

[0014] In a possible implementation, the signal generator is further configured to stop sending the channel occupancy signal at the sending start point.

[0015] In a possible implementation, the RF module is further configured to stop sending the 802.11 frame at the sending end point.

5 **[0016]** In a possible implementation, the MAC agent module is further configured to control the signal generator based on the channel contention result or the control word obtained through decapsulation by the first decapsulation module.

[0017] In a possible implementation, a signal transmitted between the remote unit and the central unit is a digital baseband frequency domain IQ signal. The remote unit further includes:

10 a fast Fourier transform/inverse fast Fourier transform FFT/IFFT module, configured to perform fast Fourier transform/inverse fast Fourier transform on the 802.11 frame received by the RF module, transform the 802.11 frame from a time domain to a frequency domain, and obtain and send content of a long training field LTF field and fields following the LTF field in the transformed 802.11 frame to the first encapsulation module, where the first encapsulation module
15 is further configured to encapsulate and send content of the LTF field and the fields following the LTF field to the central unit, and obtain and send a signal SIG field in the transformed 802.11 frame to a SIG detection module; and

the SIG detection module, configured to demodulate and decode the SIG field to complete format detection of the 802.11 frame, and send a decoding result to the first encapsulation
20 module, where the first encapsulation module is further configured to encapsulate and send the decoding result to the central unit.

[0018] The FFT/IFFT module and the SIG detection module are disposed in the remote unit, so that the digital baseband frequency domain IQ signal can be transmitted between the FFT/IFFT module and the SIG module, and SIG detection can be completed on the remote unit side, to
25 implement first and second AGC adjustments.

[0019] In a possible implementation, a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal. The remote unit further includes:

a synchronization module, configured to detect validity and a start boundary of the 802.11 frame, and perform frame synchronization and symbol synchronization on the 802.11 frame;
30 where

the first decapsulation module is further configured to receive an encapsulated

method further includes:

[0069] The remote unit receives a channel contention message from the central unit.

[0070] Before the remote unit performs CCA detection, the method further includes:

[0071] The remote unit sends the channel contention result to the central unit, controls based on the channel contention result or the control word obtained through decapsulation, whether to send the channel occupancy signal ~~a channel occupancy symbol~~.

[0072] In a possible implementation, a signal transmitted between the remote unit and the central unit is a digital baseband frequency domain IQ signal. The method further includes:

[0073] The remote unit performs fast Fourier transform/inverse fast Fourier transform on the received 802.11 frame, transforms the 802.11 frame from a time domain to a frequency domain, obtains, encapsulates, sends content of a long training field LTF field and fields following the LTF field in the transformed 802.11 frame to the central unit, obtains, demodulates and decodes a signal SIG field in the transformed 802.11 frame, completes format detection of the 802.11 frame, and encapsulates and sends the decoding result to the central unit.

[0074] In a possible implementation, a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal. The method further includes:

The remote unit sends the 802.11 frame to the central unit;

the central unit performs fast Fourier transform/inverse fast Fourier transform on the 802.11 frame, completing transformation of the 802.11 frame from a time domain to a frequency domain, obtains, demodulates and decodes a signal SIG field in the transformed 802.11 frame, completes format detection of the 802.11 frame, and sends the decoding result to the central unit; and

the remote unit detects a start boundary of the 802.11 frame, obtains the decoding result through decapsulation, generates an automatic gain control command based on the decoding result; performs, based on the automatic gain control command, automatic gain control on signal power of the 802.11 frame, and adjusts power of a signal input into a digital-to-analog/analog-to-digital converter.

[0075] In a possible implementation, if the remote unit detects a legacy short training field L-STF field in the 802.11 frame during detection of the start boundary of the 802.11 frame, the remote unit indicates to perform first automatic gain control on the signal power of the 802.11 frame.

[0076] After obtaining decoding results of a legacy signal field L-SIG field and first three

orthogonal frequency division multiplexing OFDM symbols following the L-SIG field of the 802.11 frame that are obtained by the central unit, the remote unit runs a local AGC state machine based on the decoding result, to generate a second automatic gain control command or a third automatic gain control command, and performs second automatic gain control or third automatic gain control on the signal power of the 802.11 frame.

