Digital audio broadcasting reception apparatus and digital audio broadcasting reception method

The digital audio broadcasting reception apparatus (100) which receives broadcasting waves generated by multiplexing audio services and data services including a broadcasting website (BWS) includes a display unit (7), a tuner (2), and a controller (5) which detects a reception state of a broadcasting signal being received. When a level of the reception state of the broadcasting signal becomes lower than a predetermined level, the controller (5) receives an ensemble which is different from an ensemble being broadcasting a BWS being received but which is broadcasting the same service and displays a page the same as a page being viewed in a display unit (7). The controller (5) stores information on the BWS page of the received data service in a storage unit (8), configures the same page with reference to the information on the BWS page, and outputs the page to a screen of the display unit (7).

FIG. 1
Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to digital audio broadcasting reception apparatuses and digital audio broadcasting reception methods, and particularly relates to a digital audio broadcasting reception apparatus which is suitable for receiving a broadcasting website (BWS) service using a DAB (Digital Audio Broadcasting) receiver and a digital audio broadcasting reception method.

2. Description of the Related Art

[0002] In recent years, the trend of a broadcasting method transiting from analog broadcasting to digital broadcasting capable of outputting high-quality images and high-quality audio and capable of multiplexing various data. In Europe, DAB has been brought into practical use.

[0003] In the digital audio broadcasting DAB, frequency-multiplexed broadcasting signals including a plurality of data fields to which audio signal data of a certain program is inserted in a frequency-multiplexing manner and information fields to which program arrangement data representing relationships between programs and data fields are input are orthogonally modulated so as to be transmitted from a broadcasting station. The frequency-multiplexed broadcasting signals are received by a frequency-multiplexed broadcasting receiver, the frequency-multiplexed signals which have been inserted into the data fields in accordance with a program specified by a user are demodulated, and the demodulated frequency-multiplexed signals are converted into audio signals to be output.

[0004] When a reception state of such a DAB receiver is degraded, the DAB receiver receives the same program from another broadcasting station which also broadcasts the program. Japanese Unexamined Patent Application Publication No. 2000-224064 discloses a technique of continuously outputting a program utilizing a function of a link among digital audio broadcasts when a reception state of one of the digital audio broadcasts is deteriorated. In this technique, the function of the link among the digital audio broadcasts is not available, the program is continuously output utilizing a function of a link among digital audio broadcasts and FM broadcasts.

[0005] As described above, when a reception of digital broadcasting by the DAB receiver becomes unavailable during the reception, service linking to a broadcasting station which broadcasts the same program and which has been detected in advance is performed.

[0006] On the other hand, in digital audio broadcasting, image information signals and text information signals are compressed in a predetermined format and information signals of different channels are multiplexed as data signals to be transmitted so as to be compatible with a plurality of services.

[0007] An example of such data broadcasting includes a BWS (Broadcasting Web Site) service capable of displaying pages of websites. Even when a reception of the BWS service becomes unavailable in the course of the reception of the BWS service, the BWS service may be continuously received utilizing service linking to another broadcasting station which provides the same BWS service as described above.

[0008] However, when the service linking to another broadcasting station which provides the same BWS service is performed, a top page of a website is displayed. Therefore, the user has to perform an operation of moving to a layer including a page which has been viewed by the user again.

SUMMARY OF THE INVENTION

[0009] Accordingly, it is an object of the present invention to provide a digital audio broadcasting reception apparatus capable of displaying a page the same as a page which has been viewed by the user without an operation performed by the user utilizing BWS service linking and a digital audio broadcasting method.

[0010] According to an embodiment of the present invention, there is provided a digital audio broadcasting reception apparatus which receives broadcasting waves obtained by multiplexing a plurality of audio services and a plurality of data services including at least a broadcasting website (BWS). The digital audio broadcasting reception apparatus includes a tuner configured to receive broadcasting waves of a broadcasting station in accordance with an instruction, a controller configured to detect a reception state of a broadcasting signal which is being received, and a display unit controlled by the controller. The controller allows an ensemble different from an ensemble being broadcasting a BWS being received but which is broadcasting the same service to be received and instructs the display unit to display a page the same as a page which has been viewed in a screen of the display unit.

[0011] The digital audio broadcasting reception apparatus may further include a storage unit which is instructed by the controller to store information on the page of the BWS which is being viewed of the received data service. The controller may configure the same page with reference to information on the page of the BWS which is being viewed and output the configured same page to the screen of the display unit. The controller may store information on a layer including the page of the BWS which is being viewed of the received data service in the storage unit, configure a page in the same layer with reference to information on the page of the BWS which is being viewed and the information on the layer, and output the page in the screen of the display unit. The controller may output the page of the BWS which is being viewed and which is stored in the storage unit in the screen of
the display unit until the page of the BWS is obtained from an ensemble after the different ensemble is received.

