

REMOTE UNIT AND INFORMATION TRANSMISSION METHOD

[0001] This application claims priority to Chinese Patent Application No. 202010246510.2, filed with the China National Intellectual Property Administration on March 31, 2020 and entitled "REMOTE UNIT AND INFORMATION TRANSMISSION METHOD", which is incorporated
5 herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the field of communications technologies, and in particular, to a remote unit and an information transmission method.

BACKGROUND

10 [0003] With development of wireless local area network (Wireless Local Area Network, WLAN) technologies, collaboration and multi-antenna technologies become one of mainstream evolution directions. A distributed architecture can coordinate multiple spatially distributed nodes. This can prevent problems of an excessively large size and high complexity of a single device, and make full use of spatial multiplexing and diversity gains. Due to easy expansion and flexible
15 deployment, it is especially applicable to improving capacities of densely populated areas, such as shopping malls, airports, and stations. It can also improve coverage quality in areas with poor signals, such as enterprise headquarters, office buildings, and underground parking lots. In the distributed architecture, complete functions of traditional access points (Access Points, APs) are divided into two parts, that is, a central unit (Center Unit, CU) and a remote unit (Remote Unit,
20 RU), and the AP is deployed in a distributed manner. Because the CU and the RU are distributed devices and are no longer tightly coupled, there is a round trip delay of several microseconds between the RU and the CU during downlink transmission or uplink reception of data. However, there is a unique delay constraint in a Wi-Fi scenario, for example, a carrier sense multiple access/collision avoidance (Carrier Sense Multiple Access/Collision Avoidance, CSMA/CA) delay
25 constraint. In a channel contention process, a device first waits for fixed random backoff time

(Arbitration Interframe Space, AIFS). In this waiting time period, if it is detected that a channel remains in idle state, the device enters a random backoff phase (a backoff phase, including a time period of N slots). Whether a channel is idle is detected in each slot (slot). When backoff is performed until a last slot, if a clear channel assessment (Clear Channel Assessment, CCA) module determines, through detection, that the channel is idle, information sending needs to be started at an end boundary of the last slot.

[0004] In a conventional technology, a CCA module, a media access control (Media Access Control) processing module, and a baseband module are disposed at a CU side. In this way, when information needs to be sent to an external device, the CCA module can notify the MAC processing module after detecting that the channel is idle. The MAC processing module performs MAC sending processing, generates and sends to-be-sent information to the baseband module. The baseband module generates a digital baseband in-phase quadrature (In-phase Quadrature, IQ) signal based on the to-be-sent information, and outputs the signal to an RU side. Finally, the RU side sends the signal to the external device. In this sending process, the RU needs to exchange information with the CU. There is a round-trip delay in the information exchange. As a result, a time period in which the RU side sends the information to the external device cannot satisfy the CSMA/CA delay constraint, and a channel obtained through contention may also be occupied by another device, causing an information sending failure.

SUMMARY

[0005] To resolve the technical problem, embodiments of this application provide a remote unit and an information transmission method, to satisfy a CSMA/CA delay constraint in a Wi-Fi scenario and ensure normal information transmission.

[0006] According to a first aspect, an embodiment of this application provides a remote unit. The remote unit may include:

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; and

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.

[0007] In this way, the channel occupancy signal sent by the signal generator occupies the channel, to reserve time for a central unit side to generate and transmit to-be-sent information. This ensures that the channel is not contended by another device while satisfying the CSMA/CA delay constraint, prevents contention interference from the another device, and implements normal information transmission.

[0008] In a possible implementation, the remote unit further includes:

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.

[0009] The MAC agent module is configured to provide a MAC agent function for message forwarding between the central unit and the remote unit, to ensure normal transmission of specific information between the central unit and the remote unit.

[0010] In a possible implementation, the remote unit further includes:

an RF module, configured to send an 802.11 frame through a channel occupied by the signal generator, where the 802.11 frame includes a digital baseband in-phase quadrature IQ signal generated by the central unit.

[0011] In a possible implementation, the remote unit further includes:

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.

[0012] In a possible implementation, 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 included in the data packet. The control word indicates a sending start point and a sending end point of an 802.11 frame carried in the data packet.

[0013] The carried control word can notify the remote unit of the sending start point and the sending end point of the 802.11 frame, so that the remote unit may be used together with the signal generator. The remote unit can use the sending start point to stop the signal generator from sending the channel occupancy signal and start transmitting the 802.11 frame, and stop sending the 802.11 frame at the sending end point, to implement normal signal transmission.

[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 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 implement
25 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

decoding result from the central unit, and send a decapsulated decoding result to an automatic gain control AGC adjustment module, where 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;

5 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.

10 **[0020]** The FFT/IFFT module and the SIG module are disposed in the central unit side, so that a digital baseband time domain IQ signal can be transmitted between the FFT/IFFT module and the SIG module. In addition, after the AGC adjustment module is added to the remote unit side to obtain the decoding result of the SIG detection module, the AGC module can be controlled, an AGC adjustment command is generated, and the first and second/third AGC adjustments are
15 completed.

[0021] In a possible implementation, 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.

[0022] The decoding result is decoding results of a legacy signal field L-SIG field and first
20 three orthogonal frequency division multiplexing OFDM symbols following the L-SIG field of the 802.11 frame that are obtained by the central unit.

[0023] 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.

25 **[0024]** According to a second aspect, an embodiment of this application provides an information transmission method, and the method may include:

 A remote unit performs 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, the remote unit sends a channel
30 occupancy signal at an end boundary of a last slot in which channel detection is performed.

