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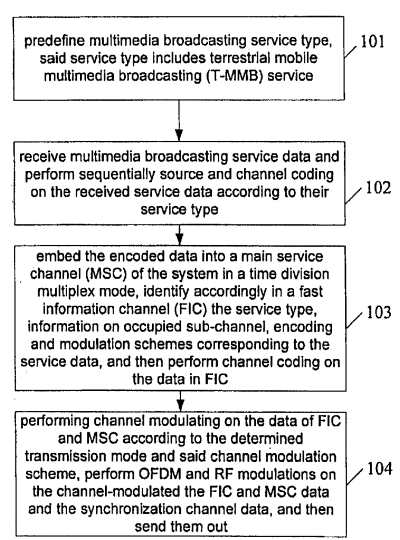
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(54) **DAB-compatible transmitting and receiving method and system for terrestrial mobile multimedia broadcasting**

(57) The present invention discloses a DAB-compatible transmitting method for terrestrial mobile multimedia broadcasting in which service type of multimedia broadcasting is predefined to be including terrestrial mobile multimedia broadcasting (T-MMB) service, the method comprises the steps of receiving multimedia broadcasting service data and performing sequentially source coding and channel coding on said service data according to their service type; embedding the encoded data into the main service channel (MSC) of the system in a time division multiplex mode, identifying accordingly information on subchannel, etc. corresponding to the service data in the fast information channel (FIC) of the system, and performing channel coding on the data in FIC; performing channel modulation, OFDM modulation and radio frequency (RF) modulation on the channel-modulated data of FIC, MSC according to the transmission mode and the channel modulation scheme, and then sending them out. With the invention, it is possible to effectively transmit multiple types of multimedia broadcasting service data in a mobile environment. The invention also discloses a DAB-compatible system and reception method

for terrestrial mobile multimedia broadcasting.

Fig1



EP 1 841 106 A2

Description**BACKGROUND OF THE INVENTION**5 **FIELD OF INVENTION**

[0001] The present invention relates to technological field of digital information transmission, in particular to a transmitting and receiving method for terrestrial mobile multimedia broadcasting and a system thereof which are compatible with digital audio broadcasting (DAB).

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DESCRIPTION OF PRIOR ART

[0002] Digital multimedia broadcasting refers to a multimedia broadcasting method used for handheld terminals. Standards for digital multimedia broadcasting, which now attract more attention from those skilled, are European standard DVB-H, MediaFLO of US and Korean standard T-DMB.

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[0003] T-DMB (short for Digital Multimedia Broadcasting) is developed on the basis of DAB. DAB digital broadcasting is initiated by the famous EUREKA-147, an association of 12 members. The system of EUREKA-147, whose original name is digital audio broadcasting (DAB), has always been utilized as a standard for distinguishing the real DAB from other digital audio broadcastings. EUREKA-147 was selected by the International Standardization Organization (ISO) as an international standard for digital audio broadcasting in 1994. Today, digital broadcasting according to this standard has been either implemented or under test in most part of the world. European Union first carried out a test on EUREKA-147 DAB at World Radio Administrative Conference in September 1988, and then the EUREKA-147 DAB mode has been standardized since 1995. It is a typical DAB system which has gained considerable development in some countries and regions other than Europe, such as Canada, Singapore, Australia, etc. Compared with the conventional AM/FM broadcasting system, the DAB (Digital Audio Broadcasting) has such advantages as saved frequency resource, low transmission power, large capacity of information and high audio quality, and becomes a 3G broadcasting (the third generation broadcasting) following the conventional AM/FM broadcasting. Digital broadcasting has such advantages as noise resistance, interference proof, resistance against attenuation in electric wave transmission and adaptability to high-speed mobile reception. It provides stereo audio quality equivalent to that of CDs and nearly no distortion in signal.

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[0004] T-DMB is a terrestrial digital multimedia broadcasting system introduced from Korea, which can be still referred as the international standard of Europe in a strict sense. The standard is established on the basis of the EUREKA-147 digital audio broadcasting (DAB) system developed by European manufacturers and has some modification so as to broadcast on-air digital TV programs for handheld devices such as mobile phones, PDAs and portable TVs. T-DMB has entered a commercial phase in Korea. The T-DMB broadcasting operators in Korea have been issued new licenses. Meanwhile, the mobile digital TV broadcasting system DVB-H developed in Europe has just been put into test.

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[0005] T-DMB makes full use of the technological advantages of DAB (capable of reliably receiving signals in a high-speed mobile environment) and functionally expands the single audio information transmission to various carriers, such as data, text, graphics and video. T-DMB compresses, encodes, modulates and transmits digitalized audio and video signals and various data service signals in a digital state, thereby realizing a high-quality transmission, while it possesses multimedia characteristics and transmits data information with a large capacity, high efficiency and robust reliability. The transition from DAB to T-DMB means a great stride from a digital audio broadcasting to a digital multimedia broadcasting, which enables any digital information to be delivered by means of a digitalized platform system. Such a system can offer for users an integrated audiovisual information service and entertainment containing audio and video.

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[0006] DVB-H (short for Digital Video Broadcasting Handheld) is a transmission standard for providing multimedia service to portable/handheld terminals via a terrestrial digital broadcasting network, specialized by Europe DVB organization after it proposed a series of standards for digital TV transmission.

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[0007] DVB-H is established to be above both DVB (data broadcasting) and DVB-T (transmission) standards and considered as an extended application of DVB-T standard. DVB-H actually focuses on protocol implementation though being a transmission standard. Front end of the system consists of a DVB-H encapsulator responsible for encapsulating IP data into a MPEG-2 system transport stream and a DVB-H modulator responsible for channel coding and modulation, while the terminal of the system consists of a DVB-H demodulator responsible for channel demodulation and decoding and a DVB-H terminal responsible for displaying and processing relevant services.

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[0008] DVB-H retains partly compatibility with a DVB-T receiving circuit, while much technological improvement has been made in order to meet requirement from receiving characteristics of handheld devices, such as low power consumption, great mobility, common platform and no-interruption in switching network service, thereby ensuring a normal view indoors, outdoors, in walking or in a traveling vehicle. To increase service time of battery, the terminal periodically powers off part of the receiving circuit for saving power consumption. To satisfy the purpose of portability, the antenna of a DVB terminal is smaller and more flexible in movement. The transmitting system can ensure DVB-H services to be

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successfully received at various moving rates. The system has a strong resistance against any interference and can offer sufficient flexibility for applications with different transmission bandwidths and channel bandwidths.

[0009] The MediaFLO technology proposed by QAULCOMM is essentially a new air interface. It is designed for mobile multicast reception with a quick channel switching, a low power-consumption receiver and rich service contents. The MediaFLO enables a modulation mode supporting a robust data rate up to 11 Mbps within a channel of 6MHz. A quick channel switching time of average 1.5s is also highlighted and taken as one of the MediaFLO's trumps for exceeding other competitive mobile TV standards. When different programs are sent in TDM mode, the receiver extracts transmission time of a target service from head information of a transmission frame, and starts receiving from this moment. In US, the Qualcomm has purchased a frequency of 700MHz (UHF TV Channel 55) and can transmit at a power up to 50kW.

[0010] The three standards of T DMB, DVB-H and MediaFLO have drawbacks of different levels. T-DMB has a low spectrum utilization efficiency, hardly provides enough information throughput to satisfy such a high-quality service as the mobile TV, and lacks sufficient power-saving mechanism for a receiver. As for DVB-H, since it is derived from DVB-T which is a stationary receiving system, room for optimizing the mobile environment is rather limited. DVB-H has no enough power-saving mechanism for a receiver while some other performance indices are sacrificed, for example, the time for switching is increased to 5s. In addition, the number of the operating frequencies available for DVB-H is small. Finally, MediaFLO as an independent system has no compatibility and is designed mainly for a frequency of 700MHz, thereby lacking possibility for common application.

SUMMARY OF THE INVENTION

[0011] In view of the above problems, the present invention provides a DAB-compatible transmitting method for terrestrial mobile multimedia broadcasting, which can effectively transmit service data of multimedia broadcasting under a mobile environment.

[0012] The present invention further provides a DAB-compatible receiving method for terrestrial mobile multimedia broadcasting, which can effectively receive service data of multimedia broadcasting under a mobile environment.

[0013] Moreover, the present invention provides a DAB-compatible system for terrestrial mobile multimedia broadcasting, by which it can be realized that service data of multimedia broadcasting is effectively transmitted and received under a mobile environment.

[0014] To achieve the above objects, the specific solutions of the present invention are as follows.

[0015] A DAB-compatible method for transmitting terrestrial mobile multimedia broadcasting in which the service type of multimedia broadcasting is predefined to be including terrestrial mobile multimedia broadcasting (T-MMB) service, the method comprises the steps of

Receiving service data of multimedia broadcasting and performing sequentially source coding and channel coding on said service data according to their service type;

Embedding the encoded data into a main service channel (MSC) of the system in a time division multiplex mode, identifying accordingly the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data in a fast information channel (FIC) of the system, and performing channel coding on the data in the FIC;

Performing Channel modulating on the data of FIC and MSC according to the determined transmission mode and said channel modulation scheme, performing OFDM modulation and radio frequency (RF) modulation on the channel-modulated data of FIC, MSC and data of a synchronization channel, and then sending them out.

[0016] Preferably, between the source coding and the channel coding on the received service data, the method can further comprises performing sequentially conditional access scrambling and energy dispersal on the source-encoded data, and after the channel coding and before the time division multiplexing, the method can further comprises performing time interleaving on the channel-encoded data.

[0017] Preferably, when the service type is T-MMB service, said channel coding on the service data can be a channel coding on the service data with concatenated code or low density parity check (LDPC) code.

[0018] Preferably, the channel modulation for the T-MMB service data in a transmission frame can be a channel modulate on said T-MMB service data by means of Differential Quadrature Phase Shift Keying (DQPSK), 8-level Differential Phase Shift Keying (8DPSK), 16-level Differential Amplitude and Phase Shift Keying (16DAPSK) or 64-level Differential Amplitude and Phase Shift Keying (64DAPSK).

[0019] Preferably, when the encoded data is embedded into the main service channel (MSC) of a DAB system in a time division multiplex mode, the size of the corresponding capacity units (CUs) in MSC is determined according to the channel modulation scheme of the service data.

[0020] Preferably, said determined size of the corresponding CUs in MSC is $n \times 32$ bits, where $n=2$ represents that the service data is modulated with DQPSK, $n=3$ with 8DPSK, $n=4$ with 16DAPSK, $n=5$ with 32DAPSK and $n=6$ with 64DAPSK.

[0021] Preferably, said step of identifying accordingly the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data in the fast

information channel (FIC) of the system can comprise constructing a fast information group (FIG) of the FIC of T-MMB system based on the FIG of the FIC of DAB system and identifying the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data in the FIG of the FIC of DAB system.

5 **[0022]** Preferably, when the service type is T-MMB service, said step of identifying the service type corresponding to the service data in the FIG of the FIC of DAB system can comprise adding a description for the service type of T-MMB system to a field for data service component type in FIG type 0/extended mode 2 of the FIC of T-MMB system, and adding a description for T-MMB user application to a field for user application type in FIG type 0/extended mode 13 of the FIC of T-MMB system.

10 **[0023]** Preferably, when the service type is T-MMB service, said step of identifying information on sub-channel occupied by the service data in the FIG of the FIC of T-MMB system can comprise adding a sub-channel identification field in the FIG of the FIC of T-MMB system to identify the sub-channel occupied by the service data, and adding an initial address field in the FIG of the FIC of DAB system to identify the address of the first CU of the sub-channel.

15 **[0024]** Preferably, when the service type is T-MMB service, said step of identifying the channel coding scheme and the channel modulation scheme of the service data in the FIG of the FIC of T-MMB system can comprise adding a CodingType field into the FIG of the FIC of T-MMB system to identify the channel coding scheme of T-MMB service, adding a Sub-channel field into the FIG of the FIC of T-MMB system to identify the sub-channel size of T-MMB service and the protection level of the employed error correction code, and adding a ModuType field for the modulation type in the FIG of the FIC of T-MMB system to identify the channel modulation scheme of T-MMB service.

20 **[0025]** Preferably, said step of determining the transmission mode can comprise, with reference to the correspondence relationship between the predefined channel modulation scheme, transmission mode and operating frequency, determining the transmission mode according to the employed channel modulation scheme and the operating frequency specified by the system.

25 **[0026]** Preferably, when said channel modulation scheme is m-DPSK or m-DAPSK, wherein m is any of 16, 32 and 64 or their arbitrary combination, the transmission mode IV is used in case that the operating frequency of T-MMB is BandIII, and the transmission mode III is used in case of L-Band; when said channel modulation scheme is DQPSK, the transmission mode I is used in case that the operating frequency of T-MMB is BandIII, and the transmission mode II is used in case of L-Band.

30 **[0027]** A DAB-compatible receiving method for terrestrial mobile multimedia broadcasting comprises the steps of Performing RF demodulation, OFDM demodulation and synchronization on the received signal, obtaining the data of FIC and MSC, and judging the employed transmission mode;
Performing sequentially channel demodulation and channel decoding on said FIC data, and extracting service data of a corresponding type in a sub-channel from MSC based on control information of FIC;
Performing sequentially channel demodulation, channel decoding and source decoding on the extracted service data
35 based on the judged transmission mode and the identified methods of channel modulation, channel coding and source coding of various service data in the FIC.

[0028] Preferably, said step of judging the transmission mode can comprise, with reference to the correspondence relationship between the predefined channel modulation scheme and the transmission mode and operating frequency, judging the transmission mode according to the employed channel modulation scheme and the operating frequency
40 specified by the system.

