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ANALYSING AND BROADCASTING TRANSPORT STREAMS OVER DIGITAL CABLE
TELEVISION NETWORKS

ANALÝZA A VYSÍLÁNÍ STREAMOVANÉHO SIGNÁLU PROSTŘEDNICTVÍM DIGITÁLNÍ
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Abstract

Broadband cable TV access networks have been going through a dramatic transformation worldwide. At the Department of Automation, University of Miskolc a group of the staff and students have dealt with building, maintenance and managing Digital Cable Television Head-end and broadcasting. With the invention and emergence of the Internet as information superhighway, cable subscribers and small businesses didn't want to be left behind and were eager for high-speed access. [1]. Our objectives are to get a great insight into the digital CATV broadcasting as well as to obtain a method for measuring of the quality of digital transmission and analyzing Transport Streams containing audio, video and data elements.

Abstrakt

Vývoj připojení kabelových televizí prošel celosvětově dramatickým vývojem. Na Katedře automatizace, University v Miškolci se skupina pracovníků a studentů zabývá budováním, údržbou a správou Digital Cable Television Head-end a dále vysíláním. S příchodem a rozvojem sítě Internet jako informační superdálnice, zákazníci kabelového připojení a malé firmy stále častěji vyžadovali přístup k rychlému připojení do sítě Internet [1]. Naše cíle zahrnují provedení rozsáhlé analýzy digitálního CATV vysílání a dále nalezení způsobu měření kvality digitálního přenosu a analýzu streamovaného signálu přenášejícího audio, video a data.

1 INTRODUCTION

Advanced applied technologies required CableWorld Ltd. to develop beside the 115 kbit/s CWBus a much faster bus system for operating the new products. This bus system of max. 100 Mbit/s data rate is referred as CW-Net. CW-Net is an open bus system permitting the user to integrate it into their systems and build optimised solutions by its use. The physical layer of CW-Net is the 100 MBit/s Ethernet network, which performs the data traffic under UDP/IP protocol. Building the network and connecting the devices is made using the standard elements used in computer networks, no special elements or cables are required. The CW-Net [2] performs both device control, loading data and continuous transmission of the transport stream.

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2 FUNDAMENTALS OF CREATING NETWORK TO ANALYSE TRANSPORT STREAMS

For connecting the devices UTP (Unshielded Twisted Pair) or STP (Shielded Twisted Pair) cables of at least category 5 have to be used. The connections are made with RJ45 8-pin telephony connectors.

Two devices are connected with crossover cable in order to connect the transmitter of one device to the receiver of the other and reversed. Wiring of the crossover cable is shown in Figure 1.

Fig. 1. Pin allocation of RJ45 connectors and wiring of the crossover cable

Today's advanced devices are able to automatically recognize the inputs and outputs. Devices marked with "Auto-negotiation" feature are capable of this and they make automatic cross-switching of the inputs and outputs if necessary. Earlier models use manual switch.

Devices can be connected with each other through a special switching device only, which can be a Hub, Switch, Router or Gateway. For beginner users application of switches is recommended; experienced users can apply any of them. It is important that: between switch and device straight cable (not crossover) has to be used!

The simple mini switches designed for home use are suitable for transmitting simpler instructions, but not suitable for errorless transmission of the high-speed transport stream! For transmitting the transport stream, high quality industrial switch is needed, and the more complex system is to be built, the more professional switch is required. Computers can be equipped with Ethernet network connection thus directly being connected to the system, or can be equipped with network card afterwards for getting ready to that. Most of such cards are available in 10/100 Mbit/s versions; the 10 Mbit/s versions are not suitable for this job. The Gigabit Ethernet (1000 Mbit/s) cards are especially suitable if they have 100 Mbit/s operation mode.

The computer can be operated in automatic data rate recognizing mode, but most secure operation is setting the „100 Mbit/s Full Duplex" mode. The CableWorld devices can establish connection and receive simpler instructions even in 10 Mbit/s mode, but the continuous transmission of the transport stream is not possible at this data rate, even for theoretical reasons. Next to the RJ45 network connector generally one or more LEDs are placed. When devices operate correctly the green LED continuously lights, the yellow LED continuously lights or flashes. The CableWorld devices go automatically to 100 Mbit/s-os data rate if the connected device (computer, switch etc.) is capable of working at this speed.

