(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 December 2010 (16.12.2010)

PCT

(10) International Publication Number
WO 2010/142853 A1

(51) International Patent Classification:
H04L 29/06 (2006.01) *H04N 7/24* (2006.01)

(21) International Application Number:
PCT/FI2010/050478

(22) International Filing Date:
10 June 2010 (10.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/186,462 12 June 2009 (12.06.2009) US

(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FI-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **TUPALA, Miika** [FI/FI]; Schalininkatu 7 A 9, FI-20320 Turku (FI). **ALA-MAUNU, Jyrki** [FI/FI]; Luolavuorentie 46 A 15, FI-20720 Turku (FI). **VÄRE, Jani** [FI/FI]; Valotie 7, FI-20780 Kaarina (FI). **TALMOLA, Pekka** [FI/FI]; Nupukuja 1, FI-20740 Turku (FI). **HAKALA, Piritta** [FI/FI]; Poronkatu 23 A 2, FI-20750 Turku (FI). **JOKELA, Tero** [FI/FI]; Mestarinkatu 3 B 8, FI-20810 Turku (FI).

(74) Agent: **Nokia Corporation**; IPR Department, Virpi Tognetty, Keilalahdentie 4, FI-02150 Espoo (FI).

(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, CL, 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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,

[Continued on next page]

(54) Title: BASEBAND FRAME HEADER MODIFICATIONS FOR DIGITAL VIDEO BROADCASTING

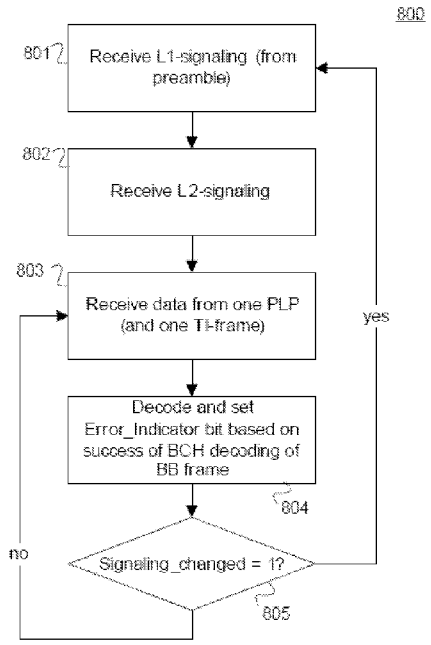

FIG. 8

(57) Abstract: A digital video broadcasting (DVB) receiver processes baseband (BB) frames at both a basebase (BB) block level and a terminal block level. At the BB block, the DVB receiver synchronizes BB frames from synchronization information inserted in the BB frame headers. The BB block configures the error indicator based on whether an error is detected in the BB frame. The DVB receiver also processes signaling information in the preamble of the T2 physical layer frame only if indicated by the signal changed field. The BB passes the processed BB frame to the terminal block of the DVB receiver for processing network packets that is contained in the BB frame. A DVB transmitter inserts a synchronization field and payload type field in the BB frame header of the BB frame and also determines 10 whether there has been a change in the signaling information at the physical layer and configures the signaling changed indicator accordingly.

WO 2010/142853 A1

TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

BASEBAND FRAME HEADER MODIFICATIONS FOR DIGITAL VIDEO BROADCASTING

FIELD OF THE INVENTION

The invention relates to Digital Video Broadcasting systems and more particularly to methods, apparatuses and computer readable mediums for modifying baseband frame header for digital video broadcasting and increasing the rate of correct data transmission from baseband block to terminal block.

BACKGROUND ART

Digital Video Broadcasting (DVB) systems distribute data using a variety of approaches, including satellite (DVB-S, DVB-S2 and DVB-SH), DVB-SMATV for distribution via Satellite Master Antenna Television (SMATV)), cable (DVB-C), terrestrial television (DVB-T, DVB-T2), and digital terrestrial television for handhelds (DVB-H, DVB-SH). The associated standards define the physical layer and data link layer of the distribution system. Devices interact with the physical layer, for example through a synchronous parallel interface (SPI), synchronous serial interface (SSI), or asynchronous serial interface (ASI). Data may be transmitted in Moving Pictures Experts Group-2 (MPEG-2) transport streams with some additional constraints (DVB-MPEG).

The distribution systems for the different DVB standards differ mainly in the modulation schemes used and error correcting codes used, due to the different technical constraints. For example, DVB-S (SHF) uses Quaternary Phase Shift Keying (QPSK), 8PSK or 16-QAM. DVB-S2 uses QPSK, 8PSK, 16APSK or 32APSK, based as a broadcaster's option. QPSK and 8PSK are the versions regularly used. DVB-C (VHF/UHF) uses Quadrature Amplitude Modulation (QAM): 16-QAM, 32-QAM, 64-QAM, 128-QAM or 256-QAM. DVB-T (VHF/UHF) uses 16-QAM or 64-QAM (or QPSK) in combination with Coded Orthogonal Frequency-Division Multiplexing (COFDM) and can support hierarchical modulation.

The DVB-T2 standard ("Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)," ETSI EN 302 755) is an update for DVB-T operation in order to provide enhanced quality and capacity. While the DVB-T2 standard provides more robust TV reception and increases the possible bit-rate over previous DVB standards, the standardization for the next generation handheld (DVB-NGH) television system is ongoing. Mobile and handheld reception may be partially supported in the DVB-T2 system, and thus the new DVB-NGH standards may be based on the DVB-T2 standards. In addition, a DVB network may support both DVB-T2 and DVB-NGH operation. Consequently, the DVB network may support backwards compatibility with traditional DVB-T2 receivers.

SUMMARY

This Summary is provided to introduce a selection of concepts and embodiments in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the present invention.

According to the present invention, the advantages over traditional systems includes the simplification of the functions of a receiver such as the DVB receiver, the simplification of the frame structures around the baseband frames between the baseband block of the physical layer and the terminal block of the link and upper layers of the DVB receiver, the increase of forwarding more correct data from baseband block to the terminal block for upper layers, reducing therefore the error rates, and finally the possibility for the baseband frame headers to provide backwards compatible with the standards DVB-T2 wherein DVB-T2 can discard baseband frames dedicated to DVB-NGH receivers.

A digital video broadcasting (DVB) receiver, according to some embodiments of the present invention, processes baseband (BB) frames at both a baseband (BB) block level and a terminal block level. At the BB block, the DVB receiver synchronizes BB frames from synchronization information inserted in the BB frame headers. The BB block configures the error indicator based on whether an error is detected in the BB frame. The DVB receiver also processes signaling information in the preamble of the T2 physical

layer frame only if indicated by the signal_changed field. The BB block subsequently passes processed BB frames to the terminal block of the DVB receiver for processing of one or more network packets that may be contained in the BB block.

In some embodiments, a DVB receiver processes a BB frame presented to the terminal block by the BB block. When the error indicator indicates that there are no errors in the BB frame or when the error indicator indicates at least one error in the BB frame and the network packet header checksum is correct, the terminal block extracts a network packet from the BB frame. However, when the error indicator indicates at least one error in the BB frame and network packet header is not correct, the terminal block searches for a new network packet.

In other embodiments, a DVB transmitter inserts a synchronization field and a payload_type field in the BB frame header of a BB frame. The DVB transmitter determines whether there has been a change in the signaling information at the physical layer and configures the signaling_changed indicator accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the exemplary embodiments the present invention and the advantages thereof may be acquired by referring to the following description in consideration of the accompanying drawings, in which like reference numbers indicate like features and wherein:

Figure 1 is a block diagram for transmitting multiple physical layer pipes in accordance with an exemplary embodiment of the invention.

Figure 2 shows baseband frames in accordance with an exemplary embodiment of the invention.

Figure 3 is a system diagram of a receiver in accordance with an exemplary embodiment of the invention.

Figure 4 shows a baseband frame header in accordance with background art.

Figure 5 shows an exemplary protocol stack for DVB-T2 in accordance with the background art.

Figure 6 shows a GSE packet header in accordance with the background art.

Figure 7 shows a baseband frame header in accordance with an exemplary embodiment of the invention.

Figure 8 is a flow diagram for a baseband (BB) block of a receiver in accordance with an exemplary embodiment of the invention.

Figure 9 is a flow diagram for a terminal block of a receiver in accordance with an exemplary embodiment of the invention.

Figure 10 is a flow diagram for network layer packet parsing in accordance with an exemplary embodiment of the invention.

Figure 11 shows an apparatus for generating a digital stream in accordance with an exemplary embodiment of the invention.

Figure 12 shows an apparatus for processing a received digital stream in accordance with an exemplary embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

In the following description of the various exemplary embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention.

A service supported by a DVB (digital video broadcasting) system is typically conveyed on a transport stream (TS) that is transmitted with a data stream over a DVB communications channel. Each service is associated with one or more physical layer pipes (PLPs). Figure 1 shows block diagram 100 for transmitting multiple physical layer pipes 101, 102, and 103 in accordance with an exemplary embodiment of the invention. Each transmitted physical layer pipe is associated with a baseband (BB) header at blocks 110, 111, or 112 (corresponding to PLPs 101, 102, and 103, respectively) so that a DVB receiver can distinguish among the different PLPs when supporting a service selected by a user. The PLP streams are subsequently bit interleaved, coded, modulated, and built into physical layer frames consisting of certain number of OFDM symbols. A T2 physical layer frame may contain one or more baseband frames or a fraction of a baseband frame. The number of baseband frames in a T2 physical layer frame may not necessarily be an integer. For example, a baseband frame may be spread over multiple T2 physical layer frames.