[0029] A DAB-compatible system for terrestrial mobile multimedia broadcasting comprises a network control centre (NCC) for sending multimedia broadcasting service data to a transmitting station, said transmitting station for receiving the multimedia broadcasting service data from said NCC, performing source coding and channel coding on said service data based on their service type, embedding the encoded data into the MSC of the system in a time division multiplex mode, identifying accordingly in a fast information channel (FIC) the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, performing channel coding on the data in FIC, and for performing channel modulation on the data of FIC and MSC based on the determined transmission mode and said channel modulation scheme, and performing OFDM modulation and RF modulation on the channel modulated data of FIC and MSC and data of the synchronization channel before transmitting
45 them to a receiver in the system, and said receiver for performing RF demodulation, OFDM demodulation and synchronization on the received RF signal from said transmitting station, extracting service data of a corresponding service type in a sub-channel based on the FIC control information obtained after channel demodulation and channel decoding, and performing channel demodulation, channel decoding and source decoding.

[0030] Preferably, said transmitting station includes a receiving module for receiving multimedia broadcasting service data from said NCC and forwarding the service data to a source coding module, said source coding module for performing source coding on the signal forwarded from said receiving module based on the service type of the service data and then sending the result of source coding to a channel coding module, said channel coding module for performing channel coding on the received data and sending the result to a channel multiplexing module, a FIC data formation module for
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identifying accordingly in FIC the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, performing channel coding on the data in the FIC and sending the encoding result to said channel multiplexing module, said channel multiplexing module for embedding the received service data into MSC based on the service type in a time division multiplex mode and multiplexing the MSC data and the FIC encoding result sent from said FIC data formation module before sending them to a modulating & transmitting module, said modulating & transmitting module for performing channel modulation on the received FIC and MSC data based on the determined transmission mode and said channel modulation scheme, and performing OFDM modulation and RF modulation on the channel-modulated FIC and MSC data and the data of the synchronization channel before sending them to said receiver.

[0031] Preferably, said transmitting station can further includes a conditional access scrambler for perform conditional access scrambling on the received data from said source coding module before sending them to an energy disperser, said energy disperser for performing energy dispersal on the received data before send them to said channel coding module, and a time interleaver for performing time interleaving on the received data from said channel coding module before sending them to said channel multiplexing module.

[0032] Preferably, said receiver can be one of a DAB receiver, a DAB-IP receiver, a T-DMB (Digital Multimedia Broadcasting) receiver and a T-MMB receiver or their arbitrary combination.

[0033] Preferably, said T-MMB receiver can include a receiving & demodulating module for receiving the RF signal from said transmitting station, performing RF demodulation, OFDM demodulation and synchronization on the received signal, obtaining FIC and MSC data and sending them to a FIC data extracting module and a service data extracting module respectively, said FIC data extracting module for performing channel demodulation and channel decoding on the received FIC data and sending the FIC control information to said service data extracting module, a channel demodulation module, a channel decoding module and a source decoding module, said service data extracting module for extracting various service data from MSC based on the FIC control information and sending them to said channel demodulation module, said channel demodulation module for performing channel demodulation on the received service data based on the judged transmission mode and the channel modulation of various service data identified in FIC, and sending the demodulated data to said channel decoding module, said channel decoding module for performing correspondingly channel decoding on the received signal based on the channel coding scheme identified in FIC, and sending the result to said source decoding module, said source decoding module for performing source decoding on the received signal based on the service type.

[0034] As will see from the above technical solution, the invention based on DAB system predefines the service type of multimedia broadcasting to be transmitted, and at the transmitting end of multimedia broadcasting service data, receives the original service data and then performs source and channel coding on them based on their service type; and then embedding the encoded data into MSC of the system in a time division multiplex mode, identifying accordingly the control information, such as sub-channel, corresponding to the service data in FIC, and performing channel coding on the data in FIC; and performs channel, OFDM and RF modulations on the multiplexed data of FIC and MSC and then sending them out. At the receiving end, the invention performs corresponding RF and OFDM demodulations on the received data to obtain FIC data and performs channel demodulation and channel decoding on them, and then performs channel demodulation, channel and source decoding on the data in each service channel based on the extracted control information of FIC to obtain the original service data. Therefore, the system is enabled to support the transmission of various multimedia service data by identifying the used sub-channel and the encoding and modulation schemes of different kind of service data in FIC.

[0035] Further, since efficient channel coding and modulation schemes can be adopted, the system can provide an improved utilization ratio of frequency band and a strong interference proof for the transmitted data so as to be more suitable for the transmission of video programs.

[0036] In conclusion, the solution is based on a multimedia service extension of the matured DAB system, which is designed for handheld mobile terminals, and proved to be reliable. The solution overcomes the disadvantages of existing DAB system such as the low efficiency of frequency band and a single service type and becomes more suitable for the transmission of video programs. Compared with mobile multimedia technology of other modes, the invention has advantages such as a good availability of frequency, a simple synchronization easy to implement, a good compatibility, a high utilization ratio of frequency band, support for portable and mobile reception, and a low-complexity receiver easy to implement.

[0037] Meanwhile, the invention can be used not only for terrestrial, satellite and other transmitting medium but also for data broadcasting, Internet and other broadband multimedia information transmission as well as an integrated data service field.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038]

Fig. 1 is a general flowchart for a DAB-compatible method for T-MMB transmission of the present invention.

Fig. 2 is a general flowchart for a DAB-compatible method for T-MMB reception of the present invention.

5 Fig. 3 is a general flowchart for a DAB-compatible T-MMB system of the present invention.

Fig. 4 is a principal block diagram for a T-MMB transmission method of the present invention.

10 Fig. 5 is a detailed flowchart for the DAB-compatible T-MMB transmission method in an embodiment of the present invention.

Fig. 6 is a schematic diagram for a RS outer interleaver and a de-interleaver used in an embodiment of the transmission method of the present invention.

15 Fig. 7a is a frame configuration of the T-MMB system when the modulation scheme is 8DPSK and the channel coding scheme is LDPC coding.

20 Fig. 7b is a frame configuration of the T-MMB system when the modulation scheme is 16DAPSK and the channel coding scheme is RS plus concatenated convolutional coding.

Fig. 8 is a structural diagram for the service organization section of a FIC information channel used in the embodiment of the transmission method of the present invention.

25 Fig. 9 is a structural diagram for the new service sub-channel of a FIC information channel used in the embodiment of the transmission method of the present invention.

Fig. 10 a structural diagram for user application information of a FIC information channel used in the embodiment of the transmission method of the present invention.

30 Fig. 11 is a symbolic constellation diagram for 8PSK used in the embodiment of the transmission method of the present invention.

35 Fig. 12 a symbolic constellation diagram for 16APSK used in the embodiment of the transmission method of present invention.

Fig. 13 is a detailed flowchart for the DAB-compatible T-MMB reception method in an embodiment of the present invention.

40 Fig. 14 is a detailed structural diagram for the DAB-compatible T-MMB system in the embodiment of the present invention.

Fig. 15 is a detailed structural diagram for a transmitting station of the DAB-compatible T-MMB transmission system in the embodiment of the present invention.

45 Fig. 16 is a detailed structural diagram for a T-MMB receiver in the embodiment of the present invention.

[0039] Meaning indicated by each identifier in Fig. 10 is as follows.

50 SId: service identifier;

Service Identifier description:

-Country Id: country identifier;

55 -Service reference;

-ECC: extended country code;

Local flag;

CAId: conditional access identifier;

5 Number of service components;

Service component description:

10 -TMId: transmission mechanism identifier;

-ASCTy: audio service component type;

-SubChID: sub-channel identifier;

15 -P/S: primary/secondary identifier;

-CA flag;

20 -DSCTy: data service component type;

-FIDCId: fast information data channel identifier.

[0040] The specific content of each identifier above can be referred to the DAB standard (ETSI EN300 401).

25 **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

[0041] Principal idea of the invention is that it predefines a service type of multimedia broadcasting to be transmitted, and at a transmitting end of multimedia broadcasting service data, it receives original service data of the multimedia broadcasting and performs source and channel coding on them based on their service type; and then it embeds the encoded data into MSC of the system in a time division multiplex mode, identifies accordingly control information, such as sub-channel, corresponding to the service data in FIC, and performing channel coding on the data in FIC; and then it performs channel, OFDM and RF modulations on the data multiplexed by the MSC and FIC, and sends them out. At a receiving end, the invention performs corresponding RF and OFDM demodulations on the received data to obtain FIC channel data, and performs channel demodulation and channel decoding on them; and then it performs channel demodulation, channel and source decoding on the data in each service channel based on the extracted control information of FIC, to obtain the original service data.

[0042] The present invention is a new system and method for multimedia transmission established on the conventional DAB system. In the present invention, channel composition is the same as that of the DAB system and includes a FIC channel, a MSC channel and a synchronization channel, wherein the MSC channel carries service data, the FIC channel carries control data, and the synchronization channel is used for signal synchronization.

[0043] To further clarify the object, technical solution and advantages of the present invention, hereafter the invention will be explained in detail with reference to the figures and preferable embodiments.

45 Fig. 1 is a general flowchart for the DAB-compatible method for T-MMB transmission of the present invention. As shown in Fig. 1, the method comprises

Step 101 of predefining multimedia broadcasting service type, said service type including terrestrial mobile multimedia broadcasting (T-MMB) service;

50 Step 102 of receiving multimedia broadcasting service data, and performing sequentially source and channel coding on the received service data according to their service type;

55 Step 103 of embedding the encoded data into the main service channel (MSC) of the system in a time division multiplex mode, identifying accordingly the service type, information on occupied sub-channel, encoding and modulation schemes corresponding to the service data in the fast information channel (FIC), and then performing channel coding on the data in FIC;

Step 104 of performing channel modulation on the data of FIC and MSC according to the determined transmission

mode and said channel modulation scheme, performing OFDM and RF modulations on the channel-modulated FIC and MSC data and synchronization channel data, and then sending them out.

Accordingly, Fig. 2 is a general flowchart for the DAB-compatible method for T-MMB reception of the present invention. As shown in Fig. 2, the method comprises:

5 Step 201 of receiving the data sent from the transmitting end, performing RF demodulation, OFDM demodulation and synchronization on them to obtain the data of FIC and MSC, and then judging the employed transmission mode;

10 Step 202 of performing sequentially channel demodulation and channel decoding on the FIC data, and extracting the service data of a corresponding service type in the sub-channel from the MSC based on the control information of FIC;

15 Step 203 of performing sequentially channel demodulation, channel decoding and source decoding on the extracted service data based on the judged transmission mode and the channel modulation, channel coding and source coding modes of various service data identified in FIC.

Fig. 3 is a general flowchart for the DAB-compatible T-MMB system of the present invention. As shown in Fig.3, the system includes a network control center (NCC) 310, a transmitting station 320 and a receiver 330.

20 **[0044]** In the system, the NCC 310 is used for sending multimedia broadcasting service data to the transmitting station 320. The transmitting station 320 receives the multipath digital multimedia broadcasting (program) signal from the NCC 310, performs source coding and channel coding on the signal based on their service type, embeds the encoded data into MSC of the system in a time division multiplex mode, identifies accordingly in the fast information channel (FIC) the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, and then performs channel coding on the data in the FIC. The transmitting station 320 is also used for performing channel modulation on the data in FIC and MSC based on the determined transmission mode and the channel modulation scheme, and performing OFDM modulation and RF modulation on the channel modulated data of FIC and MSC and the data of the synchronization channel before transmitting them to the receiver 330.

25 **[0045]** The receiver 330 is used for performing RF demodulation, OFDM demodulation and synchronization on the received RF signal, extracting the service data of a corresponding service type in the sub-channel based on the control information of FIC obtained after channel demodulation and channel decoding, and performing channel demodulation, channel decoding and source decoding.

30 **[0046]** The above is a general description for the DAB-compatible method for T-MMB transmission and reception and system of the present invention, in which the processing before multiplexing the service data into MSC is source coding and channel coding. In practice, as is in DAB system, an optional processing of conditional access scrambling and energy dispersal can be added between the source coding and the channel coding, and a processing of time interleaving can be add after the channel coding for a better adaptation to a channel environment with a great time variability.

35 **[0047]** T-MMB is a digital multimedia broadcasting method based on the multimedia service extension of digital audio broadcasting (DAB) system. It incorporates latest technologies and gives an integrated consideration to such factors as frequency resource, receiver complexity, utilization ratio of frequency spectrum, system performance, etc. to overcome the problems existing in the above prior art, thereby realizing a full compatibility with DAB, a low-cost and low-power-consumption design, a good frequency availability, support to mobile reception, a single frequency network implementation, a high spectrum efficiency, multi-service, a high-quality service, etc. T-MMB is characterized in that

(1) It is fully compatible with Eureka-147 (DAB), DAB-IP in UK and T-DMB in Korean. T-MMB makes full use of the technological advantage of DAB (able to reliably receive signals under the high-speed mobile environment) and functionally extends a single audio information transmission to various carriers such as data, text, graphics and video;

50 (2) It solves such a drawback in DAB system as a low efficiency of frequency band;

(3) It employs an advanced channel error correction coding technology of LDPC code and an efficient and low-complexity modulation scheme of DAPSK;

55 (4) It has advantages such as lower complexity, lower power consumption, better availability of frequency, greater compatibility, etc. when compared to other modes, for example, DVB-H and MediaFLO.

[0048] The invention embeds new multimedia service into the old DAB system as sub-channels by using the existing transmitter in DAB system, in order to construct a new T-MMB system. Audiovisual programs or multimedia information such as data, text and graphics are transmitted by one or more transmitters to cover certain regions after having undergone source coding, transmission encoding and channel coding (the conventional encoding schemes for the old service DAB signal, while new encoding schemes for the new service T-MMB signal). These transmitters can be flexibly networked such that they can constitute a Multi-Frequency Network (MFN) or a Single Frequency Network (SFN).

Fig. 4 is a principal block diagram for the T-MMB transmission method of the present invention. As shown in Fig. 4, the signal structure in T-MMB system is composed of three parts of a compression layer, a transport layer and a physical layer. The transmitted signal in T-MMB system can be synthesized from four signals of DAB signal, DAB-IP signal, T-DMB signal and T-MMB signal, in which the T-MMB, T-DMB and DAB-IP signals are embedded into DAB system as independent services. The main difference between the four signals lies in the physical layer.