[0025] In a possible implementation, the method further includes:

The remote unit receives a channel contention message from a central unit; and
the remote unit sends a channel contention result to the central unit.

[0026] In a possible implementation, the method further includes:

5 **[0027]** The remote unit sends an 802.11 frame through a channel occupied by the channel occupancy signal. The 802.11 frame includes a digital baseband in-phase quadrature IQ signal generated by the central unit.

[0028] In a possible implementation, the method further includes:

The remote unit encapsulates a signal sent by the remote unit to the central unit; and
the remote unit decapsulates the signal sent by the central unit to the remote unit.

10 **[0029]** In a possible implementation, the method further includes:

[0030] The remote unit receives and decapsulates an encapsulated data packet sent by the central unit, and obtains the digital baseband IQ signal and a control word included in the data packet, where the control word indicates a sending start point and a sending end point of an 802.11 frame carried in the data packet.

15 **[0031]** In a possible implementation, the method further includes:

[0032] The remote unit stops sending the channel occupancy signal at the sending start point.

[0033] In a possible implementation, the method further includes:

[0034] The remote unit stops sending the 802.11 frame at the sending end point.

[0035] In a possible implementation, the method further includes:

20 **[0036]** The remote unit controls based on the channel contention result or the control word obtained through decapsulation, whether to send the channel occupancy signal.

[0037] 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:

25 **[0038]** 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 sends the decoding result to the central unit.

30 **[0039]** 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 detects validity and a start boundary of the 802.11 frame, and performs synchronization;

the remote unit receives an encapsulated decoding result from the central unit, and encapsulates and obtains the decoding result, where 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;

the remote unit generates an automatic gain control command based on the decoding result; and

the remote unit 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.

[0040] In a possible implementation, 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 on the signal power of the 802.11 frame.

[0041] 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.

[0042] When the decoding result satisfies a preset condition, 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.

[0043] According to a third aspect, an embodiment of this application provides an access point, including:

a remote unit and a central unit.

[0044] The remote unit includes:

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; and

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.

[0045] The central unit includes:

a media access control MAC processing module, 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 baseband module of generating and outputting a digital baseband in-phase/quadrature IQ signal; during uplink sending, the MAC processing module receives output information from a baseband module and performs MAC receiving processing; and

the baseband module, responsible for generating, and performing sending and receiving processing of the digital baseband IQ signal, where the baseband module includes a baseband TX channel and a baseband RX channel; in a downlink direction, the baseband module receives a command and data from the MAC processing module, and generates and outputs the digital baseband IQ signal; in an uplink direction, the baseband module performs receiving processing on the digital baseband IQ signal, and then sends the signal to the MAC processing module; and the baseband module may be specifically divided into:

- a baseband TX channel, configured to send the digital baseband IQ signal; and
- a baseband RX channel, configured to receive the digital baseband IQ signal.

[0046] The remote unit further includes:

an RF module, configured to send an 802.11 frame through a channel occupied by the signal generator, where the 802.11 frame includes the digital baseband IQ signal generated by the baseband module.

[0047] Specifically, the 802.11 frame may be sent by sending an RF signal. For example, during downlink sending, the RF signal obtained after D/A digital-to-analog conversion and up-conversion are performed on the digital baseband IQ signal is sent through the channel occupied by the signal generator. In addition, during uplink reception, the RF module may be further configured to receive the RF signal, and subsequently convert the RF signal into the digital baseband IQ signal through down-conversion and A/D analog-to-digital conversion.

[0048] In a possible implementation, the central unit further includes:

- a first encapsulation module, configured to perform encapsulation processing on a signal sent by the central unit to the remote unit; and
- a first decapsulation module, configured to perform decapsulation processing on a

signal sent by the remote unit to the central unit.

[0049] The remote unit further includes:

a second encapsulation module, configured to perform encapsulation processing on a signal sent by the remote unit to the central unit; and

5 a second decapsulation module, configured to perform decapsulation processing on the signal sent by the central unit to the remote unit.

[0050] In a possible implementation, the first encapsulation module is specifically configured to encapsulate the digital baseband IQ signal into a data packet, add a control word to the data packet, and output the data packet. The control word indicates a sending start point and a sending
10 end point of an 802.11 frame carried in the data packet.

[0051] The second decapsulation module is specifically configured to decapsulate the data packet to obtain the digital baseband IQ signal and the control word.

[0052] In a possible implementation, the signal generator is further configured to stop sending the channel occupancy signal at the sending start point based on the sending start point that is of
15 the 802.11 frame and that is obtained by the second decapsulation module.

[0053] In a possible implementation, the RF module is further configured to stop sending the 802.11 frame at the sending end point.

[0054] In a possible implementation, the remote unit further includes:

a MAC agent module, configured to: receive the channel contention message from the
20 central unit, forward the channel contention message to the CCA module, and receive and send the channel contention result output by the CCA module to the central unit.

[0055] 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 second decapsulation module.

25 **[0056]** 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:

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
30 and send content of a long training field LTF field and fields following the LTF field in the transformed 802.11 frame to the second encapsulation module, where the second 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 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 second encapsulation module, where the second encapsulation module is further configured to encapsulate and send the decoding result to the central unit.

[0057] In a possible implementation, a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal. The central unit further includes:

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 from the remote unit, transform the 802.11 frame from a time domain to a frequency domain, and obtain and send a 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 module, where the first encapsulation module is further configured to encapsulate and send the decoding result to the remote unit.