Figure 2 shows baseband frames 251 and 252 in accordance with an exemplary embodiment of the invention. The length of the consecutive BB frames 251 and 252 received by a DVB receiver (*e.g.,* receiver 300 as shown in Figure 3) and presented to the terminal block (*e.g.,* terminal block 303) may change. For example, if consecutive BB frames 251 and 252 belong to different physical layer pipes, frames 251 and 252 may have different code rate and thus different BB frame lengths. Also, in-band signaling or padding (*e.g.,* padding 203) may result in a variable BB frame length.

Each BB frame 251 and 252 begins with BBF header 211 and 212, respectively, and carries BBF payloads 201 and 202, respectively. While BBF headers 211 and 212 are typically constant in length, BB frames 251 and 252 may have different frame lengths as determined by the length of the BB frame payloads (corresponding to data field length (DFL) 253) and padding or in-band signaling 203.

With a traditional DVB receiver, when in-band signaling or padding is inserted, BB frames carried from the BB block to the terminal block of the traditional DVB receiver may not be found by the traditional terminal block without additional frame structure being built around BB frames. In some traditional receiver architectures the in-band signaling is

processed by the BB block and hence the traditional terminal block does not understand padding or in-band signaling. If the next BB frame does not follow immediately after a previous BB frame payload, that next BB frame may not be found. Consequently, all consecutive BB frames and network layer packets inside them may not be received with the traditional terminal block. Also, when erroneous BB frames (corresponding to an error being detected in the BB frame) are forwarded to the traditional terminal block, the next BB frame may not be found without synchronization if the BB frame payload length of the previous BB frame is lost. With an aspect of the invention, by adding synchronization into the BB frame header, additional frame structure may be avoided as will be further discussed.

While DVB-T2 standards, which are directed to a second generation transmission for terrestrial television services, have been published, the standardization for the next generation handheld (DVB-NGH) television system is currently ongoing. Mobile and handheld reception may be partially supported with a DVB-T2 system, and thus DVB-NGH standards may be an extension to the DVB-T2 standards. Supporting both DVB-T2 and DVB-NGH transmission by a single system with backwards compatibility with traditional DVB-T2 receivers may be desirable.

The baseband (BB) frame header typically used in traditional DVB-T2 systems was originally designed for DVB-S2 systems (a second generation transmission standard for satellite television system) and may not optimally perform in a DVB-NGH system. Consequently, modifications to a traditional BB frame header may be desirable for DVB-NGH operation.

Figure 3 shows a system diagram of DVB receiver 300 in accordance with an exemplary embodiment of the invention. With one aspect of the invention, synchronization of BB frames headed by BB headers 211 and 212 is supported. DVB receiver 300 includes BB block 301 (physical layer) and terminal block 303. BB frame interface 302 resides between BB block 301 and terminal block 303 and separates the physical layer from the link and upper layers.

BB block 301 outputs BB frames 251 and 252 to terminal block 303 via a serial connection through BBF interface 302. The BB block may also remove the padding/in-band signaling part 203. Terminal block 303 may not be able to properly receive BB frames 251 and 252 from the serial connection without synchronization and consequently may not receive network layer packets. In order to simplify receiver implementation and to avoid additional frame structures between BB block 301 and terminal block 303, synchronization may be implemented within the BB frames (*e.g.,* BBF_SYNC 701 and BBF_SYNC 703 within BB headers 700 as shown in Figure 7). With some embodiments, for example, an additional encapsulation or header in each packet may be circumvented.

In some embodiments, an error indicator (*e.g.,* error-indicator bit 720 as shown in Figure 7) is included in BB frame headers 251 and 252 to enhance receiver functions of DVB receiver 300. If the error indicator bit indicates that the BB frame is error-free, receiver 300 may perform actions accordingly as will be further discussed. An application layer FEC (forward error correction) may utilize the error indicator as erasure information.

In some embodiments, receiver 300 may be enhanced by adding a signaling-changed bit (*e.g.,* signaling_changed bit 721 as shown in Figure 7) to the BB frame header. The signaling-changed bit indicates whether the physical layer (L1) signaling has changed. Receiver 300 does not need to check L1 signaling preamble if the signaling has not changed. Consequently, the power consumption of the receiver 300 may be reduced.

In some embodiments, the BB frame layer and the upper encapsulation layer may be merged into one. Referring to traditional protocol stack 500 as shown in Figure 5, the relevant functionality of the GSE (generic stream encapsulation) packet header 600 as shown in Figure 6 may be included into BB frame header 700. For example, information may be assigned to the payload type (*e.g.,* IPv4 and IPv6), which is information that may be included in the GSE packet header in DVB-NGH, if the payload type is not known.

Figure 4 shows baseband frame header 400 in accordance with the background art (*e.g.,* ETSI EN 302 755). The lengths of the fields are given in "bytes" (B) or "bit" (b) in brackets below the field names. With traditional systems, synchronization for BB frames is

not supported in the structure of BB frame header 400. SYNC field 405 does not correspond to synchronization for BB frames but is merely a copy of a sync-byte of an upper layer packet. Also, there is no error indicator in the present structure of the BB frame header. Consequently, the physical layer typically discards those BB frames which have even one bit error rather than having the option to forward erroneous BB frames to the upper layers for parsing of correct data. The signaling-changed indicator is also missing at the BB frame layer. With BB frame header 400, the MATYPE-1 field 401, UPL/ISSY field 403, and SYNC/ISSY field 405 may not be useful for the needs of NGH, and therefore these fields may be used for other purposes.

Figure 5 shows exemplary protocol stack 500 for DVB-T2 in accordance with the background art. With traditional systems, GSE layer 503 performs an encapsulation of network layer packets from network layer 504 into GSE packets, which are inserted into BB frames by BB frame layer 502. BB frames are further encapsulated by DVB-T2 layer 501 into a DVB communications channel. Completing the upper portion of protocol stack 500, audio/visual data 506 (as identified by field 507) is encapsulated into UDP packets by UDP layer 505, which resides over network layer 504.

Figure 6 shows a GSE packet header in accordance with the background art. The payload type of the network layer packets is indicated in the protocol type field 601 of GSE packet header 600. In some embodiments, payload type information (*e.g.,* payload type field 722 as shown in Figure 7) may be included in BB frame header 700. Because the information within the GSE packet header may not be needed for the DVB-NGH operation, GSE layer 503 may be eliminated in the protocol stack.

Figure 7 shows baseband frame header 700 in accordance with an exemplary embodiment. The BB layer and GSE layer header structures of traditional systems are merged and include enhancements for DVB-NGH operation. As previously discussed, enhancements include synchronization (corresponding to fields 701 and 703), an error indicator (corresponding to error-indicator field 720 that is contained within indicators field 705), and signaling-changed indicator (corresponding to signaling_changed field 721). In an embodiment, the above fields are processed by BB block 301 as shown in Figure 3.

The payload type information (corresponding to field 722) may also be migrated to BB block 301. Consequently, one layer may be eliminated from traditional protocol stack 500 as previously discussed.

In some embodiments, fields 701, 703, 705, and 707 are included in BB frame header 700. BBF_SYNC field 701 may be treated as a sync-byte when the field is restricted to a predetermined value. In at least one embodiment, the input stream format is selected to be configured for Generic Continuous Stream (GCS), Multiple Input Streams (MIS) (*i.e.,* multiple PLPs, are used), Adaptive Coding and Modulation (ACM), Input Stream Synchronization Indicator (ISSYI) and Null Packet Deletion (NPD) not active (because ISSY and NPD are not used) corresponding to fields 710, 711, 712, 713, and 714, respectively. Also, the EXT field may be set to a predetermined value '01' (corresponding to field 715). Thus, field 701 may be configured with a predetermined value '01000010' ('0x42' in hexadecimal). In at least some embodiments, field 701 may replace MATYPE-1 field 401 of traditional header 400 as shown in Figure 4.

To further enhance the synchronization of BB frames to be more robust, the 3rd and 4th byte (corresponding to field 703) are also assigned for synchronization. Field 703 may replace UPL/ISSY field 403 in traditional BB frame header 400 as shown in Figure 4. In at least some embodiments, indicators field 705 replaces SYNC/ISSY field 405. Two bits of field 705 may be reserved for future use (corresponding to field 723). Also, CRC (cyclic redundancy check) field 707 is included so that the MODE (which refers to either the normal mode (NM) or the high efficiency mode (HEM) as supported by field 407 in traditional BB frame header 400) is not needed because there are no alternative modes and CRC is used solely.

In at least some embodiments, DFL field 704 and SYNCD field 706 maintain similar functionalities as fields 404 and 406 of traditional header 400. Also, field PLP_ID 702 replaces MATYPE-2 field 402 of traditional header 400.

Figure 8 shows flow diagram 800 for a method performed at baseband (BB) block 301 of DVB receiver 300 in accordance with an exemplary embodiment. The L1 (physical layer)

and L2 (link layer) signaling are first received at blocks 801 and 802. Next, data from a PLP is received at block 803. The signaling_changed bit may refer to the next T2 physical layer frame.

