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SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0005]

A transmitting method, a receiving method, a transmitting apparatus, and a receiving apparatus which allow communication using a flexible frame configuration are provided.

SOLUTIONS TO PROBLEM

[0005a]

According to a first aspect of the present disclosure, there is provided a transmitting method including: generating a preamble, a first subframe, and a second subframe such that the first subframe is provided between the preamble and the second subframe in a time direction, the preamble carrying control information, the first subframe being generated by mapping first modulated signals of a first Physical Layer Pipe (PLP) and second modulated signals of a second PLP onto time-frequency resources, the second subframe being generated by mapping third modulated signals of a third PLP onto time-frequency resources; inserting pilot signals into the preamble, the first subframe, and the second subframe; performing Inverse Fast Fourier Transform (IFFT) processing on the preamble, the first subframe, and the second subframe to generate an orthogonal frequency-division multiplexing (OFDM) signal after the pilot signals are inserted; and transmitting the OFDM signal, wherein the time-frequency resources in the first subframe include first resources and second resources that are provided for a first OFDM symbol and a second OFDM symbol, respectively, the first resources being arranged in a frequency direction and corresponding to respective OFDM subcarriers, the second resources being arranged in the frequency direction and corresponding to the respective OFDM subcarriers, the first resources being adjacent to the second resources in the time direction, the first modulated signals include a first sequence of first modulated signals and a second sequence of first modulated signals

following the first sequence, the first sequence is mapped onto the first resources within a first range in the frequency direction, from a first starting position, the second sequence is mapped onto the second resources within the first range, the second modulated signals include a third sequence of second modulated signals and a fourth sequence of second modulated signals following the third sequence, the third sequence is mapped onto the first resources within a second range in the frequency direction, from a second starting position, the fourth sequence is mapped onto the second resources within the second range, a sequence of the third modulated signals is mapped onto the time-frequency resources in the second subframe from a third starting position, and the control information includes the first starting position, the second starting position, and the third starting position.

[0005b]

According to a second aspect of the present disclosure, there is provided a receiving method including: receiving an orthogonal frequency-division multiplexing (OFDM) signal; and demodulating the received OFDM signal to obtain data of at least one of a first Physical Layer Pipe (PLP), a second PLP, or a third PLP, wherein the OFDM signal is generated by: inserting pilot signals into a preamble, a first subframe, and a second subframe such that the first subframe is provided between the preamble and the second subframe in a time direction; and then performing Inverse Fast Fourier Transform (IFFT) processing on the preamble, the first subframe, and the second subframe, the preamble carries control information, the first subframe is generated by mapping first modulated signals of the first PLP and second modulated signals of the second PLP onto time-frequency resources, the second subframe is generated by mapping third modulated signals of the third PLP onto time-frequency resources, the time-frequency resources in the first subframe include first resources and second resources that are provided for a first OFDM symbol and a second OFDM symbol, respectively, the first resources being arranged in a frequency direction and corresponding to respective OFDM subcarriers, the second resources being arranged in the frequency direction and corresponding to the respective OFDM subcarriers, the first resources being adjacent to the second resources in the time direction, the first modulated signals include a first sequence of first modulated signals and a second sequence of first modulated signals following the first sequence, the first sequence is mapped onto the first resources within a first range in the frequency direction, from a first starting position, the second sequence is mapped onto the second resources within the first range, the second modulated signals include a third sequence of second modulated signals and a fourth sequence of second modulated signals following the third sequence, the third sequence is mapped onto the first resources within a second range in the frequency direction, from a second starting position, the fourth sequence is mapped onto the second resources within the second range, a sequence of the third modulated signals is mapped onto the time-frequency resources from a third starting position, and the control information includes the first starting position, the second starting position, and the third starting position.

