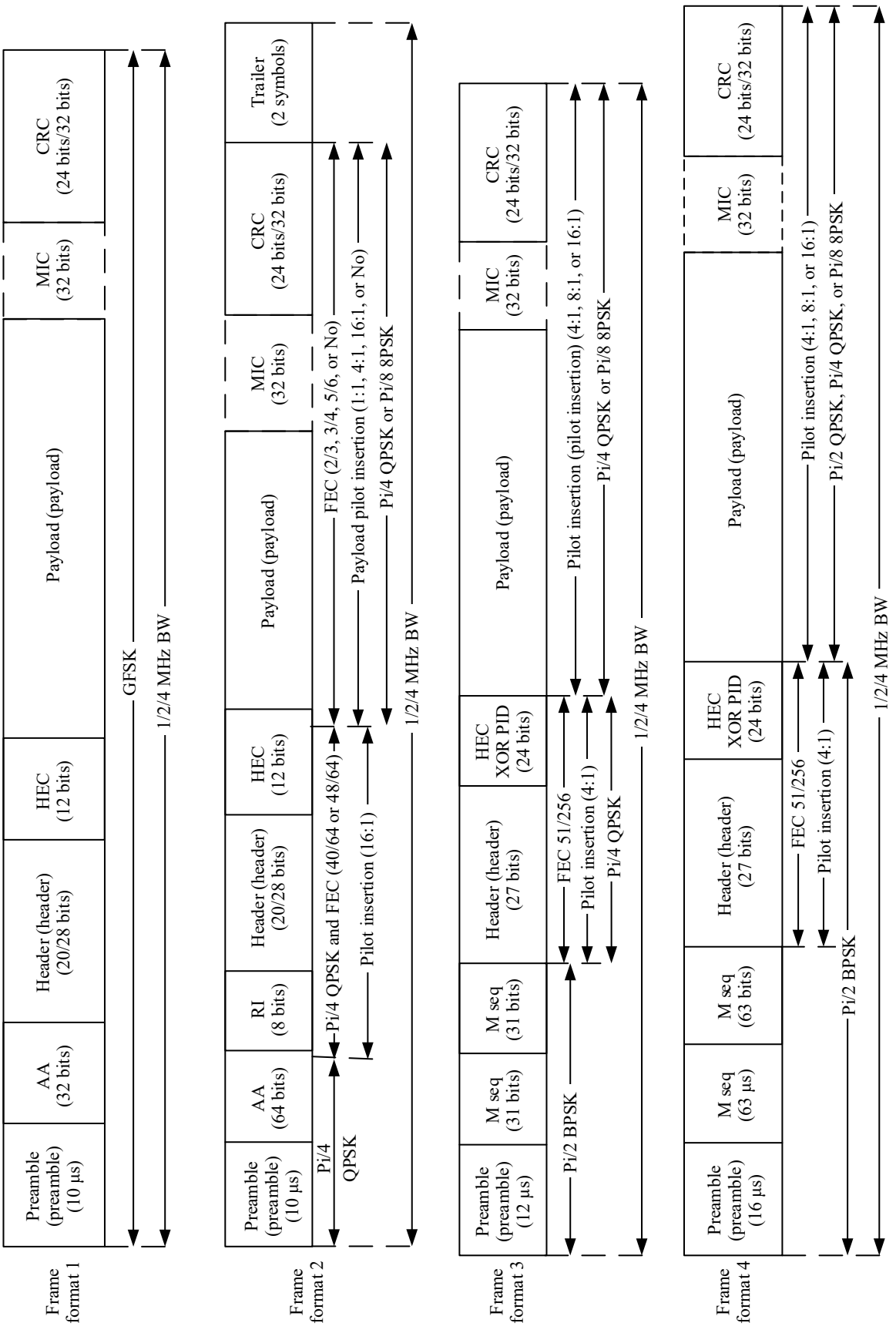

Frame format 1
Preamble (preamble) (10 μs)
AA (32 bits)
Header (header) (20/28 bits)
HEC (12 bits)
Payload (payload)
MIC (32 bits)
CRC (24 bits/32 bits)
GFSK
1/2/4 MHz BW
Frame format 2
Preamble (preamble) (10 μs)
AA (64 bits)
RI (8 bits)
Header (header) (20/28 bits)
HEC (12 bits)
Payload (payload)
MIC (32 bits)
CRC (24 bits/32 bits)
Trailer (2 symbols)
Pi/4 QPSK
Pi/4 QPSK and FEC (40/64 or 48/64)
FEC (2/3, 3/4, 5/6, or No)
Pilot insertion (16:1)
Payload pilot insertion (1:1, 4:1, 16:1, or No)
Pi/4 QPSK or Pi/8 8PSK
1/2/4 MHz BW
Frame format 3
Preamble (preamble) (12 μs)
M seq (31 bits)
M seq (31 bits)
Header (header) (27 bits)
HEC XOR PID (24 bits)
Payload (payload)
MIC (32 bits)
CRC (24 bits/32 bits)