[0058] 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;

an automatic gain control AGC adjustment module, configured to obtain the decoding result after the second decapsulation module of the remote unit decapsulates the encapsulated decoding result, and 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.

[0059] In a possible implementation, 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.

[0060] The SIG detection module is specifically configured to obtain 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 send the decoding results to the AGC adjustment module.

[0061] The AGC adjustment module is specifically configured to 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.

[0062] According to a fourth aspect, an embodiment of this application provides an information transmission method, and the method may include:

A remote unit of an access point performs carrier sense multiple access/collision avoidance CSMA/CA channel detection during channel contention, to determine a busy or idle state of a channel;

when it is determined that the channel is idle, the remote unit sends a channel occupancy signal at an end boundary of a last slot in which channel detection is performed;

after receiving a channel contention result, a central unit of the access point generates and outputs a digital baseband in-phase/quadrature IQ signal; and

the remote unit sends the digital baseband IQ signal through a channel occupied by the signal generator.

[0063] In a possible implementation, the method further includes:

The central unit encapsulates the digital baseband IQ signal into a data packet, add a control word to the data packet, and output the data packet, where the control word is used to indicate a sending start point and a sending end point of an 802.11 frame carried in the data packet; and

the remote unit decapsulates the data packet to obtain the digital baseband IQ signal and the control word.

[0064] In a possible implementation, the method further includes:

[0065] The remote unit stops sending the channel occupancy signal at the sending start point based on the sending start point that is of the 802.11 frame and that is obtained through decapsulation.

[0066] In a possible implementation, the method further includes:

[0067] The remote unit stops sending the 802.11 frame at the sending end point.

[0068] In a possible implementation, before the remote unit performs CCA detection, the

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
5 on the channel contention result or the control word obtained through decapsulation, whether to send 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
10 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
20 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;
25 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
30 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 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

and receive a signal, and the memory is configured to store a computer program. The processor is configured to run the computer program in the memory, to enable the apparatus to perform the method completed by the remote unit according to any one of the second aspect or the possible implementations of the second aspect.

5 **[0083]** According to a seventh aspect, a system is provided. The system includes an access point including the remote unit and the central unit, and a station.

10 **[0084]** According to an eighth aspect, a computer-readable storage medium is provided, to store a computer program, and the computer program includes an instruction used to perform the method according to any one of the second aspect or the possible implementations of the second aspect.

15 **[0085]** According to a ninth aspect, a computer program product is provided. The computer program product includes computer program code. When the computer program code is run on a computer, the computer is enabled to perform the method in any one of the second aspect or the possible implementations of the second aspect.

15 **BRIEF DESCRIPTION OF DRAWINGS**

20 **[0086]** To describe the technical solutions in embodiments of this application or in the background more clearly, the following briefly describes the accompanying drawings for describing embodiments of this application or the background.

25 **[0087]** FIG. 1 is a schematic diagram of an architecture of a communications system according to an embodiment of this application;

30 **[0088]** FIG. 2A and FIG. 2B are a schematic diagram of composition of a remote unit and a central unit according to an embodiment of this application;

35 **[0089]** FIG. 3 is a schematic flowchart of an information transmission method according to an embodiment of this application;

40 **[0090]** FIG. 4 is a schematic flowchart of another information transmission method according to an embodiment of this application;

45 **[0091]** FIG. 5 is a schematic diagram of a time sequence in which an RU sends a channel occupancy signal according to an embodiment of this application;

50 **[0092]** FIG. 6 is a schematic diagram of another time sequence in which an RU sends a channel

occupancy signal according to an embodiment of this application;

[0093] FIG. 7 is a schematic diagram of fields on which receiving processing is performed at a RU side and a CU side in different frame formats according to an embodiment of this application;

[0094] FIG. 8A and FIG. 8B are schematic diagram of another composition of a remote unit and a central unit according to an embodiment of this application;

[0095] FIG. 9 is a schematic flowchart of an AGC adjustment method according to an embodiment of this application;

[0096] FIG. 10A and FIG. 10B are a schematic diagram of a time sequence of a second/third AGC adjustment for receiving 802.11 frames in different formats according to an embodiment of this application;

[0097] FIG. 11A to FIG. 11C are a schematic flowchart of an AGC adjustment method according to an embodiment of this application; and

[0098] FIG. 12 is a schematic diagram of another composition of a remote unit according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0099] The following describes embodiments of this application with reference to the accompanying drawings in embodiments of this application.

[00100] The terms "including", "including", or any other variant thereof mentioned in the specification, claims, and the accompanying drawings of this application, are intended to cover a non-exclusive inclusion. For example, a process, a method, a system, a product, or a device that includes a series of steps or units is not limited to the listed steps or units, but optionally further includes an unlisted step or unit, or optionally further includes another inherent step or unit of the process, the method, the product, or the device.

[00101] FIG. 1 is a schematic diagram of an architecture of a communications system according to an embodiment of this application. For ease of description and understanding, only one central unit and three remote units are shown in the architecture shown in FIG. 1, and communications between the central unit and the remote unit is used as an example for description. It may be understood that, in an actual scenario, a case of one or more remote units may be further included. This is not limited in embodiments of this application.

[00102] In a conventional Wi-Fi scenario, multiple stations (Station, STA) are served in one AP coverage area, different APs operate on a same frequency or different frequencies, and all STAs/APs contend for accessing a channel in a CSMA/CA manner. In a remote Wi-Fi scenario, complete functions of a traditional AP are divided into two parts, that is, a central unit and a remote unit, and the AP is deployed in a distributed manner.