At block 804 the contents of the BB frame is checked based on cyclic redundancy coding (*e.g.,* CRC encoding 113 as shown in Figure 1) to determine if an error is detected. While error indication field 720 is transmitted with a value of '0' over the DVB communications channel to receiver 300, BB block 301 inserts the results of error detection into error indication field 720 to terminal block 303 through interface 302. The error_indicator 720 is set depending on the results of decoding, where values of '0' and '1' denote that the BB frame is error-free or erroneous, respectively. At block 805, the signaling_changed bit (field 721) is checked. If it has a value '1', signaling in the L1-signaling preamble is processed again to obtain the changed signaling data. Otherwise, data from the next PLP can be received directly.

Signaling_changed field 721 may be used for improving power efficiency. The L1 signaling data is transmitted in the preamble of the T2 physical layer frame and the service data may be located in a different place. Networks typically have a static frame configuration, and the L1 signaling may be constant for a long time. By utilizing signaling_changed field 721 to indicate whether L1 signaling changes, receiver 300 may not need to wake up for the preamble. Consequently, the sleep time can be longer. Depending on the frame structure, this approach may significantly reduce the power consumption.

Figure 9 shows flow diagram 900 for terminal block 303 of receiver 300 in accordance with an exemplary embodiment of the invention. At block 901 a BB frame is received from BB block 301. If block 902 determines that error indication equals '0' (*i.e.,* no errors are detected in the BB frame), block 903 parses the network layer packets from the BB frame. The packets are then stored and the next BB frame is handled at block 904 as further shown in Figure 10. However, if block 902 determines that error indication equals '1' (*i.e.,* the BB frame is erroneous), block 905 determines whether terminal block 303 is capable of parsing erroneous BB frames. If so, block 906 determines if any errors are detected from

CRC field 707. If no errors are detected in the BBF header, then block 903 is executed, in which terminal block 303 attempts to parse the network layer packets from the erroneous BB frame payload. Instead of directly discarding erroneous BB frames at the physical layer, the erroneous BB frames are forwarded to the upper layers with the possibility of parsing correct packets from the erroneous BB frames. Consequently, error rates may be reduced when more correct data reaches the upper layers, especially for short packets inside BB frames. If terminal block 303 is not capable of parsing erroneous BB frames or the BB frame header is erroneous, the processed BB frame is discarded and the next BB frame is handled at block 901.

Figure 10 shows flow diagram 1000 for network layer packet parsing within a BB frame (corresponding to block 903 as shown in Figure 9) in accordance with an exemplary embodiment. At block 1001, the pointer (corresponding to SYNCD field 706 as shown in Figure 7) is fetched. At block 1002, data in the BB frame is extracted as identified by the pointer. There can be multiple (short) network layer packets in the BB frame, and the pointer indicates the beginning of the first network layer packet in this BB frame. Block 1003 determines whether the error_indicator equals '1'. (As previously discussed, when the error_indicator equals '1', an error in the BB frame has been detected.) If the error indicator indicates an error-free BB frame (*i.e.,* error_indicator equals '0'), the network layer packet length is directly fetched from the packet header, *e.g.,* Total Length –field in IPv4, at block 1005. The network layer packet is then stored at block 1006. If there is data left in the BB frame, as determined at block 1007, the length of the following network layer packet is fetched so that the next network packet can be processed.

If the error indicator indicates that the BB frame payload has errors at block 1003, the network layer packet header checksum is checked at block 1004. If the header is correct, the network packet is processed at blocks 1005, 1006, and 1007 as previously discussed. However, if the packet header checksum indicates an erroneous packet header at block 1004, the processed network packet is discarded and the next packet is searched at block 1009. For example, the search for the new packet may be performed by attempting to find

the IP version number. If there is additional data in the BB frame, as determined at block 1008, the next network packet is processed.

Figure 11 shows apparatus 1100 for generating a digital stream (for example, as shown in Figure 1) in accordance with certain embodiments. Processor 1101 obtains content 1151, 1153 for services A and B referred as DATA_SERVICE_A and DATA_SERVICE_B through data interface 1105 and generates a data stream, which may comprise transport streams (TS1) 1155 and (TSn) 1157. (A service may be conveyed in one transport stream, although it may be conveyed in a plurality of transport streams.) The data stream may be transmitted over a communications channel (for example, a digital terrestrial television broadcasting system) through communications interface 1107, which may include one or more transmitters.

Processor 1101 may execute computer executable instructions from a computer-readable medium, for example, memory 1103 in order perform a data transmission process (any or all of the transmission processes described herein). Computer storage media may include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media include, but may not be limited to, random access memory (RAM), read only memory (ROM), electronically erasable programmable read only memory (EEPROM), flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to store the desired information and that can be accessed by processor 1101. The executable instructions may carry out any or all of the method steps described herein.

Figure 12 shows apparatus 1200 for processing a received digital stream in accordance with some embodiments (any or all of the reception processes described herein). Receiver 1205 processes RF signals 1251, for example, a digital terrestrial television broadcast signal, to obtain PLPs such as PLP1 1253 and PLPn 1255. Service renderer 1207 forms streams 1257 and 1259 for selected services from PLPs 1253 and 1255 based on service

selection 1261 so that content from the PLPs can be combined to provide an offering (*e.g.,* a multi-media presentation) to the user. Service selection 1261 may be determined from a user (not shown) choosing a service through user interface 1209 and processor 1201. Processor 1201 then consequently provides service data 1263 to user interface 1209.

A user (not shown) chooses a service through user interface 1209 to generate service selection indication 1261 to processor 1201. Accordingly, processor 1201 selects PLPs 1257 and 1259 that may be associated with the selected service in order to render the service on device 1207.

Processor 1201 may execute computer executable instructions from a computer-readable medium, for example, memory 1203 as described above in connection with Figure 11.

Apparatus 1100 or apparatus 1200 may be implemented as one or more ASICs or other integrated circuits having instructions for performing operations as described in connection with one or more of any of the embodiments described herein. Said instructions may be software and/or firmware instructions stored in a machine-readable medium and/or may be hard-coded as a series of logic gates and/or state machine circuits in one or more integrated circuits and/or in one or more integrated circuits in combination with other circuit elements.

According to the present invention, some embodiments may provide advantages over traditional systems including:

- Simplification of the receiver functions for DVB receiver 300.
- Circumvent the need for additional frame structures around BB frames 251 and 252 between BB block 301 and terminal block 303 of receiver 300.
- Enable forwarding more correct data from BB block 301 and terminal block 303 for upper layers. Consequently, error rates may be reduced.

- BB frame headers 211 and 212 provide backwards compatible with DVB-T2. For example DVB-T2 receivers can discard BB frames dedicated for DVB-NGH receivers.

An exemplary embodiment of the invention is a method implemented for instance in a DVB receiver with baseband block. The method comprises: synchronizing baseband (BB) frames with baseband (BB) frame header; processing BBF SYNC field as a sync-byte when the field is restricted to a predetermined value; determining whether an error occurs in the BB frame header and indicating according an error indicator; processing signaling information in preamble of T2 physical layer frame only if indicated by signaling_changed field; passing BB frame to terminal block for processing of network packet; and processing a payload_type field to identify a protocol carried in BB frames.

An exemplary embodiment of the invention is an apparatus such as a DVB receiver with baseband block. The apparatus comprises a processor configured to cause the apparatus to synchronize BB frames with BB frame header, to process BBF SYNC field as a sync-byte when the field is restricted to a predetermined value, to determine, by BB block, whether an error occurs in the BB frame header and indicate according an error indicator, to process signaling information in preamble of T2 physical layer frame only if indicated by signaling_changed field, to pass BB frame to terminal block for processing of network packet, and to process payload_type field to identify the protocol carried in BB frames.

An exemplary embodiment of the invention is a computer-readable medium that contains computer readable instructions that cause a device such as a DVB receiver with baseband block to perform: processing payload_type field to delete GSE layer in protocol stack, synchronizing BB frames with BB frame header, processing BBF SYNC field as a sync-byte when the field is restricted to a predetermined value, determining, by BB block, whether an error occurs in the BB frame header and indicating accordingly an error indicator, processing signaling information in preamble of T2 physical layer frame only if indicated by signaling_changed field, passing BB frame to terminal block for processing of network packet, and processing payload_type field to identify the protocol carried in BB frames.

An exemplary embodiment of the invention is a method implemented for instance in a DVB receiver with terminal block. The method comprises : extracting network packets from BB frame when error indicator indicates no errors in BB frame, extracting network packet from BB frame when error indicator indicates error in BB frame and network packet header checksum is ok, and searching for new network packet when error indicator indicates error in BB frame and network packet header is not ok.

An exemplary embodiment of the invention is an apparatus such as DVB receiver with terminal block. The apparatus comprising: a processor configured to cause the apparatus to extract network packets from BB frame when error indicator indicates no errors in BB frame, to extract network packet from BB frame when error indicator indicates error in BB frame and network packet header checksum is ok, and to search for new network packet when error indicator indicates error in BB frame and network packet header is not ok.

