

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 July 2008 (24.07.2008)

PCT

(10) International Publication Number
WO 2008/087599 A2

- (51) International Patent Classification:
H04L 1/00 (2006.01)
- (21) International Application Number:
PCT/IB2008/050162
- (22) International Filing Date: 16 January 2008 (16.01.2008)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/885,149 16 January 2007 (16.01.2007) US
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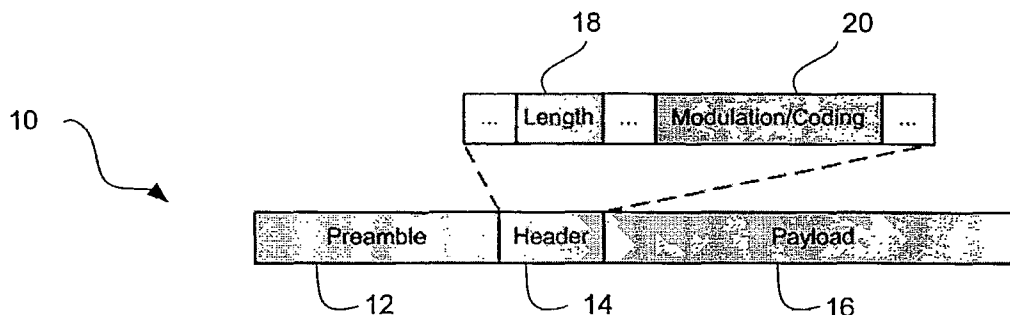
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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- Declarations under Rule 4.17:**
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
 - as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

- Published:**
- without international search report and to be republished upon receipt of that report

(54) Title: SYSTEM AND METHOD FOR EFFICIENT TRANSMISSION OF MULTIMEDIA AND DATA



Conventional packet structure

(57) Abstract: A system and method for efficient transmission of different types of source data in the same packet, hence, enabling efficient transmission of multimedia and data content with unequal error protection are provided. The present disclosure defines a packet structure where the packet consists of a number of segments or payloads. The packet includes a field indicative of a number of payloads included in the packet; and at least one data field for each payload in the packet, the at least one data field defining at least one characteristic of the payload. The at least one data field includes a length of the payload, modulation and coding scheme, existence of a frame check sum (FCS), and existence of a midamble. The at least one data field may further include a continuation element indicative of whether two consecutive payloads are portions of a same data frame.

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SYSTEM AND METHOD FOR EFFICIENT TRANSMISSION OF MULTIMEDIA AND DATA

Cross Reference to Related Applications

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[0001] This application claims the benefit of prior filed, co-pending U.S. provisional application: Serial No. 60/885,149, filed on January 16, 2007.

BACKGROUND OF THE INVENTION

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1. Field of the Invention

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[0002] The present disclosure generally relates to data communications and data communications systems, and more particularly, to a system and method for efficient transmission of multimedia and data.

2. Description of the Related Art

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[0003] In many communication systems, data is transmitted in packets (also known as frames). Referring to FIG. 1, a packet 10 often consists of a preamble 12, a header 14 and the payload 16. The preamble 12 is often used for synchronization, channel estimation or for clear channel assessment. The header 14 usually contains data such as source and destination, the length of the payload 18, modulation and coding type 20, etc. Since the correct detection of the information is often essential to receive and deliver the payload, the header 14 is usually heavily protected with different types of redundancy such as a Forward Error Correcting (FEC) code.

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[0004] When the correct delivery of payload needs to be guaranteed, often a retransmission scheme is used. In other words, an error detecting code (such as a Cyclic Redundancy Check or CRC) is used. Parity bits are calculated at the transmitter and are included in the packet in a data field often called Frame Check Sum or FCS, as illustrated in FIG. 2. At the receiver these parity bits are used to determine whether an error has occurred in the payload. In case of errors, the receiver will ask the transmitter to retransmit all or part of the packet. When correct delivery

of data does not need to be guaranteed (“best effort”) the use of such method is not needed.

5 [0005] Normally, the preamble is used for synchronization, channel estimation, and frequency offset estimation. However, when the packet is long, the information estimated during the preamble may no longer be up-to-date when nearing the end of the packet. In this case, a midamble 24 can be placed in the middle of the packet to assist the updating of the channel and frequency offset estimation as well as re-synchronization, as shown In FIG. 3.