[00103] For example, the architecture shown in FIG. 1 include a central unit 10, several remote units 20, and several stations 30.

[00104] A distributed access point including the central unit 10 and the remote unit 20 may be a device used by a user terminal 30 to access a wireless local area network (Wireless Local Area Network, WLAN). The device may be a communications server, a router, a switch, a bridge, a computer, a mobile phone, or the like.

[00105] The remote unit 20 may communicate with the station 30. The station 30 may also be a user terminal. The user terminal may also be referred to as a mobile terminal, a terminal device, a user equipment, or the like. The user terminal may be a computer, a mobile phone, a tablet computer, a handheld device, an augmented reality (Augmented Reality, AR) device, a virtual reality (Virtual Reality, VR) device, a machine type communications terminal, or other device that can access the network.

[00106] In this embodiment of this application, the station 30 is located in a signal coverage area of the remote unit 20. During uplink transmission, the station 30 may send data to the remote unit 20, and then the remote unit 20 sends the data to the central unit 10 for baseband processing. During downlink transmission, the central unit 10 may send data to the remote unit 20, and then the remote unit 20 sends the data to the station 30.

[00107] Signals are transmitted between the central unit 10 and the remote unit 20 in two forms: an analog signal and a digital signal. Remote analog signal deployment manners include remote RF deployment and remote intermediate frequency deployment.

[00108] Remote RF deployment means that an antenna and an RF module (including an RF front-end power amplifier) that are located in the remote unit 20 and another part located in the central unit 10 perform remote RF deployment using a coaxial cable. A disadvantage is that a loss of the coaxial cable increases with an increase of the RF. Therefore, a remote distance is limited.

[00109] Remote intermediate frequency deployment means that an antenna and RF modules (including an RF front-end power amplifier and an RF transceiver) that are located in the remote

unit 20 and another part located in the central unit 10 perform remote deployment using an Ethernet twisted pair cable. Because the remote unit 20 needs to perform complex analog domain signal equalization and filtering, costs are difficult to reduce.

[00110] A third manner of performing remote transmission through a digital signal is usually a remote baseband manner in which transmission is performed by using an optical fiber or an Ethernet twisted pair cable. In this manner, baseband data can be transmitted over a long distance without signal attenuation.

[00111] Based on this, this application designs an architecture based on a remote digital baseband IQ signal in a Wi-Fi scenario.

[00112] Because the central unit 10 and the remote unit 20 are distributed devices and are no longer tightly coupled, there is a round trip delay of several microseconds between the remote unit 2 and the central unit 10 during downlink transmission or uplink reception. Different from cellular communication, the Wi-Fi scenario has a unique delay constraint. Therefore, when function division is considered in design, a remote digital baseband deployment solution and a packet transmission method need to satisfy a Wi-Fi time sequence requirement.

[00113] The following describes in detail architecture implementation, and composition of the remote unit and the central unit in this application with reference to FIG. 2A and FIG. 2B to FIG. 10A and FIG. 10B.

[00114] FIG. 2A and FIG. 2B are a schematic diagram of composition of a remote unit and a central unit according to an embodiment of this application. As shown in FIG. 2A and FIG. 2B, in a distributed access point including the RU and the CU:

the RU side may mainly include the following parts.

an RF module is configured to send or receive an RF signal. In a transmit direction, a digital baseband IQ signal is converted into an analog signal through digital-to-analog conversion, up-converted to an RF band, and then sent by the RF module. In a receive direction, a received radio analog RF signal is down-converted to a baseband using the RF module, and then converted into a digital signal through analog-to-digital conversion.

[00115] A digital-to-analog/analog-to-digital converter (AD/DA) is configured to perform digital-to-analog/analog-to-digital conversion on a received or sent signal.

[00116] A transceiver digital front end (Digital Front End, DFE) is located between the AD/DA and a digital baseband, and functions as a bridge. In a transmitter, the DFE includes components

in a digital domain that process baseband signals of various channels and provide up-converted digital signals. In a receiver, the DFE includes components that process demodulated radio frequency (Radio Frequency, RF) digital signals.

[00117] A clear channel assessment (Clear Channel Assessment, CCA) module is 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.

[00118] A signal generator is 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.

[00119] A media access control (Media Access Control, MAC) agent module is 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.

[00120] A synchronization (SYNC) module is configured to detect validity and a start boundary of a received 802.11 frame, and perform frame synchronization and symbol synchronization on the 802.11 frame. Frame synchronization specifically means detecting whether the 802.11 frame arrives and determining a start location of the 802.11 frame, to implement coarse time synchronization in signal processing. Symbol synchronization means accurately determining a boundary of each orthogonal frequency division multiplexing (Orthogonal Frequency Division Multiplexing, OFDM) symbol in the 802.11 frame, to implement fine time synchronization in signal processing. After frame synchronization and symbol synchronization are performed, a time sequence positioning basis for signal processing may be provided to a subsequent related module. For example, after synchronization is performed, a field location may be determined, a field type may be detected, and a related field may be demodulated and decoded. In addition, the synchronization module may be further configured to indicate an automatic gain control (Automatic Gain Control, AGC) module to perform a first AGC adjustment.

[00121] An AGC module is configured to perform automatic gain control on signal power of the received 802.11 frame, and adjust power of a signal input into a digital-to-analog/analog-to-digital converter.

