Description

Title of Invention

COMMUNICATION CONTROL APPARATUS, COMMUNICATION APPARATUS, COMMUNICATION CONTROL METHOD, COMMUNICATION METHOD, AND PROGRAM

Technical Field

[0001]

The present invention relates to a communication control apparatus, a communication apparatus, a communication control method, a communication method, and a program.

Background Art

[0002]

Wireless local area networks (LANs), typified by IEEE (Institute of Electrical and Electronics Engineers) 802.11, have in recent years been widespread, leading to an increase in the information amount of transmitted contents and the number of wireless LAN-capable products. Therefore, to improve the efficiency of communication over an entire network, the standard IEEE 802.11 is still being enhanced.

[0003]

In the 802.11ac standard, which is an example enhanced version of the standard IEEE 802.11, multi-user multi-input multi-output (MU-MIMO) is employed for a downlink (DL). MU-MIMO is a technique for allowing transmission of a plurality of signals during the same period of time through space-division multiplexing. The technique can improve the efficiency of use of frequencies, for example.

[0004]

However, different communication apparatuses may transmit frames during different transmission time periods. In this case, the number of multiplexed frames fluctuates during a period of time when the frames are received. Therefore, the reception power of a communication apparatus that receives multiplexed frames fluctuates during the reception time period. The fluctuation of the reception power may have an influence on the performance of reception. To address this problem, a technique of transmitting frames during equal transmission time periods has been proposed.

[0005]

For example, Patent Literature 1 describes a communication apparatus that appropriately adds a padding to a plurality of frames having different transmission time periods and thereby transmits the plurality of frames during equal transmission time periods.

[0006]

In addition, Patent Literature 2 describes a communication method in which a communication apparatus serving as an access point (AP) transmits uplink (UL) permission information designating a transmission time period of a UL frame and a communication apparatus receiving the UL permission information transmits a UL frame over the designated transmission time period.

Citation List

Patent Literature

[0007]

Patent Literature 1:	JP 2010-263490A
Patent Literature 2:	JP 2010-263493A

Disclosure of Invention

Technical Problem

[0008]

In the inventions disclosed in Patent Literatures 1 and 2, reception characteristics of multiplexed frames deteriorate in some cases. For example, when reception signal strengths of frames received from communication apparatuses performing multiplex communication are different and signals are amplified in accordance with a reception signal strength of a frame to be transmitted from a certain communication apparatus, a reception signal of a frame to be transmitted from another communication apparatus different from the certain communication apparatus may be saturated. A reception signal involved in the other communication apparatus is relatively compressed with respect to a reception signal involved in the certain communication apparatus. As a result, it may be difficult to receive a frame transmitted from the other communication apparatus.

[0009]

Accordingly, embodiments of the present invention disclose a novel and improved communication control apparatus, a novel and improved communication apparatus, a novel and improved communication control method, a novel and improved communication method, and a novel and improved program capable of suppressing deterioration in reception characteristics of a multiplexed frame in a wireless LAN.

Solution to Problem

[0010]

According to a first aspect of the present invention, there is provided a communication control apparatus including: a control unit configured to decide transmission power for multiplex communication in a wireless local area network (LAN) on the basis of

information obtained through reception from another communication apparatus; a processing unit configured to generate a frame including transmission power information indicating the transmission power for the multiplex communication decided by the control unit; and a communication unit configured to transmit the frame generated by the processing unit to the other communication apparatus, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and an uplink frame are permitted to be transmitted as responses to the frame including the transmission power information.

[0011]

According to a second aspect of the present invention, there is provided a communication apparatus including: a control unit configured to set transmission power of the own apparatus on the basis of transmission power information indicating transmission power for multiplex communication in a wireless local area network (LAN) decided on the basis of information obtained through reception from the communication apparatus; and a communication unit configured to receive a frame including the transmission power information and transmit an ACK frame and an uplink frame with the transmission power set by the control unit, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and wherein the communication unit is further configured to transmit the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.

[0012]

According to a third aspect of the present invention, there is provided a communication control method including: deciding, by a control unit, transmission power for multiplex communication in a wireless local area network (LAN) on the basis of information obtained through reception from another communication apparatus; generating a frame including transmission power information indicating the decided transmission power for the multiplex communication; and transmitting the generated frame to the other communication apparatus, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission

transmission period in which the ACK frame and an uplink frame are permitted to be transmitted as responses to the frame including the transmission power information.