10 [0006] In many communication systems, different types of data are needed to be communicated. These different types of data often have different requirements on the error rate, and tolerable delay. As a result, different modulation and coding should be used for different types of data. For example, in the transmission of multimedia, often
15 video, audio, security (encryption) information and control information need to be transmitted. Aside from these different sources, even different data bits from one source (e.g. video) could have different requirements of the error rate.

20 [0007] Hence, it is desirable that different modulation and coding schemes are employed such that different protection levels are provided for the data with different levels of sensitivity. In a conventional packet structure, only one type of modulation and coding can be used. Hence, the different types of data must be transmitted using different packets. This will increase the packet overhead (preamble, header and inter packet guard times), and reduces the efficiency of the system. Therefore, a need exists
25 for techniques for generating a data packet of different types of source data in the same packet enabling efficient transmission of multimedia and data content.

SUMMARY OF THE INVENTION

30 [0008] A system and method for efficient transmission of different types of source data in the same packet, hence, enabling efficient transmission of multimedia and data content with unequal error protection are provided. The present disclosure defines a packet structure where the packet consists of a number of segments or payloads. Each segment may have different length, modulation and coding. Also,

each segment may contain error detection code parity bits (FCS). Furthermore, each segment may or may not include a midamble at its beginning or at its end. Also, other characteristics of each segment may also be different. The length, modulation and coding method for each segment, as well as whether the segment includes FCS or a midamble, or its other characteristics, will be specified in one or more information fields in the packet.

[0009] According to one aspect of the present disclosure, a data transmission system for transmitting multimedia and data includes means for generating a packet of data including a preamble, header and at least one payload; means for inserting in the packet a field indicative of a number of payloads included in the packet; and means for inserting in the packet at least one data field for each payload in the packet, the at least one data field defining at least one characteristic of the payload.

[00010] In a related aspect, the at least one data field defining at least one characteristic of the payload includes a length of the payload, modulation and coding scheme, existence of a frame check sum (FCS), and existence of a midamble.

[00011] In a further related aspect, the at least one data field defining at least one characteristic of the payload is a continuation element indicative of whether two consecutive payloads are portions of a same data frame.

[00012] According to another aspect of the present disclosure, a method for generating a data packet including multimedia and data is provided. The method includes generating a packet of data including a preamble, header and at least one payload; inserting in the packet a field indicative of a number of payloads included in the packet; and inserting in the packet at least one data field for each payload in the packet, the at least one data field defining at least one characteristic of the payload.

[00013] According to a further aspect of the present disclosure, a data packet for transmitting multimedia and data including a preamble, header and at least one payload is provided. The data packet includes a field indicative of a number of payloads included in the packet; and at least one data field for each payload in the packet, the at least one data field defining at least one characteristic of the payload.

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BRIEF DESCRIPTION OF THE DRAWINGS

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[00014] These, and other aspects, features and advantages of the present disclosure will be described or become apparent from the following detailed description of the preferred embodiments, which is to be read in connection with the accompanying drawings.

[00015] **FIG. 1** is an exemplary illustration of a conventional data packet structure;

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[00016] **FIG. 2** is an illustration of the data packet of FIG. 1 including a frame check sum (FCS) data field;

[00017] **FIG. 3** is an illustration of the data packet of FIG. 1 including a frame check sum (FCS) data field and a midamble;

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[00018] **FIG. 4** is a diagram of an exemplary communication system in accordance with an embodiment of the present disclosure;

[00019] **FIG. 5** is an illustration of a data packet structure in accordance with an embodiment of the present disclosure;

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[00020] **FIG. 6** is an illustration of a data packet structure in accordance with another embodiment of the present disclosure; and

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[00021] **FIG. 7** is an illustration of a data packet structure in accordance with a further embodiment of the present disclosure;

[00022] It should be understood that the drawing(s) is for purposes of illustrating the concepts of the disclosure and is not necessarily the only possible configuration for illustrating the disclosure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

5 [00023] It should be understood that the elements shown in the FIGS. may be implemented in various forms of hardware, software or combinations thereof. Preferably, these elements are implemented in a combination of hardware and software on one or more appropriately programmed general-purpose devices, which may include a processor, memory and input/output interfaces.

10 [00024] The present description illustrates the principles of the present disclosure. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the disclosure and are included within its spirit and scope.

15 [00025] All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the principles of the disclosure and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions.

