Overview of SDT and EIT analysis in DVB systems

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Prehľad SDT a EIT analyzy v systéme DVB

This article presents the service information in the digital broadcasting systems (DVB). It gives some details about the transport stream and about some special information, which is contained by different tables. The transport stream is a communication protocol for audio, video and data transmission, which is specified in the MPEG-2 systems. A service description table (SDT) contains data describing the services in the system. An event information table (EIT) comprises data, which specifies the events or the programs, such as event name, start time and duration. Finally, a transport stream analyzer program will be introduced, which is responsible for gathering information from SDT and EIT tables. The application processes the descriptors belonging to the corresponding tables and displays the data from these tables.

Key words: *digital video broadcasting (DVB), transport stream (TS), service information (SI), service descriptor table (SDT), event information table (EIT).*

Introduction

Digital television (DTV) is a new and interesting platform for developing next generation multimedia services and for broadcasting and receiving moving pictures and sound with the help of the digital signals. It has several advantages over the traditional analogue TV. The most significant one is that digital channels take up less bandwidth space and DTV also provides movie-quality picture and CD-quality sound along with a variety of other enhancements. Due to the effective compression methods, about five digital programs can be broadcast via an analogue channel. It results in significant frequency saving and wider choice of programs. Consequently, digital broadcasters can provide more digital channels in the same space. In addition, it can also provide a High-Definition digital service or other services, such as multimedia or interactive services. An electronic program guide (EPG) allows easier orientation between digital programs. Moreover, additional information can be obtained for the programs. If the television set has a bilateral channel, the Internet service can be received.

DVB Systems

Digital broadcasting has been gaining more and more ground in the world of television broadcasting. This technology has the potential to radically change the television habits. A pan-European platform, known as DVB, was established in 1993. Its aim was to create standards and to disperse it world-wide. DVB standards were evolved in order to specify the transmission and encoding technology of digital broadcasting in different platforms: satellite, cable, terrestrial and mobile. Each platform is a well-proven and efficient MPEG-2 image and voice encoding process, which is widely used and standardized. The error correcting process is called Reed-Solomon encoding. Examining the standard, substantial differences can be found between the platforms.

In case of the digital broadcasting via satellite (DVB-S), more disturbances can occur due to electro-magnetic disorders, such as lightning, the rapid change in the ionosphere properties, etc. Therefore, we should complement an additional Viterbi error-correcting code to the transmitted data. QPSK modulation, which is a digital modulation scheme that conveys data by modulating the four different phases of a reference signal, is used for the transmission.

DVB-C is a standard for the broadcast transmission of digital television over cable. This system uses the QAM modulation with channel coding. Quadrature amplitude modulation (QAM) is a modulation scheme, which conveys data by changing the amplitude and the phase of the carrier waves. Transmitting data via cable has a great advantage that is the signal travels on only one route.

Digital video broadcasting via terrestrial channel (DVB-T) transmits a compressed digital stream using OFDM modulation with concatenated channel coding. OFDM is a digital multi-carrier modulation scheme, which uses a large number of closely-spaced orthogonal sub-carriers. Each sub-carrier is modulated with

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a conventional modulation scheme, such as QAM, at a low symbol rate. The global introduction of this system is envisaged for 2012 in the European Union.

DVB-H is a technical specification for transmitting broadcast services to handheld receivers, such as mobile phones. It is the latest development within the set of DVB transmission standards. DVB-H technology adapts the successful DVB-T system for digital terrestrial television to the specific requirements of handheld, battery-powered receivers.

Transport Streams

Two types of packets were standardized for the signals generated by MPEG: one of them is called "program stream" (PS), the other one is called "transport stream" (TS). A program stream belongs to only one television program and carries summed image and voice data. It is developed for transmission systems, where packets have a variable standard format, the parts of data stream have a common time-base and last but not least it is developed for undisturbed transmission. A transport stream consists of television and radio programs together with the accompanying service information. Data stream parts have different time-base. Packets have a constant size and particularly it is developed for disturbance loaded transmission.

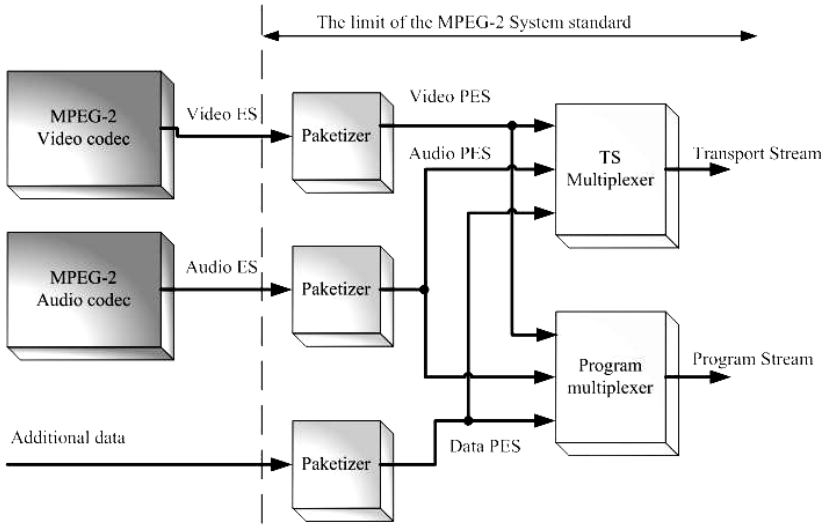

Fig. 1. MPEG-2 program and transport streams.