[0013]

According to a fourth aspect of the present invention, there is provided a communication method including: receiving, by a communication unit, a frame including the transmission power information indicating transmission power of multiplex communication in a wireless local area network (LAN); setting transmission power of an own apparatus on the basis of the transmission power information decided on the basis of information obtained through reception from a communication apparatus; and transmitting an ACK frame and an uplink frame with the set transmission power, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and wherein the communication method further comprises transmitting the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.

[0014]

According to a fifth aspect of the present invention, there is provided a program causing a computer to realize: a control function of deciding transmission power for multiplex communication in a wireless local area network (LAN) on the basis of information obtained through reception from another communication apparatus; a processing function of generating a frame including transmission power information indicating the transmission power for the multiplex communication decided through the control function; and a communication function of transmitting the frame generated by the processing function to the other communication apparatus, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and an uplink frame are permitted to be transmitted by the other communication apparatus as responses to the frame including the transmission power information.

[0015]

According to a sixth aspect of the present invention, there is provided a program causing a computer to realize: a communication function of receiving a frame including transmission power information indicating transmission power for multiplex communication in a wireless local area network (LAN); a control function of setting transmission power of an

own apparatus on the basis of the transmission power information decided on the basis of information obtained through reception from a communication apparatus; and a communication function of transmitting an ACK frame and an uplink frame with the set transmission power,, wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and wherein the program causing the computer to further realize a communication function of transmitting the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.

Advantageous Effects of Invention

[0016]

As described above, embodiments of the present invention provide a novel and improved communication control apparatus, a novel and improved communication apparatus, a novel and improved communication control method, a novel and improved communication method, and a novel and improved program capable of suppressing deterioration in reception characteristics of a multiplexed frame in a wireless LAN. Note that the effects described above are not necessarily limitative. With or in the place of the above effects, there may be achieved any one of the effects described in this specification or other effects that may be grasped from this specification.

Brief Description of Drawings

[0017]

[FIG. 1] FIG. 1 is a diagram exemplifying a communication system configured to include communication apparatuses according to an embodiment of the present disclosure.

[FIG. 2] FIG. 2 is a block diagram showing a schematic functional configuration of a communication apparatus according to a first embodiment of the present disclosure.

[FIG. 3] FIG. 3 is a diagram showing a configuration example of a frame including transmission power range information according to the present embodiment.

[FIG. 4] FIG. 4 is a diagram showing another configuration example of the frame including the transmission power range information according to the present embodiment.

[FIG. 5] FIG. 5 is a flowchart conceptually showing a process of the communication system according to the present embodiment.

CLAIMS

1. A communication control apparatus comprising:

a control unit configured to decide transmission power for multiplex communication in a wireless local area network (LAN) on the basis of information obtained through reception from another communication apparatus;

a processing unit configured to generate a frame including transmission power information indicating the transmission power for the multiplex communication decided by the control unit; and

a communication unit configured to transmit the frame generated by the processing unit to the other communication apparatus,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and an uplink frame are permitted to be transmitted by the other communication apparatus as responses to the frame including the transmission power information.

2. The communication control apparatus according to claim 1,

wherein the information obtained through the reception includes information that changes in accordance with a propagation path.

3. The communication control apparatus according to claim 2,

wherein the information that changes in accordance with the propagation path includes information indicating a propagation attenuation amount.

4. The communication control apparatus according to claim 3,

wherein, in communication of a first frame generated by the processing unit and a second frame received as a response to the first frame, the control unit estimates the propagation attenuation amount on the basis of power involved in the communication of the first frame or the second frame.

5. The communication control apparatus according to claim 4,

wherein the first frame includes second power information indicating transmission power of the second frame,

the communication unit receives the second frame transmitted with the transmission power indicated by the second power information included in the first frame, and

the control unit estimates the propagation attenuation amount on the basis of the transmission power indicated by the second power information and reception power of the second frame.

6. The communication control apparatus according to claim 4,

wherein the second frame includes second power information indicating transmission power of the second frame,

the communication unit receives the second frame transmitted with the transmission power indicated by the second power information included in the second frame, and

the control unit estimates the propagation attenuation amount on the basis of the transmission power indicated by the second power information and reception power of the second frame.