[0049] Analyzed from another perspective, the baseband signal at the transmitting end of T-MMB system can be divided into such parts as source compression encoding, code stream multiplexing, channel error correction coding, channel modulation and etc. Code stream multiplexing belongs to the transport layer and primarily multiplexes several basic code streams according to the MPEG-2 system level specification, that is, synthesizes various code streams such as audio code stream, video code stream and data code stream into one transmission code stream with a fixed length of transmission packet so as to facilitate channel transmission. The structure of the transport layers for DAB and T-DMB signals remain the same, while the structure of the transport layer for T-MMB signal differs from the conventional DAB system and adopts different error correction coding and modulation schemes to improve frequency spectrum efficiency and error correction performance and make the T-MMB system suitable for transmitting video programs. In addition, the structure of the transport layer for FIC also remains the same. According to the above structure of the transport layer, the digital code stream is converted into data symbols and inserted into the synchronization channel, which is formed as the base-band signal via an OFDM signal generator and then sent to a RF modulator of the DAB transmitter with the same RF bandwidth as that of DAB.

[0050] The present invention emphasizes on the transport layer. In order to be compatible with the existing DAB system, the invention maintains the transmission structure of DAB system. T-MMB system modifies only the structure of the transport layer for service sub-channel newly added to the DAB system, while other aspects such as the transmission frame configuration, the multiplex mode, the interleaving mode, the FIC structure, the synchronization channel, the structure of the OFDM signal generator and the transmitter of the system all remain the same. To be more precise, the T-MMB system extends the DAB system to support new channel coding and modulation technologies, making the T-MMB system able to transmit video programs. The following is an introduction of technical details related in the present invention with aspect to newly-added parts in the DAB system-based invention, while the description for the same parts in the T-MMB system as that of the DAB system will be omitted.

[0051] The embodiment of the present invention explains specific implementation of the transmitting and receiving method and system for multimedia broadcasting service data in the invention, by example of the transmission for service data of four types of DAB, DAB-IP, T-DMB and T-MMB.

Embodiment:

[0052]

Fig. 5 is a detailed flowchart for the DAB-compatible T-MMB transmission method in an embodiment of the present invention. In this embodiment, before the service data are multiplexed to MSC, source coding, conditional access scrambling, energy dispersal, channel coding and time interleaving are sequentially performed, which remains consistent with the processing of the DAB system. As shown in Fig. 5, the method comprises specifically

Step 501 of predefining multimedia broadcasting service type, said service type including terrestrial mobile multimedia broadcasting (T-MMB) service;

At this step, the service to be transmitted is defined to include service data of four types of DAB, DAB-IP, T-DMB and T-MMB;

Step 502 of receiving multimedia broadcasting service data and performing source coding, conditional access scrambling and energy dispersal on the received service data according to their service type;

The source coding is previously mentioned compression layer and includes compression coding for voice and image. At this step, the data of four service types can be currently source-compressed mainly according to a series standards of MPEG1, MPEG2, MPEG4 and AVS of ISO/IEC, and with development of the technology, other new compression algorithms, for example, wavelet coding and fractal coding, can be adopted. The cor-

responding data stream or data packet is formed after completing source compression. Then, conditional access scrambling and energy dispersal are performed in the same mode as in DAB system. Of course, since conditional access scrambling is an optional operation in the DAB system, herein this processing can be omitted;
 Step 503 of performing channel coding and time interleaving on the energy-dispersed service data based on their service type;

At this step, for the service data of DAB and DAB-IP, the channel coding scheme of audio (program) and data service defined in DAB system EN 300 401 [1] can be used. Though the error protection method in the MSC stream mode can ensure the quality of the audio service, it cannot ensure the quality of a data service transmitted in a stream mode, such as a video service. Thus, it is specified in this embodiment that a stronger error correction coding scheme is used for a T-MMB signal, and in particular, the specific channel coding can be RS plus concatenated convolutional coding or LDPC coding.

a. RS plus concatenated convolutional coding

[0053] To share as more common characteristics as possible between transmitting and receiving devices, the outer coding directly uses the standard of DVB-T EN 300 744 to provide appropriate error protection.

[0054] In this embodiment it provides an additional processing of outer coding (RS coding) and outer interleaving (convolutional interleaving). This processing lies between MPEG2 transmission multiplexing and DAB sub-channel stream multiplexing.

[0055] Moreover, the processing is consistent with that defined in EN 300 744.

[0056] The error protection for DAB sub-channel data stream and 188-byte transmission packet is as follows.

1) The general principle

[0057] Each of the inputted transmission packets has a length of 188 bytes with the beginning byte being a synchronization byte of value 0x47. The transmission packets can contain any data. Further details of transmission packets can be referred to ISO/ IEC 13818.

2) The outer coding

[0058] The outer coding and the outer interleaving used for the inputted transmission packets are as shown in Table 1.

Table 1

Synch byte 0x47	MPEG2 transport stream data (187 bytes)
-----------------	---

RS (204,188,t=8) truncation coding originates from system RS (255,239,t=8) coding and is used for each transmission packet (188 bytes) to generate a packet for error protection. The protection range of RS coding contains the synchronization byte (0x47). In this embodiment, the length of RS coding and information segment are set to be 204 bytes and 188 bytes respectively, so as to correct an error within any 8 bytes among the received 204 bytes.

[0059] The code-generating polynomial is $g(x)=(x + \lambda^0)(x + \lambda^1)(x + \lambda^2)\dots(x + \lambda^{15})$, in which $\lambda=2$.

[0060] The domain-generating polynomial is $p(x) = x^8 + x^4 + x^3 + x^2 + 1$.

[0061] The truncation RS coding can add 51-byte zeros at the front of the 188 information bytes and put them into a RS (255,239,t=8) encoder. Following the RS coding, the added 51-byte zeros are discarded to obtain a RS code of N=204 as shown in Table 2.

Table 2

Synch byte 0x47	MPEG2 transport stream data (187 bytes)	Check word (16 bytes)
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3) The outer interleaving

[0062] As shown in Fig.6, the outer interleaving for a byte is based on the Forney's method with an interleaving depth l=12. According to the method shown in Fig.6, a convolutional interleaver with the interleaving depth l=12 is used for a packet with error protection.

[0063] The convolutional interleaving process based on Forney's method is compatible with the method of Ramsey type III, where l=12. The interleaver has l (=12) branches connected by making cycle of input switch equal to input stream connection. Each branch is a first-in-first-out (FIFO) shift register whose width is j•M units, M=17=N/l and N=204.

Each FIFO unit contains one byte, and the input and output switches need to be synchronized. For the purpose of synchronization, the synchronization byte (0x47) must always pass through the branch "0" (corresponding to no delay) of the interleaver.

5 [0064] The principle for the de-interleaver is similar to that for the interleaver except that the branch pointers are inverted to each other (i.e. $j=0$ corresponding to the largest delay). Synchronization for de-interleaving can be realized by making the first recognized synchronization byte pass through the branch "0".

b. LDPC coding

10 [0065] LDPC code can provide a function of forward error correction like the convolutional code, while LDPC code has a stronger error-correcting capability, is more suitable for information transmission of poor-quality channels, and becomes convergent through several iterative decoding in a high SNR. Therefore, the receiver saves more power in the same condition. When appropriately designed, LDPC code has a very low bit error rate without concatenating any outer code.

15 [0066] In the embodiment of the present invention, LDPC code provides equal error protection for the same service and independent coding for different services. The forward error correction coding uses LDPC code of a quasi-cyclic structure, which can use a shift register to carry out encoding and is convenient to be stored.

[0067] A check matrix H of the quasi-cyclic LDPC code can be denoted as the following form:

20

$$H = \begin{bmatrix} A_{1,1} & A_{1,2} & \cdots & A_{1,c} \\ A_{2,1} & A_{2,2} & \cdots & A_{2,c} \\ \vdots & \vdots & \ddots & \vdots \\ A_{\rho,1} & A_{\rho,2} & \cdots & A_{\rho,c} \end{bmatrix}$$

25

wherein $A_{i,j}$ represents a $t \times t$ dimension cyclic matrix with its row (column) weight being $\omega_{i,j}$ and $\omega_{i,j} \ll t$. The code word represented by the matrix H is called (N, K) LDPC code, in which $N (=c \times t)$ represents the code length, and $K (=c - \rho) \times t$ represents the length of code information bits. The first row in $A_i = [A_{i,1}, A_{i,2}, \dots, A_{i,c}]$, $i=1, 2, \dots, \rho$ is called the i th row generator, and then H has ρ row generators in all.

30

[0068] The generation matrix G corresponding to the check matrix H can be denoted as $G = [I|P]$, wherein I is a unit matrix, and the quasi-cyclic matrix P can be denoted as follows:

35

$$P = \begin{bmatrix} P_{1,1} & P_{1,2} & \cdots & P_{1,\rho} \\ P_{2,1} & P_{2,2} & \cdots & P_{2,\rho} \\ \vdots & \vdots & \ddots & \vdots \\ P_{c-\rho,1} & P_{c-\rho,2} & \cdots & P_{c-\rho,\rho} \end{bmatrix}$$

40

45 [0069] The first column in $P_j = [P_{1,j}, P_{2,j}, \dots, P_{c-\rho,j}]^T$, $j=1, 2, \dots, \rho$ is called the j th column generator of the generation matrix G, and then G has ρ column generators in all.

[0070] The coding process consists in the steps of first filling b zeros at back of the source bits to obtain code information bits with its length being K, and then performing LDPC coding. The number of the filled zeros varies for LDPC codes of different code rates. Table 3 shows the coding parameters for LDPC codes of two code rates.

50

Table 3

N	K	b	t	$\omega_{i,j}$
4608	2304	0	72	0 or 1
4608	3096	24	72	0 or 1

55

[0071] The above suitable channel coding schemes are employed on demand to perform channel coding on the T-MMB service data, thereby obtaining a great interference proof.

In order to better adapt to a channel environment of great time variability, the channel-encoded service data can be subject to time interleaving, which also ensures that DAB system is applicable to mobile reception. In this embodiment, the channel-encoded data undergoes time interleaving in the same mode as that in the DAB system.

5 Step 504 of embedding the time-interleaved service data into the main service channel (MSC) of the DAB system in a time division multiplex mode;

In this embodiment, the transmission frame of the system uses the same format as that of the DAB transmission frame. The main service channel is composed of common interleaved frames (CIFs). The minimum address unit of one CIF is capacity unit (CU), and each CIF consists of 864 CUs. The size of a CU is $32 \times n$ bits, and n has three values corresponding to three different differential modulation schemes respectively, that is, $n=2$ for DQPSK, $n=3$ for 8DPSK, and $n=4$ for 16DAPSK. Taking the transmission mode being I and the T-MMB service being transmitted in the stream mode as example, frame configuration of the T-MMB system is as shown in Fig.7a when the modulation scheme is 8DPSK and the channel coding scheme is LDPC coding, and the frame configuration of the T-MMB system is as shown in Fig.7b when the modulation scheme is 16DAPSK and the channel coding scheme is RS plus concatenated convolutional coding.

[0072] Of course, in practice, channel modulation schemes of a higher order can also be used, for example, 32DAPSK ($n=5$), 64DAPSK ($n=6$), etc.

20 [0073] As seen in Fig.7, the transmission method of this embodiment maintains the frame configuration of DAB system, the size of CUs corresponding to DAB, DAB-IP and T-DMB signals remains unchanged, the size of CU corresponding to T-MMB signal varies with the modulation scheme, but the number of CUs contained in CIF is the same. The frame configuration in the system of this embodiment enables the newly-added service to support various modulation schemes.

[0074] The above Fig.7 shows the frame configuration explained by the example in which T-MMB service is transmitted in the stream mode. In fact, the method of the invention can also support the transmission of T-MMB service in a packet mode. When T-MMB service is transmitted in the packet mode, the frame configuration is formed as shown in Fig.7, except that the subsequent processing such as channel coding should be performed after it is packetized to data packets of certain length in the DAB packet mode. If LDPC coding is used, the data packets of certain length are need to be buffered as LDPC code length before they are encoded.

25 [0075] Step 505 of identifying accordingly in the fast information channel (FIC) the service type, information on occupied sub-channel, encoding and modulation schemes corresponding to the service data of four types, and then performing channel coding on the data in the FIC;

[0076] In this embodiment, to achieve multiplex transmission for various service data, the service type of each service data, the information on the occupied sub-channel when embedded into MSC, encoding and modulation schemes of the service data are identified accordingly in the FIC. More specifically, it establishes the fast information group (FIG) for FIC in T-MMB system based on the FIG transmitted in FIC of DAB system, and identifying in FIG of FIC in T-MMB system the service type, the information on the occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data.

a. Service Type Description

40 [0077] FIG type 0/ extension mode 2 (0/2) transmitted in FIC defines the service information in DAB, as shown in Fig. 8, and the specific definition can be referred to ETSI EN 300 401. In this embodiment, extension is made to part content in FIG 0/2 as follow.

45 - ASCTy (Audio service component Type): the 6-bit field indicates the type of audio service component, and the following identifiers for two audio coding schemes added to this embodiment are
000011 : MPEG-4 HE AAC V2
000100 : MPEG-4 ER-BSAC

50 - DSCTy (Data Service Component Type): the 6-bit field indicates the type of data service component, and a detail explanation for this part is found in the definition in Table 2, TS 101 756[2]. A new service type identifier is added to this embodiment as
011101: T-MMB Service.

55 [0078] The sub-channel information and the coding and modulation schemes for various services are indicated by the reserved FIG 0/15 (ETSI EN 300 401 [1]) as shown specifically in Fig.9.

- SubChId (Sub-channel identifier): the 6-bit field is encoded to an unsigned binary number for indicating some sub-channel.