Pi/2 BPSK
FEC 51/256
Pilot insertion (4:1)
Pi/4 QPSK
Pilot insertion (pilot insertion) (4:1, 8:1, or 16:1)
Pi/4 QPSK or Pi/8 8PSK
1/2/4 MHz BW
Frame format 4
Preamble (preamble) (16 μs)
M seq (63 μs)
M seq (63 bits)
Header (header) (27 bits)
HEC XOR PID (24 bits)
Payload (payload)
MIC (32 bits)
CRC (24 bits/32 bits)
Pi/2 BPSK
FEC 51/256
Pilot insertion (4:1)
Pilot insertion (4:1, 8:1, or 16:1)
Pi/2 QPSK, Pi/4 QPSK, or Pi/8 8PSK
1/2/4 MHz BW

FIG. 29

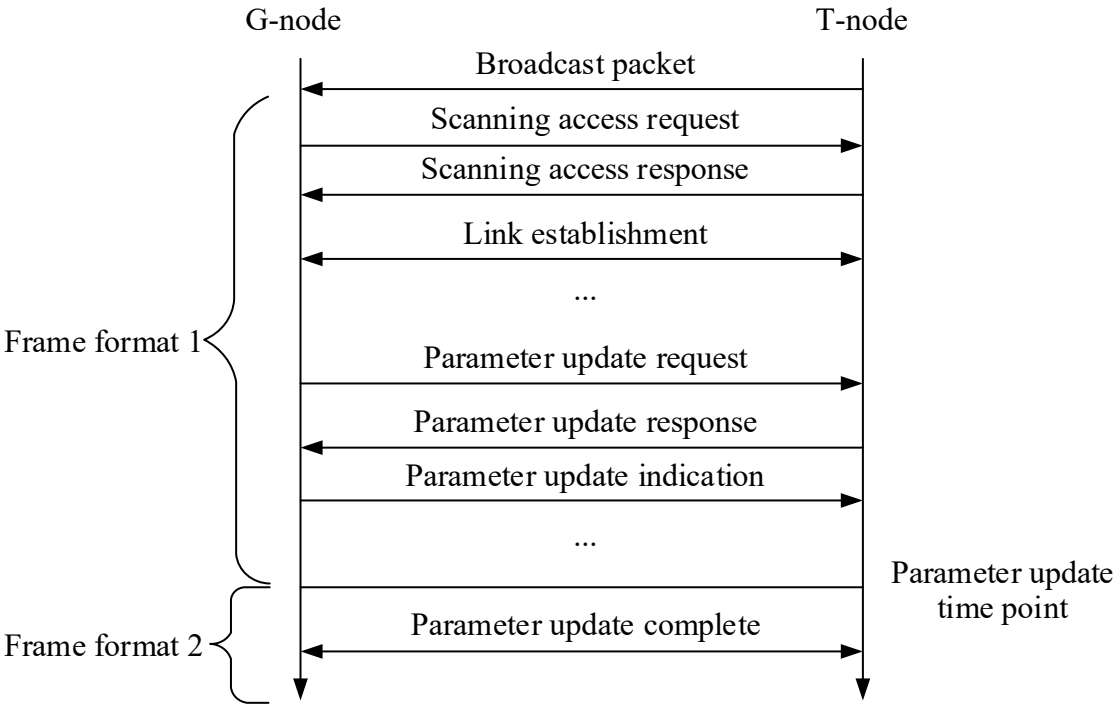

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Link establishment
...
Frame format 1
Parameter update request
Parameter update response
Parameter update indication
...
Parameter update time point
Frame format 2
Parameter update complete