20 [00026] Moreover, all statements herein reciting principles, aspects, and embodiments of the disclosure, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as
25 equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

30 [00027] Thus, for example, it will be appreciated by those skilled in the art that the block diagrams presented herein represent conceptual views of illustrative circuitry embodying the principles of the disclosure. Similarly, it will be appreciated that any flow charts, flow diagrams, state transition diagrams, pseudocode, and the like represent various processes which may be substantially represented in computer readable media and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

[00028] The functions of the various elements shown in the figures may be provided through the use of dedicated hardware as well as hardware capable of executing software in association with appropriate software. When provided by a processor, the functions may be provided by a single dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term “processor” or “controller” should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor (“DSP”) hardware, read only memory (“ROM”) for storing software, random access memory (“RAM”), and nonvolatile storage.

[00029] Other hardware, conventional and/or custom, may also be included. Similarly, any switches shown in the figures are conceptual only. Their function may be carried out through the operation of program logic, through dedicated logic, through the interaction of program control and dedicated logic, or even manually, the particular technique being selectable by the implementer as more specifically understood from the context.

[00030] In the claims hereof, any element expressed as a means for performing a specified function is intended to encompass any way of performing that function including, for example, a) a combination of circuit elements that performs that function or b) software in any form, including, therefore, firmware, microcode or the like, combined with appropriate circuitry for executing that software to perform the function. The disclosure as defined by such claims resides in the fact that the functionalities provided by the various recited means are combined and brought together in the manner which the claims call for. It is thus regarded that any means that can provide those functionalities are equivalent to those shown herein.

[00031] A system and method for efficient transmission of different types of source data in the same packet, hence, enabling efficient transmission of multimedia and data content with unequal error protection are provided. The present disclosure defines a packet structure where the packet consists of a number of segments or payloads. Each segment may have different length, modulation and coding. Also,

each segment may contain error detection code parity bits (FCS). Furthermore, each segment may or may not include a midamble at its beginning or at its end. Also, other characteristics of each segment may also be different. The length, modulation and coding method for each segment, as well as whether the segment includes FCS or a midamble, or its other characteristics, will be specified in one or more information fields in the packet.

Transmitter

10 [00032] **FIG. 4** is a functional block diagram of an example embodiment of a data transmitter 100 configured in accordance with the present disclosure. This is but one example embodiment and it is contemplated that one of ordinary skill in the art may enable other embodiments that do not depart from the scope of the present disclosure. As will be appreciated by those skilled in the art, the various functions shown in **FIG.**
15 **4** may be physically implemented using a software-controlled microprocessor, hard-wired logic circuits, or a combination thereof. Also, while the functional blocks are illustrated as being segregated in **FIG. 4** for explanation purposes, they may be combined in any physical implementation.

20 [00033] As shown, inputs are provided from multiple data sources or streams, including, for example, payload data 16 and header data 14. Channel Encoder 105 includes a demultiplexer or switch for selectively inputting one of the payload data or header data.

25 [00034] The channel encoder 105 channel-encodes the selected data stream according to a coding method. The channel encoder 105 can be a block encoder, a convolutional encoder, a turbo encoder, or some combination thereof including a concatenated code.

30 [00035] The output of the channel encoder 105 is coupled to a channel interleaver 107 which interleaves the coded data according to an interleaving method. While not shown in **FIG. 4**, it is clear that a rate matcher including a repeater and a puncturer can reside between the channel encoder 105 and the channel interleaver 107.

[00036] Data symbols output from the channel interleaver 107 are then sent to a pilot inserter 111 where pilot symbols are inserted among the data symbols. The pilot inserter 111 generates pilot symbols which may be used to facilitate receiver detection of the transmitted signal. As shown, preamble, midamble inserter 113 includes a demultiplexer or switch for selectively providing a midamble and/or preamble among the data symbols. A more detailed description of the insertion of midamble and preamble symbol insertion is discussed further below with reference to **FIG. 5-7**.

[00037] The data symbols are then passed to a guard interval inserter 115 to add prefixes to the data symbols. The data symbols are then passed through an upsample filter 117, a digital-to-analog converter 119 and a radio frequency (RF) transmitter 121 which transmits the data symbols as a signal through a transmitting antenna 123.

[00038] The system 100 described above will generate and transmit a data packet including multimedia and data content in accordance with the present disclosure.