[00122] A fast Fourier transform/inverse fast Fourier transform (Fast Fourier Transform/Inverse Fast Fourier Transform, FFT/IFFT) module is configured to perform fast Fourier

transform/inverse fast Fourier transform on the 802.11 frame received by an RF module, transform the 802.11 frame from a time domain to a frequency domain, and obtain field content of the transformed 802.11 frame. For example, the FFT/IFFT module obtains and sends content of a long training field (Long Training Field, LTF) field and fields following the LTF field in the transformed 802.11 frame to the central unit, and obtain and send a signal (Signal, SIG) field in the transformed 802.11 frame to a SIG detection module. Because the 802.11 frame may have multiple formats, there are also multiple corresponding long training fields. The LTF field herein may also be described as an X-LTF field corresponding to various formats, and may be a legacy long training field (Legacy Long Training Field, L-LTF) field. In more current and future application scenarios, the LTF field may also be an LTF in a 802.11 protocol of a later version, for example, a high throughput long training field (High Throughput Long Training Field, HT-LTF), a very high throughput long training field (Very High Throughput Long Training Field, VHT-LTF), a high efficiency long training field (High Efficiency Long Training Field, HE-LTF), or an extremely high throughput long training field (Extremely High Throughout Long Training Field, EHT-LTF). The LTF field may also be an LTF in an 802.11 protocol of a later version formed after development of a future communications technology. For ease of brief description, the LTF fields are collectively referred to as an X-LTF in this application.

[00123] The SIG detection module is configured to demodulate and decode the SIG field in the 802.11 frame to complete format detection of the 802.11 frame, send a decoding result to the central unit, and indicate, based on the decoding result, the AGC module to perform a second AGC adjustment.

[00124] A first encapsulation module is configured to perform encapsulation processing on a signal sent by the remote unit to the central unit. For example, a channel contention result, content of the X-LTF field and fields following the X-LTF field in the 802.11 frame, and the decoding result of the SIG field, and the like that are sent by the remote unit to the central unit all need to be encapsulated by the first encapsulation module and then continue to be sent.

[00125] Optionally, the first encapsulation module may include a first frame encoding submodule and a first compression submodule. The first frame encoding submodule is configured to perform 802.11 frame encoding processing on the received signal, and the first compression submodule is configured to perform compression processing on the received signal.

[00126] A first decapsulation module is configured to perform decapsulation processing on a

signal sent by the central unit to the remote unit, for example, a channel contention message, a data packet, and a decoding result obtained during SIG detection by the central unit that are sent by the central unit to the remote unit. Optionally, the first decapsulation module may include a first frame decoding submodule and a first decompression submodule. The first frame decoding submodule is configured to perform frame decoding processing on the received 802.11 frame, and the first decompression submodule is configured to perform decompression processing on the received signal.

[00127] In addition, 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.

[00128] The signal generator is further configured to stop sending the channel occupancy signal at a sending start point based on the sending start point that is of the 802.11 frame and that is obtained by the first decapsulation module.

[00129] Signal processing and flow at the RU side are as follows:

[00130] During downlink sending, the CU sends a channel contention message to the RU, so that the RU starts channel contention. Specifically, the first decapsulation module of the RU receives the channel contention message from the central unit, and decapsulates and outputs the channel contention message to the MAC agent module of the RU. The MAC agent module receives the channel contention message, notifies the CCA module of starting channel detection, and obtains a busy or idle state of a channel from the CCA module. After obtaining a channel contention message result, the MAC agent module outputs the channel contention message result to the encapsulation module for encapsulation, and then sends the channel contention message result to the central unit.

[00131] A main signal flow at the RU side is as follows: the central unit-the first decapsulation module-the MAC agent module-the CCA module-the MAC agent module-the first encapsulation module-the central unit.

[00132] At the same time, after obtaining the channel contention result, the MAC agent sends a control command to the signal generator, to control the signal generator to send a channel occupancy signal. After obtaining a sending start point of the data packet, the first decapsulation module notifies the MAC agent module of the sending start point of the data packet. The MAC agent module sends a control command to the signal generator, to control the signal generator to

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

MAC receiving processing.

[00141] The baseband module is responsible for generating, and performing sending and receiving processing of the digital baseband IQ signal. The baseband module includes a baseband TX channel and a baseband RX channel. In a downlink direction, the baseband module receives a command and data from the MAC processing module, and generates and outputs the digital baseband IQ signal. In an uplink direction, the baseband module performs receiving processing on the digital baseband IQ signal, and then sends the signal to the MAC processing module. The baseband module may be specifically divided into: a baseband TX channel, configured to send the digital baseband IQ signal; and a baseband RX channel, configured to receive the digital baseband IQ signal.

[00142] A second encapsulation module is configured to perform decapsulation processing on a signal sent by the CU side, for example, a channel contention message, a data packet, and a decoding result obtained during SIG detection by the central unit that may be sent. Optionally, similar to the first decapsulation module, the second encapsulation module may include a second frame encoding submodule and a second compression submodule.

[00143] A second decapsulation module is configured to perform decapsulation processing on a received signal, for example, a channel contention result, content of the X-LTF field and fields following the X-LTF field in the 802.11 frame, and the decoding result of the SIG field, and the like that may be received. Optionally, similar to the first decapsulation module, the second decapsulation module may include a second frame decoding submodule and a second decompression submodule.