- Start Address: the 10-bit field is encoded to an unsigned binary number in the range from 0 to 863 and indicates the address of the first capacity unit (CU) in the sub-channel.
- ModuType (Modulation Type): the 2-bit field is used to indicate DQPSK/8DPSK/16DAPSK modulation in such mode as
 00: DQPSK;
 01: 8DPSK;
 10: 16DAPSK;
 11: reserved.
- Coding Type: the one bit is used to indicate the channel coding scheme in such mode as
 0: RS concatenated convolutional coding;
 1: LDPC coding;
- Rfu: the one bit is reserved for the future addition and is set to 0 before it is defined.
- Sub-channel field (Sub-channel Data Field): the 12-bit field indicates the size of the sub-channel and the code rate of the channel coding.
- PL(Protection Level): the two bits indicate the code rate of the channel coding in such mode as
 00: protection level 1-C denoting that the code rate of the channel coding is 1/2;
 01: protection level 2-C denoting that the code rate of the channel coding is 2/3;
 Other values are reserved for use in future.
- Sub-channel Size: the 10-bit field is encoded to an unsigned binary number in the range from 1 to 864 and gives the number of the capacity units occupied by the sub-channel, which is obtained according to the modulation scheme and the protection level, as shown in Table 4 and 5. Table 4 shows the sizes of the data sub-channels with different modulation schemes when the protection level is 1-C and the data rate is 24n Kbit/s (n is an integer greater than or equal to 1), while Table 5 shows the sizes of the data sub-channels with different modulation schemes when the protection level is 2-C and the data rate is 32n Kbit/s (n is an integer greater than or equal to 1).

Table 4

Modulation scheme	DQPSK	8DPSK	16DAPSK
Sub-channel size(CUs)	18n	12n	9n

Table 5

Modulation scheme	DQPSK	8DPSK	16DAPSK
Sub-channel size(CUs)	18n	12n	9n

b. User information Description

[0079] User application information is defined in FIG 0/13(ETSI EN 300 401 [1]). This embodiment extends part content of the mode as specifically shown in Fig. 10.

User Application Type: the 11 bits give the user applications required to be decoded. These applications are identified by service identifier (SId) and service component identifier (SCId), the definitions of which can be referred to Table 16, TS 101 756 [2]. In this embodiment, the item is extended as follows:

0x00b: T-MMB service

User Application data: the $m \times 8$ bits are used to transmit the user application information data which is decided by User Application Type when decoding. For a new service of T-MMB system, one byte denoted as VideoServiceObjectProfiled is needed to express the service property of T-MMB system.

T-MMB video service framework 1 and framework 2 can be identified VideoServiceObjectProfileId=0x01 and VideoServiceObjectProfileId=0x02, respectively.

The process of performing channel coding on FIC data is the same as that in DAB system, the description of which will be omitted here.

Step 506 of performing channel modulation on the data of FIC and MSC according to the determined transmission mode and the channel modulation scheme, performing OFDM and RF modulations on the channel-modulated the FIC and MSC data and the synchronization channel data, and then sending them out.

[0080] In this embodiment it is specified that one transmission frame is composed of a synchronization channel (Sync), a fast information channel (FIC) and a main service channel (MSC) and has the same basic structure as that of DAB system, the description of which will be omitted here.

[0081] In this embodiment, the modulation for OFDM sub-carrier is particularly called channel modulation, and the process of OFDM multiplexing and symbol formation is called OFDM modulation in order to clarify the technology related to each part. The RF modulation following the OFDM modulation is to modulate the OFDM symbols to a specified operating frequency. Since the channel modulation performed on respective channel data is actually the modulation for OFDM sub-carrier, the above channel modulation and OFDM modulation can be called OFDM modulation as a whole.

[0082] The channel modulation scheme in the old DAB system is Differential Quadrature Phase Shift Keying (DQPSK). since digital video data has a high code rate, the use of the channel modulation scheme in the old DAB system will give rise to a disadvantage of a low utilization rate of frequency band. To solve this disadvantage, in this embodiment, the support to two new modulation schemes, 8-level Differential Phase Shift Keying (8DPSK) and 16-level Differential Amplitude and Phase Shift Keying (16DAPSK) is provided on the basis of the DAB system. These channel modulation schemes all have a process of performing symbol mapping first and then differential modulation.

[0083] Hereafter, a detail introduction will be given to the two newly-added modulation schemes, which begins with symbol mapping.

1) 8-level Phase Shift Keying (8PSK)

[0084] Fig. 11 shows constellation for 8PSK. For each OFDM symbol, it is needed to map a $3K$ -bit vector $(p_{l,n})_{n=0}^{3K-1}$ (where $p_{l,n}$ is referred to Section 14.4.2, ETSI EN 300 401[1]) into K symbols of 8PSK in such mode as

$$q_{l,m} = e^{j\Phi_{l,m}}, m=0,1,2,\dots,K-1$$

Where K represents the number of sub-carriers, $\Phi_{l,m}$ is shown in Table 6.

Table 6

$\Phi_{l,m}$	$p_{l,3m} p_{l,3m+1} p_{l,3m+2}$
0	0 0 1
$\pi/4$	0 0 0
$\pi/2$	1 0 0
$3\pi/4$	1 1 0
π	0 1 0
$5\pi / 4$	0 1 1
$3\pi/2$	1 1 1
$7\pi/4$	1 0 1

2) 16-level Amplitude and Phase Shift Keying (16APSK)

[0085] Fig. 12 shows constellation for 16APSK. For each OFDM symbol, it is needed to map a $4K$ -bit vector $(p_{l,n})_{n=0}^{4K-1}$ into K symbols of 16APSK in such mode as

$$q_{l,m} = A_{l,m} e^{j\Phi_{l,m}}, m=0,1,2,\dots,K-1$$

Where $\Phi_{l,m}$ is shown in Table 7, and $A_{l,m} = \alpha p_{l,4m}$.

Table 7

$\Phi_{l,m}$	$p_{l,4m+1} p_{l,4m+2} p_{l,4m+3}$
0	0 0 1
$\pi/4$	0 0 0
$\pi/2$	1 0 0

(continued)

$\Phi_{l,m}$	$\rho_{l,4m+1} \rho_{l,4m+2} \rho_{l,4m+3}$
$3\pi/4$	1 1 0
π	0 1 0
$5\pi/4$	0 1 1
$3\pi/2$	1 1 1
$7\pi/4$	1 0 1

[0086] Next, differential modulation is introduced.

1) 8DPSK

[0087] The differential modulation is performed on one and the same sub-carrier of two adjacent OFDM symbols (that is, temporal differential) based on the following expression

$$z_{l,k} = z_{l-1,k} \cdot y_{l,k},$$

$l = 2, 3, 4, \dots, L,$
 $-K/2 \leq k \leq K/2$

[0088] Where $z_{l-1,k}$ represents a differential modulated signal of the k th sub-carrier of the $(l-1)$ th OFDM symbol, and $y_{l,k}$ represents the mapped signal of the k th sub-carrier of the l th OFDM symbol after frequency domain interleaving.

2) 16DAPSK

[0089] DAPSK is a combined modulation scheme of differential amplitude and phase, in which differential modulation is performed on amplitude and phase independently. In 16DAPSK, the amplitude is modulated by 2DASK, while the phase is modulated by 8DPSK.

[0090] The differential modulation is performed on one and the same sub-carrier of two adjacent OFDM symbols based on the following expressions

$$z_{l-1,k} = R_L \cdot \alpha^{p_{l-1,4k}'} \cdot e^{j\Phi_{l-1,k}}$$

$$y_{l,k} = \alpha^{p_{l,4k}'} \cdot e^{j\Phi_{l,k}}$$

$$z_{l,k} = R_L \cdot \alpha^{(p_{l-1,4k}' + p_{l,4k}') \bmod 2} \cdot e^{j(\Phi_{l-1,k} + \Phi_{l,k})},$$

$l = 2, 3, 4, \dots, L,$
 $-K/2 \leq k \leq K/2$

[0091] Where R_L represents the inner loop amplitude of 16DAPSK, $p_{l-1,4k}'$ and $p_{l,4k}'$ represents the amplitude mapped bit in the corresponding symbol after frequency domain interleaving, and $\Phi_{l-1,k}$ and $\Phi_{l,k}$ represent the phase information after frequency domain interleaving.

[0092] The above describes the two newly-added channel modulation schemes. Different channel modulation schemes can be adopted according to different channels occupied by various data. In this embodiment, the data in FIC are still channel-modulated by use of DQPSK in the DAB system, and the data in the synchronization channel is also used for

the differential modulation with the data in FIC and MSC in the same mode as that in the DAB system. The DAB, DAB-IP and T-MMB data in MSC are channel-modulated by means of the old DQPSK in the DAB system. The T-MMB signal in MSC can use appropriately the old or newly-added channel modulation schemes according to the requirements.

[0093] Since the channel modulation is essentially the modulation on OFDM sub-carriers, the data must be first divided into blocks prior to the channel modulation. Then, according to different channel modulation schemes, the symbol mapping is performed on data in the different channels. The obtained result for the symbol mapping is frequency-interleaved and inserted into a phase reference symbol of the synchronization channel for differential modulation together with the frequency-interleaved result. Thus, the overall channel modulation process is completed.

[0094] The data on sub-carriers are divided into blocks depending on different transmission modes. The so-called transmission mode means that during OFDM modulation in the old DAB system, parameters, such as the number of sub-carriers, guard gap length and wave band, are combined to form four modes selectable by users. Table 8 shows the parameters corresponding to the four modes.

Table 8 Parameters for DAB modes

Parameters	Transmission mode I	Transmission mode II	Transmission mode III	Transmission mode IV
S	76	76	153	76
K	1536	384	192	768
N	2048	512	256	1024
T_s	~1246	~312	~156	~623
T_u	1000	250	125	500
T_G	~246	~62	~31	~123
T_F	96	24	24	48

[0095] The meaning of each symbol in Table 8 is as follows.

S: the number of OFDM symbols in each transmission frame (excluding null symbol)

K: the number of sub-carriers in one OFDM symbol

N: FFT size (dots)

T_s : the overall duration of one OFDM symbol (μ s)

T_u : the duration of effective signal in one OFDM symbol (μ s)

T_G : guard gap (μ s)

T_F : the duration of each transmission frame (ms)

[0096] Theoretically, the DAB supports various wave bands. Table 9 shows the wave bands available for each DAB mode, and Table 10 shows frequency range of each wave band.

Table 9 Wave bands available for DAB modes

Transmission mode	Wave bands available in the DAB standard
Transmission mode I	Band I □ Band II □ Band III
Transmission mode II	Band I □ Band II □ Band III □ Band IV □ Band V □ L-Band
Transmission mode III	<3GHz
Transmission mode IV	Band I □ Band II □ Band III □ Band IV □ Band V □ L-Band

Table 10 Wave band range

Wave bands	Frequency range□MHz□
Band I	47-86
Band II	87.5-108
Band III	174-230
Band IV/V	470-790
L-Band	1452-1492

[0097] At present, the DAB operating frequencies Band III and L-Band have been distributed in most part of the world, especially in Europe where the infrastructure for DAB has accounted for 80%. Table 11 shows the actual application status of various modes and wave bands for DAB. The modes of common use are substantially of two types corresponding to Band III and L-Band, respectively. It is worth emphasizing that such correspondence is optimal when the modulation scheme is DQPSK, while such corresponding relation with operating frequency in the current mode is not optimal when the T-MMB system adopts a high-order modulation scheme such as 16DAPSK. Therefore, it is necessary to re-select modes.

Table 11 Actual application status

Wave bands	Actually used wave bands in DAB system	Actually corresponding transmission modes in DAB system	Recommended transmission modes in T-MMB system
Band I	NO	NO	NO
Band II	NO	NO	NO
Band III	Yes	Transmission mode I	Transmission mode IV
Band IV	NO	NO	NO
L-Band	Yes	Transmission mode II	Transmission mode III

[0098] Since a higher-order modulation scheme is used in the T-MMB system, the time variable interference cannot be neglected. The factors affecting the time variable interference consist of moving speed, carrier frequency and the block length of OFDM symbol. In order to resist the time variable interference, the parameters, such as the number of carriers, the length of guard gap, the operating frequency and the number of modulation constellations, are recombined in the T-MMB system. The time variable interference is resisted by reducing the block length of OFDM symbol. To be compatible with the DAB system, the block length of OFDM symbol in the T-MMB is reduced by adjusting the modes corresponding to the wave bands actually used in the DAB. After the above modification, the T-MMB system can support the high efficient and low-complexity 16DAPSK modulation scheme as well as the high-speed mobile reception. Table 11 shows the modes and corresponding wave bands recommended in the T-MMB system, where the number of carriers of OFDM symbol is reduced by half, as compared with the DAB, DAB-IP and T-DMB systems.

[0099] In this embodiment, the correspondence between channel modulation schemes, used transmission modes and operating frequencies can be preset, for example, the old correspondence between transmission modes and operating frequencies can be used when the channel modulation scheme is DQPSK, while the correspondence between transmission modes and operating frequencies as shown in Table 11 can be used when the channel modulation scheme is a more efficient channel coding scheme, such as 16QAPSK.

[0100] Prior to the channel modulation, the transmission mode is determined with reference to the preset correspondence, based on the channel modulation scheme and system operating frequency to be used by the data in each channel, and the size of data block is further determined so as to divide the data in different channels into blocks. Then, the channel modulation and OFDM modulation are performed on the data in each channel according to the set parameters in the transmission mode and the channel modulation scheme to be used by each channel. Finally, the OFDM symbol is modulated onto the specified operating frequency and sent out.

[0101] By far, the flow of the DAB-compatible T-MMB transmission method in this embodiment has been completed. As seen from the above flow, the transmission method of the invention can simultaneously transmit all kinds of service data including DAB, DAB-IP, T-DMB and T-MMB, and on the basis of the old DAB system, extends the channel coding and modulation schemes to enable the system to support more efficient coding and modulation schemes. In this em-

bodiment, it additionally provides the channel modulation schemes of 8DPSK and 16DAPSK, and of course, a more efficient modulation scheme, for example, 64DAPSK, can be used as well. The system in this embodiment is more suitable for transmitting video data, thanks to the application of various high efficient coding and modulation schemes. Furthermore, when a high efficient channel modulation scheme is adopted, the actually used frequency and transmission mode in the embodiment are modified accordingly, to better suit for the high-efficient and low-complexity modulation scheme.