FIG. 30

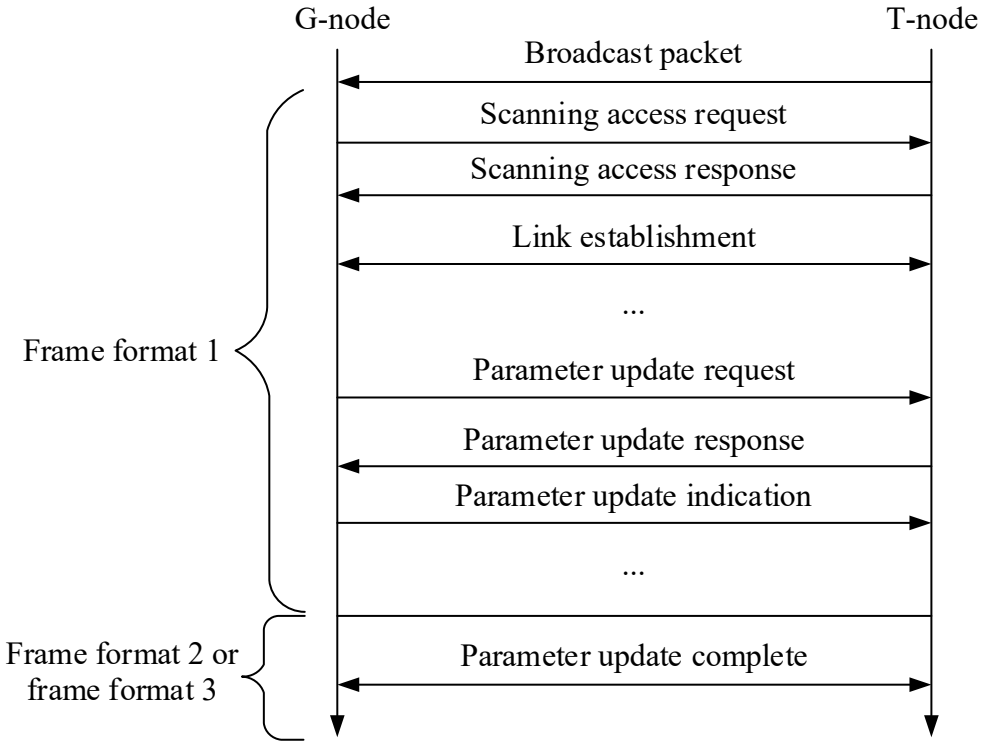

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Link establishment
...
Frame format 1
Parameter update request
Parameter update response
Parameter update indication
...
Frame format 2 or frame format 3
Parameter update complete

FIG. 31

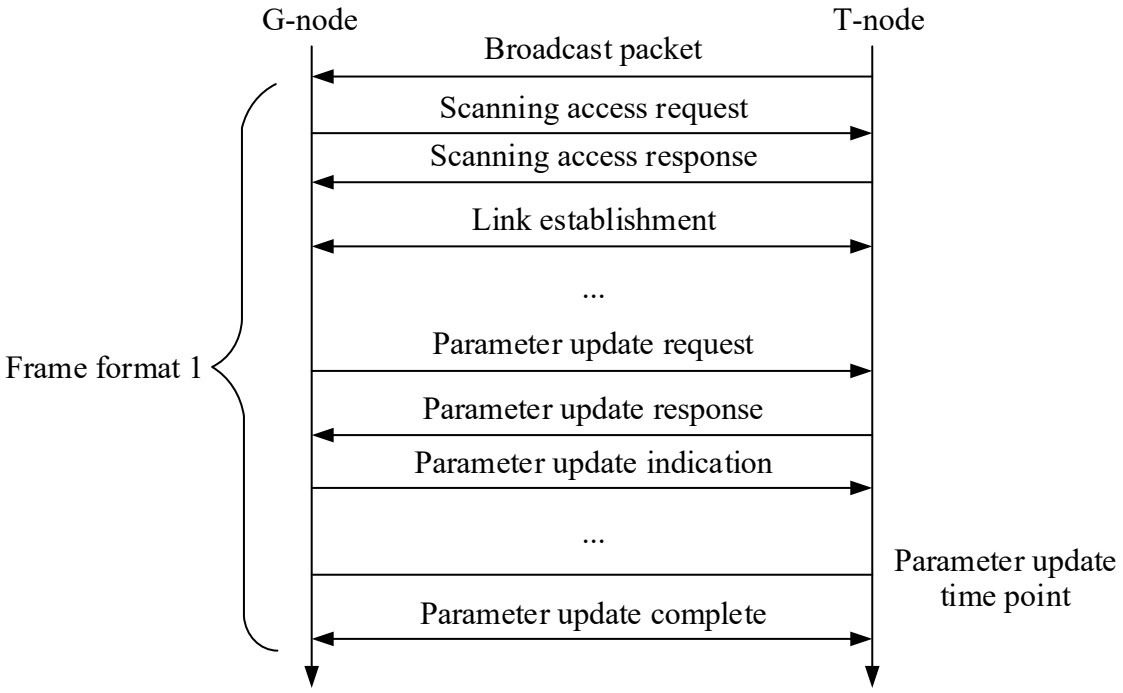

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Link establishment
...
Parameter update request
Parameter update response
Parameter update indication
...
Parameter update complete
Frame format 1
Parameter update time point