[00144] In this architecture, a signal transmitted between the remote unit and the central unit is a digital baseband frequency domain IQ signal. When the access point needs to send information to a station, the CCA module that performs channel contention is located at the RU side, and both the MAC processing module that generates to-be-sent information and the baseband module that generates the digital baseband IQ signal based on the to-be-sent information are located at the CU side. It takes time to feedback the channel contention result, generates and transmits the to-be-sent information, and generates and transmits the digital baseband IQ signal. Therefore, CSMA/CA delay constraint cannot be satisfied. Therefore, in this application, the information transmission method shown in FIG. 3 may be applied to transmit information. The method may specifically include the following steps.

[00145] S301: A remote unit performs carrier sense multiple access/collision avoidance (CSMA/CA) channel detection during channel contention, to determine a busy or idle state of a channel.

[00146] S302: When it is determined that the channel is idle, the remote unit sends a channel occupancy signal at an end boundary of a last slot in which channel detection is performed.

[00147] Optionally, the channel occupancy signal may be a monophonic signal, and may occupy the channel through energy detection. Alternatively, the channel occupancy signal may be a legacy short training field (Legacy Short Training Field, L-STF) field of a 802.11 frame, in other words, a preamble portion of the 802.11 frame, and may occupy the channel through detection of a signal of a specific signal type.

[00148] In this way, a channel obtained through contention by the RU can be continuously occupied during information exchange between the RU and a CU, so that to-be-sent information at the CU side is sent when CSMA/CA delay constraint is satisfied.

[00149] For a specific sending procedure, refer to FIG. 4. FIG. 4 is a schematic flowchart of another information transmission method according to an embodiment of this application. The method may specifically include the following steps.

[00150] S401: A central unit sends a channel contention message to a remote unit.

[00151] S402: A remote unit performs carrier sense multiple access/collision avoidance (CSMA/CA) channel detection during channel contention, to determine a busy or idle state of a channel.

[00152] S403: The remote unit sends a channel contention result to the central unit.

[00153] S404: When it is determined that the channel is idle, the remote unit sends a channel occupancy signal at an end boundary of a last slot in which channel detection is performed.

[00154] S405: The central unit generates and encapsulates a digital baseband IQ signal into a data packet, and adds a control word to the data packet.

[00155] S406: The central unit sends the data packet to the remote unit.

[00156] S407: The remote unit decapsulates the data packet, and obtains the digital baseband IQ signal and a control word, where the control word indicates a sending start point and a sending end point of an 802.11 frame carried in the data packet.

[00157] S408: The remote unit stops sending the channel occupancy signal based on the sending start point of the 802.11 frame in the control word.

[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 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

and a central unit according to an embodiment of this application. Compared with FIG. 2A and FIG. 2B, the FFT/IFFT module and the SIG detection module that are located at the RU side in FIG. 2A and FIG. 2B are configured to be at the CU side, and an AGC adjustment module is added at the RU side. It should be noted that information output by the SIG detection module to the RU side also needs to be encapsulated by the second encapsulation module, and is indicated by a dashed line for ease of drawing. In this architecture, a signal transmitted between the remote unit and the central unit is a digital baseband time domain IQ signal.

[00166] In a WLAN system, a receiver needs to adjust a power gain of a received 802.11 frame, so that a signal enters AD/DA at a proper power. The 802.11 frame may be divided into two parts: a preamble (Preamble) portion and a data (Data) portion. When the receiver in the WLAN system receives the 802.11 frame, to adjust a received signal power, a short training field (Short Training Field, STF) and X-STF fields in various formats are used for a second AGC adjustment in Wi-Fi, such as a high throughput short training field (High Throughput Short Training Field, HT-STF) field, a very high throughput short training field (Very High Throughput Short Training Field, VHT-STF), and a high efficiency short training field (High Efficiency Short Training Field, HE-STF). A first AGC adjustment is performed using L-STF sequence during demodulation of L-STF, and can roughly adjust the signal to a dynamic range of ADC. Then the second AGC adjustment is performed using the HT-STF/VHT-STF/HE-STF. It can be seen that the second AGC adjustment is determined based on a determined frame structure type. Certain time is required during a time period from determining the frame structure to performing the second AGC, to ensure sufficient time for AGC adjustment. In the architecture shown in FIG. 2A and FIG. 2B, the synchronization module, the FFT/IFFT module, the SIG detection module, and the AGC module that are related to AGC adjustment are all located at the RU side. Therefore, there is no delay constraint problem in AGC adjustment. However, in this embodiment of this application, to implement digital baseband time domain IQ signal transmission between the RU and the CU, the FFT/IFFT module and the SIG detection module are configured at the CU side. Therefore, a transmission delay is required for the CU to notify the RU of a frame format detection result, there may be a delay constraint problem in AGC adjustment.

[00167] Therefore, in this embodiment of this application, the AGC adjustment module is disposed at the RU side, and is configured to receive an encapsulated decoding result sent by the central unit from a first decapsulation module, and generate an automatic gain control command

based on the decoding result. 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.

[00168] Compared with the AGC module in FIG. 2A and FIG. 2B, the AGC module in this embodiment of this application is further 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.

[00169] The synchronization module is specifically configured to: when an 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.

[00170] The decoding result is decoding results of a legacy signal field (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.

[00171] 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.

[00172] For a specific method procedure, refer to FIG. 9. FIG. 9 is a schematic flowchart of an AGC adjustment method according to an embodiment of this application. The method may specifically include the following steps.

