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Early Warning Information Releasing System Based on Adaptive Grouping

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Abstract: A design scheme of message transmission in business information channel of DAB (Digital Audio Broadcasting) transmitter was presented based on the structure of DAB information channel. According to the demand of diversity, real-time and intelligence for transmitting message by DAB, an adaptive packet mode of transport mechanism is put forward to release various text messages (weather warning information, traffic information, etc.) through DAB transmitting system aimed at MOT (Multimedia Object Transfer) protocol. Through the method of adaptive grouping, flexibility and capacity utilization of sub-channels in DAB transmission system are improved greatly. Thus, it is convenient for transfer various early warning information efficiently. The encoding scheme based on adaptive grouping has been achieved through DAB system at present.

Key words: Digital audio broadcasting, business information channel, adaptive grouping

INTRODUCTION

Digital Audio Broadcasting (DAB) is the third generation broadcasting (Dong, 2001) - the digital signal broadcasting, following AM, FM traditional analog broadcasting. DAB is based on digital technology, taking use of advanced digital audio coding data compression, error correction coding and digital modulation techniques. Series of digital radio signals can be broadcast by DAB fluently. DAB has the advantages for anti-noise, interference, anti-fading radio propagation and high-speed mobile reception. In addition to the transmission of audio, any form of data signals, such as broadcast messages, still images can be also sent by DAB (Fang, 2008).

With the promotion of DAB technology in China, DAB digital audio broadcasting system technology has been a primary means of warning information transmission. For example, through meteorological operational systems of China Meteorological Administration and weather information dissemination system, a complete set of business systems is built up, including the information collection, information processing and information transmission (Li-Li *et al*., 2009).

The current transmission mode in DAB system is based on stream mode. In the stream mode, the capacity of a DAB channel is completely occupied by a specific application and a constant data rate is provided (Sun and Sun, 2010). Due to above features, the transmission for variable data rate and non-synchronous data whose data rate is less than 8 kb sec^{-1} are not optimal. However, weather warning information contains a variety of factors and types (Fang, 2008). In order to meet the special demand of early warning information transmission, it is urgent to improve current DAB transmission method.

An adaptive grouping method based on packet mode is put forward to implement early warning information releasing. Through adaptive grouping, multiple business data can be transmitted in the same sub-channel and are combined by multiplexer of data packet in DAB transmitter, such as different early warning types and other service data. At the same time, through the header information of packet address, each kind of business data can be identified immediately in DAB receiver. Based on the study of principles and standards of DAB technology (Shi *et al*., 2009), transferring asynchronous data with variable rate is possible. Thus, the optimal use of capacity can be achieved by packet transmissions in the main service channel in DAB system. The efficiency of DAB transmission system is improved greatly.

THE STRUCTURE OF MAIN BUSINESS CHANNEL AND TRANSFER PROTOCOL

The structure of main business channel: A kind of composite structure of the transmission business combined with multiple digital audio signals and data signals is designed in DAB system. The transmission

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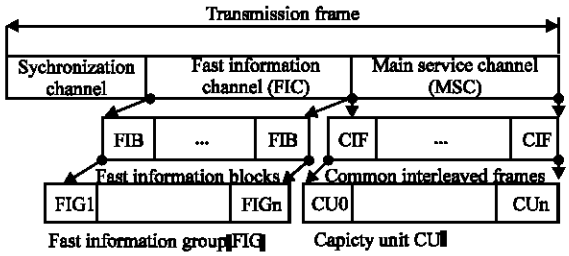

Fig. 1: The structure of DAB transmission system

system consists of three channels (Lingyun and Hong, 2006) Synchronization Channel (SC), Fast Information Channel (FIC) and Main Service Channel (MSC). The structure is of the transmission system is shown in Fig. 1. Synchronization channel is used to implement the synchronization for all kinds of audio information. FIC is consisted of a number of FIBs (Fast Information Blocks). Each FIB can transmit numbers of data groups, called as FIGs(Fast Information Groups). MSC is mainly used to transport all kinds of services for audio data and it is composed of a number of CIFs (Common Interleaved Frames). A CIF is contained of 55296-bit data and it is grouped into 864 CUs (Capacity Units). Each CU is contained of 64 bits. All these data are transmitted through the sub-channel. Each sub-channel contains number of CUs. That is, a CIF can contain up to 64 sub-channels.

Data transmission based on MOT: MOT (Multimedia Object Transfer) protocol (ETS, 2006b), as a kind of data transmission protocol, can provide convenient transmission as ASCII text in DAB system.

The data transfer flow of MOT protocol is as follows: firstly, the text to be transmitted should be processed to generate MOT object (Cong *et al*., 2007) in MOT encoder. Then, MOT object is encoded by using adaptive packet mode. This adaptive packet mode contains multiple programs in sub-channels, whose data stream can be distinguished through their packet address respectively. Lastly, these sub-channels are combined to groups of DAB signal.