[00039] In accordance with the present disclosure, the packet will consist of a number of segments. Each segment may have different length, modulation and coding. Also, each segment may contain error detection code parity bits (FCS). Furthermore, each segment may or may not include a midamble at its beginning or at its end. Furthermore, other characteristics of each segment may also be different. The length, modulation and coding method for each segment, as well as whether the segment includes FCS or a midamble, or its other characteristics, will be specified in one or more information fields in the packet.

[00040] Referring now to **FIG. 5**, in one embodiment of the present disclosure, a field 220 in the header 214 will specify the number of segments in the packet 200, K. This will be followed by K fields each containing length 222, modulation and coding scheme 224 as well as the existence of FCS 226 (FCS ex.) and midamble 228 (Midam. Ex.). Furthermore, another information element (CONT) 230 may exist that determines whether two consecutive segments are portions of the same data frame, and must be rejoined at a receiver.

[00041] Referring now to **FIG. 6**, in another embodiment of the present disclosure, a field 320 in the header 314 will specify the number of segments in the packet 300, K. At the beginning of each segment or payload 316, another information field will contain length 322, modulation and coding scheme 324 as well as the existence of FCS 326 (FCS ex.) and midamble 328 (Midam. Ex.) . Furthermore, another information element (CONT) 330 may exist that determines whether two consecutive segments are portions of the same data frame, and must be rejoined at the receiver.

[00042] In yet another embodiment of the present disclosure, at the beginning of each segment or payload 416, an information field will contain length 422, modulation and coding scheme 424 as well as the existence of FCS 426 (FCS ex.) and midamble 428 (Midam. Ex.) as shown in **FIG. 7**. Furthermore, another information element (CONT) 430 may exist that determines whether two consecutive segments are portions of the same data frame, and must be rejoined at the receiver. In each of these information fields, one information element 420 will determine whether this is the final segments or if another segment is following.

[00043] The techniques of the present disclosure can be applied to many data and multimedia transmissions when different types of source data maybe available, and the bandwidth efficiency is important. Particularly, it can be applied to the multi gigabit 60GHz communication links carrying multimedia and data.

[00044] Although embodiments which incorporate the teachings of the present disclosure have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings. Having described preferred embodiments for a system and method for efficient transmission of multimedia and data in the same packet (which are intended to be illustrative and not limiting), it is noted that modifications and variations can be made by persons skilled in the art in light of the above teachings. It is therefore to be understood that changes may be made in the particular embodiments of the disclosure disclosed which are within the scope and spirit of the disclosure as outlined by the appended claims. Having thus described the disclosure with the details and particularity required by the patent laws, what is claimed and desired protected by Letters Patent is set forth in the appended claims.

WHAT IS CLAIMED IS:

1. A data transmission system for transmitting multimedia and data comprising:
5 means for generating a packet of data including a preamble, header and at least one payload;
means for inserting in the packet a field indicative of a number of payloads included in the packet; and
means for inserting in the packet at least one data field for each payload in the packet,
10 the at least one data field defining at least one characteristic of the payload.
2. The data transmission system as in claim 1, wherein the at least one data field defining at least one characteristic of the payload includes a length of the payload, modulation and coding scheme, existence of a frame check sum (FCS), and existence of a
15 midamble.
3. The data transmission system as in claim 2, wherein the at least one data field defining at least one characteristic of the payload is a continuation element indicative of whether two consecutive payloads are portions of a same data frame.
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4. The data transmission system as in claim 1, wherein the field indicative of a number of payloads and the at least one data field defining at least one characteristic of the payload are inserted in the header.
- 25 5. The data transmission system as in claim 1, wherein the field indicative of a number of payloads is inserted in the header and the at least one data field defining at least one characteristic of the payload is inserted before each payload.
6. The data transmission system as in claim 1, wherein the field indicative of a number of payloads inserted before each payload and determines whether the payload is the final
30 payload of the packet.
7. A method for generating a data packet including multimedia and data comprising:
generating a packet of data including a preamble, header and at least one payload;

inserting in the packet a field indicative of a number of payloads included in the packet; and

inserting in the packet at least one data field for each payload in the packet, the at least one data field defining at least one characteristic of the payload.

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8. The method as in claim 7, wherein the at least one data field defining at least one characteristic of the payload includes a length of the payload, modulation and coding scheme, existence of a frame check sum (FCS), and existence of a midamble.

