TITLE

METHOD FOR CONSTRUCTING FRAME STRUCTURES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Nos. 60/929,798, entitled "Frame Structure in Wireless Communication Systems," filed July 12, 2007, and 60/973,157, entitled "Bandwidth Scalable OFDMA Frame Structure," filed September 17, 2007. These applications are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] The present invention generally relates to orthogonal frequency-division multiple access (OFDMA) systems, and more particularly, the present invention relates to methods for constructing frame structures in OFDMA systems.

[0003] Orthogonal Frequency Division Multiple Access (OFDMA) is a multiple access scheme for transmitting data in different subcarriers in a channel, wherein the data may come from different users and may be transmitted in disjoint subsets of sub-channels in a transmission bandwidth. The orthogonality property among the subcarriers may allow simultaneous transmission of data from different users without interference from one other. The multiple access scheme of the OFDMA may generally be applied in various communication systems, such as those defined in IEEE standard 802.16e ("legacy system" hereafter) and IEEE standard 802.16m ("new system" hereafter). The new system defined in the IEEE standard 802.16m may be required to provide enhanced spectrum efficiency, higher speed tolerance and full backward compatibility with the legacy system defined in the IEEE standard 802.16e.

[0004] FIG. 1 is a diagram illustrating an OFDMA frame structure under the IEEE 802.16 standard. Referring to FIG. 1, the frame structure may include a downlink sub-frame (DL sub-frame) 16 and an uplink sub-frame (UL sub-frame) 18. The UL sub-frame 18 may follow the DL sub-frame 16 in time domain with a transmit/receive transmission gap (TTG) 17 from the DL sub-frame 16. Moreover, the frame structure may be separated from the next frame structure, led by a preamble 10-2, by a receive/transmit transmission gap (RTG) 19.

[0005] The DL sub-frame 16 may include a preamble 10-1, a frame control header (FCH) 11, a downlink map (DL-MAP) 12, a downlink burst (DL burst#1) 13 and a data region (DATA) 14-

1. The UL sub-frame 18 may include a ranging sub-channel 15 and a data region (DATA) 14-2. Since the DL-MAP 12 may be used to identify the division or structure of the DATA 14-1 in the DL sub-frame 16, it may be desirable to integrate the OFDMA frame structure of an old OFDMA system with that of a new OFDMA system by using the DL-MAP 12 to define different zones in the DATA 14-1 and DATA 14-2 of the frame structure for data of the old OFDMA system and data of the new OFDMA system.

[0006] FIG. 2 is a diagram illustrating a placement of guiding signals (or pilot symbols) 24-1 for time-domain and frequency-domain OFDMA signals under the IEEE 802.16 standard. Referring to FIG. 2, upper and lower frequency bands may serve as guard bands 22-1 and 22-2, respectively, which may not be used to carry information. The placement of information may include a first part and a second part. For example, the first part of the placement includes a preamble 10'-1 having a fixed length, and the second part of the placement includes data and guard intervals between an upper row and a lower row of the data interlaced with the pilot symbols 24-1, represented by blocks marked with "X". In some applications such placement of information may be inflexible to bandwidth scaling due to the fixed-length preambles 10'-1 and/or 10'-2 and the often unusable guard bands 22-1 and 22-2. Moreover, the placement may be susceptible to a Doppler effect in a high mobility scenario because the placement may be usually designed with a relatively large symbol period, which in turn may induce relatively short carrier spacing and less dense pilot symbol placement. Moreover, the limitation on pilot symbol placement may cause channel estimation error at a receiving end because of insufficient information provided for channel estimation.

SUMMARY

[0007] Examples of the present invention may provide a method for constructing a frame structure for data transmission, the method comprising generating a first section comprising data configured in a first format compatible with a first communication system, generating a second section following the first section comprising data configured in a second format compatible with a second communication system, wherein the second format is different from the first format, generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section, and combining the first section, the second section and the at least one non-data section to form the frame structure.