An exemplary embodiment of the invention is a computer-readable medium that contains computer readable instructions that cause a device such as a DVB receiver with terminal block to perform : extracting network packets from BB frame when error indicator indicates no errors in BB frame, extracting network packet from BB frame when error indicator indicates error in BB frame and network packet header checksum is ok, and searching for new network packet when error indicator indicates error in BB frame and network packet header is not ok.

An exemplary embodiment of the invention is a method implemented for instance in a DVB transmitter. The method comprises : inserting synchronization field into BB frame header, determining signaling_changed indicator and inserting in BB frame, reserving error indicator in BB frame, and inserting payload_type field in BB frame.

An exemplary embodiment of the invention is an apparatus for instance a DVB transmitter. The apparatus comprises a processor configured to cause the apparatus to insert synchronization field into BB frame header, to determine signaling_changed indicator and insert in BB frame, toreserve error indicator in BB frame, and to insert payload_type field in BB frame.

An exemplary embodiment of the invention is a computer-readable medium that contains computer readable instructions that cause a device for instance a DVB transmitter to perform: inserting synchronization field into BB frame header, determining signaling_changed indicator and inserting in BB frame, reserving error indicator in BB frame, and inserting payload_type field in BB frame.

While some embodiments have been described with respect to specific examples, other embodiments include numerous variations and permutations of the above described systems and techniques.

WHAT IS CLAIMED IS:

1. A method comprising:

- synchronizing at least one baseband (BB) frame with at least one baseband (BB) frame header;
- determining whether an error occurs in the at least one BB frame header according to an error indicator;
- processing at least one payload_type field to identify a protocol carried in the at least one BB frame header; and
- transmitting the at least one BB frame from a physical layer to an upper layer for processing at least one network packet.

2. The method of claim 1 further comprising:

- processing signaling information in a preamble of a T2 physical layer frame only if indicated by a signaling_changed indicator.

3. The method of claim 1 further comprising:

- processing a BBF_SYNC field as a sync-byte when the field is restricted to a predetermined value.

4. The method of claim 1 wherein the at least one network packet is used for carrying multimedia content.

5. An apparatus comprising at least one processor configured to cause the apparatus to:

- synchronize at least one baseband (BB) frame with at least one baseband (BB) frame header;
- determine whether an error occurs in the at least one BB frame header according to an error indicator;

- process at least one payload_type field to identify a protocol carried in the at least one BB frame header; and

- transmit the at least one BB frame from a physical layer to an upper layer for processing at least one network packet.

6. The apparatus of claim 5 wherein the at least one processor is further configured to cause the apparatus to:

- process a BBF_SYNC field as a sync-byte when the field is restricted to a predetermined value.

7. The apparatus of claim 5 wherein the at least one processor is further configured to cause the apparatus to:

- process signaling information in a preamble of a T2 physical layer frame only if indicated by a signaling_changed indicator.

8. The apparatus of claim 5 wherein the network packets are used for carrying multimedia content.

9. A computer-readable medium that contains computer readable instructions that cause a device to perform:

- processing a payload_type field to delete a generic stream encapsulation (GSE) in a protocol stack;

- synchronizing at least one baseband (BB) frame with at least one baseband (BB) frame header;

- determining whether an error occurs in the at least one BB frame header according to an error indicator;

- processing at least one payload_type field to identify the protocol carried in the at least one BB frame; and

- transmitting the at least one BB frame from a physical layer to an upper layer for processing at least one network packet.

10. A method comprising:

- when an error indicator indicates no errors in at least one baseband (BB) frame, extracting at least one network packet from the at least one BB frame;

- when an error indicator indicates an error in at least one BB frame and a network packet header checksum is ok, extracting at least one network packet from the at least one BB frame;

- when an error indicator indicates an error in at least one BB frame header and a network packet header is not ok, searching for a new network packet; and

- processing the network packets.

11. The method of claim 10 wherein the searching for a new network packet includes finding an IP version number.

12. An apparatus comprising at least one processor configured to process network packets and to cause the apparatus:

- when an error indicator indicates no errors in at least one baseband (BB) frame header, to extract network packets from at least one baseband (BB) frame;

- when an error indicator indicates error in at least one baseband (BB) frame and a network packet header checksum is ok, to extract at least one network packet from the at least one BB frame; and

- when an error indicator indicates error in at least one baseband (BB) frame header and a network packet header is not ok, to search for a new network packet.

13. The apparatus of claim 12 wherein the network packets are used for carrying multimedia content.

14. A method comprising:

- inserting at least a synchronization field into at least one baseband (BB) frame header;
- determining a signaling_changed indicator and inserting in the at least one BB frame header;
- reserving an error indicator in the at least one BB frame header; and
- inserting at least one payload_type field in the at least one BB frame header.

15. An apparatus comprising at least one processor configured to process at least one baseband (BB) frame header and to cause the apparatus to:

- insert at least a synchronization field into the at least one baseband (BB) frame header;
- determine signaling_changed indicator and insert in the at least one BB frame header;
- reserve error indicator in the at least one BB frame header; and
- insert payload_type field in the at least one BB frame header.

16. The apparatus of claim 15 wherein the at least one BB frame header encapsulates network packets that are used for carrying multimedia content.

17. An apparatus comprising:

a memory for storing data;

at least one processor configured to receive data signals from a data interface and to transmit at least one data stream; and

at least a communications interface configured to receive the at least one data stream from the at least one processor over at least a communications channel and to generate digital streams.

18. The apparatus of claim 17 wherein the data interface is configured to receive RF signals from a digital terrestrial television broadcast.

19. The apparatus of claim 17 wherein the communication interface is configured to receive at least one service selection from at least one user, and wherein the apparatus further comprises a service renderer configured to form data stream responsive to the at least one service selection to provide an offering to the at least one user.

20. The apparatus of claim 19 wherein the data signals are multimedia signals and wherein the offering is a multimedia offering which combines the multimedia signals received by the at least one processor.

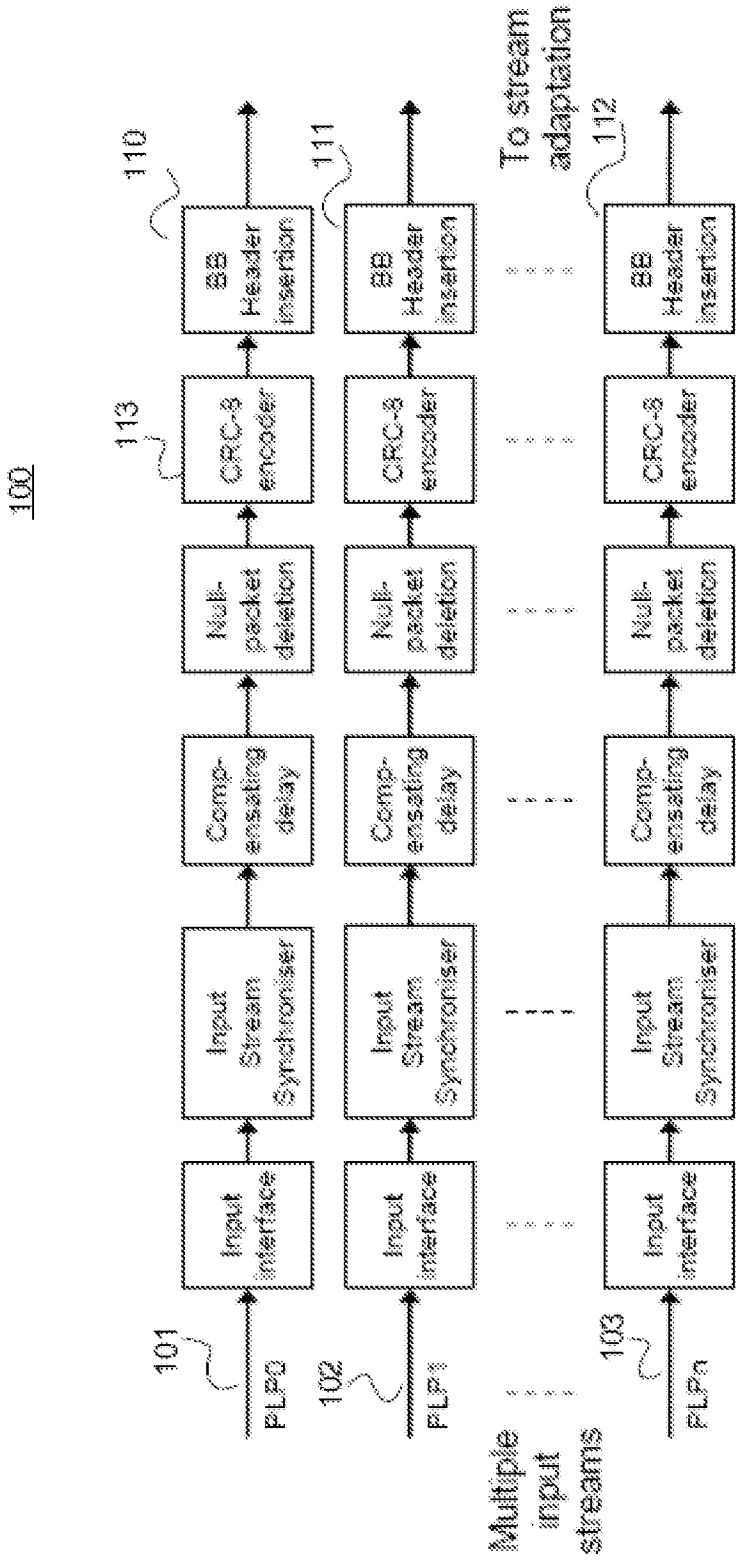
100
Multiple input streams
101
PLP0
102
PLP1
103
PLPn
Input interface
Input Stream Synchroniser
Compensating delay
Null-packet deletion
CRC-8 encoder
BB Header insertion
110
111
112
113
To stream adaptation