[0012] The controller may configure a page the same as the page of the BWS which is being viewed and which is stored in the storage unit when a reception state becomes good and output the configured page in the screen of the display unit. When determining that the different ensemble which is in a good state and which is receivable does not exist, the controller may output the page of the BWS which is being viewed and which is stored in the storage unit in the screen of the display unit. The controller may perform a determination as to whether the different ensemble exists in accordance with service linking information and information on other ensembles. The controller may configure a page the same as the page of the BWS which is being viewed and which is stored in the storage unit and output the configured same page to the screen of the display unit.

[0013] According to another embodiment of the present invention, there is provided a digital audio broadcasting reception method including a step of detecting a reception state of a broadcasting signal of a BWS service which is being received, a step of detecting an ensemble which is different from an ensemble which is being broadcasting a BWS being received but which is broadcasting the same service when a level of the reception state is lower than a predetermined level, and a step of receiving the different ensemble and outputting a page the same as a page which is viewed in the BWS service.

[0014] The digital audio broadcasting reception method may further include a step of storing the page of the BWS service which is being received in a storage unit which is performed before the step of detecting the different ensemble. In the step of outputting the same page, the same page may be configured with reference to the page of the BWS which is being received and which is stored in the storage unit. The digital audio broadcasting reception method may further include a step of storing information on a layer including the page of the BWS service which is being received in a storage unit which is performed before the step of detecting the different ensemble. In the step of outputting the same page, the same page may be configured with reference to information on the page of the BWS service which is being received and which is stored in the storage unit and the information on the layer. The digital audio broadcasting reception method may further include a step of outputting the page of the BWS service which is being received and which is stored in the storage unit in the screen of the display unit until the page of the BWS service of the different ensemble is obtained which is performed before the step of outputting the same page.

[0015] The step of detecting the different ensemble may include a step of determining whether another ensemble which is in a good state and which is receivable exists. The digital audio broadcasting reception method may further include a step of displaying the page of the BWS which is being viewed and which is stored in the storage unit in the screen of the display unit when it is determined that the different ensemble which is in a good state and which is receivable does not exist after the step of detecting the different ensemble. In the step of detecting the different ensemble, the different ensemble may be detected in accordance with service linking information included in the ensemble which is being received and information on other ensembles. When the reception state becomes good, a page the same as the page of the BWS service which is being viewed and which is stored in the storage unit may be configured and the configured page may be displayed in the screen of the display unit.

[0016] According to the digital audio broadcasting reception apparatus and the digital audio broadcasting reception method, when service linking is performed in response to a deterioration of a reception state in a state in which a BWS service is received and a page of a certain layer is displayed, the page of the certain layer which has been displayed before the service linking is performed is also displayed in a BWS service of a linking destination. Accordingly, it is not necessary to move from the top page of the BWS displayed in the destination of the linking to the page in the layer which has been viewed.

[0017] Furthermore, until the page of the layer which has been viewed is reached in the destination of the linking, the page of the BWS received in the ensemble before the linking is displayed. Therefore, since the page of the BWS is displayed while the service linking is performed, a sense of discomfort caused by a state in which nothing is displayed on the screen for the user while the service linking is performed is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fig. 1 is a block diagram illustrating a configuration of a digital audio broadcasting reception apparatus according to an embodiment of the present invention;
Fig. 2 is a diagram illustrating a configuration of services of DAB;
Figs. 3A to 3C are diagrams illustrating configurations of transmission frames of the DAB;
Figs. 4A and 4B are diagrams illustrating reconfigurations of a MOT object;
Fig. 5 is a diagram illustrating a configuration of a page layer displayed in a BWS service;
Figs. 6A and 6B are diagrams illustrating layer descriptions of a BWS;
Fig. 7 is a first flowchart illustrating a same-layer page displaying process performed after service linking is performed;
Fig. 8 is a diagram illustrating a state in the service linking;
Figs. 9A and 9B are diagrams illustrating formats of
DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] An embodiment of the present invention will be described hereinafter with reference to the accompanying drawings. In a description of this embodiment, a DAB receiver is used as an example of a digital audio broadcasting reception apparatus 100.

[0020] Fig. 1 is a block diagram illustrating a configuration of the digital audio broadcasting reception apparatus 100 according to the embodiment of the present invention. As shown in Fig. 1, the digital audio broadcasting reception apparatus 100 includes an antenna 1, a tuner 2, an A/D converter 3, a baseband decoder 4, a controller 5, an operation unit 6, a display unit 7, and a storage unit 8. The baseband decoder 4 includes an FFT 11, a demultiplexer 12, a channel decoder 13, an audio decoder 14, a PAD decoder 15, and a packet mode decoder 16.