[0077] According to a fifth aspect, an embodiment of this application provides a remote unit. The remote unit may include:

a processor, a memory, and a bus, where the processor and the memory are connected through the bus, the memory is configured to store a group of program code, and the processor is configured to invoke the program code stored in the memory to perform the method according to the second aspect or any item of the second aspect.

[0078] According to a sixth aspect, an embodiment of this application provides an apparatus. The apparatus provided in this application has a function of implementing actions of the remote unit in the foregoing method aspect, and includes a corresponding means (means) configured to perform steps or functions described in the foregoing method aspect. The steps or the functions may be implemented by using software, hardware (for example, a circuit), or a combination of hardware and software.

[0079] In a possible design, the apparatus includes one or more processors and a communications unit. The one or more processors are configured to support the apparatus in performing corresponding functions of the remote unit in the foregoing methods. Optionally, the apparatus may further include one or more memories. The memory is configured to be coupled to the processor, and store a program instruction and/or data that are/is necessary for the apparatus. The one or more memories may be integrated with the processor, or may be separate from the processor. This is not limited in this application.

[0080] The apparatus may be a router, a switch, a computer, an intelligent terminal, or the like. The communications unit may be a transceiver or a transceiver circuit. Optionally, the transceiver may alternatively be an input/output circuit or an interface.

[0081] The apparatus may alternatively be a communications chip. The communications unit may be an input/output circuit or interface of the communications chip.

[0082] In another possible design, the apparatus includes a transceiver, a processor, and a memory. The processor is configured to control the transceiver or an input/output circuit to send

stop sending the channel occupancy signal.

[00133] A main signal flow at the RU side is as follows: the central unit-the first decapsulation module-the MAC agent module-the signal generator.

5 **[00134]** When receiving the 802.11 frame, the fast Fourier transform/inverse fast Fourier transform (FFT/IFFT) module sends content of an X-LTF field and fields following the X-LTF field (for example, in a form such as X-LTF IQ, Data IQ, and digital baseband frequency domain IQ) after FFT is performed to the first encapsulation module for encapsulation, and then the content of the X-LTF field and fields following the X-LTF field are remotely transmitted to the CU through a PHY interface.

10 **[00135]** A main signal flow at the RU side is as follows: the DFE receiver of the RU-the FFT/IFFT module-the first encapsulation module.

[00136] When SIG field content (in a form of SIG IQ and digital baseband frequency domain IQ signal) ~~processed by the~~ FFT module is sent to the SIG detection module, a signal flow at the RU side is: the DFE receiver of the RU-the FFT/IFFT module-the SIG detection module.

15 **[00137]** When the decoding result of the SIG is parsed and sent to the first encapsulation module for encapsulation, and then is remotely transmitted to the CU through the PHY interface, a signal flow at the RU side is: the FFT/IFFT module-the SIG detection module-the first encapsulation module-the central unit.

[00138] When the 802.11 frame is sent, digital baseband frequency domain IQ data is obtained
20 through decapsulation by the first decapsulation module, and is sent to the FFT/IFFT module to complete transformation from a frequency domain to a time domain. A signal flow at the RU side is as follows: the central unit-the first decapsulation module-the FFT/IFFT module-the DFE transmitter of the RU.

[00139] The CU side may mainly include the following parts.

25 **[00140]** A MAC processing module is configured to: generate and send a channel contention message to the CCA module, receive a channel contention result sent by the CCA module, and perform MAC sending processing and MAC receiving processing. For example, during downlink sending, after receiving the channel contention result, the MAC processing module performs MAC sending, generates and sends to-be-sent information to a baseband module, and notifies the
30 baseband module of generating and outputting a digital baseband IQ signal. During uplink sending, the MAC processing module receives output information from a baseband module and performs

[00158] S409: The remote unit sends the digital baseband IQ signal generated by the central unit in a form of the 802.11 frame through a channel occupied by sending the channel occupancy signal, and stops sending the 802.11 frame based on the sending end point of the 802.11 frame in the control word.

