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MODERN TECHNOLOGIES DIGITAL SYSTEMS OF CABLE TELEVISION

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Digital television is practically in every house. Digital television broadcast is provided by many telecommunications services operators. The operator, which has a numerous transport network, can choose what technology will be appropriate for work.

Look at some work's principles of these technologies.

IPTV. Internet Protocol Television (IP-TV, IP- television) – technology of digital television in data transmission networks using the IP protocol used by telecommunications service operators.

Digital TV, transmitted over networks based on IP-protocol, gives great opportunities to the service provider [1].

As a client equipment can be computers, specialized TV set-top boxes, TVs with Smart TV technology.

Access to IPTV resources can be carried out using of special applications and with the help of its Internet browser.

IP-network, depends on the distortions due to the loss of data packets and their delay in time, since these networks are related to packet switching networks.

When switching packets, all data transferred by the user is split by the transmitting node into small parts - packets. The transmission of packets over the network occurs independently of each other and is processed by aggregation equipment.

The structure of the IPTV complex, as a rule, includes the following components:

- Subsystem for complex and service management, also called "Intermediate Software" or "IPTV Middleware";
- Subsystem for receiving and processing content;
- Content protection subsystem;
- Subsystem of video servers;
- Subsystem for monitoring the quality of flows and client equipment.

In IPTV networks, the complexity of delivering data from a source in multicast mode increases with the increase in the number of users, the effect of emerging in-mesh in networks [2-3] and, accordingly, a decrease in the

transmission rate. Therefore, it is necessary not only to react to the arising overload, but also to prevent its occurrence.

DOCSIS. The first standard, intended for the retrieval of packet data on DQSIG networks - DOCSIS 1.0, developed in the USA in 1998 by the Cable Labs consortium in cooperation with MCNS (Multimedia Cable Network System), a group of companies that unites a wide range of cable equipment manufacturers. This standard was strictly focused on the use of the Internet, i.e. To implement a single standard platform for IP-based services, such as voice over IP (VoIP), interactive television, VoD, and a number of other additional services. As a result, the standard DOCSIS provides for the use of standard Ethernet frames. At the same time, the DOCSIS specification allows for several peer-to-peer encapsulation options for IP packets, including, for example, IP over ATM, IP over Ethernet, depending on the organization of the provider's network of interactive services and the service user. In addition, the DOCSIS 1.0 standard took into account the parameters of the television channels operating in North America (the bandwidth of the frequency channel is 6 MHz, the frequency range reserved for the transmission of signals in the opposite direction is $5 \cdot .42$ MHz) [4].

In 2013, the DOCSIS 3.1 specification is presented, which regulates the forward channel speed of 10 Gbit / s and more and 1 Gbit / s of the reverse channel, using the 4096 QAM modulation scheme. Here, instead of frequency division of channels with a width of 6 MHz and 8 MHz, subcarriers of 20 kHz to 50 kHz width with OFDM multiplexing are used. They can be placed in a spectrum up to 200 MHz wide. DOCSIS 3.1 also regulates energy management tools that will reduce the energy intensity of the cable television industry.

DVB-C. The alternative to DOCSIS standards group is the DVB-C standard, developed in Europe by the non-profit organization Project DVB, functioning under the auspices of the EBU(European Broadcasting Union).

The DVB-C standard was developed on the basis of the use of ATM cells as for the transmission of basic data, i.e. Transport packages MPEG-2, and for the organization of interactive services. In this case, the standard assumes the use of standard methods for ATM quality assurance services. Unlike the DOCSIS standard, the transmitted IP packets are first converted to ATM cells, which are transmitted over the cable, which reduces the requirements for a cable modem and network equipment.

DVB-C2. DVB-C2 is the second generation of the broadcasting standard via DVB-C cable. The DVB-C2 standard allows maintaining the channel capacity of 83.1 Mbps at 8 MHz using 4096-QAM modulation; Further improvements will allow maintaining the channel capacity up to 97 Mbit / s and 110.8 Mega-bps per channel using 16384-QAM and 65536-AQAM modulation, respectively. This, in turn, will require such an increase in the capacity of cable channels, which in many of the existing networks is unattainable. The standard provides LDPC-coding, as well as the use of QAM-modulation with a dimension up to 4096 QAM. In addition, it uses OFDM instead of a single carrier, thereby providing additional flexibility and immunity.

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