[0021] The antenna 1 receives electric waves of digital broadcasting of an OFDM (Orthogonal Frequency Division Multiplexing) method.

[0022] The tuner 2 selectively extracts broadcast wave signals having reception frequencies corresponding to a desired channel from among the electric waves of the digital broadcasting including DAB (Digital Audio Broadcasting) and DMB (Digital Multimedia Broadcasting) and outputs the broadcast wave signals which have been converted into baseband signals through down converting. The A/D converter 3 converts the analog baseband signals obtained through the down converting into digital signals.

[0023] The FFT 11 performs fast Fourier transform on the baseband signals which have been converted into digital signals so as to obtain reception symbols. The demultiplexer 12 demultiplexes a multiplexed signal.

[0024] The channel decoder 13 extracts an arbitrary music channel and an arbitrary data channel from a DAB transmission frame including the reception symbols. Furthermore, the channel decoder 13 separates the DAB transmission frame including the reception symbols obtained through demodulation into a fast information channel (FIC) and a main service channel (MSC) including a plurality of music channels and a plurality of data channels. Furthermore, the channel decoder 13 performs various processes including deinterleaving, Viterbi decoding, and energy diffusion descrambling on a channel selected from the MSC by a user. Furthermore, the channel decoder 13 performs the Viterbi decoding, the energy diffusion descrambling, and the like also on the FIC.

[0025] The audio decoder 14 decodes an audio signal of the extracted music channel. The decoded audio signal is output as audio through a D/A converter, an amplifier, and a speaker, not shown.

[0026] The PAD decoder 15 decodes program association data (PAD) and MOT (Multimedia Object Transfer) data which have been added to a service extracted by the channel decoder 13 and reconfigures the data as data of a data group level.

[0027] The packet mode decoder 16 decodes a packet included in the service extracted by the channel decoder 13 and reconfigures the data as data of a data group level.

[0028] The controller 5 including a microcomputer controls the various units of the digital audio broadcasting reception apparatus 100. When a control signal for setting a channel is input by means of an operation of the operation unit 6, the controller 5 determines a channel to be received by the tuner 2 and sets a reception frequency corresponding to the channel to the tuner 2.

[0029] Furthermore, the controller 5 decodes the MOT data which has been decoded by the PAD decoder 15 or the packet mode decoder 16, and thereafter, reconfigures a MOT object and analyzes a fast information group (FIG) included in the FIC whereby it is determined whether there is any broadcasting station which has been broadcasting the same content.

[0030] The operation unit 6 includes operation buttons used to operate the digital audio broadcasting reception apparatus 100 and is used to issue an instruction for selecting a desired broadcasting station.

[0031] The storage unit 8 including a hard disk or a semiconductor memory receives a BWS service and stores a page which has been being viewed and information on a layer.

[0032] The display unit 7 including a liquid crystal display device (LCD) displays data obtained after being decoded by the PAD decoder 15 or the packet mode decoder 16. Furthermore, the display unit 7 displays a menu screen to which various instructions are to be input. When the user inputs an instruction using a touch panel, for example, included in the display unit 7, the display unit 7 functions as the operation unit 6.

[0033] When the digital audio broadcasting reception apparatus 100 is configured as described above performs service linking to another ensemble since a reception state of the digital audio broadcasting reception apparatus 100 is degraded while the digital audio broadcasting reception apparatus 100 receives a BWS service, it is desirable to display a page of a layer of a BWS which has been received after the service linking is performed.

[0034] Hereinafter, a process of naturally switching to a BWS which has been viewed by a user when another ensemble is received due to a bad reception state in reception of a BWS will be described with reference to Figs. 2 to 10. Fig. 2 and Figs. 3A to 3C are extracted from written standards of the DAB (EN300401 and EN301234).

[0035] Fig. 2 is a diagram illustrating a configuration of services of DAB. When selecting a service, the user accesses a service component. When selecting an ensemble, the user may access a plurality of services. Each of the services has one or more service components.
A basic service component of each of the services is referred to as a primary service component. Although the primary service component normally corresponds to an audio program service component, the primary service component may correspond to a data service component.

An ensemble having an ensemble label (ensemble name) "DAB ensemble 1 (DAB ensemble one)" include a plurality of services such as services having service labels "alpha 1 radio", "beta radio", and "alpha 2 radio".