[0102] In the above transmission method, the process of performing source coding and channel coding on the service data and embedding it into MSC precedes the step of identifying in FIC the coding and modulation schemes and the sub-channel information, that is, Step 505 follows Steps 502~504. In fact, after the determination of the coding and modulation schemes, the process of source and channel coding and embedding into MSC can be performed in parallel with the operation of identifying in FIC the coding and modulation schemes and the sub-channel information, or it can be carried out in an inverse order.

[0103] In this embodiment, it also provides the DAB-compatible T-MMB reception method corresponding to the transmission method, which is used to receive the data processed and sent by the above transmission method and process accordingly the data to recover the original multimedia service data.

[0104] Fig. 13 is a detailed flowchart for the DAB-compatible T-MMB reception method in this embodiment of the present invention. As shown in Fig.13, the method comprises

Step 1301 of performing RF demodulation, synchronization and OFDM demodulation on the received signal to obtain the data in FIC and MSC;

In this step, the RF demodulation, synchronization and OFDM demodulation on the received signal are performed according to the schemes in the DAB system, the description of which will be omitted here.

Step 1302 of performing channel demodulation and channel decoding on the data of FIC, and extracting the service data of a corresponding service type in the sub-channel from MSC based on the control information in FIC;

In this step, the channel demodulation and channel decoding on the data of FIC are the same as that in the DAB system, thereby obtaining various control information in FIC and the coding and modulation schemes of various service data.

[0105] Corresponding to the mode that the sub-channel information is identified in FIC at the transmitting end, the positions in MSC for the data of each service type are read according to the positions in FIC for the sub-channel information in Fig.8, and then the four types of service data are extracted based on the read positions.

Step 1303 of performing channel demodulation on the extracted service data in MSC based on the judged transmission mode and the channel modulation scheme for various service data identified in FIC;

In this step, with reference to the preset correspondence between the channel modulation scheme and the transmission mode and operating frequency, the transmission mode is judged according to the employed channel modulation scheme and the operating frequency specified by the system.

When the service data is channel de-modulated, the DAB, DAB-IP and T-DMB signals are channel de-modulated according to the old DAB standard. As for T-MMB signal, since the channel modulation scheme added to this embodiment may be used at the transmitting end, it is required to extract the control information for the corresponding channel modulation scheme in FIC based on the preset control information for the channel modulation scheme, and to perform accordingly the channel de-modulation depending on the identifiers therein. Specifically, in this embodiment, since the channel modulation scheme shown in Fig.8 is used at the transmitting end, the content of corresponding fields is also extracted as shown in Fig.8 in this step, and the channel modulation scheme is analyzed for channel demodulation.

Step 1304 of performing channel decoding and source decoding on the service data of various types based on the control information in FIC;

In this step, the DAB, DAB-IP and T-DMB signals are processed according to the old DAB standard. As for T-MMB signal, since the channel coding scheme added to this embodiment may be used at the transmitting end, it is required to extract the control information for the corresponding coding scheme from FIC based on the preset control information for the coding scheme upon performing channel and source decoding on the signals of two types, and to perform accordingly the source and channel decoding based on the identified source and channel coding schemes therein. Specifically, in this embodiment, since the source and channel coding schemes shown in Fig.8 are used at the transmitting end, the content of corresponding fields is also extracted as shown in Fig.8, and the source and channel coding schemes are analyzed for source and channel decoding.

[0106] When at the transmitting end it includes conditional access scrambling, energy dispersal and time interleaving, accordingly, the time de-interleaving, channel decoding, energy de-dispersal, conditional access descrambling and

source decoding are performed sequentially on the data in each sub-channel after the service data are extracted at the receiving end.

5 [0107] By far, the DAB-compatible T-MMB reception method corresponding to the transmission method in this embodiment has been completed. In fact, since in the present invention, the coding and modulation on the three types of signals of DAB, DAB-IP and T-DMB in the transmitted data are based on their own old standards, respectively, each type of signal can be successfully received by using DAB, DAB-IP or T-DMB reception method and normally played after de-modulation and decoding. On the other hand, with the reception method of the invention, four types of signals including DAB, DAB-IP, T-DMB and T-MMB can be normally received and accordingly de-modulated, decoded and played.

10 [0108] The above describes the detailed implementation for the DAB-compatible T-MMB transmission and reception methods in this embodiment of the invention, which can achieve the goal of efficiently transmitting multiple types of service data, are suitable for mobile reception and have excellent frequency availability.

15 [0109] The above transmission method of this embodiment can be implemented in physical transmitters, by which the formed multimedia service signals can be transmitted to cover a certain region. The corresponding receivers within this region can receive the multimedia service signals by means of the above reception method. These transmitters and receivers can be flexibly networked such that they can constitute a Multi-Frequency Network (MFN) or a Single Frequency Network (SFN), thereby constituting a DAB-compatible T-MMB transmission system. Hereafter, the detailed implementation for the DAB-compatible T-MMB transmission system in the invention will be explained by example of a single frequency network.

20 [0110] Fig. 14 is a detailed structural diagram for the DAB-compatible T-MMB system in the embodiment of the present invention. As shown in Fig.14, the system comprises a broadcasting station or network control center (NCC) 1410, more than one transmitting stations 1420 located in different areas which can be local broadcasting stations or regional transmitting base stations, and more than one receivers 1430.

25 [0111] In this way, an integral terrestrial mobile multimedia broadcasting network can be established, which is a single frequency network in this embodiment. The transmitting stations 1420 receive multipath digital multimedia broadcasting (program) signals, which can include DAB, DAB-IP, T-DMB and T-MMB signals, from some broadcasting station or the network control center 1410, perform source and channel coding on the signals, and embed the encoded data into the main service channel (MSC) of the DAB system in a time division multiplex mode. The transmitting stations 1420 further identify accordingly in the fast information channel (FIC) the service type, information on occupied sub-channel, coding and modulation schemes corresponding to the service data, and then perform channel coding on the data in FIC. The transmitting stations 1420 also perform channel modulation on the data in FIC and MSC based on the determined transmission mode and the channel modulation scheme, and perform OFDM modulation and RF modulation on the channel modulated data of FIC and MSC and the data of the synchronization channel before sending them out. The transmitted signals are sent to terrestrial mobile receivers or portable receivers 1430, for example, mobile phone TV, via ground wave. The receivers 1430 are used for performing RF demodulation, OFDM demodulation and synchronization on the received RF signals, extracting the service data of a corresponding service type in the sub-channel based on the control information from FIC obtained after channel demodulation and channel decoding, and performing sequentially channel demodulation, channel decoding and source decoding on the extracted service data according to the coding schemes for the service type in FIC.

35 [0112] The user receivers 1430 within the coverage region can be DAB, DAP-IP, T-DMB and T-MMB receivers. The coverage range depends on many factors, for example, landform, the height and power of transmission tower, receiver antenna and gain/ directionality, etc.

40 [0113] Therefore, the signals received by users include not only the directly arriving signals, but also the signals undergone one or more reflections as well as the signals transmitted by remote transmitters in a multi-frequency network or a same frequency network. This gives rise to the problem of multipath interference. In addition, Doppler effect exists for mobile receivers. Thus, the transmission channel is modeled as a time variable multipath channel. Because the present invention uses the structure of DAB system, in which the design of the transport layer itself is customized for this time variable multipath channel, the T-MMB transmission system of the invention supports mobile reception and SFN networking.

45 [0114] The most basic transmitting station includes a receiving module, a source coding module, a channel coding module, a channel multiplexing module and a modulating & transmitting module. In this embodiment, it further includes a conditional access scrambler, an energy disperser and a time interleaver. Specifically, the transmitting station 1420 has a structure as shown in Fig. 15. The transmitting station 1420 comprises a receiving module 1421, a source coding module 1422, a conditional access scrambler 1423, an energy disperser 1424, a channel coding module 1425, a time interleaver 1426, a FIC data formation module 1427, a channel multiplexing module 1428 and a modulating & transmitting module 1429.

50 [0115] In the transmitting stations 1420, the receiving module 1421 is used for receiving the multipath digital multimedia broadcasting (program) signals from some broadcasting station or the network control center 1620 and forwarding the

signals to the source coding module 1422. These signals can include DAB, DAB-IP, T-DMB and T-MMB signals.

[0116] The source coding module 1422 is used for performing source coding on the signals forwarded from the receiving module 1421 based on the service type of the signals and then sending the encoded result to the conditional access scrambler 1423. The conditional access scrambler 1423 is used for performing conditional access scrambling on the received data and then sending the result to the energy disperser 1424. The energy disperser 1424 is used for performing energy dispersal on the received data and then sending the result to the channel coding module 1425. The channel coding module 1425 is used for performing channel coding on the received signals based on the service type of the signals, the process of which can be specifically carried out according to the channel coding scheme at the Step 503 shown in Fig.5, and sending the result to the time interleaver 1426. The time interleaver 1426 is used for performing time interleaving on the received data and then sending the result to the channel multiplexing module 1428. The FIC data formation module 1427 is used for identifying accordingly in FIC the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, performing channel coding on the data in FIC and sending the encoded result to the channel multiplexing module 1428. The channel multiplexing module 1428 is used for inserting the signals into MSC based on the service type in a time division multiplex mode, and multiplexing the MSC data and the FIC encoded result sent from the FIC data formation module 1427 before sending them to the modulating & transmitting module 1429. The modulating & transmitting module 1429 is used for performing channel modulation on the received FIC and MSC data based on the determined transmission mode and the channel modulation scheme, performing OFDM modulation on the channel-modulated FIC and MSC data and the data of the synchronization channel, and modulating the result to the preset operating frequency before sending them out.

[0117] DAB, DAB-IP and T-DMB receivers each can successfully receive respective signals and be normally played after demodulation and decoding. Here the structure of a T-MMB receiver is introduced in detail. Fig. 16 is a detailed structural diagram for the T-MMB receiver in the embodiment of the present invention. The receiving end includes primarily four steps in an order and a procedure inverse to the transmitting end, that is, RF demodulation, base band demodulation, channel decoding and source decoding. Specifically, the T-MMB receivers 1430 comprise a receiving & demodulating module 1431, a FIC data extracting module 1432, a service data extracting module 1433, a channel demodulation module 1434, a channel decoding module 1435 and a source decoding module 1436. Further, since the transmitting station in this embodiment includes the conditional access scrambler, the energy disperser and the time interleaver, the receiver also includes a time de-interleaver 1437, an energy de-disperser 1438 and a conditional access descrambler 1439.

[0118] In the receivers 1430, the receiving & demodulating module 1431 is used for receiving the signals via the antenna, performing RF demodulation, synchronization and OFDM demodulation on the received signals to obtain FIC and MSC data, and sending them to the FIC data extracting module 1432 and the service data extracting module 1433, respectively. The FIC data extracting module 1432 is used for performing channel demodulation and channel decoding on the received FIC data and sending the FIC control information to the service data extracting module 1433, the channel demodulation module 1434, the channel decoding module 1435 and the source decoding module 1436.

[0119] The service data extracting module 1433 is used for extracting various service data from MSC based on the control information from FIC, and sending them to the channel demodulation module 1434. The channel demodulation module 1434 is used for performing channel demodulation on the received service data based on the judged transmission mode and the channel modulation scheme of various service data identified in FIC, and sending the demodulated data to the time de-interleaver 1437. The time de-interleaver 1437 is used for performing time de-interleaving on the received data, and sending them to the channel decoding module 1435.

[0120] The channel decoding module 1435 is used for performing accordingly channel decoding on the received signal based on the channel coding scheme of the signals identified in FIC, and sending the result to the energy de-disperser 1438. The energy de-disperser 1438 is used for performing energy de-dispersal on the received data, and then sending them to the conditional access descrambler 1439. The conditional access descrambler 1439 is used for performing conditional access descrambling on the received data, and then send them to the source decoding module 1436. The source decoding module 1436 is used for performing source decoding on the received signal based on the service type.

[0121] Since the transmission structure for DAB and T-DMB signals remains unchanged, when the user is a DAB, DAB-IP or T-DMB receiver, the receiver can process the corresponding service signals but not T-MMB service signal. On the other hand, the T-MMB receiver can process signals of four types of DAB, DAB-IP, T-DMB and T-MMB. Therefore, the T-MMB system can be sufficiently compatible with DAB, DAB-IP and T-DMB systems.

[0122] The above describes the detail structure of the T-MMB transmission system based on a single frequency network in the embodiment of the present invention. It is obvious that multiple single frequency networks can be combined into a multi-frequency network, in which the specific inner structures of transmission stations and receivers are the same as those in the single frequency networks, except for a different networking form and a larger coverage region. Here the repeated description will be omitted.

[0123] The above description is for the specific implementation of the present invention. In the embodiment, it is

assumed that DAB, DAB-IP, T-DMB and T-MMB signals are transmitted in the system. In practice, the types of service data to be transmitted in the system can be adjusted based on actual demand, while the selected transmission methods for signals remain the same.

[0124] The T-MMB transmitting and receiving method and system of the present invention are based on the multimedia service extension of the matured DAB system. On one hand, since DAB system is designed for handheld mobile terminals, the invention is also suitable for mobile reception and exhibits a satisfactory reception effect. On the other hand, since the control information in FIC extends the description for the information on each service sub-channel so that the method and the system of the invention are able to transmit simultaneously multiple types of multimedia service data, the drawback in the DAB system of a single service type is overcome. Further, the system of the invention extends the channel coding and modulation schemes of the existing DAB system, introduces high efficient channel modulation schemes, such as 8DPSK and 16QAPSK to overcome the disadvantage of the existing DAB system with a low efficiency for frequency band. The invention also introduces a stronger error correction coding scheme such as LDPC code so as to provide a stronger interference proof for multimedia data, especially video data, and makes the overall methods and system more suitable for the transmission of video programs. Finally, with respect to the used efficient channel modulation schemes and the problem of increased time variable interference due to these schemes, the invention makes compensation by shortening the block length for OFDM symbols, and gains an excellent effect in practical measurement, thereby fulfilling the signal quality requirement from users while improving the utilization ratio for frequency band.