Data streams are slightly distinct in the different levels of the signal processing. Therefore, it is necessary to distinguish them. In the output of the encoders, where the signal of a picture or voice appears independently, the name of the stream is elementary stream (ES). By sorting them into packets, a packetized elementary stream (PES) is obtained, which is a separate data stream. TS packets are brought about when PES packets are sectioned and every transport stream packet contains one section of PES packet.

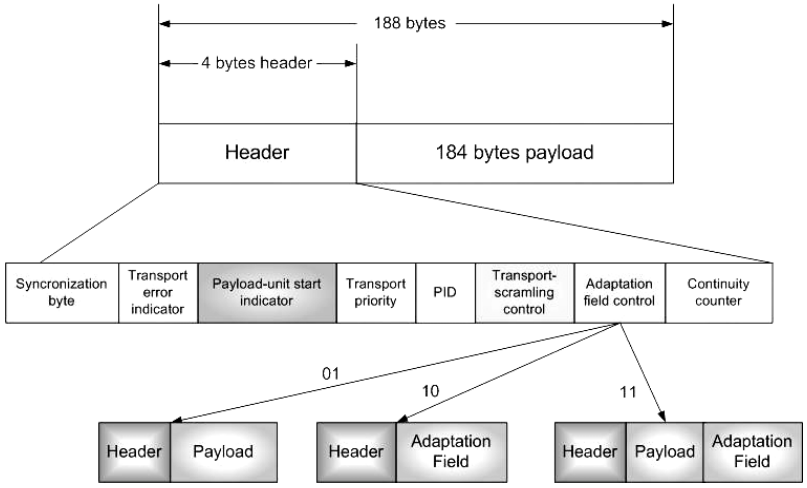

Fig. 2. The structure of the transport stream.

Consequently, TS packets are derived from elementary streams, service information, private data, and conditional access control. All packetized elementary streams, including video and audio that are multiplexed together, are converted into transport packets. Similarly, the system information, the private and conditional access control data are also converted into transport packets. Then the resulting transport packets will be the output sequentially to form an MPEG-2 transport packet stream. Null packets are used to soak-up any spare multiplex capacity, which can also appear in the TS.

Transport streams have a constant packet size containing 188 bytes. The first one is the synch. Packets should be protected against noise, so at the end of the TS there is a Reed-Solomon error correcting code, which adds eight additional bytes to the stream. Thus, packets have 204 bytes together. We can distinguish packets from each other due to some data. They are located in front of the TS called headers. The 4-byte header is followed by a payload or an adaptation field or both. The payload is 184 bytes in length.

Program Specific Information

Unfortunately, for receiving a given program it is not enough to transmit video, voice and possibly TXT signals, because TS consists of several signals. PSI tables comprise the information, which is necessary for the receiver to be able to search for and decode the program wanted in the data stream. Tables are generally made up of separate packets having their own PID.

The service information (DVB-SI) is based on four SI tables, plus a series of optional tables. Each table contains ordinary and descriptor fields outlining the characteristics of the services or events being described. Each descriptor can have nested descriptors. The PSI data is structured in the following four tables:

The *Program Association Table* (PAT) indicates the location (i.e., the Packet Identifier (PID) values of the TS packets) of the corresponding Program Map Table (PMT). It also gives the location of the Network Information Table (NIT). The *Conditional Access Table* (CAT) provides information on the Conditional Access (CA) system used in the multiplex. The *Program Map Table* (PMT) identifies and indicates the locations of the streams that make up each service and the location of the Program Clock Reference fields for a service. The *Network Information Table* (NIT) contains information relating to the physical organization of the multiplexes carried via a specified network and the relevant tuning information. It groups the services together belonging to a particular network provider. It is also used to signal the change in the tuning information.

In addition to the PSI, further data is needed to provide the identification of services and events carried by different multiplexes. This data is structured in the following tables:

The *Service Description Table* (SDT), which can be seen in the third figure, contains data describing the services in the system, such as the names of services, the service provider, etc. It lists the names and other parameters associated with each service in a multiplex.