The service "alpha 1 radio" includes a primary service component and a secondary service component. The primary service component corresponds to "audio" and the secondary service component corresponds to "TMC (Traffic Message Channel)".

The audio component is transmitted through a sub-channel (SubCh) and the TMC is transmitted through an FIDC (Fast Information Data Channel) included in the FIC (Fast Information Channel).

The service "beta radio" includes two service components which correspond to audio components transmitted through a sub-channel of the MSC.

The service "alpha 2 radio" has the same service component "TMC" as the service "alpha 1 radio" and a service component "audio" may be the same as that of the service "alpha 1 radio" depending on a way of switching.

As the service component "TMC" shown in Fig. 2, in the DAB, not only audio but also a data service is broadcasted using broadcasting signals. Examples of a broadcasting protocol for data broadcasting includes a MOT (Multimedia Object Transfer) protocol. The MOT protocol is normally used when time-independent data such as data of a BWS (Broadcasting Website) and data of a slide show is broadcasted on an object-by-object basis.

Such data of the BWS may be included in a service component of audio as an X-PAD (Extend Program Associated Data) or may be in a packet mode. In each data channel, the data is transmitted using the MOT protocol. The PAD is located at the end of a frame, among transmission frames, including audio information. In the packet mode in which a data program is transmitted, a data program is divided into blocks each of which is referred to as a "packet" having a certain size, and the obtained blocks are transmitted in several batches.

The data transmitted through the MOT protocol includes MOT header data and MOT body data corresponding to the MOT header data. Of the two, the MOT body data corresponds to actual content data including a plurality of MOT object data items and the MOT header data stores information on a size of the corresponding MOT body data, a service type, and a transport ID which is unique information for each MOT object data item. Furthermore, for data having a layer structure such as the BWS, information on the layer structure is represented by MOT directories.

After receiving the MOT data, the digital audio broadcasting reception apparatus 100 obtains original data by reconfiguring the MOT body data received in accordance with the transport ID, and provides a service for the user by using the obtained data.

Such MOT data generally includes a plurality of MSC (Main Service Channel) data items.

The MSC data items are received through a plurality of packet data items received through a broadcasting station or are received through sub-fields of an X-PAD (Extend Program Associated Data). The MSC data items have serial information used to configure the MOT object data items. It is assumed that the MSC data items used to configure a MOT header includes first serial information to tenth serial information whereas the MSC data items used to configure a MOT body includes first serial information to tenth serial information as well. In this case, the MSC data items further include, in addition to the serial information, information on a determination as to whether MOT object data configured using the MSC data items corresponds to the MOT header or the MOT body.

Figs. 3A to 3B are diagrams illustrating configurations of transmission frames of the DAB. A DAB signal is transmitted as an OFDM signal modulated by the OFDM method. The transmission frame shown in Fig. 3 is obtained by demodulating an OFDM signal obtained by demodulating the modulated OFDM signal.

The DAB transmission frame includes a synchronization channel, an FIC (Fast Information Channel), and an MSC (Main Service Channel) as shown in Fig. 3A.

The synchronization channel which identifies a frame is used for basic functions of a demodulator including transmission frame synchronization, automatic frequency control, channel state estimation, and transmitter identification.

The FIC which allows a receiver to promptly access information includes information such as multiplexing arrangement, a name of a service, paging codes, and traffic message control. The FIC includes a plurality of blocks FIBs (Fast Information Blocks). Each of the FIBs includes an FIB data region of 30 bytes and CRC (Cyclic Redundancy Check) of 16 bits. The FIB data region includes one or more FIG (Fast Information Group), an end marker, and a padding ("0" is inserted into remaining bits so that the FIB data region has 30 bytes).

The FIG includes an FIG header having an FIG type and a length and an FIG data field. The FIG type represents a type of data recorded in the FIG data field and the length represents a length of the FIG data field.

For example, an FIG type 0 is used to represent a current and future multiplex configuration, a multiplex reconfiguration, a date and time, and other basic information. An FIG data field of the FIG type 0 includes an extension field and a type-0 field. The extension field is used to identify one of 32 types of interpretations of the type-0 field.

The MSC is used to transmit video images, au-
dio, and data service components, and includes a number of CIFs (Common Interleaved Frames) corresponding to a transmission mode. In each of the CIFs, a plurality of music sub-channels and a plurality of general-data sub-channels are multiplexed. A single sub-channel corresponds to a signal program.

[0055] Fig. 3B shows an example of X-PAD included in each of the MSC data items when the BWS is included in the audio service. As shown in Fig. 3B, in the digital audio broadcasting reception apparatus 100, each of the MSC data items is constituted by data received in an X-PAD mode.