[0006]

Disclosed herein is a transmission method that includes: configuring a

frame using a plurality of orthogonal frequency-division multiplexing (OFDM) symbols, by allocating a plurality of transmission data to a plurality of areas; and transmitting the frame. Each of the plurality of areas is identified by at least one time resource among a plurality of time resources and at least one frequency resource among a plurality of frequency resources. The frame includes a first period in which a preamble which includes information on a frame configuration of the frame is transmitted, and a second period in which the plurality of transmission data are transmitted by at least one of time division and frequency division. The second period includes a first area among the plurality of areas, and the first area includes a data symbol generated from first transmission data among the plurality of transmission data, a data symbol generated from second transmission data among the plurality of transmission data and subsequent to the data symbol generated from the first transmission data, and a dummy symbol subsequent to the data symbol generated from the second transmission data.

[0007]

Disclosed herein is a receiving that includes receiving a frame, obtaining information, and performing demodulation. When receiving a frame, a frame which includes a first period in which a preamble is transmitted, and a second period in which a plurality of transmission data are transmitted by at least one of time division and frequency division is received. The frame is configured using a plurality of orthogonal frequency-division multiplexing (OFDM) symbols, by allocating the plurality of transmission data to a plurality of areas. Each of the plurality of areas is identified by at least one time resource among a plurality of time resources and at least one frequency resource among a plurality of frequency resources. When obtaining information, information on a frame configuration of the frame is obtained from the preamble. When performing demodulation, at least one of the plurality of transmission data transmitted in the second period is demodulated based on the information on the frame configuration.

[0008]

Disclosed herein is a transmitting that includes: a frame configuring unit configured to configure a frame using a plurality of orthogonal frequency-division multiplexing (OFDM) symbols, by allocating a plurality of transmission data to a plurality of areas; and a transmitter which transmits the frame. Each of the plurality of areas is identified by at least one time resource among a plurality of time resources and at least one frequency resource among a plurality of frequency resources. The frame includes a first period in which a preamble which includes information on a frame configuration of the frame is transmitted, and a second period in which the plurality of transmission data are transmitted by at least one of time division and frequency division. The second period includes a first area among the plurality of areas, and the first area includes a data symbol generated from first transmission data among the plurality of transmission data, a data symbol generated from second transmission data among the plurality of transmission data and subsequent to the data symbol generated from the first transmission data, and a dummy symbol subsequent to the data symbol generated from the second transmission data.

[0009]

Disclosed herein is a receiving that includes a receiver, a preamble processor, and a demodulator. The receiver receives a frame which includes a first period in which a preamble is transmitted, and a second period in which a plurality of transmission data are transmitted by at least one of time division and frequency division. The frame is configured using a plurality of orthogonal frequency-division multiplexing (OFDM) symbols, by allocating the plurality of transmission data to a plurality of areas. Each of the plurality of areas is identified by at least one time resource among a plurality of time resources and at least one frequency resource among a plurality of frequency resources. A preamble processor obtains information on a frame configuration of the frame from the preamble. A demodulator demodulates, based on the information on the frame configuration, at least one of the plurality of transmission data transmitted in the second period.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010]

According to embodiments of the transmitting apparatus, the receiving apparatus, the transmitting method, and the receiving method, communication can be performed using a flexible frame configuration. This yields advantageous effects that high efficiency in data transmission can be achieved in a communications system and furthermore the receiving apparatus can efficiently obtain data.

BRIEF DESCRIPTION OF DRAWINGS

[0011]

FIG. 1 is a view illustrating an example of a configuration of a transmitting apparatus.

FIG. 2 is a view illustrating an example of a frame configuration.

FIG. 3 is a view illustrating an example of a frame configuration.

FIG. 4 is a view illustrating an example of a frame configuration.

FIG. 5 is a view illustrating an example of a frame configuration.

FIG. 6 is a view illustrating an example of a frame configuration.

FIG. 7 is a view illustrating an example of a configuration in a case where a transmitting method using space time block codes is performed.

FIG. 8 is a view illustrating an example of a configuration in a case where the transmitting method using space time block codes is performed.

FIG. 9 is a view illustrating an example of a configuration in a case where a transmitting method using an MIMO method is performed.

FIG. 10 is a view illustrating an example of a configuration in a case where the transmitting method using the MIMO method is performed.