FIG. 1

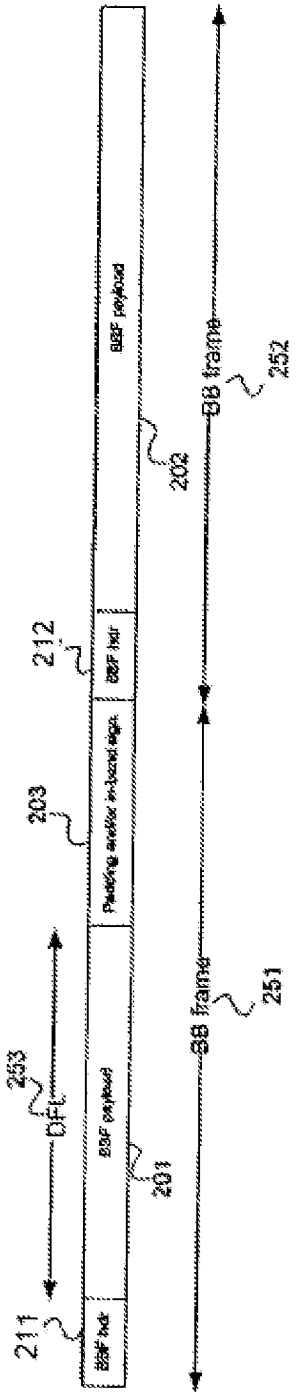
BBF hdr
BBF payload
Padding and/or in-band sign.
BBF hdr
BBF payload
DFL
211
253
201
203
212
202
BB frame
251
BB frame
252

FIG. 2

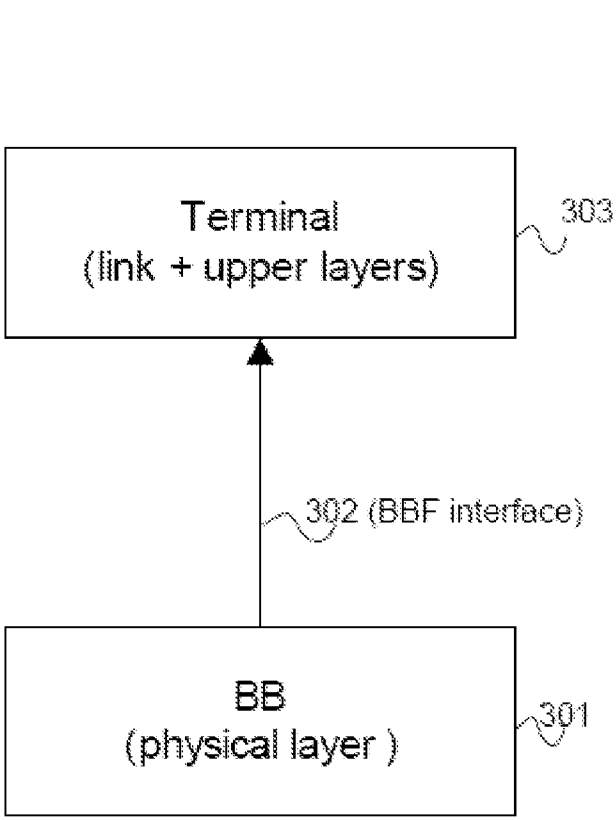
300
Terminal
(link + upper layers)
303
302 (BBF interface)
BB
(physical layer)
301

FIG. 3

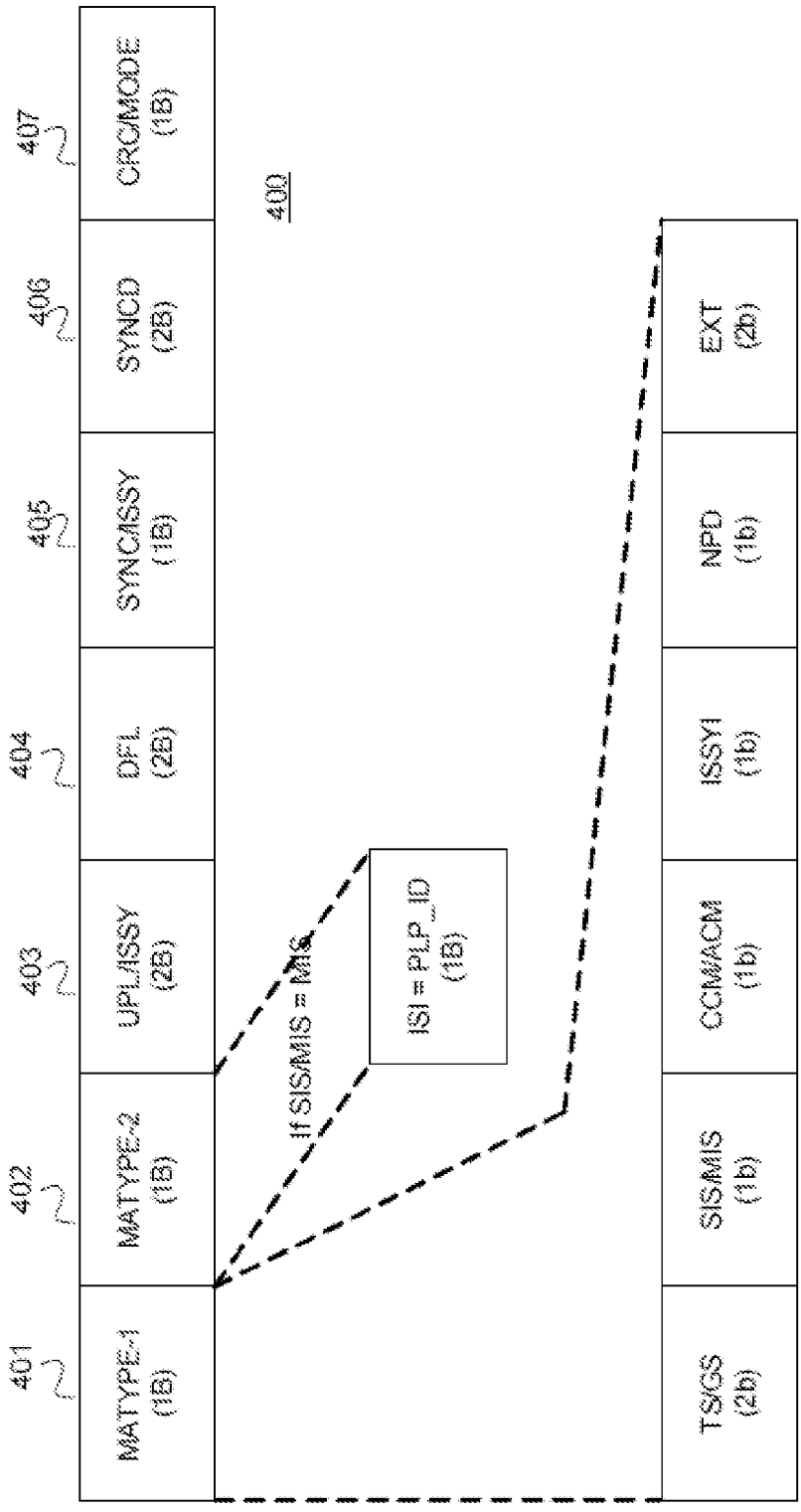

FIG. 4 (Prior Art)