5 **[00159]** FIG. 5 shows a diagram of a time sequence of sending the channel occupancy signal in step S404. When detecting that a channel is in a busy state (CCA BUSY), a CCA module waits for fixed random backoff time. The fixed random backoff time is usually an arbitration interframe space (Arbitration Interframe Space, AIFS). In this waiting time period, if the detected channel remains in an idle state, a random backoff phase (backoff) phase is entered, including a time of N
10 slots (slot). The CCA module detects whether the channel is idle in each slot. When backoff is performed until end of a last slot, if the CCA module determines, through detection, that the channel is idle, channel occupancy symbol sending needs to be started at an end boundary of the last slot. A ~~position of a~~ time point 1 indicates that a RU determines that the channel is idle in the last backoff slot. A time point 2 indicates that the RU feeds back the channel contention result to
15 a CU and prepares to generate the channel occupancy signal. A time point 3 indicates an end boundary of a last slot in which channel detection is performed, and the RU sends the channel occupancy signal at the time point 3 in which the last backoff slot ends, to occupy the channel. In this case, time is reserved for preparing a data packet for the CU and remotely transmitting the data packet to the RU. A time point 4 indicates that when the RU receives a data packet
20 encapsulated with a digital baseband IQ signal, the RU decapsulates the data packet and obtains a sending start point of a 802.11 frame through the control word. At the same time, sending of the channel occupancy signal is stopped, a decapsulated digital baseband IQ signal is sent by a subsequent sending unit of the RU and finally sent by an RF module, and sending of the 802.11 frame is stopped based on a sending end point of the 802.11 frame in the control word.

25 **[00160]** It should be noted that, to occupy the channel, an RU usually continuously sends the channel occupancy signal. Sending of an L-STF field is used as an example. FIG. 6 is a schematic diagram of a time sequence of sending a channel occupancy signal according to an embodiment of this application. As shown in the figure, when a RU does not receive a data packet of a CU, the RU continuously sends the L-STF field to occupy the channel, stops sending the L-STF field until
30 receiving a data packet and obtaining a sending start point of a 802.11 frame included in a control word, and starts sending information of the 802.11 frame such as content of the L-LTF field.

[00161] Certainly, if another device contends for the channel based on a specific cycle, the RU may also send the channel occupancy signal based on the cycle or an interval shorter than the cycle. Alternatively, if an access point knows that no other device contends for the channel in a specific time period, the RU may not send the channel occupancy signal in the time period, but send the channel occupancy signal beyond the time period. Alternatively, in some cases, if an access point can use the channel in preset duration after successfully contending for the channel, the RU may not send the channel occupancy signal in the preset duration, and may send the channel occupancy signal after the preset duration is reached. This is not limited in embodiments of this application.

[00162] In this architecture, modules related to AGC adjustment are located at the RU side.

Content of an X-LTF field and fields following the X-LTF field at the RU side is transformed into a digital baseband frequency domain IQ signal by FFT, the digital baseband frequency domain IQ signal is encapsulated into a data packet by the first encapsulation module, and the data packet is remotely sent to the CU. The CU side obtains content of an X-LTF field and fields following the X-LTF field in a form of digital baseband frequency domain IQ through decapsulation by the second decapsulation module, and the CU side completes baseband receiving processing. SIG detection is completed at the RU side, and a result is encapsulated and sent to the CU. The L-STF and X-STF end at the RU side to complete AGC adjustment. For fields on which receiving processing is performed at a RU side and a CU side in different frame formats, refer to FIG. 7.

~~FIG. 7 is a schematic diagram of the fields on which receiving processing is performed at the RU side and the CU side in different frame formats.~~

[00163] It should be noted that in FIG. 7, only a frame format corresponding to 802.11ax and a standard earlier than 802.11ax is used as an example. This embodiment of this application may be further applied to a frame format corresponding to 802.11be and a standard later than 802.11be.