[0056] Each of the MSC data items includes an MSC data group header which stores information used to configure MOT object data, i.e., a transport ID, a segment number which is a serial number of the MSC data item, a number of the last segment which is required for constituting the MOT object data and which corresponds to the transport ID, and the like. Furthermore, the MSC data group header may include information on the number of MSC data items required for constituting the MOT object data.

[0057] Fig. 3C shows an example of packet data included in each of the MSC data items. Data of the BWS is written in a packet data field. As with the X-PAD mode of Fig. 3B, in the digital audio broadcasting reception apparatus 100, the MSC data items are configured using data received in a packet mode.

[0058] Figs. 4A and 4B are diagrams illustrating a reconfiguration of the MOT object. Data of an X-PAD subfield decoded by the channel decoder 13 is decoded by the PAD decoder 15 so that a portion of MSC data group data of a data group level is configured. Furthermore, packet data is decoded by the packet mode decoder 16 so that a portion of the MSC data group data is configured. The data of the MSC data group is input to a MOT data decoder so that an MOT segment is obtained through a data group decoder. The MOT directory and the MOT body are reconfigured in accordance with the MOT segment. An MOT object including the MOT directory and the MOT body is converted into image data using a decoder included in a user terminal and is output.

[0059] From the MOT object reconfigured as described above, a layer of a screen displayed when the BWS service is received is detected. By referring to the MOT directory in which a layer configuration of the BWS service is described, a page and a layer which have been reconstructed are detected.

[0060] Fig. 5 is a diagram illustrating a layer of a screen displayed in the BWS service. Furthermore, Fig. 6 is a diagram illustrating a layer description of a certain BWS. As shown in Fig. 5, a page of the BWS has a plurality of layers below the topmost page "top news". Each of the layers has one or more pages. Data of the topmost page and data of the layers are described in the MOT directory.

[0061] Fig. 6A shows logic configurations of two programs (news and sport) and Fig. 6B shows examples of descriptions of directories corresponding to Fig. 6A. For example, a page "news1-1" shown in Fig. 6A is represented by data "/news/index/news1/news1-1.html" shown in Fig. 6B.

[0062] When another ensemble is received using service linking, a page which is configured first is the topmost page. Therefore, even when the user has been viewing a page in the lowermost layer, the page of the lowermost layer is not displayed. Accordingly, the page desired by the user is displayed by operating a menu or the like again after reconfiguration is completed. It is assumed that the user is viewing a screen corresponding to a layer 2-5 shown in Fig. 5. In this case, a screen displayed first after the service linking is performed is the page of "top news", and therefore, the user has to move from the page of "top news" to the page of the layer 2-5.

[0063] In this embodiment, information on a page which has been viewed and information on a layer of the page are stored in the storage unit 8, and a page the same as the page in the layer which has been viewed is displayed after the ensemble is received after service linking is performed. Specifically, in accordance with the information on the MOT object including the MOT directory and the MOT body, a top page is not displayed but a page the same as the page which has been viewed is displayed at the time when the page is configured.

[0064] Note that a period of time required for configuring the same page is unknown. Although the page "top news" is configured first, an order of configurations of screens of lower layers is not determined. Therefore, a screen which has been viewed may be displayed first, or alternatively, it may take long time to display the screen which has been viewed. Accordingly, when an ensemble is to be received after the service linking is performed, data of a page at a time when an ensemble stored in the storage unit 8 is changed may be used for display until the same page is configured. By this, when the same page is configured thereafter, data of the configured page may be used for re-display.

[0065] As described above, when a reception state is degraded while the digital audio broadcasting reception apparatus 100 receives a BWS service in this embodiment, a page the same as a page of a BWS service which has been viewed is displayed by detecting a different ensemble which has been broadcasting the same service. In this way, when the service linking is performed, it is not necessary to move to the page which has been viewed.

[0066] Referring now to Figs. 7 to 10, a process of displaying the same page after service linking will be described.

[0067] Fig. 7 is a first flowchart illustrating a process of displaying the same page performed by the controller 5 included in the digital audio broadcasting reception apparatus 100 after service linking. Note that this process is performed when deterioration of a state of a reception of digital broadcasting is detected. The deterioration of a reception state is determined when a BER obtained from the channel decoder 13 exceeds a specified value
or determined by a reception strength, for example.

[0068] First, in step S11 of Fig. 7, service linking association information is obtained. As shown in Fig. 8 which illustrates states of DAB broadcasting (1) which is being received and DAB broadcasting (2) to be linked which are involved in service linking, when the DAB broadcasting (1) is being received, FIG data of a transmission frame is obtained so that it is determined whether an ensemble which is broadcasting the same service exists, and information thereon is stored. The service linking association information is included in FIG0/6 (a type 0 field for an extension 6) included in the FIC data of DAB which is being received. The FIG data is obtained and it is determined whether the service linking is being performed. Fig. 9A shows an FIG0/6 format. When the service linking is being performed, a service (broadcasting station) to be linked is described in SId of the FIG0/6.