EARLY WARNING INFORMATION RELEASING PROGRAM BASED ON ADAPTIVE GROUPING

The standard of DAB early warning information: The releasing of DAB is adopted by Chinese text mode, early-warning information is composed of six parts, that is: releasing department, releasing unit, releasing time, early warning type, early warning level and influenced region. The code of releasing department and releasing unit are ruled by the "People's Republic of administrative division code (GB2260) ". According to the rule of GB2260 (Lianan, 2009), data length of releasing department, releasing unit, releasing time and influenced region are unpredictable and variable. Meanwhile, there are four levels in early warning: red alert, orange alert, yellow alert and blue alert. Types of early warning are also composed of various kinds: disasters of accidents, natural disasters, disasters of public health, social security and other information.

From above, early warning information contains a variety of factors and types. Due to the variable data rate and sudden performance, it is urgent to realize releasing early warning in real-time accurately.

Encoding of early warning information based on adaptive grouping: The transmission of DAB business data has mainly two ways: data stream mode in MSC and data packet mode (ETS, 2002). In data stream mode, the capacity of a sub-channel is completely occupied by a specific application and a constant data rate which is equal to n*8 kb sec^{-1} is provided. Due to above features, the transmission for variable data rate and non-synchronous data whose data rate is less than 8 kb sec^{-1} are not optimal. Because of the un-efficient use of transmission capacity, it is not good for weather warning information transmission to use data stream mode. Data packet mode is an efficient method for weather early warning information transmission. In this mode, multiple business data can be transmitted in the same sub-channel and are combined by multiplexer of data packet, such as early warning of different cities or other service data. At the same time, through the header information of packet address, each type of business data is identified clearly in receiver. Thus the efficiency of utilization is improved greatly. The structure of packet mode data is shown in Fig. 2.

Due to the special application of early warning information, an adaptive grouping method is put forward. The adaptive grouping method based on data packet mode makes early warning information transmission more flexible and intelligent (Zhaoming, 2007; Wei *et al*., 2011) The main property of this method is as follows:

- According to the transmission demand of business data, necessary header flags, such as the reorganization of flags, including the address spaces, are added to realize re-organizing distributed data by receiver intelligently
- Error detecting function is adopted to improve business data transmission

Adaptive grouping encoding scheme of early warning information: A typical format of weather warning

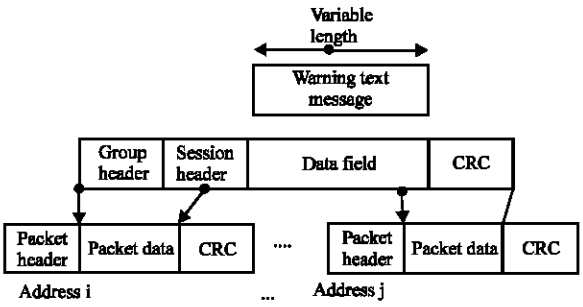

Fig. 2: The structure of packet mode

information is as follows: Beijing Meteorological Bureau; at 17:00 on December 25th, 2010; orange alert for fog; the affected regions are included Dongcheng District, Xicheng District, Chongwen District, Xuanwu District, Chaoyang District, Fengtai District, Shijingshan District, Haidian District; the district center of affected disaster areas: north latitude 39 degrees 57 min 6 sec, east longitude 116 degrees 19 min 12b sec; releasing radius is 100 km.

Based on above format of weather warning information, a transmission scheme of early warning information based on adaptive grouping coding is put forward. Firstly, the whole transmission business data capacity is judged. If the capacity is less than 91 bytes, which is the largest amount a data packet can accommodate, packet encoding method is adopted and business data is transferred by a free sub-channel directly. If the capacity is lager than 91 bytes, necessary header identification information and CRC (Cyclic Redundancy Check) bits are added. Secondly, business data group is split into fixed-size packets and is loaded into sub-channels to transmit. In order to receive early warning information orderly, six parts of early warning information, according to above early warning information format, are loaded into six different data packages. For example, the information of releasing department, Beijing Meteorological Bureau, is loaded into the first packet. Then, the information of releasing time is loaded into the second packet. Other parts of early warning information are loaded into following packets. Lastly, the address of the packet can be used as an identification code of administrative divisions for early warning information releasing department. Each address represents for some fixed region in our country, so it is easy for early warning information receiver to warning information intelligently. That is to say, according to the packet address decoded through releasing department, region-selective receiving is realized. The whole process of transmission based on adaptive grouping is shown in Fig. 3.