FIG. 32

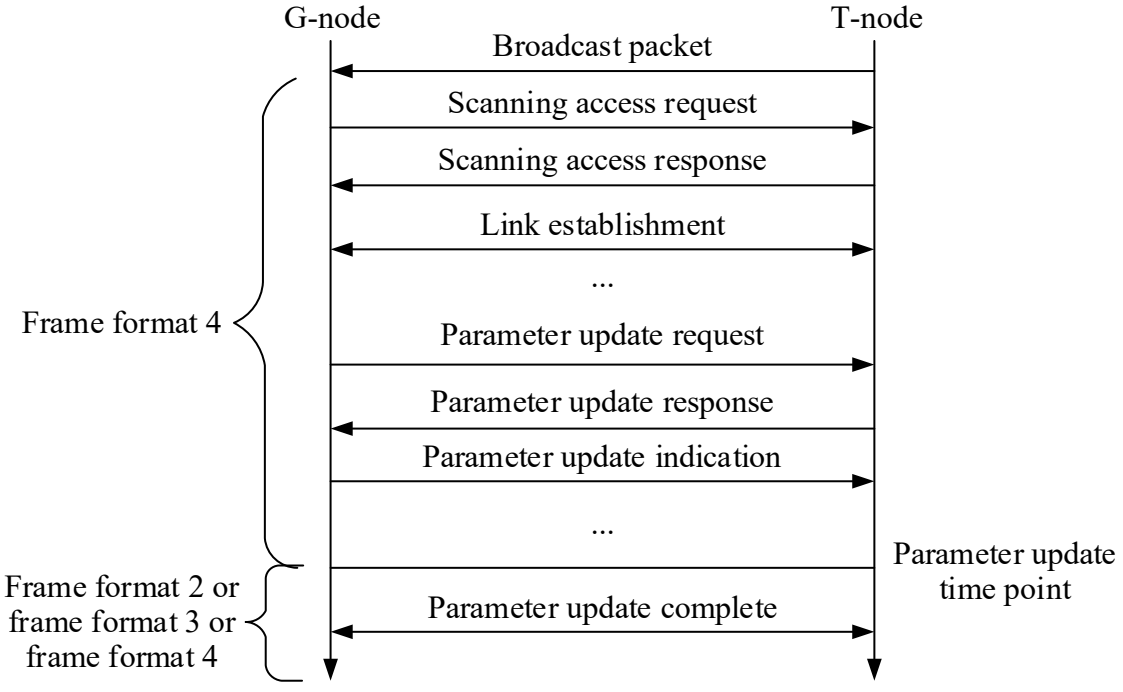

G-node
T-node
Broadcast packet
Scanning access request
Scanning access response
Link establishment
...
Parameter update request
Parameter update response
Parameter update indication
...
Parameter update complete
Frame format 4
Frame format 2 or frame format 3 or frame format 4
Parameter update time point