[0069] Next, in step S12, it is determined whether a frequency of a destination of a link (another ensemble) which is being broadcasting the same service as a program which is currently viewed exists. A location of the destination of the link which is broadcasting the service the same as the service which is currently received in accordance with the service linking association information obtained in step S11 and information on the other ensemble. The information on the other ensemble is included in FIG0/24 of the FIC. Fig. 9B shows a FIG0/24 format. When an ensemble corresponding to a service Sld exists, the ensemble is described in Eld.

[0070] In step S13, a reception state of the link destination is checked. The checking of the reception state is performed by performing tuning so that a frequency of the link destination is obtained and detecting a C/N ratio (carrier power-to-noise power ratio) of a broadcasting station corresponding to the link destination. As a criterion for evaluation, information on a reception level such as a reception strength or a BER may be used as well as the C/N ratio.

[0071] Next, in step S14, it is determined whether linking is available. Specifically, it is determined whether a reception state is good on the basis of the C/N ratio detected in step S13. When the determination is affirmative, the process proceeds to step S15 whereas when the determination is negative, the process proceeds to step S17.

[0072] In step S15, a layer of BWS information which is currently viewed is checked. As shown in Fig. 8, the BWS information at the time when it is determined that the reception state is degraded is obtained from the MOT directory and the MOT body.

[0073] In step S16, the other ensemble detected in step S12 is linked, and the user moves to the layer of the BWS information checked in step S15 so that a page of the BWS is output.

[0074] On the other hand, when the determination is negative in step S14, the process proceeds to step S17 where the reception of the current service is continued and the process is terminated.

[0075] Note that when the reception state of the original ensemble becomes good, the original ensemble may be linked again so that the page is displayed on the basis of the BWS information of the original ensemble.

[0076] Next, a process of continuously displaying a page of a BWS service without interruption at a time when ensembles are switched from one to another will be described.

[0077] In Fig. 10, processes in step S21 to step S24 are the same as those in step S11 to step S14 of Fig. 7, and therefore, descriptions thereof are omitted.

[0078] In step S25 of Fig. 10, a layer of BWS information which is currently viewed is checked. Here, information on a page of a BWS which is currently viewed is stored in the storage unit 8.

[0079] Next, in step S26, another ensemble is linked, and a page of the BWS received at a time when a reception state of a current ensemble is good is output until the layer checked in step S25 is reached. Specifically, in a period from when broadcasting from a destination of service linking is received to when the page of the BWS in the service is generated, display is performed on a screen using page data of the BWS stored in the storage unit 8. Thereafter, when the page of the BWS of a service of the link destination is generated, the page of the BWS is displayed in step S27, and the process is terminated.

[0080] On the other hand, when a link destination which is in a good reception state does not exist, the reception of the current service is continued and the page of the BWS at the time when the reception state is good which is stored in the storage unit 8 is output in step S28. Then, the process is terminated.

[0081] Note that, in the foregoing process, the information on the page of the BWS which is currently viewed is stored in the storage unit 8 in step S25 or step S28. However, the information on the page of the BWS which is currently viewed may be stored in the storage unit 8 before it is determined whether service linking to another ensemble is available in step S24. Furthermore, the information may be stored in the storage unit 8 when the page of the BWS to be viewed is changed. In these cases, the page of the BWS stored in the storage unit 8 is displayed in step S26 or step S28.

[0082] Alternatively, when the reception state of the original ensemble becomes good, the original ensemble is linked again and a page may be displayed on the basis of the BWS information of the original ensemble. In this case, information on the page of the BWS which has been received from the other ensemble may be stored in the storage unit 8, and the page of the BWS stored while the other ensemble is received may be displayed until the page of the BWS of the original ensemble is reconfigured.

[0083] As described above, in the digital audio broadcasting reception apparatus and the digital audio broadcasting reception method according to this embodiment, when service linking is performed in response to a deterioration of a reception state in a state in which a BWS
service is received and a page of a certain layer is displayed, the page of the certain layer which has been displayed before the service linking is performed is also displayed in a BWS service of a linking destination. Accordingly, it is not necessary to move from the top page of the BWS displayed in the destination of the linking to the page in the layer which has been viewed.