2.1. Addresses of devices and transmitting transport streams

In the CW-Net system controlling the devices and transmitting the transport stream are made under UDP/IP protocol. The following IP address system for the devices is recommended:

- IP identifier of the **CW-Net** network: **10 . 123 . 13 . 0**
- IP identifier of the controlling computers and devices receiving and analysing the TS: **above 10 . 123 . 13 . 200**
- IP identifier of devices sending and transforming the TS-t and auxiliary devices: **10 . 123 . 13 . 100** - **199**

Handling of the CW-Net network and setting the IP addresses of the devices can be made with the CW-Net Principal software. The software permits free programming of the fourth part of the IP address. A simple application example and address allocation is shown in Figure 2.
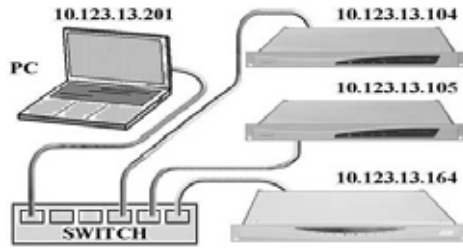
Fig. 2. Allocation of the IP addresses and connections between the devices

After interconnecting the devices and starting the data traffic, the handling software of the computer network and the switch make mapping of the system and memorize the IP addresses of the devices. Therefore when making changes in the cabling, incorrect operation may occur. For avoiding this, after making any changes in the cabling the whole system should be re-started.

3   TRANSPORT STREAM ANALYZER

With digital TV transmission, the signal of the TV program is converted into data, which are carried by the transport stream (TS). At generating or modifying (remultiplexing) transport streams, the most important step is the analysis of the transport stream, that is, checking up the structure, right arrangement and content of the data. For analysing, remultiplexing and scrambling the TS, CW-481x TRANSPORT STREAM ANALYZER [2] including SW and HW modules was developed.

3.1 Hardware and Software components of the Transport Stream Analyzer

The Department of Automation has recently joined the CabelWorld Ltd. in connection with a common project in order to make developments as research in Transport Stream analysing techniques. First of all we have taken part in software engineering and later then in developing Hardware devices. Investigating the data content occurs in the computer and the results are displayed on its screen. The measuring techniques made on the transport stream will widely develop in the next years since the value added services, the pay TV systems etc. will raise more and more demands on analysers. The SW-4811 operating software permits the elementary level in-depth analysis of the data stream thus it can excellently be used for checking up the data streams of remultiplexers, scramblers, pay TV systems and new services as well as for developing and training purposes.

Fig. 3. HW and SW components of TS Analyzer

The SW-4811 software has not been yet suitable for continuous TS monitoring, error logging, operating switches in the case of errors, but the hardware is already prepared for these jobs. The 19"×1 HU unit (Fig. 3.) receives the streams at one or more ASI inputs, depending on the type version. The inputs are selected from the PC. The SW-4811 controlling software of the analyzer runs in Windows XP Professional environment. The CW-481x TS Analyzer series consists of a simple hardware and a software package, which is being continuously developed and can even be developed by the user.

Fig. 4. TS Analyzer functions

For operating the CW-481x TS Analyzer needed is also a computer, which can be the user's notebook PC, the central computer of the system or any other one. The first member of the software series, the SW-4811 [2] was designed primarily for development, education and training purposes. The use of this device is recommended for those, possessing already basic knowledge of digital television or going to acquire it. The CW-481x hardware is suitable for performing many other jobs even without any change. For some of these jobs pieces of software has been developed. The ASI inputs of the CW-481x Transport Stream Analyzer are of bridged type, thus the device can be inserted into the system without the need of further ASI outputs and further external units. The bridged outputs deliver regenerated ASI signals, improving the parameters of the ASI line.

4 CONCLUSIONS

Digital technology forms our environment day by day and we can enjoy its advantages in more and more fields everyday. As a matter of fact television technology takes over the leading role. As regards transmission in digital television technology, signals of and sound as well as further data are carried by the same transport stream. The paper has introduced that the transport stream is a vast data stream consisting of numerous elementary streams. Testing, measuring, modifying and re-multiplexing the transport stream and transmitting [3] it over different media are the most complex tasks.

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