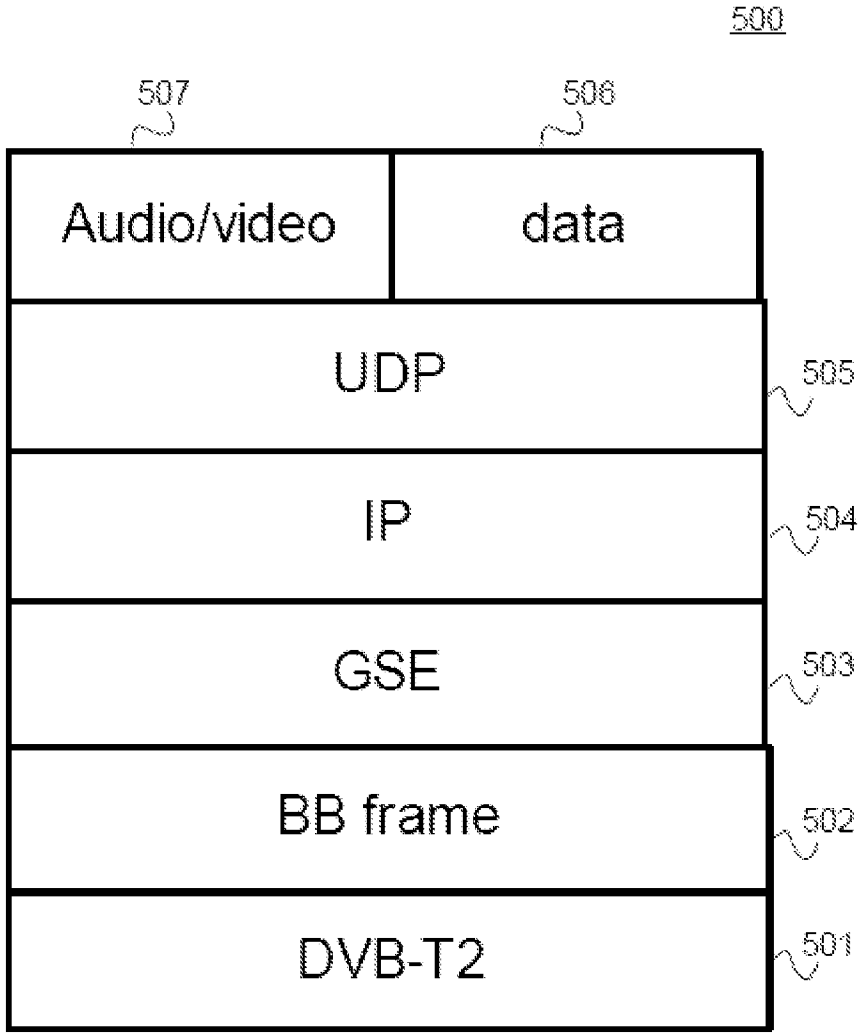

FIG. 5 (Prior Art)

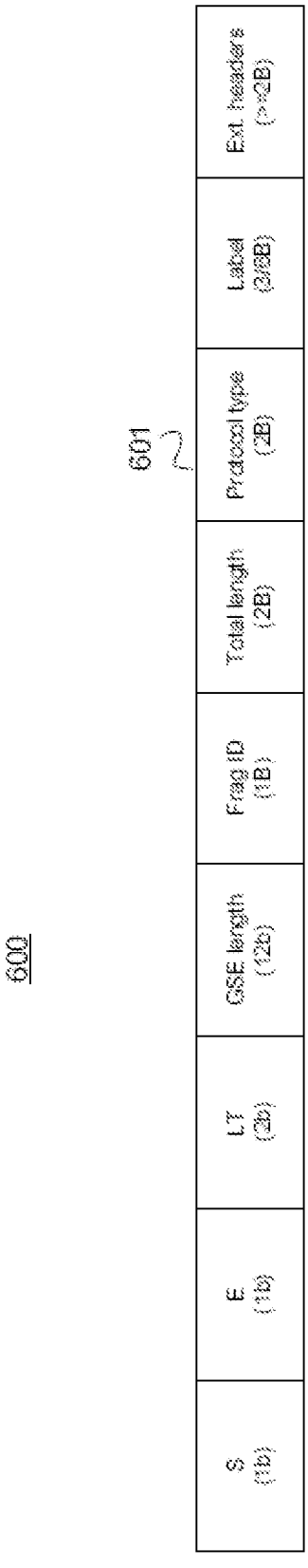

FIG. 6 (Prior Art)

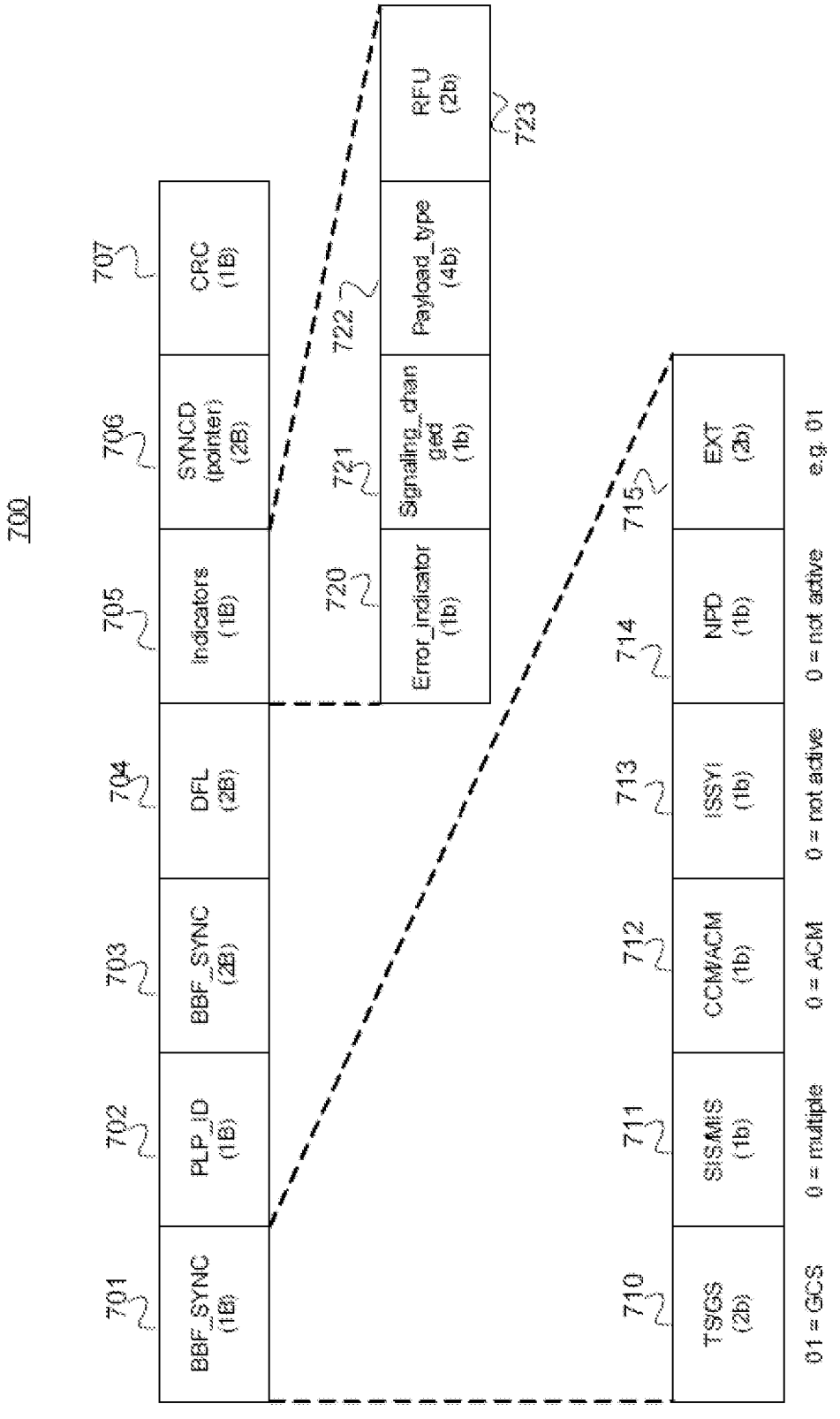
700
701
BBF_SYNC (1B)
702
PLP_ID (1B)
703
BBF_SYNC (2B)
704
DFL (2B)
705
Indicators (1B)
706
SYNCD (pointer) (2B)
707
CRC (1B)
710
TSGS (2b)
711
SISMIS (1b)
712
CCM/ACM (1b)
713
ISSYI (1b)
714
NPD (1b)
715
EXT (3b)
720
Error_indicator (1b)
721
Signaling_changed (1b)
722
Payload_type (4b)
723
RFU (2b)
01 = GCS
0 = multiple
0 = ACM
0 = not active
0 = not active
e.g. 01

FIG. 7

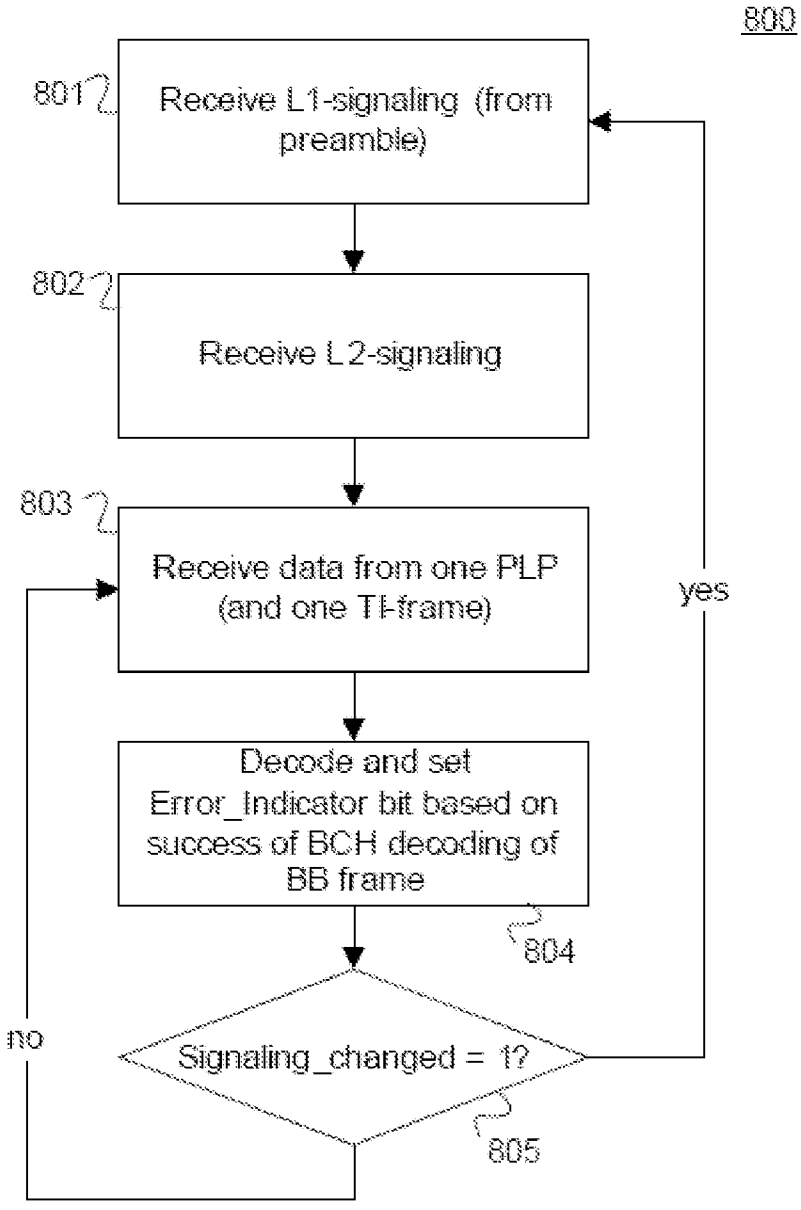
800
801
Receive L1-signaling (from preamble)
802
Receive L2-signaling
803
Receive data from one PLP (and one TI-frame)
Decode and set Error_Indicator bit based on success of BCH decoding of BB frame
804
Signaling_changed = 1?
805
yes
no