FIG. 33

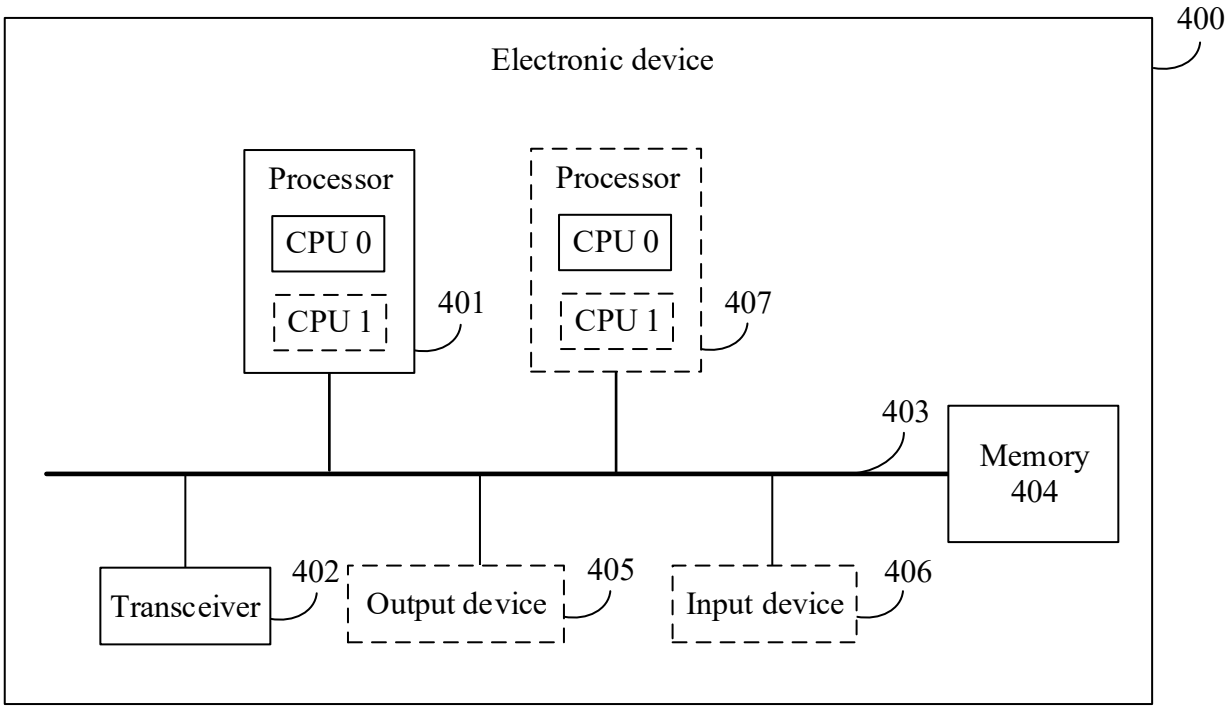

400
Electronic device
Processor
CPU 0
CPU 1
401
Processor
CPU 0
CPU 1
407
403
Memory
404
Transceiver
402
Output device
405
Input device
406

FIG. 34

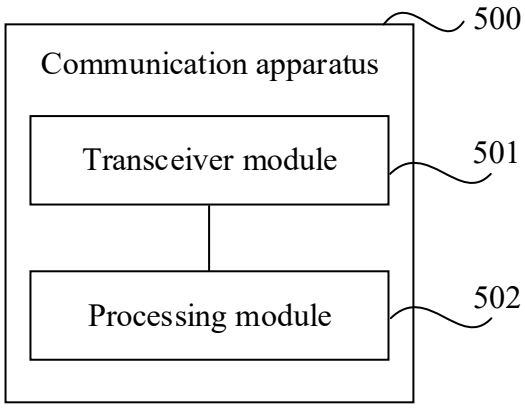

500
Communication apparatus
Transceiver module
501
Processing module
502

FIG. 35

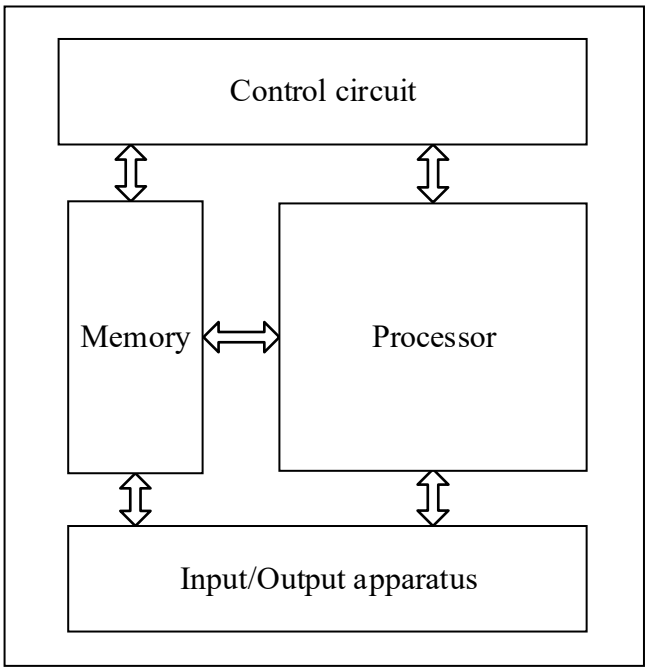


FIG. 36