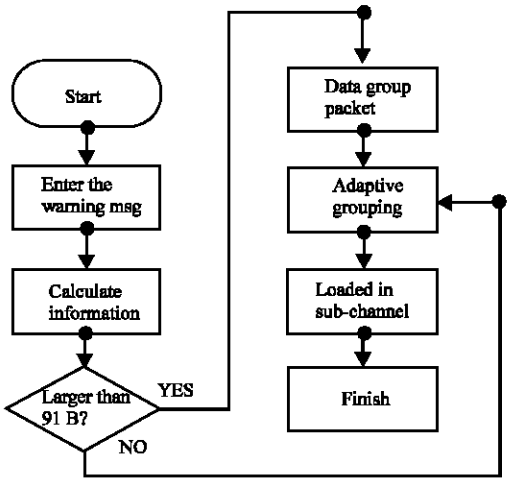

Fig. 3: The process of transmission based on adaptive grouping

Software realization of early warning information based on adaptive grouping: According to the property of adaptive grouping, modular design is adopted. There are four main modules in the modular structure of early warning information: calculation of business information capacity, coding of adaptive grouping, unpacking data group and data packet coding. With above four modules, corresponding module design is realized based on capacity of business data. Meanwhile, some configuration messages about early warning (Yu, 2002; ETS, 2006a), such as in which channel the current business is used, is transferred in FIC, so as to realize decoding information correctly for receiver.

The process of software realization of early warning information is as follows: Firstly, business data is saved as text file. A character array is used to buffer business data and a judgment is used as terminator for character array. Then the quantity of business data should be calculated. Secondly, encoding of adaptive grouping is to realize packet business data through adding header and parity flag of information. Then, in the module of unpacking data group, encoded data group is divided into fixed-size data packet stored in the two-dimensional character array. Lastly, data packet is encoded to accomplish the whole process.

In the encoding of data packet, a structure is designed to describe the header of packet (Wu *et al*., 2010). The header is consisted of the length of packet, continuous packet flag, location information of packet, address of packet, command information, length of useful data. A structure is defined as follows:

```
typedef struct{
unsigned int p_length; //2bits
unsigned int c_index; //2bits
unsigned int fl; //2bits
unsigned int addr; //10bits
unsigned int command; //1bits
unsigned int user_datalen; //7bits
unsigned char p[3];
} packet_type;
```

Error detection method of data packet is "CRC16" and its polynomial is (Chao *et al*., 2010). $G(X)=X^{16}+X^{15}+X^{2}+1$.

The "CRC16" is realized through function "void crc_encode (u_char *pdata,int len)". "pdata" is pointed to data storage unit, "len" represents for the length of data packet. The detailed algorithm is as follows:

```
void eti_crc(u_char *pdata,int len)
{
   xc = 0xffff;
   for (i=0;i<len;i++)
   {
      indata = pdata[i]<<8;
      for (j=0;j<8;j++)
      {
         mask = (xc^indata) and 0x8000;
         mas= (mask>>3)+(mask>>10)+(mask>>15);
         xc = (xc<<1)^mask;
         indata<<=1;
      }
   }
      pdata[len] = (xc>>8) ^ 0xff;
   pdata[len+1] = xc ^0xff;
}
```

Data encoding of the whole early warning information is implemented in the thread function UINT encodethread (LPVOID lParam):

```
UINT encodethread(LPVOID lParam)
{
infile.Read(pBegin,len);
group_encode();
group_chai();
packet_all(group_data,len,0);
}
```

- "pBegin" is pointed to memory start address of early warning information. "packet_encode()" is called by "packet_all", through "memcpy(pd,packet[0].p,3)", packet header is added to global variable. Then, business data and CRC is added to packet by function "memcpy(pd, group _data,len)" and "eti_crc(_data,len)"

In order to entry warning information conveniently, a graphical encoding interface of early warning information for users based on adaptive grouping is designed. Only by simply clicking the "encoding" button, adaptive grouping of early warning information is achieved. Meanwhile, the function of adaptive grouping is achieved in the background thread and a file named as "out.txt" is generated. Thus, the file can be transmitted in

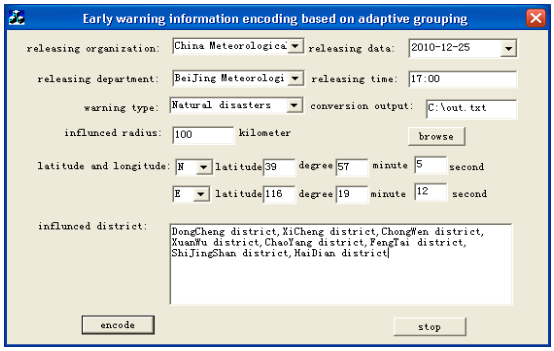

Fig. 4: Encoding interface of early warning information based on adaptive grouping

DAB transmitting system (Yong, 2007). Encoding interface of early warning information based on adaptive grouping is shown in Fig. 4.

CONCLUSION

An early warning information transmission scheme based on adaptive grouping is put forward and the transmission system is achieved successfully in main DAB business channel. Because the system is suitable for releasing information which is variable and unfixed, it is convenient for lots of types of released information packet, such as early warning information, traffic service information and other business information.

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