Syntax	Number of Bits
service_description_section(){	
table_id	8
section_syntax_indicator	1
reserved_future_use	1
reserved	2
section_length	12
transport_stream_id	16
reserved	2
version_number	5
current_next_indicator	1
section_number	8
last_section_number	8
original_network_id	16
reserved_future_use	8
for (i=0;i<N;i++){	
service_id	16
reserved_future_use	6
EIT_schedule_flag	1
EIT_present_following_flag	1
running_status	3
free_CA_mode	1
descriptor_loop_length	12
for (j=0;j<N;j++){	
descriptor()	
}	
}	
CRC_32	32
}	

Fig. 3. The structure of service description table.

The *Event Information Table* (EIT) contains data concerning events, such as event name, start time, duration, etc. The use of different descriptors in EIT allows the transmission of different kinds of event information, like the different service types. It is also used to transmit the information relating to the all events that occur or will occur in the MPEG multiplex. The *Bouquet Association Table* (BAT) provides information regarding to bouquets that are the collections of services. It provides a list of services for each bouquet as well as the name of the bouquet. A particular service can belong to one or more bouquets. The *Running Status Table* (RST) contains different control information, which is responsible for starting the video recorder in the right time. This information is important because the starting and the ending time of the programs are always changed or delayed. The current UTC time is located in the *Time and Date Table* (TDT). The receiver displays the time based on the information of this table. In case of different time zones, the appropriate time offset information is transmitted in the *Time Offset Table* (TOT). The receiver should know the place of the reception. It is important in the countries, which have more time zones. The *Stuffing Table* (ST) is responsible for overwriting the information in the MPEG streams.

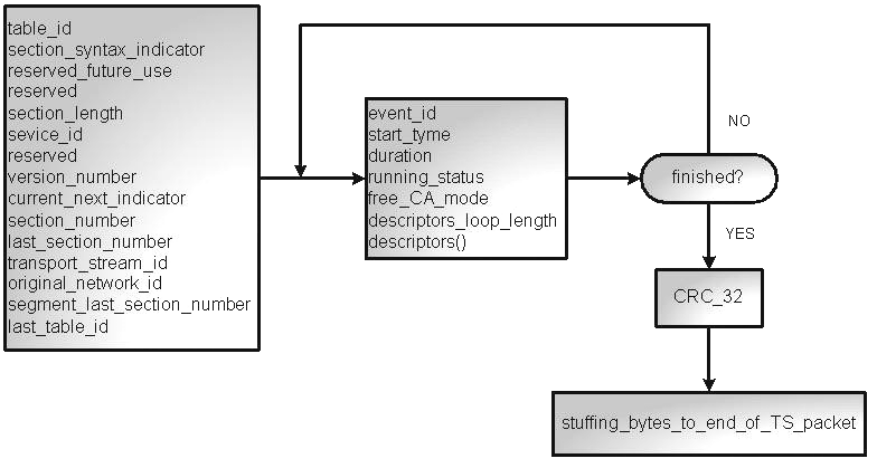

Fig. 4. The flow diagram of the event information table.

The DVB-SI tables are transmitted in sections. Each table must be segmented into one or more sections with the same table identifier (*table_id)* before being inserted into TS packets. A section is in fact a syntactic structure. Sections may be variable in length. The sections within each table are limited to 1024 bytes in length, except for sections within EIT, which are limited to 4096 bytes. Each section is uniquely identified by a combination of five fields in the section, such as *table_id*, *section_number*, etc.

In the tables the descriptors contain the essential information. Each table has some specified descriptors, which consist of three parts: the descriptor tag, the descriptor length and the content of the descriptor.

EIT and SDT analysis

An analyzer program, which has two main parts: the SDT and the EIT analyzer, is developed in the Telecommunication laboratory of Department of Automation, University of Miskolc. In our laboratory we use a digital cable television headend and special devices (hardware components) developed by CableWorld Ltd. The Transport Stream is provided by the hardware devices via a satellite connection.

The application can communicate with a hardware component called TS Analyser with IP communication. In the first interface of the program we can get sample from the TS, then the sample can be displayed. From the sample we can collect some PSI tables, such as PAT, PMT, etc.

The SDT analyzer program collects data describing the services in the system. The application processes the descriptors belonging to the SDT table. The main feature of the program can be seen in the fifth figure. A separated table is used for displaying the service types, the service and the service provider names. The program also consists of a textbox in which we can find other special information, such as the length of the section, the id of the TS, the version number, etc.

The EIT analyzer program has five main parts as you can see in the sixth figure. The first one displays the service identifiers and the channel names in a table. You can choose one of them and when you click on it, you can see details about the chosen channel in a second table. These are the program names and their starting times. There are two textboxes below the tables. They are used to display additional information from the programs and from the current stream. The fifth part contains two buttons with which you can get or load samples.