Furthermore, until the page of the layer which has been viewed is reached in the destination of the linking, the page of the BWS received in the ensemble before the linking is displayed. Therefore, since the page of the BWS is displayed while the service linking is performed, a sense of discomfort caused by a state in which nothing is displayed on the screen for the user while the service linking is performed is reduced.

Claims

1. A digital audio broadcasting reception apparatus which receives broadcasting waves obtained by multiplexing a plurality of audio services and a plurality of data services including at least a broadcasting website, the digital audio broadcasting reception apparatus comprising:

   - a tuner (2) configured to receive broadcasting waves of a broadcasting station in accordance with an instruction;
   - a controller (5) configured to detect a reception state of a broadcasting signal which is being received;
   - a display unit (7) controlled by the controller (5), wherein the controller (5) allows an ensemble which is different from an ensemble being broadcasting a broadcasting website being received but which is broadcasting the same service to be received when a level of the reception state is lower than a predetermined level and instructs the display unit (7) to display a page the same as a page which has been viewed in a screen of the display unit.

2. The digital audio broadcasting reception apparatus according to Claim 1, further comprising:

   - a storage unit (8) which is instructed by the controller (5) to store information on the page of the broadcasting website which is being viewed of the received data service, wherein the controller (5) configures the same page with reference to information on the page of the broadcasting website which is being viewed and outputs the configured same page to the screen of the display unit.

3. The digital audio broadcasting reception apparatus according to Claim 2, wherein the controller (5) stores information on a layer including the page of the broadcasting website which is being viewed of the received data service in the storage unit (8), configures a page in the same layer with reference to information on the page of the broadcasting website which is being viewed and the information on the layer, and outputs the page in the screen of the display unit.

4. The digital audio broadcasting reception apparatus according to Claim 1, wherein the controller (5) outputs the page of the broadcasting website which is being viewed and which is stored in the storage unit (8) in the screen of the display unit until the page of the broadcasting website is obtained from an ensemble after the different ensemble is received.

5. The digital audio broadcasting reception apparatus according to Claim 3 or 4, wherein the controller (5) configures a page the same as the page of the broadcasting website which is being viewed and which is stored in the storage unit (8) when a reception state becomes good and outputs the configured page in the screen of the display unit.

6. The digital audio broadcasting reception apparatus according to any of the Claims 2 to 5, wherein when determining that the different ensemble which is in a good state and which is receivable does not exist, the controller (5) outputs the page of the broadcasting website which is being viewed and which is stored in the storage unit (8) in the screen of the display unit.

7. The digital audio broadcasting reception apparatus according to any of the Claims 1 to 6, wherein, when detecting the different ensemble which is in a good state and which is receivable, the controller (5) changes a reception frequency so that a reception frequency corresponding to a reception frequency of the different ensemble is obtained, and obtains a page of a broadcasting website.

8. The digital audio broadcasting reception apparatus according to any of the Claims 1 to 7, wherein the controller (5) performs a determination as to whether the different ensemble exists in accordance with service linking information and information on other ensembles.

9. A digital audio broadcasting reception method, comprising:

   - a step of detecting a reception state of a broadcasting signal of a broadcasting website service which is being received;
   - a step of detecting an ensemble which is differ-
The digital audio broadcasting reception method according to Claim 9, further comprising:

a step of storing the page of the broadcasting website service which is being received in a storage unit (8) which is performed before the step of detecting the different ensemble, wherein, in the step of outputting the same page, the same page is configured with reference to the page of the broadcasting website which is being received and which is stored in the storage unit (8).

The digital audio broadcasting reception method according to Claim 9 or 10, further comprising:

a step of storing information on a layer including the page of the broadcasting website service which is being received in a storage unit (8) which is performed before the step of detecting the different ensemble, wherein, in the step of outputting the same page, the same page is configured with reference to information on the page of the broadcasting website service which is being received and which is stored in the storage unit (8) and the information on the layer.

The digital audio broadcasting reception method according to Claim 10 or 11, further comprising:

a step of outputting the page of the broadcasting website service which is being received and which is stored in the storage unit (8) in the screen of the display unit until the page of the broadcasting website service of the different ensemble is obtained which is performed before the step of outputting the same page.

The digital audio broadcasting reception method according to any of the Claims 9 to 12, further comprising:

a step of displaying the page of the broadcasting website which is being viewed and which is stored in the storage unit (8) in the screen of the display unit (7) when it is determined that the different ensemble which is in a good state and which is receivable does not exist after the step

of detecting the different ensemble.

The digital audio broadcasting reception method according to any of the Claims 9 to 13, wherein, in the step of detecting the different ensemble, the different ensemble is detected in accordance with service linking information included in the ensemble which is being received and information on other ensembles.