[0008] Examples of the present invention may provide a method of generating a frame for transferring data in a communication system. The communication system may include a first system and a second system. The method may include generating a first sub-frame for downlink transmission, wherein the first sub-frame comprises a first region comprising first mapping information, a second region comprising second mapping information, and a third region carrying data to be transferred in the downlink transmission, the third region comprising a first sub-region and a second sub-region, wherein the first sub-region and second sub-region are defined by the first mapping information, the first sub-region being capable of carrying first data of the first system and the second sub-region being capable of carrying second data of the second system in the downlink transmission, and generating a second sub-frame for uplink transmission, wherein the second sub-frame comprises a fourth region carrying data to be transferred in the uplink transmission, the fourth region comprising a third sub-region and a fourth sub-region, wherein the third sub-region and the fourth sub-region are defined by the second mapping information, the third sub-region being capable of carrying third data of the first system and the fourth sub-region being capable of carrying fourth data of the second system in the uplink transmission.

[0009] Examples of the present invention may also provide a method of generating a frame for transferring data in a communication system. The communication system may include a first system and a second system. The method may include generating a first frame comprising a first sub-frame for downlink transmission and a second sub-frame for uplink transmission in a first band, generating a second frame comprising a third sub-frame for downlink transmission and a fourth sub-frame for uplink transmission in a second band, identifying a guard band between the first band and the second band, and generating a third frame comprising a fifth sub-frame for downlink transmission and a sixth sub-frame for uplink transmission in the guard band.

[0010] Examples of the present invention may provide a method for allocating information in a frame of a communication system. The communication system may include a first system and a second system. The frame may be used for first data transmission of the first system and second data transmission of the second system. The method may include allocating data of the first system and the second system in first mapping information, dividing a data region of the frame to form a first sub-region and a second sub-region according to the first mapping information, performing the first data transmission of the first system by using the first sub-region and performing the second data transmission of the second system by using the second sub-region.

[0011] Examples of the present invention may provide another method for allocating information in a frame of a communication system. The frame may include a first frame, a second frame and a band between the first frame and the second frame. The communication system may include a first system and a second system. The frame may be used for first data transmission of the first system and second data transmission of the second system. The method may include allocating data of the first system and the second system in first mapping information or second mapping information, dividing a data region of the first frame or the second frame to form a first sub-region, a second sub-region, a third sub-region or a second sub-region in the data region of the first frame or the second frame according to the first mapping information or the second mapping information, performing the first data transmission of the first system by using the first sub-region or the third sub-region and performing the second data transmission of the second system by using the second sub-region or the fourth sub-region.

[0012] Additional features and advantages of the present invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The features and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[0013] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The foregoing summary, as well as the following detailed description of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there are shown in the drawings examples which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown.

[0015] In the drawings:

[0016] FIG. 1 is a diagram illustrating an orthogonal frequency-division multiple access (OFDMA) frame structure under the IEEE 802.16 standard;

[0017] FIG. 2 is a diagram illustrating a placement of guiding signals for OFDMA signals under the IEEE 802.16 standard;

[0018] FIG. 3 is a diagram illustrating an OFDMA frame structure according to an example of the present invention;

[0019] FIG. 4 is a diagram illustrating an OFDMA frame structure supporting high mobility according to an example of the present invention;

[0020] FIG. 5 is a diagram illustrating an OFDMA frame structure with a scalable bandwidth according to an example of the present invention;

[0021] FIG. 6A is a diagram illustrating an OFDMA frame structure supporting high mobility and having a scalable bandwidth according to an example of the present invention;

[0022] FIG. 6B is a diagram illustrating an OFDMA frame structure supporting high mobility and having a scalable bandwidth according to another example of the present invention; and

[0023] FIG. 7 is a diagram illustrating an exemplary placement of signals and pilots in time-domain and frequency-domain of an OFDMA system supporting high mobility and having a scalable bandwidth.

DETAILED DESCRIPTION

[0024] Reference will now be made in detail to various embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0025] Exampls of the present invention may allow data of an old orthogonal frequency-division multiple access (OFDMA) system (hereinafter a legacy system) and data of a new OFDMA system to co-exist in an OFDMA frame by changing a frame structure of the OFDMA frame. The new OFDMA system may have a larger bandwidth and support higher mobility, and may use an updated transmission technology. In order to be backward compatible with the old OFDMA system, the new OFDMA system may be developed based on the old OFDMA system.

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