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9. The method as in claim 8, wherein the at least one data field defining at least one characteristic of the payload is a continuation element indicative of whether two consecutive payloads are portions of a same data frame.

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10. The method as in claim 7, wherein the field indicative of a number of payloads and the at least one data field defining at least one characteristic of the payload are inserted in the header.

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11. The method as in claim 7, wherein the field indicative of a number of payloads is inserted in the header and the at least one data field defining at least one characteristic of the payload is inserted before each payload.

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12. The method as in claim 7, wherein the field indicative of a number of payloads inserted before each payload and determines whether the payload is the final payload of the packet.

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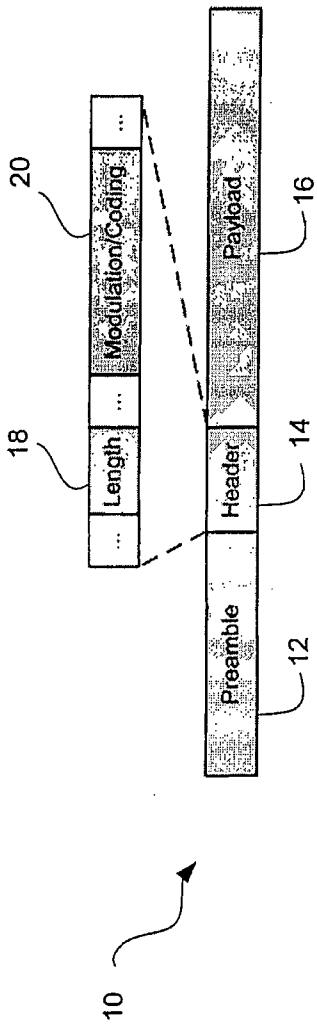
13. A data packet for transmitting multimedia and data including a preamble, header and at least one payload comprising:

a field indicative of a number of payloads included in the packet; and

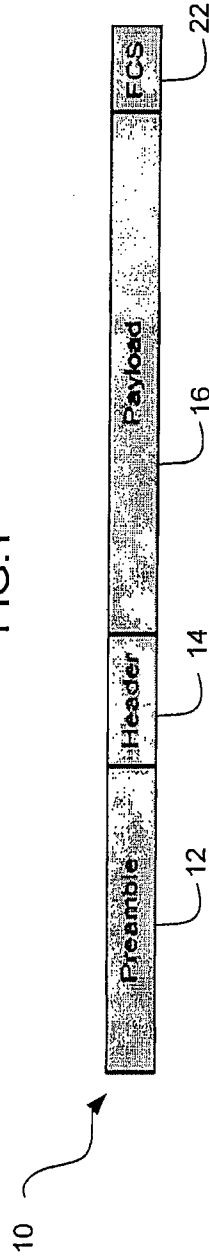
at least one data field for each payload in the packet, the at least one data field

defining at least one characteristic of the payload.

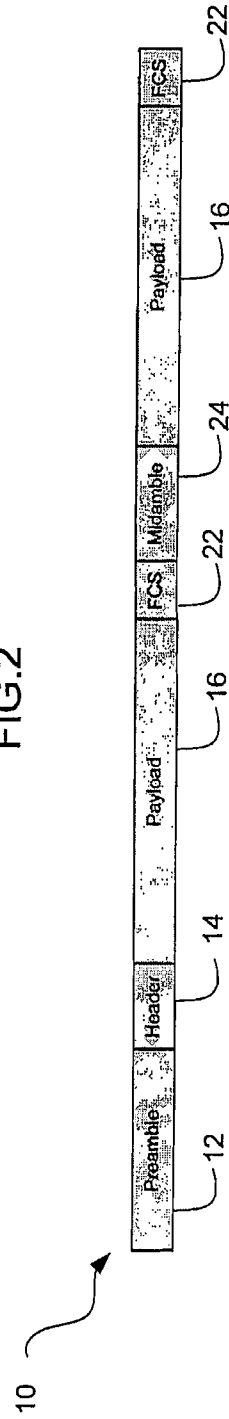
14. The data packet as in claim 13, wherein the at least one data field defining at least one characteristic of the payload includes a length of the payload, modulation and coding scheme, existence of a frame check sum (FCS), and existence of a midamble.
- 5 15. The data packet as in claim 14, wherein the at least one data field defining at least one characteristic of the payload is a continuation element indicative of whether two consecutive payloads are portions of a same data frame.
- 10 16. The data packet as in claim 13, wherein the field indicative of a number of payloads and the at least one data field defining at least one characteristic of the payload are inserted in the header.
- 15 17. The data packet as in claim 13, wherein the field indicative of a number of payloads is inserted in the header and the at least one data field defining at least one characteristic of the payload is inserted before each payload.
18. The data packet as in claim 13, wherein the field indicative of a number of payloads inserted before each payload and determines whether the payload is the final payload of the packet.