[0125] In summary, As compared with mobile multimedia technology of other modes, the invention has advantages such as a good availability of frequency, a simple synchronization easy to implement, an excellent compatibility, a high utilization ratio for frequency band, support for portable and mobile reception, and a low-complexity receiver easy to implement, and etc.

[0126] The above description is only the preferred embodiment of the present invention and not intended to restrict the scope of the invention. Thus, any change, substitution, modification, etc. made without departing from the spirit and principle of the invention should be included in the scope of the invention.

Claims

1. A DAB-compatible transmitting method for terrestrial mobile multimedia broadcasting in which service type of multimedia broadcasting is predefined to be including terrestrial mobile multimedia broadcasting (T-MMB) service, the method comprises the steps of
 receiving multimedia broadcasting service data and performing sequentially source coding and channel coding on said service data according to their service type;
 embedding the encoded data into a main service channel (MSC) of the system in a time division multiplex mode, identifying accordingly the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, in a fast information channel (FIC) of the system, and performing channel coding on the data in FIC;
 performing channel modulating on the data in FIC and MSC according to the determined transmission mode and said channel modulation scheme, performing OFDM modulation and radio frequency (RF) modulation on the channel-modulated data of FIC, MSC and data of a synchronization channel, and then sending them out.
2. The method of Claim 1, wherein between the source coding and the channel coding on the received service data, the method further comprises performing sequentially conditional access scrambling and energy dispersal on the source-encoded data; and after the channel coding and before the time division multiplexing, the method further comprises performing time interleaving on the channel-encoded data.
3. The method of Claim 1 or 2, wherein when the service type is T-MMB service, said channel coding on the service data is a channel coding on the service data with concatenated code or low density parity check (LDPC) code.
4. The method of Claim 1 or 2, wherein the channel modulation on the T-MMB service data in a transmission frame is a channel modulating on said T-MMB service data by means of Differential Quadrature Phase Shift Keying (DQPSK), 8-level Differential Phase Shift Keying (8DPSK), 16-level Differential Amplitude and Phase Shift Keying (16DAPSK) or 64-level Differential Amplitude and Phase Shift Keying (64DAPSK).
5. The method of Claim 1, wherein when the encoded data is embedded into the main service channel (MSC) of a DAB system in a time division multiplex mode, the size of the corresponding capacity units (CUs) in MSC is determined according to the channel modulation scheme of the service data.

6. The method of Claim 5, wherein said determined size of the corresponding CUs in MSC is $n \times 32$ bits, where $n=2$ represents that the service data is modulated with DQPSK, $n=3$ with 8DPSK, $n=4$ with 16DAPSK, $n=5$ with 32DAPSK and $n=6$ with 64DAPSK.
- 5 7. The method of Claim 1, wherein said step of identifying accordingly the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data in the fast information channel (FIC) of the system comprises:
- 10 constructing a fast information group (FIG) of T-MMB system FIC based on FIG of the DAB system FIC, and identifying, in the FIG of T-MMB system FIC, the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data.
- 15 8. The method of Claim 7, wherein when the service type is T-MMB service, said step of identifying in the FIG of T-MMB system FIC the service type corresponding to the service data comprises adding a description for the service type of T-MMB system to a data service component type field in FIG type 0/extended mode 2 of T-MMB system FIC, and adding a description for T-MMB user application to a user application type field in FIG type 0/extended mode 13 of T-MMB system FIC.
- 20 9. The method of Claim 7, wherein when the service type is T-MMB service, said step of identifying in the FIG of T-MMB system FIC the information on sub-channel occupied by the service data comprises adding a sub-channel identification field in the FIG of T-MMB system FIC to identify the sub-channel occupied by the service data, and adding an initial address field in the FIG of DAB system FIC to identify an address of the first CU of the sub-channel.
- 25 10. The method of Claim 7, wherein when the service type is T-MMB service, said step of identifying in the FIG of T-MMB system FIC the channel coding scheme and the channel modulation scheme of the service data comprises adding a CodingType field in the FIG of T-MMB system FIC to identify the channel coding scheme of T-MMB service, adding a Sub-channel field in the FIG of T-MMB system FIC to identify the sub-channel size of T-MMB service and protection level of the employed error correction code, and adding a ModuType field for the modulation type in the FIG of T-MMB system FIC to identify the channel modulation scheme of T-MMB service.
- 30
- 35 11. The method of Claim 1, wherein said step of determining the transmission mode comprises determining the transmission mode based on the employed channel modulation scheme and the operating frequency specified by the system, with reference to the predefined correspondence between channel modulation scheme, transmission mode and operating frequency.
- 40 12. The method of Claim 11, wherein when said channel modulation scheme is m-DPSK or m-DAPSK, m is any of 16, 32 and 64 or their arbitrary combination, the transmission mode IV is used in case that the operating frequency of T-MMB is BandIII, and the transmission mode III is used in case of L-Band; when said channel modulation scheme is DQPSK, the transmission mode I is used in case that the operating frequency of T-MMB is BandIII, and the transmission mode II is used in case of L-Band.
- 45 13. A DAB-compatible receiving method for terrestrial mobile multimedia broadcasting comprises the steps of performing RF demodulation, OFDM demodulation and synchronization on the received signal, obtaining data of FIC and MSC, and judging the employed transmission mode; performing sequentially channel demodulation and channel decoding on said FIC data, and extracting service data of a corresponding type in a sub-channel from MSC based on control information of FIC; performing sequentially channel demodulation, channel decoding and source decoding on the extracted service data based on the judged transmission mode and the identified schemes of channel modulation, channel coding and source coding of various service data in the FIC.
- 50
- 55 14. The method of Claim 13, wherein said step of judging the transmission mode comprises judging the transmission mode based on the employed channel modulation scheme and the operating frequency specified by the system, with reference to the predefined correspondence between channel modulation scheme, transmission mode and operating frequency.
15. A DAB-compatible system for terrestrial mobile multimedia broadcasting comprises a network control centre (NCC) for sending multimedia broadcasting service data to a transmitting station;

said transmitting station for receiving the multimedia broadcasting service data from said NCC, performing source coding and channel coding on said service data based on their service type, embedding the encoded data into MSC of the system in a time division multiplex mode, identifying accordingly in a fast information channel (FIC) the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, performing channel coding on the data in FIC, performing channel modulation on the data of FIC and MSC based on the determined transmission mode and said channel modulation scheme, and performing OFDM modulation and RF modulation on the channel modulated data of FIC and MSC and data of the synchronization channel before transmitting them to a receiver in the system; and
 5 said receiver for performing RF demodulation, OFDM demodulation and synchronization on the received RF signal from said transmitting station, extracting service data of a corresponding service type in a sub-channel based on FIC control information obtained after channel demodulation and channel decoding, and performing channel demodulation, channel decoding and source decoding.

16. The system of Claim 15, wherein said transmitting station includes

15 a receiving module for receiving multimedia broadcasting service data from said NCC and forwarding the service data to a source coding module,
 said source coding module for performing source coding on the signal forwarded from said receiving module based on the service type of the service data, and then sending the result of source coding to a channel coding module,
 said channel coding module for performing channel coding on the received data and sending the result to a channel
 20 multiplexing module,
 a FIC data formation module for identifying accordingly in FIC the service type, information on occupied sub-channel, source coding scheme, channel coding scheme and channel modulation scheme corresponding to the service data, performing channel coding on the data in the FIC, and sending the encoding result to said channel multiplexing module,
 25 said channel multiplexing module for embedding the received service data into MSC based on the service type in a time division multiplex mode, and multiplexing the MSC data and the FIC encoding result sent from said FIC data formation module before sending them to a modulating & transmitting module,
 said modulating & transmitting module for performing channel modulation on the received FIC and MSC data based on the determined transmission mode and said channel modulation scheme, and performing OFDM modulation
 30 and RF modulation on the channel-modulated FIC and MSC data and the data of the synchronization channel before sending them to said receiver.

17. The system of Claim 16, wherein said transmitting station further includes

35 a conditional access scrambler for performing conditional access scrambling on the received data from said source coding module before sending them to an energy disperser,
 said energy disperser for performing energy dispersal on the received data before sending them to said channel coding module, and
 a time interleaver for performing time interleaving on the received data from said channel coding module before sending them to said channel multiplexing module.

18. The system of any of Claim 15 to 17, wherein said receiver is one of a DAB receiver, a DAB-IP receiver, a T-DMB (Digital Multimedia Broadcasting) receiver and a T-MMB receiver, or their arbitrary combination.

19. The system of Claim 18, wherein said T-MMB receiver includes

45 a receiving & demodulating module for receiving the RF signal from said transmitting station, performing RF demodulation, OFDM demodulation and synchronization on the received signal to obtain FIC and MSC data, and sending them to a FIC data extracting module and a service data extracting module, respectively,
 said FIC data extracting module for performing channel demodulation and channel decoding on the received FIC data, and sending the FIC control information to said service data extracting module, a channel demodulation
 50 module, a channel decoding module and a source decoding module,
 said service data extracting module for extracting various service data from MSC based on the FIC control information, and sending them to said channel demodulation module,
 said channel demodulation module for performing channel demodulation on the received service data, based on the judged transmission mode and the channel modulation of various service data identified in FIC, and sending
 55 the demodulated data to said channel decoding module, s
 said channel decoding module for performing correspondingly channel decoding on the received signal based on the channel coding scheme identified in FIC, and sending the result to said source decoding module,
 said source decoding module for performing source decoding on the received signal based on the service type.