Consequently, the application gathers data from descriptors, such as short event descriptor, thus it provides a short text description of the event. If there is an extended event descriptor, a larger text description of the event will be displayed. So this program is similar to an EPG.

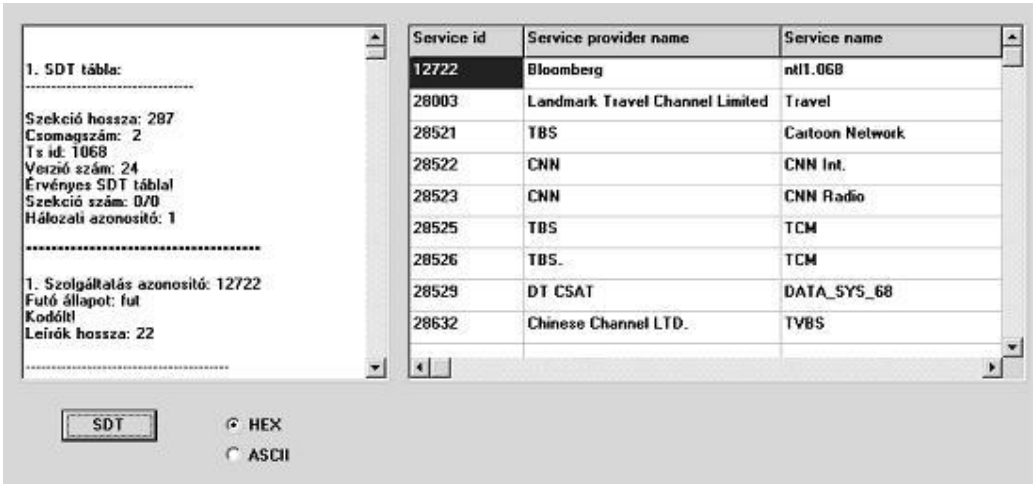

Fig. 5. SDT analyzer program.

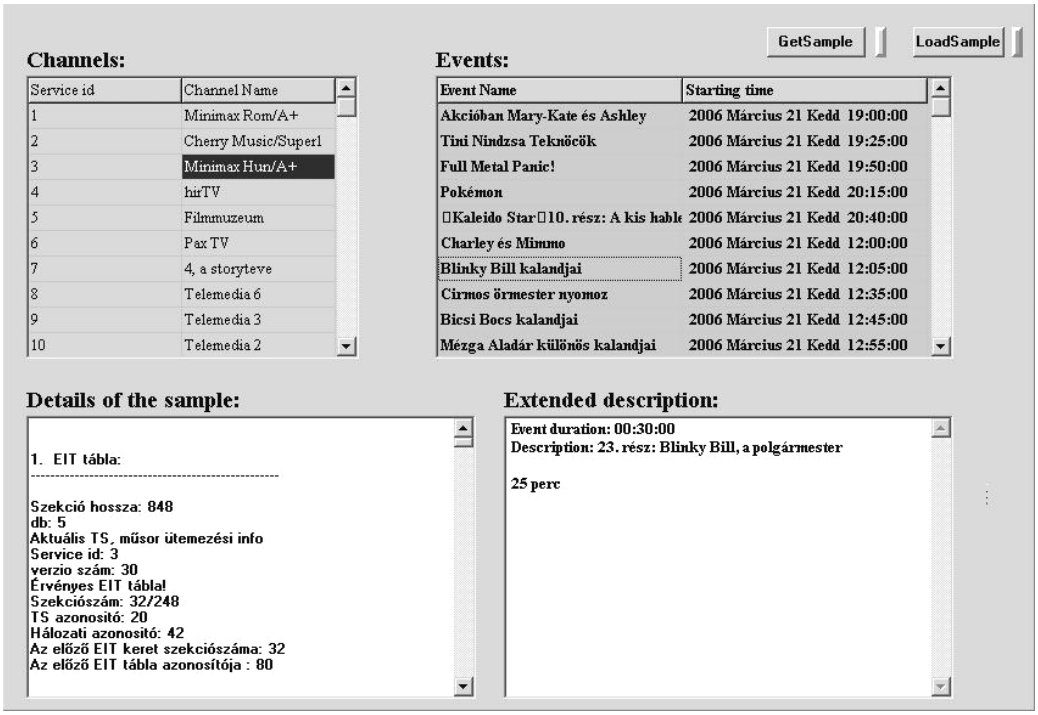

Fig. 6. EIT Analyzer application.

Concluding remarks

The knowledge of TS and PSI tables opens up new opportunities to develop software, which controls and revises the TS. We developed this program in order to be used as a part of the TS Analyzer or TS Remultiplexer software developed by CableWorld Ltd.

By adding some other analyzer parts to this application, it would be a complex Transport Stream monitoring and controlling application. A real-time monitoring system can be developed by getting sample in appropriate intervals.

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