Conventional packet structure
FIG.1



Packet with FCS
FIG.2



Packet with Midamble
FIG.3

100

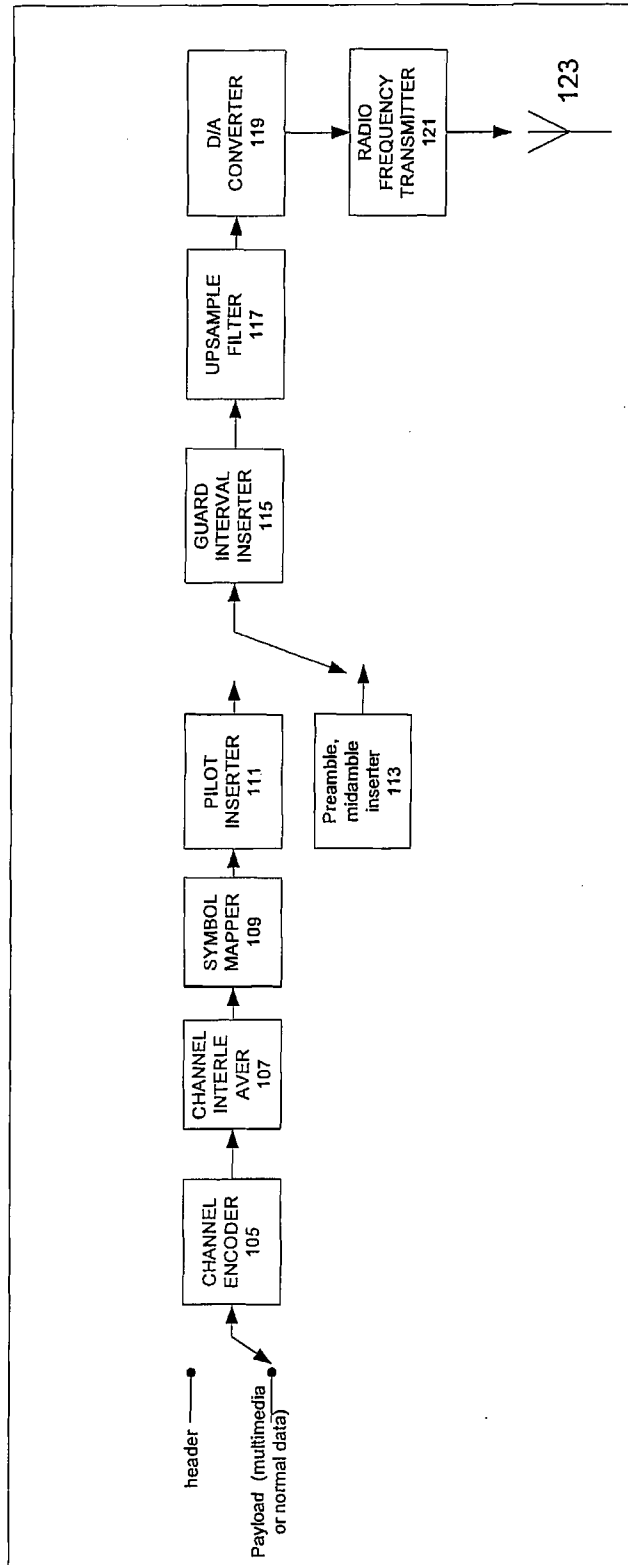


FIG. 4