The digital audio broadcasting reception method according to any of the Claims 9 to 14, wherein, when the reception state becomes good, a page the same as the page of the broadcasting service which is being viewed and which is stored in the storage unit (8) is configured and the configured page is displayed in the screen of the display unit (7).
FIG. 4A

USER APPLICATION LEVEL

TERMINAL

MOT OBJECT

OBJECT MANAGEMENT DIRECTORY

BODIES, DIRECTORIES

MOT BODIES

OBJECT LEVEL

REALLOCATION UNIT

Tld a Tld b Tld c

MOT BODY

Tld m

MOT DIRECTORY

MOT DATA DECORDER

MOT SEGMENTS

(+ ADDITIONAL INFORMATION)

DATA GROUP DECORDER

DATA GROUP LEVEL

MSC DATA GROUPS

PACKAGE MODE DATA GROUPS

PACKETS

NETWORK LEVEL

X-PAD DATA SUBFIELDS

FIG. 4B

MOT HEADER/MOT DIRECTORY/MOT BODY

SEGMENT 1 SEGMENT 2 SEGMENT N

SEGMENTATION HEADER SEGMENT

DATA GROUP HEADER SESSION HEADER DATA GROUP DATA FIELD MSC DATA GROUP CRC

DATA GROUP TYPE 3,4,5,6 OR 7
FIG. 5

TOP NEWS

LAYER 1-1  LAYER 1-2  LAYER 1-3

LAYER 2-1  LAYER 2-2  LAYER 2-3  LAYER 2-4  LAYER 2-5
FIG. 6A

- News
  - index
    - News1
      - News1-1
      - News1-2
  - News2

- Sport
  - index
    - Sport1
    - Sport2
      - Sport2-1
      - Sport2-2

FIG. 6B

- news/index.html
- news/index/news1.html
- news/index/news1/news1-1.html
- news/index/news1/news1-2.html
- news/index/news2.html
- sport/index.html
- sport/index/sport1.html
- sport/index/sport2.html
- sport/index/sport2/sport2-1.html
- sport/index/sport2/sport2-2.html
FIG. 7

START

S11: OBTAIN SERVICE-LINKING ASSOCIATION INFORMATION

S12: CHECK WHETHER FREQUENCY OF LINK (ANOTHER ENSEMBLE) EXISTS

S13: CHECK RECEPTION STATE OF LINK

S14: LINKING AVAILABLE?

NO

S17: CONTINUE RECEPTION OF CURRENT SERVICE

YES

S15: CHECK LAYER OF BWS INFORMATION

S16: LINK TO ANOTHER ENSEMBLE, MOVE TO CERTAIN LAYER, AND OUTPUT PAGE OF BWS

END
FIG. 8

- Obtain service following association fig data and generate DB
- Check whether receivable frequency exists

- Determine whether current service receivable
- Check obtained MOT body and obtained MOT directory

DAB BROADCASTING 1
SERVICE IN RECEPTION
DETERIORATION OF RECEPTION STATE
SWITCHING CONTROL

DAB BROADCASTING 2
SERVICE TO BE LINKED

TIME PASSAGE
FIG. 9A

TYPE 0 FIELD FOR EXTENSION 6

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P/D=0 AND ILS=0

Rfu

P/D=0 AND ILS=1

Rfu

P/D=0 AND ILS=0 OR 1

Rfu

FIG. 9B

TYPE 0 FIELD FOR EXTENSION 24

OTHER ENSEMBLE SERVICES V

OTHER ENSEMBLE SERVICES K

OTHER ENSEMBLE SERVICES T

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16 or 32 BITS 1 BIT 3 BITS 4 BITS 16 BITS 16 BITS

16 BITS

16 BITS
FIG. 10

START

S21 - OBTAIN SERVICE LINKING ASSOCIATION INFORMATION

S22 - CHECK WHETHER FREQUENCY OF LINK (ANOTHER ENSEMBLE) EXISTS

S23 - CHECK RECEPTION STATE OF LINK

S24 - LINK AVAILABLE?

YES

S25 - CHECK LAYER OF BWS INFORMATION

S26 - LINK TO ANOTHER ENSEMBLE AND OUTPUT PAGE OF BWS AT A TIME WHEN RECEPTION STATE IS GOOD UNTIL MOVEMENT TO CERTAIN LAYER IS COMPLETED

S27 - MOVE TO CERTAIN LAYER OF ANOTHER ENSEMBLE AND OUTPUT PAGE OF BWS

END

S28 - CONTINUE RECEPTION OF CURRENT SERVICE AND OUTPUT PAGE OF BWS AT A TIME WHEN RECEPTION STATE IS GOOD
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000224064 A [0004]