[00173] S901: A remote unit receives an 802.11 frame, and performs a first AGC adjustment when detecting an L-STF field.

[00174] S902: The remote unit encapsulates a digital baseband IQ signal included in the 802.11 frame into a data packet, and adds a control word to the data packet.

[00175] S903: The remote unit sends a data packet to a central unit.

[00176] S904: The central unit decapsulates the data packet, obtains a sending start point and a sending end point of the 802.11 frame based on the control word, demodulates and decodes the 802.11 frame, and encapsulates decoding results of an L-SIG and three OFDM symbols following the L-SIG into a control packet.

[00177] S905: The central unit sends the control packet to the remote unit.

[00178] S906: The remote unit decapsulates the control packet to obtain a decoding result, runs a local AGC state machine based on the decoding result, and generates a second/third AGC

adjustment command.

[00179] S907: Perform a second/third AGC adjustment based on the AGC adjustment command.

[00180] The 802.11 frame has multiple formats. For a schematic diagram of a second/third AGC adjustment on the 802.11 frames in different formats, refer to FIG. 10A and FIG. 10B.

5 **[00181]** FIG. 10A and FIG. 10B are a schematic diagram of a time sequence of a second/third AGC adjustment for receiving 802.11 frames in different formats. For packets in various formats, a length of a field before a HT-STF/VHT-STF/HE-STF is usually an integer multiple of 4 μ s.

[00182] A synchronization (SYNC) module at a RU side can detect an L-STF, so that a start point and an end point of a valid 802.11 frame can be determined. The RU encapsulates the
10 received 802.11 frame into a data packet and sends the data packet to a CU. As shown in the figure, t00, t10, t20, and t30 respectively indicate time points at which an L-SIG and three OFDM symbols following the L-SIG are transmitted to the CU. Due to a remote transmission delay and a demodulation processing delay after the CU receives, t01, t11, t21, and t31 respectively indicate time points at which the L-SIG and the three OFDM symbols following the L-SIG are demodulated,
15 encapsulated into a control packet, and sent to the RU. Due to the remote transmission delay, t02, t12, t22, and t32 respectively indicate time points at which the RU side obtains decoding results of the L-SIG and the three OFDM symbols following the L-SIG.

[00183] The newly added AGC adjustment module runs the local AGC state machine and generates the second/third AGC adjustment command in step S906. FIG. 11A to FIG. 11C are a
20 schematic flowchart of AGC adjustment, including a first AGC adjustment and a second/third AGC adjustment. As shown in FIG. 11A to FIG. 11C, a RU performs the first AGC adjustment when detecting an L-STF. Then, after receiving a decoding result of an L-SIG, in other words, at t02, the RU determines whether a modulation scheme of the L-SIG is binary phase shift keying (Binary Phase Shift Keying, BPSK).

25 **[00184]** If the modulation scheme of the L-SIG is BPSK, the RU further determines whether L-DATARATE is 6 Mbps. L-DATARATE is a value indicated by a RATE field in the L-SIG field, and indicates a data rate. In a PPDU packet in HT/VHT/HE format, the RATE field in the L-SIG is fixed at 6 Mbps, in other words, L-DATARATE is 6 Mbps. If L-DATARATE is 6 Mbps, a mode may be HT, VHT, or HE format, or non-HT format for BPSK data modulation. The RU determines,
30 based on a demodulation result of the L-SIG, to perform a second AGC adjustment, and further obtains a demodulation result of a first symbol following the L-SIG at 16 μ s. The RU determines

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 $\text{LENGTH} \bmod 3 == 1$ or $== 2$. 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 mod 3 == 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

time sequence problem.

[00188] FIG. 12 is a schematic diagram of composition of a remote unit according to an embodiment of this application. The composition may include:

a processor 110, a memory 120, and a bus 130. The processor 110 and the memory 120 are connected through the bus 130. The memory 120 is configured to store instructions. The processor 110 is configured to execute the instructions stored in the memory 120, to implement the steps performed by the remote unit in the methods corresponding to FIG. 3, and FIG. 4 to FIG. 9.

[00189] Further, the remote unit may further include an input port 140 and an output port 150. The processor 110, the memory 120, the input port 140, and the output port 150 may be connected through the bus 130.

[00190] The processor 110 is configured to execute the instruction stored in the memory 120, to control the input port 140 to receive a signal and control the output port 150 to send a signal, to complete the steps performed by the remote unit in the foregoing methods. The input port 140 and the output port 150 may be a same physical entity or different physical entities. When the input port 140 and the output port 150 are a same physical entity, the input port 140 and the output port 150 may be collectively referred to as input and output ports. The memory 120 may be integrated into the processor 110, or may be disposed separately from the processor 110.

[00191] In an implementation, functions of the input port 140 and the output port 150 may be implemented by using a transceiver circuit or a dedicated transceiver chip. The processor 110 may be implemented by using a dedicated processing chip, a processing circuit, a processor, or a general-purpose chip.

[00192] In another implementation, it may be considered that the remote unit provided in this embodiment of this application is implemented by using a general-purpose computer. To be specific, program code implement functions of the processor 110, the input port 140, and the output port 150 is stored in the memory, and a general-purpose processor executes the code in the memory, to implement the functions of the processor 110, the input port 140, and the output port 150.

[00193] For concepts, explanations, detailed descriptions, and other steps of the remote unit that are related to the technical solutions provided in embodiments of this application, refer to the descriptions of the content related to the remote unit in the foregoing method or other embodiments. Details are not described herein again.