[00164] In this embodiment of this application, an AGC module, a CCA module, and a SYNC module that are tightly coupled to a DFE are disposed at the RU side~~in the RU segment~~, and a signal generator is newly added. After it is detected that a channel is idle, the signal generator at the RU side is used to start sending of a channel occupancy signal at an end boundary of a last slot in a random backoff phase, to occupy the channel. In this way, a CSMA/CA time sequence problem during downlink signal sending is resolved, and sufficient time is provided to the CU side to prepare for a 802.11 frame.

[00165] FIG. 8A and FIG. 8B are a schematic diagram of another composition of a remote unit

whether content of the first symbol following the L-SIG is the same as that of the L-SIG. If the content is different, no further action is required. If the content is the same, the mode is HE. The RU determines whether $\text{LENGTH} \bmod 3$ ==is equal to 1 or ==is equal to 2. LENGTH is a LENGTH field in the L-SIG field, and indicates a quantity of bytes of a PHY service data unit (PHY Service Data Unit, PSDU) that carries a payload and that is in the PPDU. If LENGTH is equal to 1, the RU further determines whether a format is HE TB or HE SU based on a RX (RX) state machine. If the format is HE SU, the RU determines at 16 μs , based on a result of the first symbol following the L-SIG, to perform a third AGC adjustment. If the format is HE TB, the RU determines at 20 μs , based on a result of a second symbol following the L-SIG, to perform a third AGC adjustment. If LENGTH $\bmod 3$ ==is equal to 2, a format is HE ER SU. The RU obtains a demodulation result of a third symbol following the L-SIG at 24 μs , and further determines a modulation scheme of the third symbol following the L-SIG. If the modulation scheme is QBPSK and the HE ER SU format is determined, the RU determines at 24 μs , based on a result of the third symbol following the L-SIG, to perform a third AGC adjustment.

[00185] If a modulation scheme of the L-SIG is BPSK, and L-DATARATE is not equal to 6 Mbps, a mode may be non-HT format of non-BPSK data modulation, or HT-MF format. The RU further determines, based on CCA detection, whether a bandwidth BW is 40 MHz and whether a valid L-SIG is detected on both a primary channel and a secondary channel. If the valid L-SIG is detected on both the primary channel and the secondary channel, the mode is HT-MF format, and the RU further determines to perform a second AGC adjustment based on a demodulation result of the L-SIG. If no valid L-SIG is detected on both the primary channel and the secondary channel, the RU cannot determine the mode is non-HT or HT-MF, and does not perform the second AGC adjustment.

[00186] If a modulation scheme of the L-SIG is quadrature binary phase shift keying (Quadrature binary phase shift keying, QBPSK), a mode is HT-GF. A second AGC adjustment is not required.

[00187] Based on resolving the CSMA/CA delay constraint, in this embodiment of this application, an AGC adjustment module is newly added at an RU side, and the CU transmits the decoding results of the L-SIG and three symbols following the L-SIG to the RU using control packet exchange between the CU and the RU, and the AGC adjustment module assists the RU in performing the second/third AGC adjustment when receiving an 802.11 frame, to resolve an AGC

CLAIMS

What is claimed is:

1. A remote unit, comprising:
 - a clear channel assessment CCA module, configured to perform carrier sense multiple access/collision avoidance CSMA/CA channel detection during channel contention, to determine a busy or idle state of a channel;
 - a signal generator, configured to: when the CCA module determines that the channel is idle, send a channel occupancy signal at an end boundary of a last slot in which channel detection is performed.
2. The remote unit according to claim 1, wherein the remote unit further comprises:
 - a media access control MAC agent module, configured to: receive a channel contention message from a central unit, forward the channel contention message to the CCA module, and receive and send a channel contention result output by the CCA module to the central unit.
3. The remote unit according to claim 1 or 2, wherein the remote unit further comprises:
 - an RF module, configured to send an 802.11 frame through a channel occupied by the signal generator, wherein the 802.11 frame comprises a digital baseband in phase quadrature IQ signal generated by the central unit.
4. The remote unit according to claim 2 or 3, wherein the remote unit further comprises:
 - a first encapsulation module, configured to perform encapsulation processing on a signal sent by the remote unit to the central unit; and
 - a first decapsulation module, configured to perform decapsulation processing on a signal sent by the central unit to the remote unit.
5. The remote unit according to claim 4, wherein the first decapsulation module is specifically configured to receive and decapsulate an encapsulated data packet sent by the central unit, and obtain the digital baseband IQ signal and a control word comprised in the data packet, wherein the control word indicates a sending start point and a sending end point of an 802.11 frame carried in the data packet.
6. The remote unit according to claim 5, wherein the signal generator is further configured to stop sending the channel occupancy signal at the sending start point.
7. The remote unit according to claim 5, wherein the RF module is further configured to stop

sending the 802.11 frame at the sending end point.