7. The communication control apparatus according to claim 4,

wherein the communication unit receives the second frame transmitted with pre-decided transmission power of the second frame, and

the control unit estimates the propagation attenuation amount on the basis of the pre-decided transmission power of the second frame and reception power of the second frame.

8. The communication control apparatus according to claim 4,

wherein the second frame includes first power information indicating reception power of the first frame, and

the control unit estimates the propagation attenuation amount on the basis of transmission power of the first frame and the reception power indicated by the first power information.

9. The communication control apparatus according to claim 4,

wherein the first frame includes a frame indicating a request for a reference signal,

and

the second frame received as the response to the first frame includes a frame including the reference signal.

10. The communication control apparatus according to claim 1,

wherein the control unit decides the transmission power for the multiplex communication for each frequency.

11. The communication control apparatus according to claim 1,

wherein the control unit decides the transmission power for the multiplex communication on the basis of information indicating a modulation scheme and a coding scheme used for the multiplex communication.

12. The communication control apparatus according to claim 1,

wherein the communication unit receives a frame including transmission power range information indicating a range of transmission power settable in the other communication apparatus, from the other communication apparatus, and

the control unit decides transmission power which falls within the range indicated by the transmission power range information as the transmission power for the multiplex communication.

13. The communication control apparatus according to claim 1,

wherein a multiplex scheme of the multiplex communication includes a space division multiplex scheme or a frequency division multiplex scheme.

14. A communication apparatus comprising:

a control unit configured to set transmission power of the own apparatus on the basis of transmission power information indicating transmission power for multiplex communication in a wireless local area network (LAN) decided on the basis of information obtained through reception from the communication apparatus; and

a communication unit configured to receive a frame including the transmission power information and transmit an ACK frame and an uplink frame with the transmission power set by the control unit,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and

wherein the communication unit is further configured to transmit the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.

15. The communication apparatus according to claim 14, further comprising:

a processing unit configured to generate a second frame including first power information indicating reception power of a first frame or second power information indicating transmission power of the second frame as a response to the first frame received from a transmission source of the transmission power information,

wherein the communication unit receives the first frame and transmits the second frame.

16. A communication control method comprising:

deciding, by a control unit, transmission power for multiplex communication in a wireless local area network (LAN) on the basis of information obtained through reception from another communication apparatus;

generating a frame including transmission power information indicating the decided transmission power for the multiplex communication; and

transmitting the generated frame to the other communication apparatus,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and an uplink frame are permitted to be transmitted by the other communication apparatus as responses to the frame including the transmission power information.

17. A communication method comprising:

receiving, by a communication unit, a frame including the transmission power information indicating transmission power of multiplex communication in a wireless local area network (LAN);

setting transmission power of an own apparatus on the basis of the transmission power information decided on the basis of information obtained through reception from a communication apparatus; and

transmitting an ACK frame and an uplink frame with the set transmission power,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and

wherein the communication method further comprises transmitting the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.

18. A program causing a computer to realize:

a control function of deciding transmission power for multiplex communication in a wireless local area network (LAN) on the basis of information obtained through reception from another communication apparatus;

a processing function of generating a frame including transmission power information indicating the transmission power for the multiplex communication decided through the control function; and

a communication function of transmitting the frame generated by the processing function to the other communication apparatus,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which an ACK frame is permitted to be transmitted by the other communication apparatus as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and an uplink frame are permitted to be transmitted by the other communication apparatus as responses to the frame including the transmission power information.

19. A program causing a computer to realize:

a communication function of receiving a frame including transmission power information indicating transmission power for multiplex communication in a wireless local area network (LAN);

a control function of setting transmission power of an own apparatus on the basis of the transmission power information decided on the basis of information obtained through reception from a communication apparatus; and

a communication function of transmitting an ACK frame and an uplink frame with the set transmission power,

wherein the frame including the transmission power information includes information indicating a first permission transmission period in which the ACK frame is permitted to be transmitted as a response to the frame including the transmission power information, and a second permission transmission period in which the ACK frame and the uplink frame are permitted to be transmitted as responses to the frame including the transmission power information, and

wherein the program causing the computer to further realize a communication function of transmitting the ACK frame during the first permission transmission period and the uplink frame during the second permission transmission period.