FIG. 8

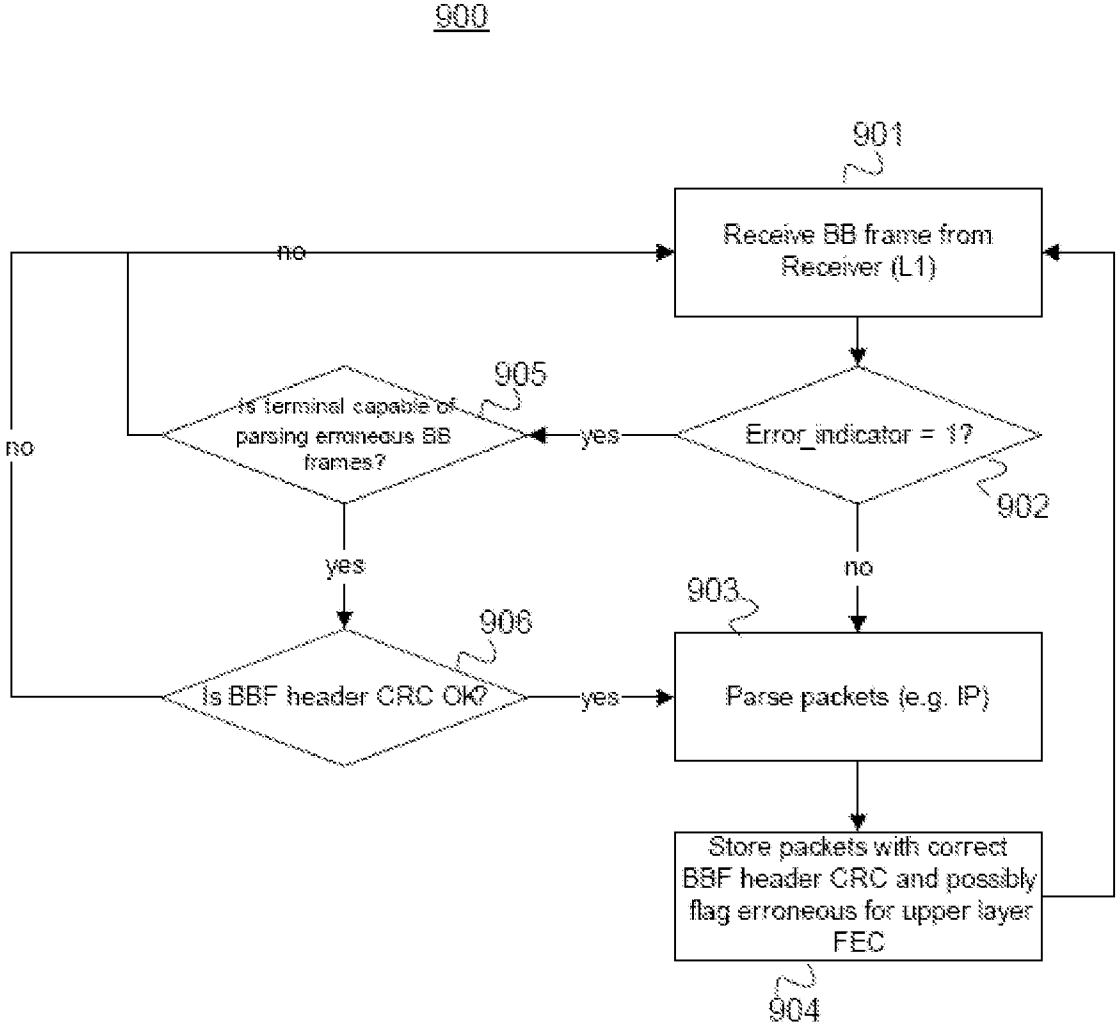
900
901
Receive BB frame from Receiver (L1)
no
Error_indicator = 1?
yes
902
Is terminal capable of parsing erroneous BB frames?
905
no
yes
no
903
Parse packets (e.g. IP)
yes
Is BBF header CRC OK?
906
Store packets with correct BBF header CRC and possibly flag erroneous for upper layer FEC
904

FIG. 9

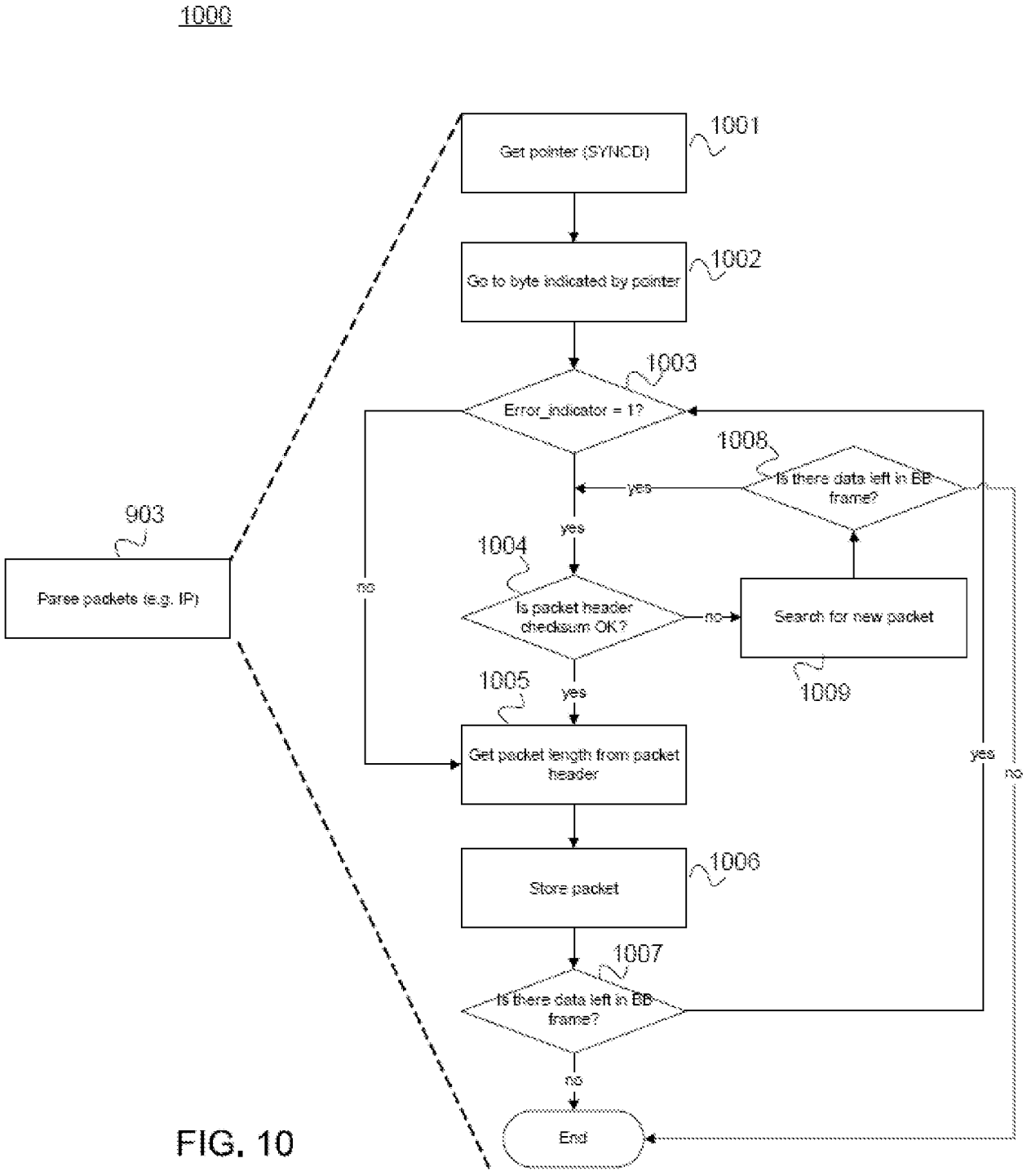
1000
903
Parse packets (e.g. IP)
Get pointer (SYNCD)
1001
Go to byte indicated by pointer
1002
Error_indicator = 1?
1003
Is there data left in BB frame?
1008
yes
yes
1004
Is packet header checksum OK?
no
Search for new packet
1009
no
1005
yes
Get packet length from packet header
yes
no
Store packet
1006
Is there data left in BB frame?
1007
no
End