8. The remote unit according to any one of claims 2 to 7, wherein the MAC agent module is further configured to control the signal generator based on the channel contention result or the control word obtained through decapsulation by the first decapsulation module.

5 9. The remote unit according to any one of claims 4 to 8, wherein a signal transmitted between the remote unit and the central unit is a digital baseband frequency domain IQ signal, and the remote unit further comprises:

10 a fast Fourier transform/inverse fast Fourier transform FFT/IFFT module, configured to perform fast Fourier transform/inverse fast Fourier transform on the 802.11 frame received by the RF module, transform the 802.11 frame from a time domain to a frequency domain, and obtain and send content of a long training field LTF field and fields following the LTF field in the transformed 802.11 frame to the first encapsulation module, wherein the first encapsulation module is further configured to encapsulate and send content of the LTF field and the fields following the LTF field to the central unit, and obtain and send a signal SIG field in the transformed
15 802.11 frame to a SIG detection module; and

the SIG detection module, configured to demodulate and decode the SIG field to complete format detection of the 802.11 frame, and send a decoding result to the first encapsulation module, wherein the first encapsulation module is further configured to encapsulate and send the decoding result to the central unit.

20 10. The remote unit according to any one of claims 4 to 8, wherein a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal, and the remote unit further comprises:

25 a synchronization module, configured to detect validity and a start boundary of the 802.11 frame, and perform frame synchronization and symbol synchronization on the 802.11 frame; wherein

the first decapsulation module is further configured to receive an encapsulated decoding result from the central unit, and send a decapsulated decoding result to an automatic gain control AGC adjustment module, wherein the decoding result is obtained after the central unit performs FFT/IFFT on the 802.11 frame to obtain a SIG field in the 802.11 frame and performs SIG
30 detection;

the automatic gain control AGC adjustment module is configured to generate an automatic

gain control command based on the decoding result; and

~~an AGC module, configured to receive the automatic gain control command, perform automatic gain control on signal power of the 802.11 frame, and adjust power of a signal input into a digital to analog/analog to digital converter.~~

5 ~~11. The remote unit according to claim 10, wherein the synchronization module is specifically configured to: when a legacy short training field L-STF field is detected in the 802.11 frame, indicate the AGC module to perform first automatic gain control on the signal power of the 802.11 frame;~~

10 ~~the decoding result is decoding results of a legacy signal field L-SIG field and first three orthogonal frequency division multiplexing OFDM symbols following the L-SIG field of the 802.11 frame that are obtained by the central unit; and~~

~~the AGC adjustment module is specifically configured to: when the decoding result satisfies a preset condition, run a local AGC state machine based on the decoding result, to generate a second automatic gain control command or a third automatic gain control command.~~

15 ~~121.~~ An information transmission method, comprising:

performing, by a remote unit, carrier sense multiple access/collision avoidance CSMA/CA channel detection during channel contention, to determine a busy or idle state of a channel; and

when it is determined that the channel is idle, sending a channel occupancy signal at an end boundary of a last slot in which channel detection is performed.

20 ~~132.~~ The method according to claim ~~121~~, wherein the method further comprises:

receiving, by the remote unit, a channel contention message from a central unit; and
sending a channel contention result to the central unit.

~~143.~~ The method according to claim ~~12 or 131 or 2~~, wherein the method further comprises:

25 sending, by the remote unit, an 802.11 frame through a channel occupied by the channel occupancy signal, wherein the 802.11 frame comprises a digital baseband in-phase quadrature IQ signal generated by the central unit.