Fig1

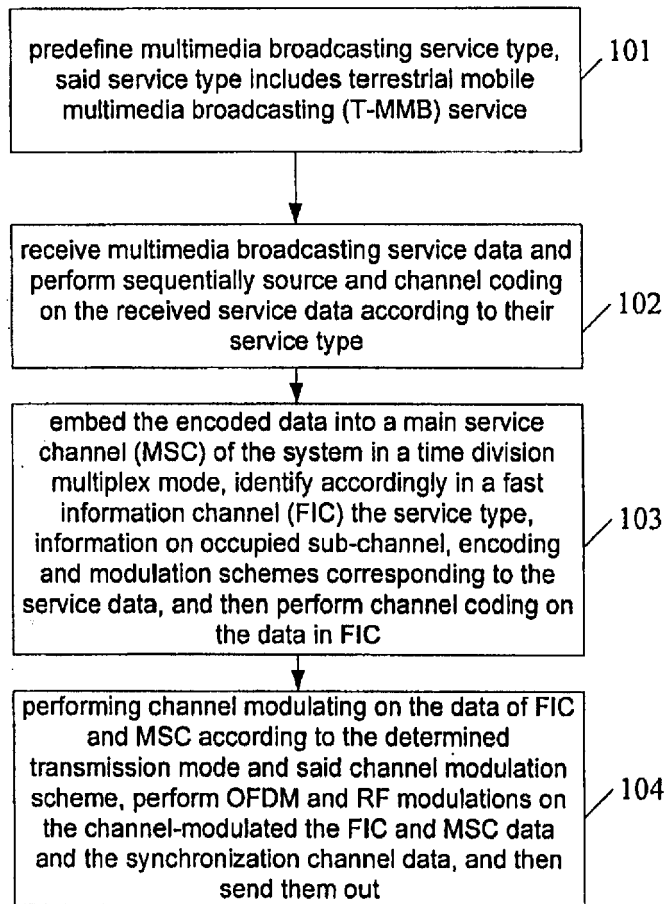


Fig2

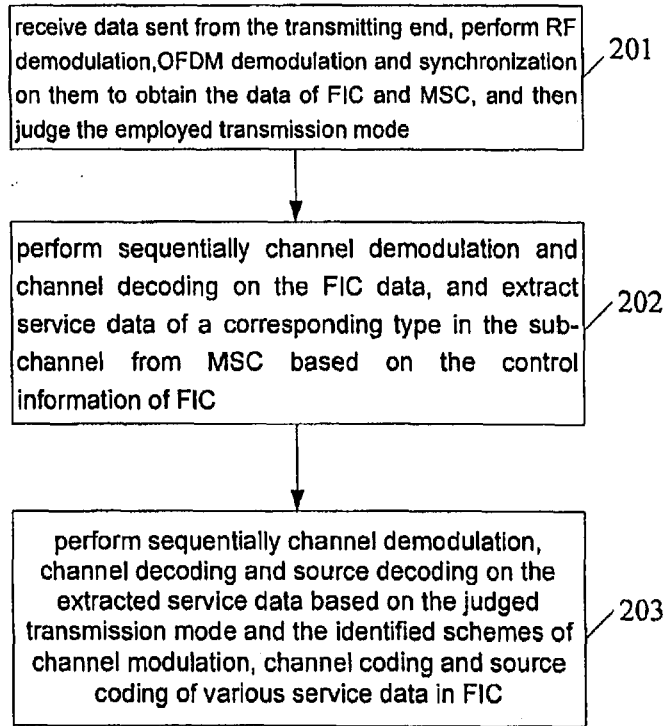


Fig3

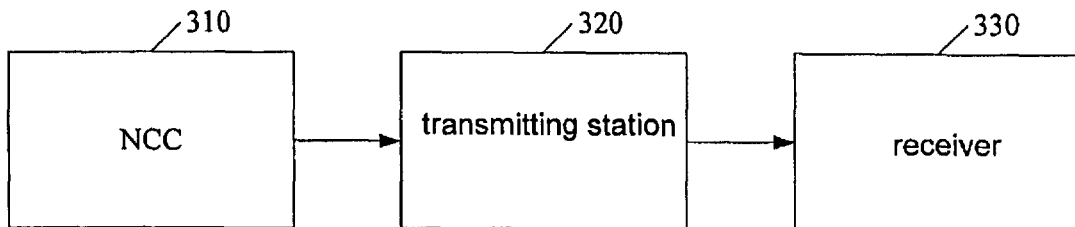


Fig4

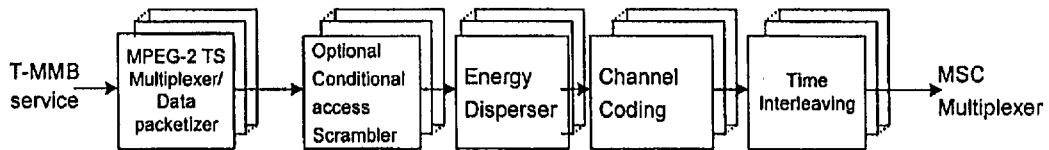
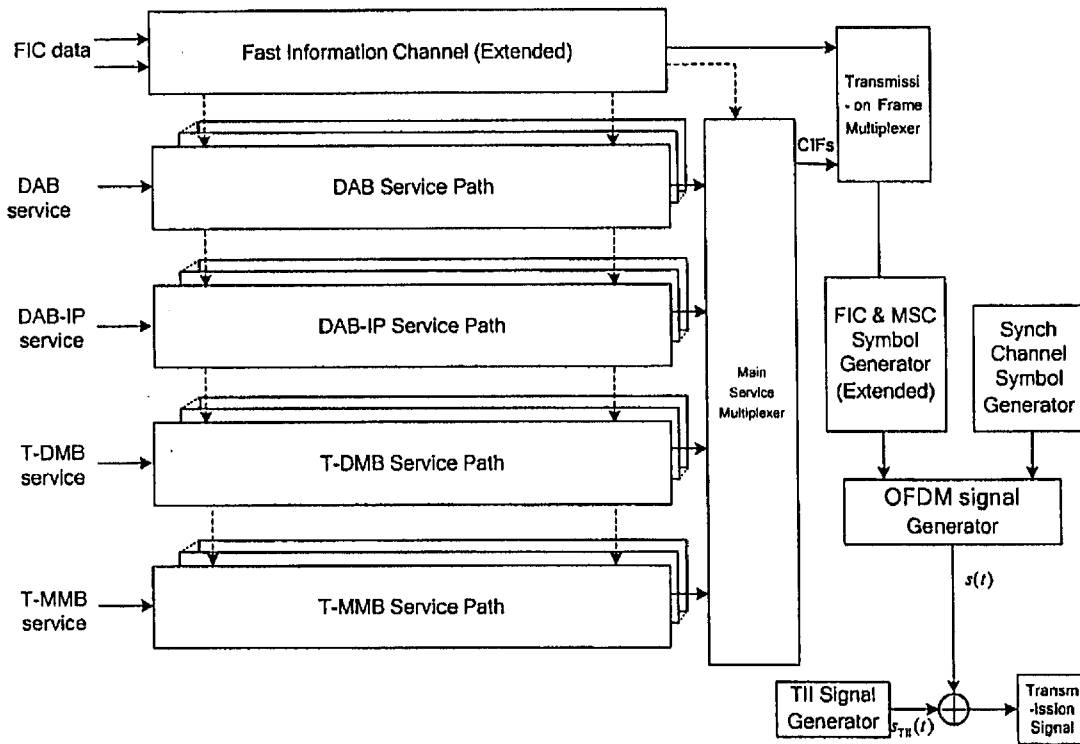