FIG. 10

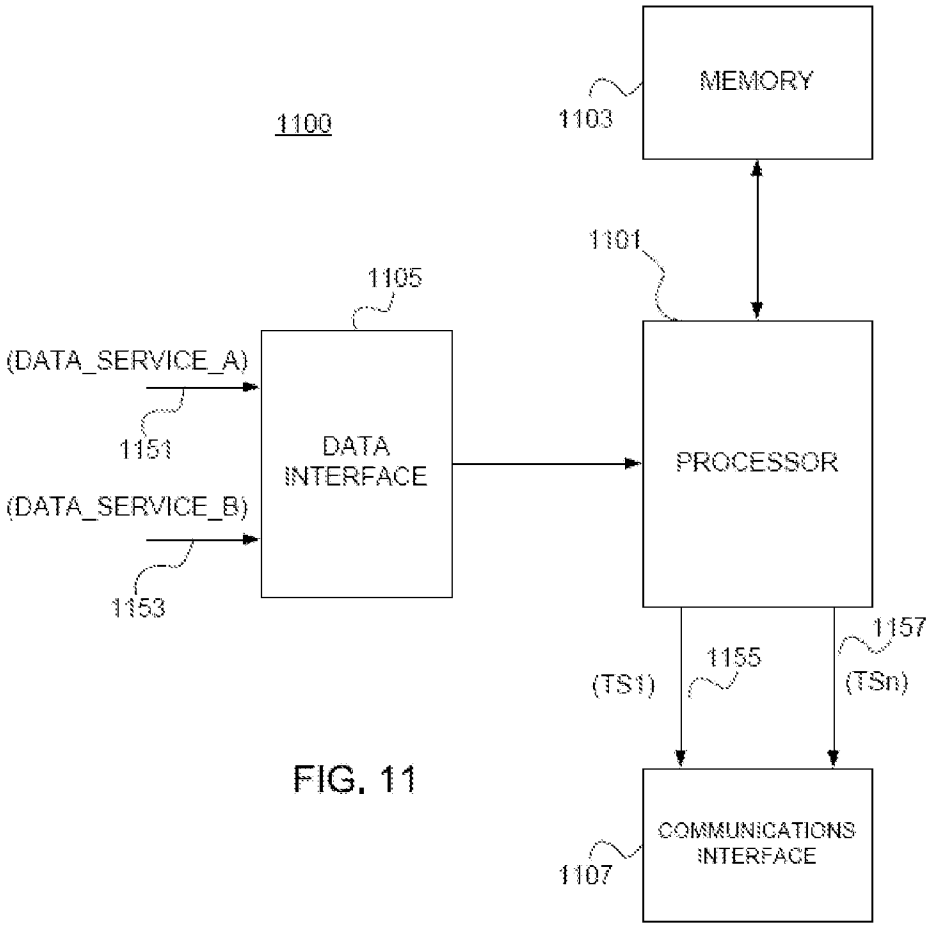
1100
MEMORY
1103
1101
1105
(DATA_SERVICE_A)
1151
DATA INTERFACE
(DATA_SERVICE_B)
1153
PROCESSOR
1157
1155
(TS1)
(TSn)
COMMUNICATIONS INTERFACE
1107

FIG. 11

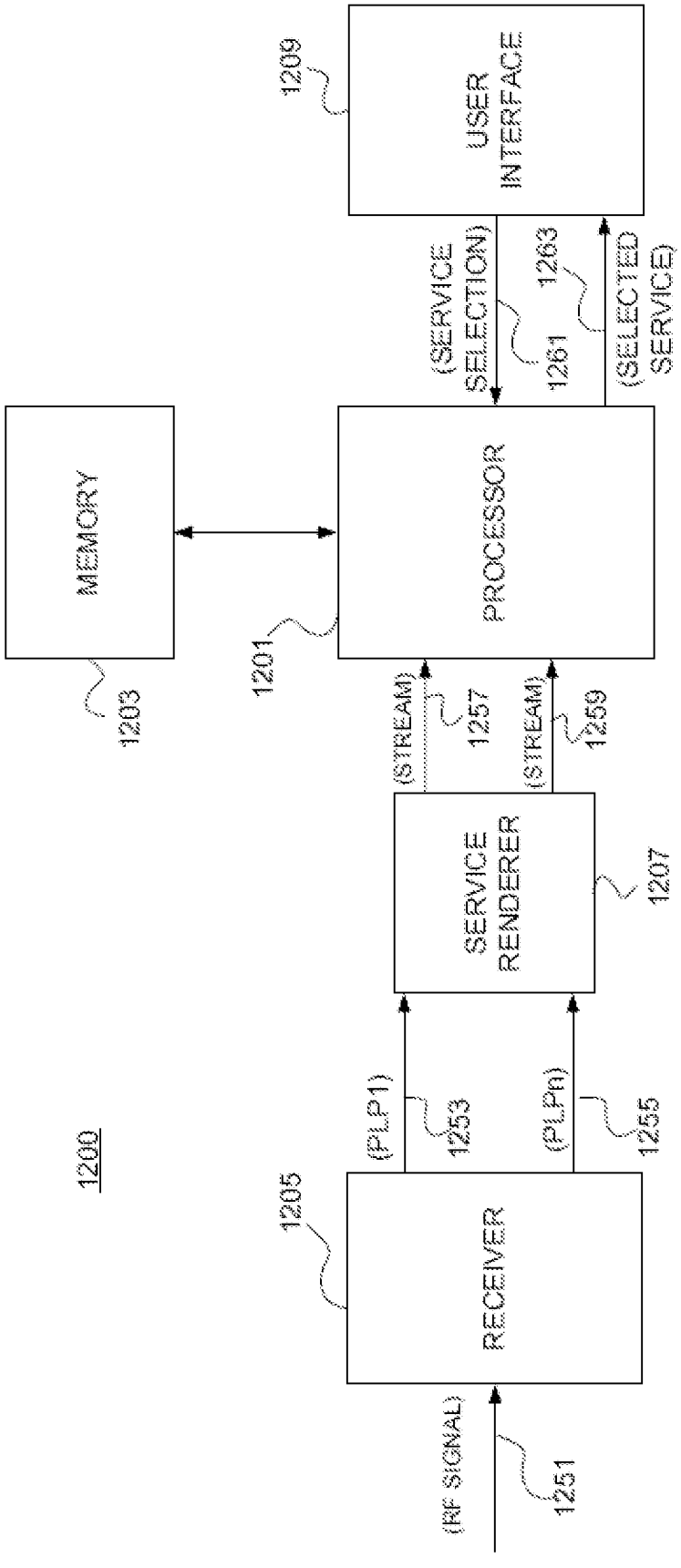
1200
1205
RECEIVER
(RF SIGNAL)
1251
(PLP1)
1253
(PLPn)
1255
SERVICE RENDERER
1207
(STREAM)
1257
(STREAM)
1259
1201
PROCESSOR
MEMORY
1203
(SERVICE SELECTION)
1261
1263
(SELECTED SERVICE)
1209
USER INTERFACE

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2010/050478

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04L, H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI, IEEE Xplore, Internet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"TM-H NGH study mission report (final)", Version 1.1, 6 June 2008. Retrieved on 1. 10. 2010 from the Internet: <URL:http://www.dvb.org/technology/dvb-ngh/DVB-NGH-Study-Mission-Report-TM-H.pdf> Summary, pages 2-6, 70-89	1-20
P, A	VANGELISTA L. et al.: "Key technologies for next-generation terrestrial digital television standard DVB-T2", IEEE Communications Magazine, pp. 146-153, Oct. 2009	1-20
P, A	"Commercial requirements for DVB-NGH", Version 1.01, 29 June 2009. Retrieved on 1. 10. 2010 from the Internet: <URL:http://www.dvb.org/technology/dvb-ngh/DVB-NGH-Commercial-Requirements.pdf>	1-20
T	D. BARQUERO et al.: "Scalable video coding for mobile broadcasting systems", IEEE Int. Conf. on Multimedia and Expo (ICME2010), 19-23 July 2010, pp. 510-515	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 October 2010 (04.10.2010)	08 October 2010 (08.10.2010)

Name and mailing address of the ISA/FI
National Board of Patents and Registration of Finland
P.O. Box 1160, FI-00101 HELSINKI, Finland
Facsimile No. +358 9 6939 5328

Authorized officer
Timo Laakso
Telephone No. +358 9 6939 500

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2010/050478

CLASSIFICATION OF SUBJECT MATTER

Int.Cl.
H04L 29/06 (2006.01)
H04N 7/24 (2006.01)