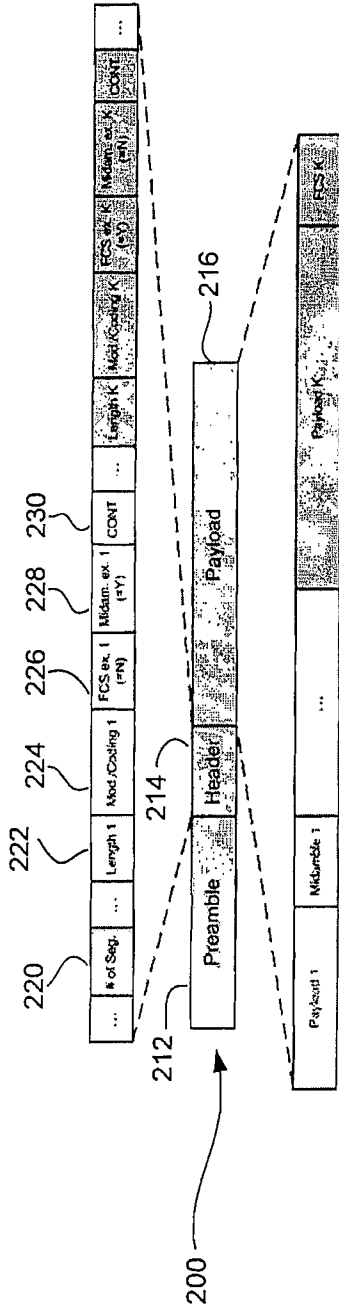


FIG. 5

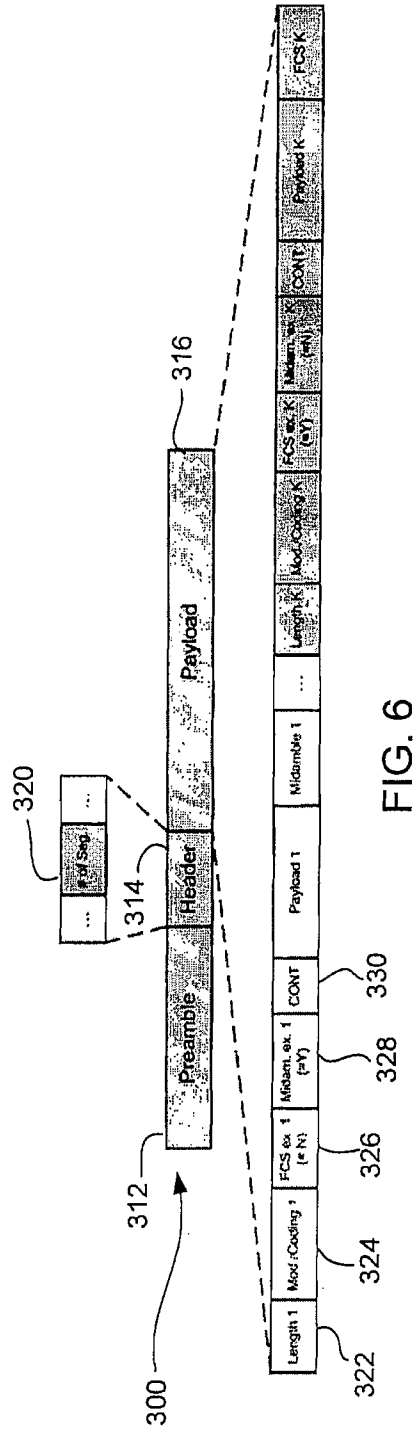


FIG. 6

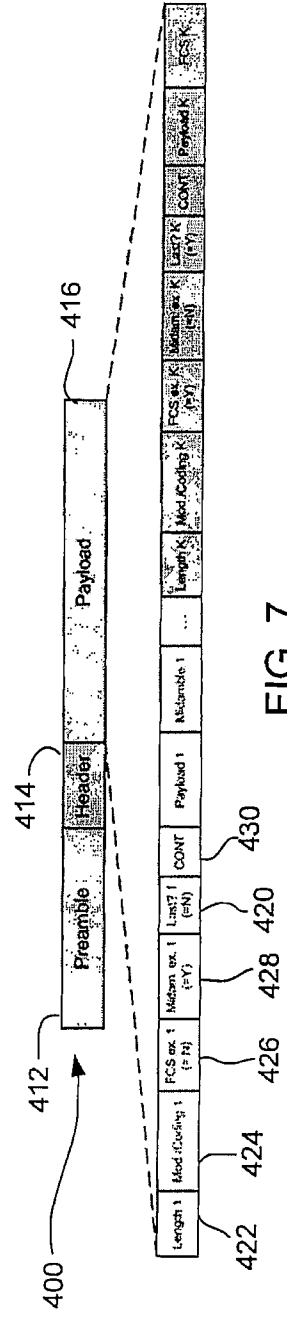


FIG. 7