~~154.~~ The method according to claim ~~13 or 142 or 3~~, wherein the method further comprises:

encapsulating, by the remote unit, a signal sent by the remote unit to the central unit; and
decapsulating, by the remote unit, the signal sent by the central unit to the remote unit.

30 ~~165.~~ The method according to claim ~~154~~, wherein the method further comprises:

receiving and decapsulating, by the remote unit, an encapsulated data packet sent by the

central unit, and obtaining the digital baseband IQ signal and a control word comprised in the data packet, wherein the control word indicates a sending start point and a sending end point of an 802.11 frame carried in the data packet.

~~176~~. The method according to claim ~~165~~, wherein the method further comprises:

stopping, by the remote unit, sending the channel occupancy signal at the sending start point.

~~187~~. The method according to claim ~~165~~, wherein the method further comprises:

stopping, by the remote unit, sending the 802.11 frame at the sending end point.

~~198~~. The method according to any one of claims ~~13-2~~ to ~~187~~, wherein the method further comprises:

controlling, by the remote unit based on the channel contention result or the control word obtained through decapsulation, whether to send the channel occupancy signal.

~~209~~. The method according to any one of claims ~~15-4~~ to ~~198~~, wherein a signal transmitted between the remote unit and the central unit is a digital baseband frequency domain IQ signal, and the method further comprises:

performing, by the remote unit, fast Fourier transform/inverse fast Fourier transform on the received 802.11 frame, completing transformation of the 802.11 frame from a time domain to a frequency domain, obtaining, encapsulating, sending content of a long training field LTF field and fields following the LTF field in the transformed 802.11 frame to the central unit, obtaining, demodulating and decoding a signal SIG field in the transformed 802.11 frame, completing format detection of the 802.11 frame, and sending the decoding result to the central unit.

~~2110~~. The method according to any one of claims ~~15-4~~ to ~~198~~, wherein a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal, and the method further comprises:

detecting, by the remote unit, validity and a start boundary of the 802.11 frame, and performing frame synchronization and symbol synchronization on the 802.11 frame;

receiving an encapsulated decoding result from the central unit, and encapsulating ~~and obtaining~~ the decoding result, wherein the decoding result is obtained after the central unit performs FFT/IFFT on the 802.11 frame to obtain a SIG field in the 802.11 frame and performs SIG detection;

generating an automatic gain control command based on the decoding result; and

performing, based on the automatic gain control command, automatic gain control on signal

power of the 802.11 frame, and adjusting power of a signal input into a digital-to-analog/analog-to-digital converter.

2211. The method according to claim 2410, wherein if the remote unit detects a legacy short training field L-STF field in the 802.11 frame, the remote unit performs first automatic gain control
5 on the signal power of the 802.11 frame;

the decoding result is decoding results of a legacy signal field L-SIG field and first three orthogonal frequency division multiplexing OFDM symbols following the L-SIG field of the 802.11 frame that are obtained by the central unit; and

when the decoding result satisfies a preset condition, the remote unit runs a local AGC state
10 machine based on the decoding result, to generate a second automatic gain control command or a third automatic gain control command.

2312. A remote unit, comprising:

a processor, a memory, and a bus, wherein the processor and the memory are connected through the bus, the memory is configured to store a group of program code, and the processor is
15 configured to invoke the program code stored in the memory to perform the method according to any one of claims ~~12 to 22~~ 1 to 11.

2413. A computer-readable storage medium, wherein

the computer-readable storage medium stores instructions, and when the instructions are run on a computer, the method according to any one of claims 1 to 11 ~~12 to 22~~ is implemented.

2514. A computer program product, comprising computer program code, wherein when the computer program code is run on a computer, the computer is enabled to implement the method
20 according to any one of claims 1 to 11 ~~12 to 22~~.

2615. A chip, comprising one or more processing circuits, wherein the one or more processing circuits are configured to implement the method according to any one of claims 1 to 11 ~~12 to 22~~.

2716. An apparatus, configured to perform the method according to any one of claims 1 to 11 ~~12 to 22~~.
25