Fig. 5

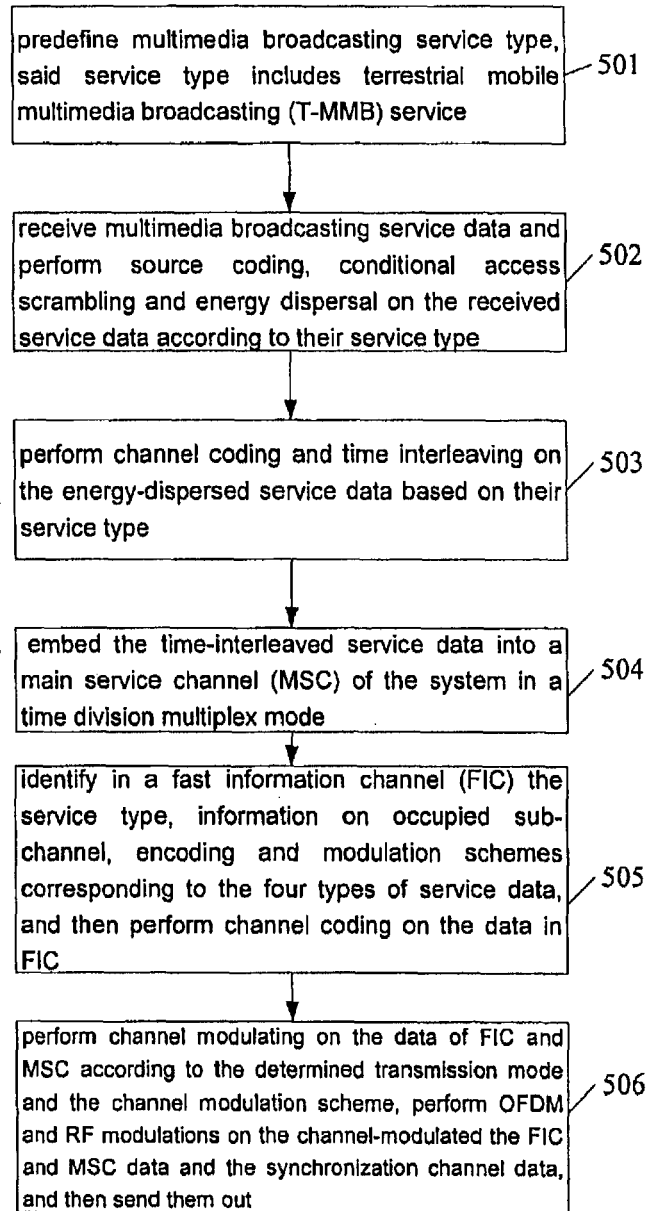


Fig6

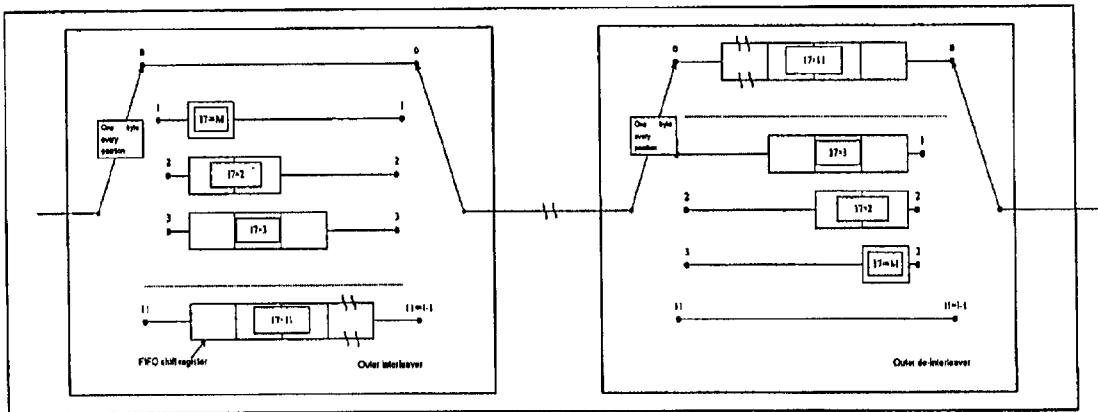


Fig7a

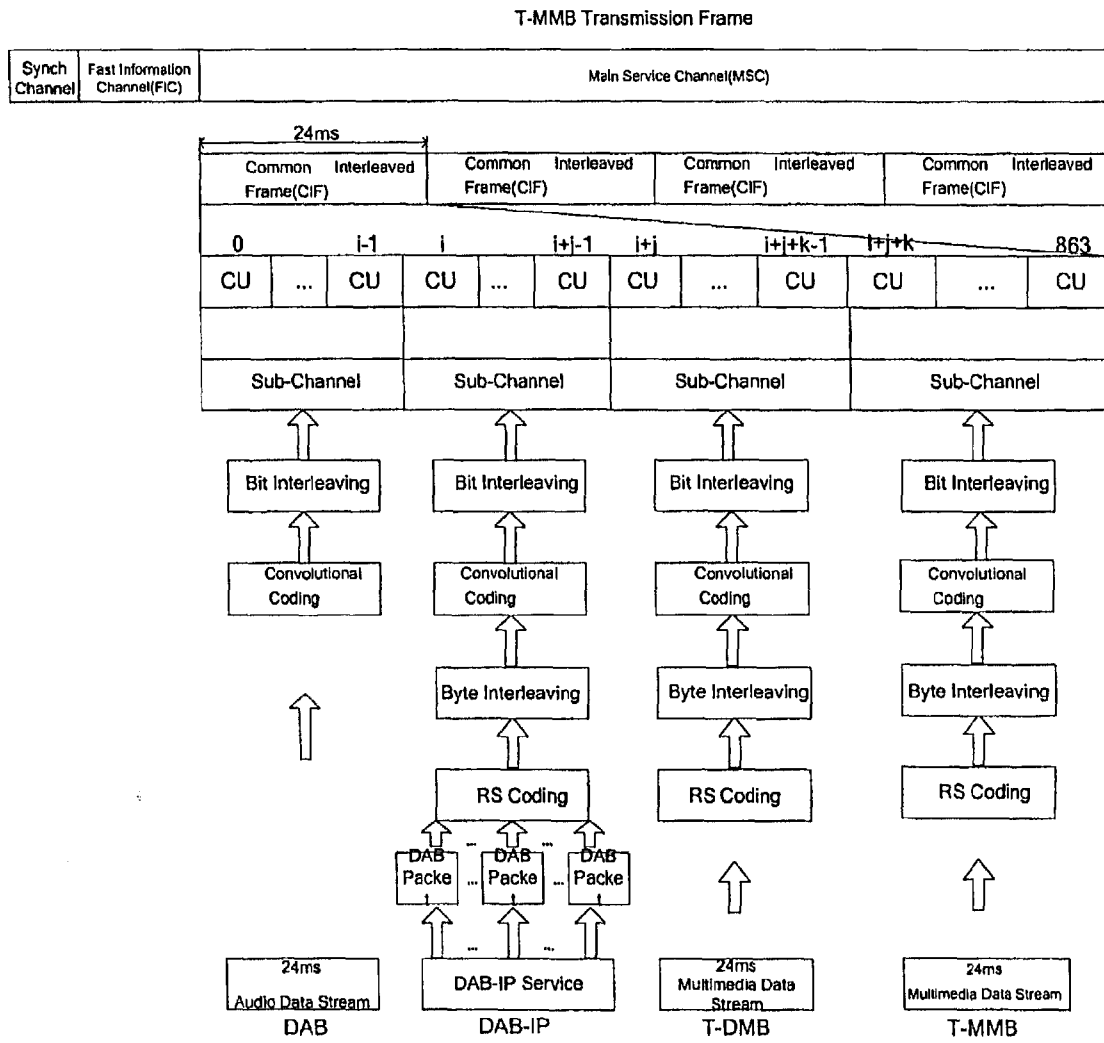


Fig7b

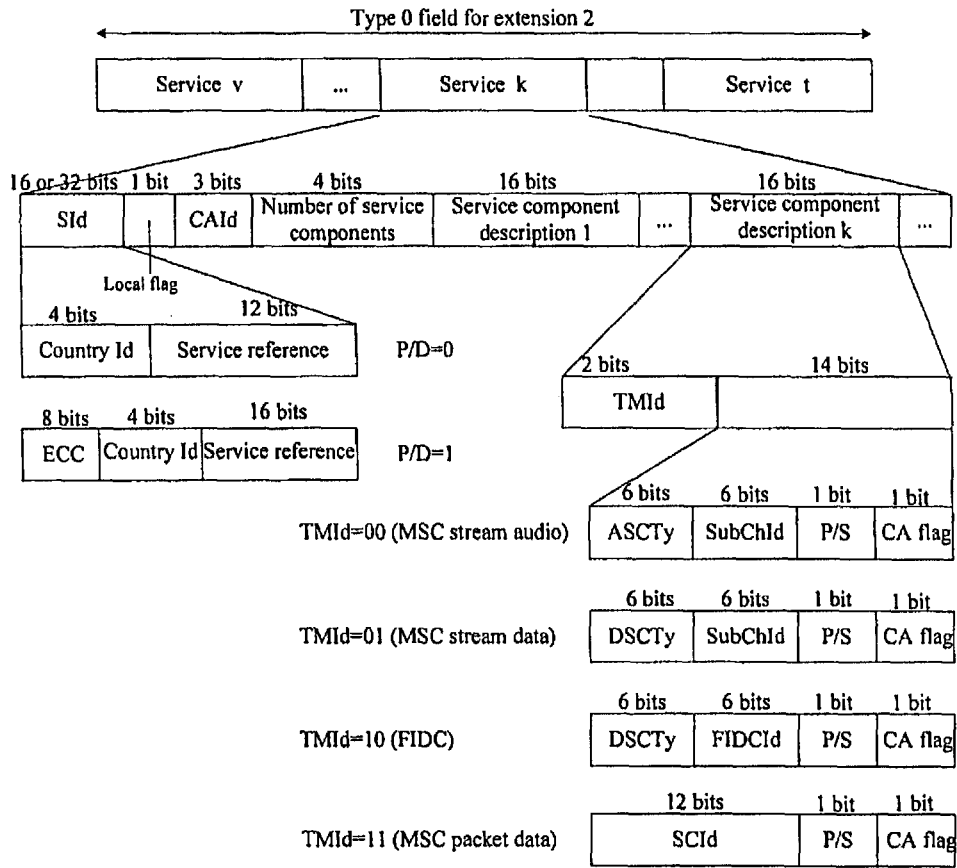


Fig8

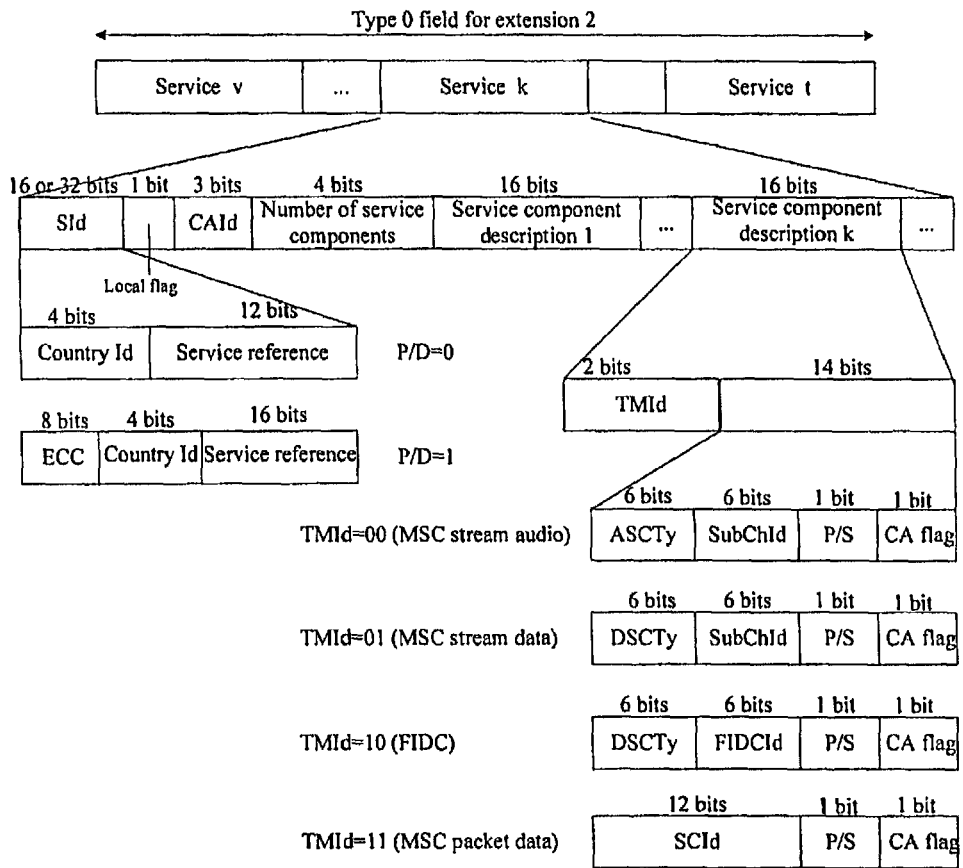


Fig9

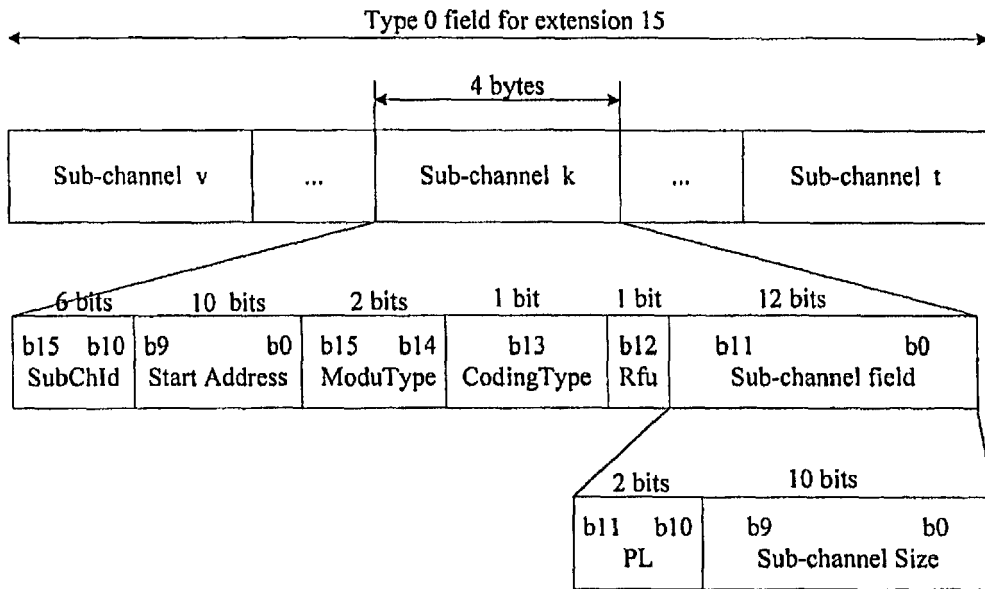


Fig10

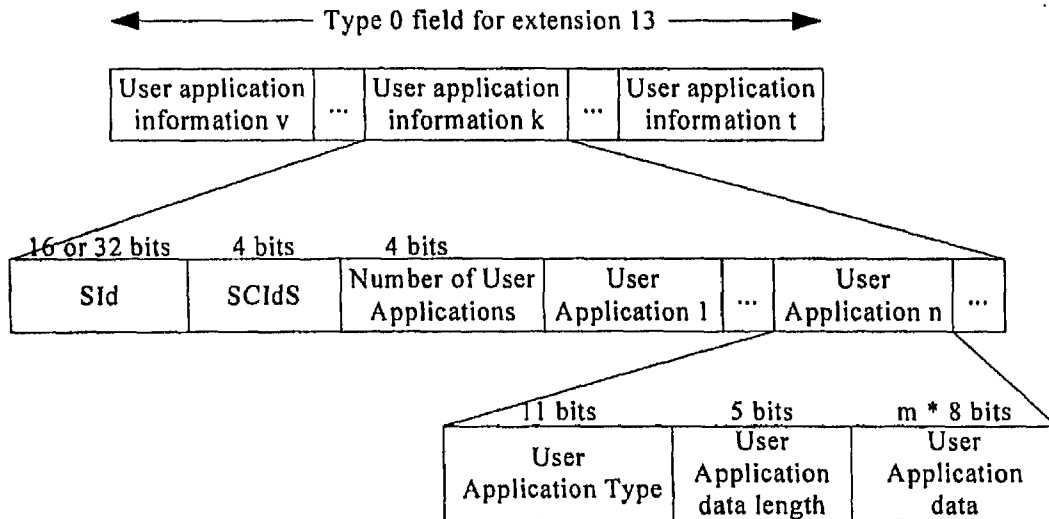


Fig11

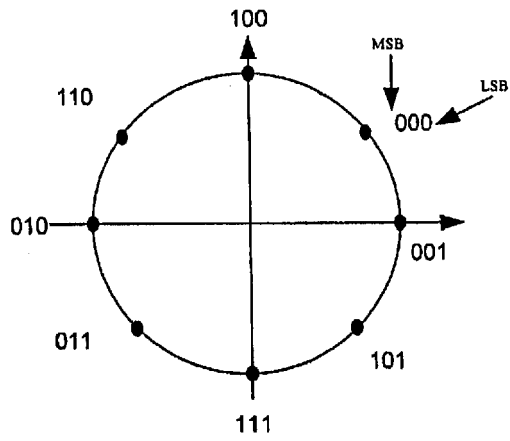


Fig12

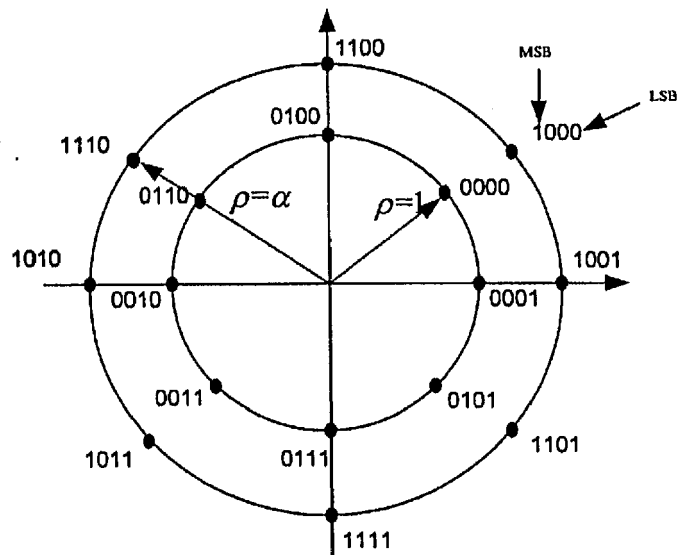


Fig13

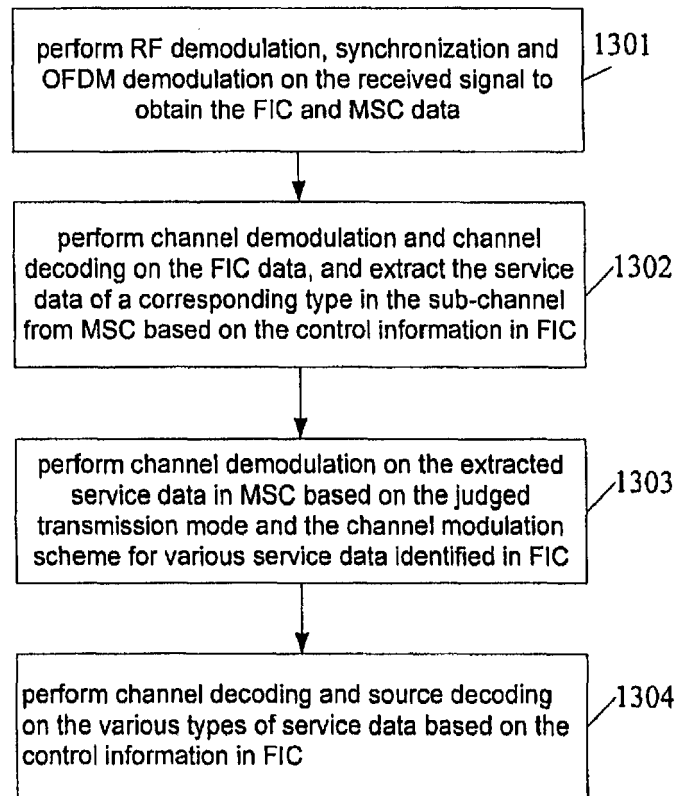


Fig14

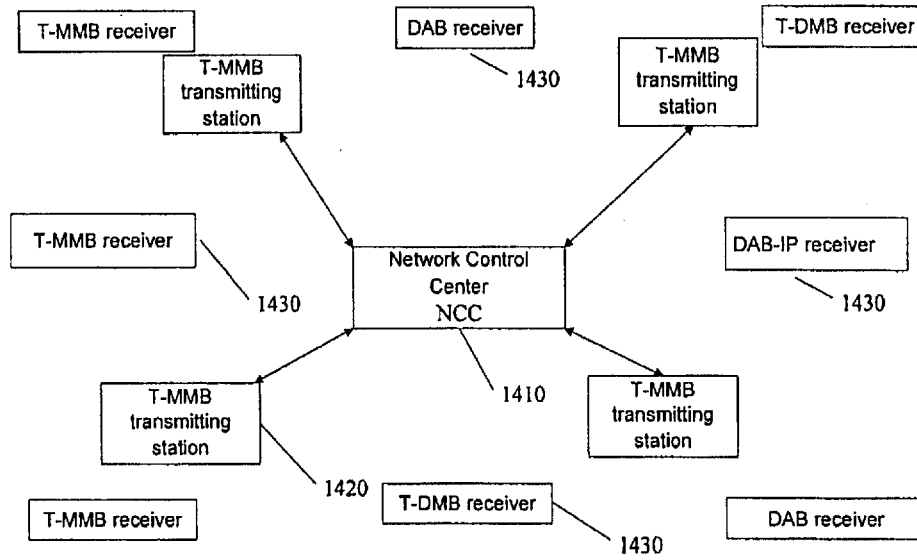


Fig15

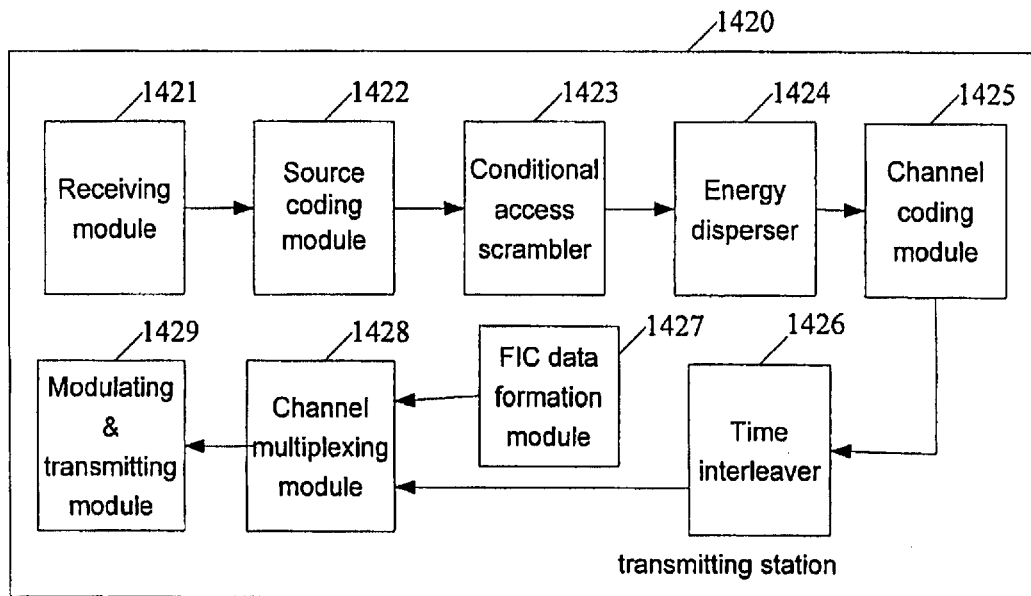


Fig16