[00194] A person skilled in the art may understand that for ease of description, FIG. 12 shows only one memory and only one processor. An actual controller may include multiple processors and multiple memories. The memory may also be referred to as a storage medium, a storage device, or the like. This is not limited in embodiments of this application.

5 **[00195]** It should be understood that, the processor in this embodiment of this application may be a central processing unit (Central Processing Unit, CPU), or the processor may further be another general-purpose processor, a digital signal processor (Digital Signal Processor, DSP), an application-specific integrated circuit (Application-Specific Integrated Circuit, ASIC), a field-programmable gate array (Field-Programmable Gate Array, FPGA), or another programmable
10 logical device, a discrete gate or transistor logical device, a discrete hardware component, or the like.

[00196] The memory may include a read-only memory and a random access memory, and provide an instruction and data to the processor. A part of the memory may further include a non-volatile random access memory.

15 **[00197]** In addition to a data bus, the bus may further include a power bus, a control bus, a status signal bus, and the like. However, for clear description, various types of buses in the figures are marked as the bus.

[00198] In an implementation process, steps in the foregoing methods can be implemented by using a hardware integrated logical circuit in the processor, or by using instructions in a form of
20 software. The steps of the method disclosed with reference to embodiments of this application may be directly performed by a hardware processor, or may be performed by using a combination of hardware in the processor and a software module. A software module may be located in a mature storage medium in the art, such as a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an electrically erasable programmable memory, or a register.
25 The storage medium is located in the memory, and a processor reads information in the memory and completes the steps in the foregoing methods in combination with hardware of the processor. Details are not described again herein to avoid repetition.

[00199] According to the method provided in embodiments of this application, an embodiment of this application further provides an access point, including the remote unit and central unit.

30 **[00200]** According to the method provided in embodiments of this application, an embodiment of this application further provides a system, including the access point and the station.

[00201] In various embodiments of this application, sequence numbers of the foregoing processes do not mean execution sequences. The execution sequences of the processes should be determined based on functions and internal logic of the processes, and should not be construed as any limitation on the implementation processes of embodiments of this application.

5 **[00202]** A person of ordinary skill in the art may be aware that, various illustrative logical blocks (illustrative logical block, ILB) and steps that are described with reference to the embodiments disclosed in this specification may be implemented by using electronic hardware or a combination of computer software and electronic hardware. Whether the functions are performed by hardware or software depends on particular applications and design constraint conditions of the technical solutions. A person skilled in the art may use different methods to implement the described functions for each particular application, but it should not be considered that the implementation goes beyond the scope of this application.

[00203] In the several embodiments provided in this application, it should be understood that the disclosed systems, apparatuses, and methods may be implemented in another manner. For example, the described apparatus embodiment is merely an example. For example, division into the units is merely logical function division and may be other division in actual implementation. For example, multiple units or components may be combined or integrated into another system, or some features may be ignored or not performed. In addition, the displayed or discussed mutual couplings or direct couplings or communications connections may be implemented through some interfaces. The indirect couplings or communications connections between the apparatuses or units may be implemented in an electrical form, a mechanical form, or other forms.

20 **[00204]** All or some of the foregoing embodiments may be implemented by using software, hardware, firmware, or any combination thereof. When software is used to implement the embodiments, all or some of the embodiments may be implemented in a form of a computer program product. The computer program product includes one or more computer instructions. When the computer program instructions are loaded or executed on the computer, the procedures or functions according to embodiments of this application are all or partially generated. The computer may be a general-purpose computer, a dedicated computer, a computer network, or another programmable apparatus. The computer instructions may be stored in the computer-readable storage medium or may be transmitted from a computer-readable storage medium to another computer-readable storage medium. For example, the computer instructions may be

transmitted from a website, computer, server, or data center to another website, computer, server, or data center in a wired (for example, a coaxial cable, an optical fiber, or a digital subscriber line) or wireless (for example, infrared, radio, or microwave) manner. The computer-readable storage medium may be any usable medium accessible by the computer, or a data storage device, such as
5 a server or a data center, integrating one or more usable media. The usable medium may be a magnetic medium (for example, a floppy disk, a hard disk, or a magnetic tape), an optical medium (for example, a DVD), a semiconductor medium (for example, a solid-state disk), or the like.

[00205] The foregoing descriptions are merely specific implementations of this application, but are not intended to limit the protection scope of this application. Any variation or replacement
10 readily figured out by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

CLAIMS

What is claimed is:

1. A remote unit, comprising:

a clear channel assessment CCA module, configured to perform carrier sense multiple
5 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.

10 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:

15 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:

20 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
25 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.

30 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 12. 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 13. The method according to claim 12, 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.

14. The method according to claim 12 or 13, 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.

15. The method according to claim 13 or 14, 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 16. The method according to claim 15, 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.

17. The method according to claim 16, wherein the method further comprises:

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

18. The method according to claim 16, wherein the method further comprises:

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

19. The method according to any one of claims 13 to 18, wherein the method further comprises:

10 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.

20. The method according to any one of claims 15 to 19, 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:

15 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
20 detection of the 802.11 frame, and sending the decoding result to the central unit.

21. The method according to any one of claims 15 to 19, 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
25 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;

30 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.

22. The method according to claim 21, 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.

23. 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.

24. 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 12 to 22 is implemented.

20 25. 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 according to any one of claims 12 to 22.

26. 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 12 to 22.

25 27. An apparatus, configured to perform the method according to any one of claims 12 to 22.