Internet Protocol Television System in the Internet Protocol Suites

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ABSTRACT: *The traditional system of television services is delivered in terrestrial, satellite, signal, and cable formats. This system has inherent limitations. To offset such limitations, we in this paper advocated the Internet Protocol Television system where the services use Internet protocol suite during the packed switched network. The benefits are widely discussed further in this paper.*

Keywords: IPTV, VoD, MPEG4 AVC, H.264

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1. Introduction

A new method of delivering and viewing television channels over IP network and high speed broadband access technology is called IPTV, short for internet protocol television and also known as broadband TV. It is not only a distribution method, but also bring new interactive features and changes the way we watch TV. Ability to pause, resume and fast forward TV shows gives freedom to every user to make individual custom program schedule is only a small part of innovations presented by interactive television. Internet protocol television differs from Internet television as Internet TV is streaming video content over public Internet while IPTV is streaming dedicated video content via private managed network with quality of service (QoS). If service provider is delivering three services: Broadband internet, voice over IP (VoIP) and IPTV the technology is called *Triple play* and if wireless mobility is added then it becomes *Quad play*. World largest IT companies like Microsoft, Cisco and Google are involved in developing end-to-end IPTV solutions: Microsoft TV, Google TV and Cisco Content Delivery System.

2. IPTV Architecture

End-to-end IPTV infrastructure consist of three major components: originate (head-end), distribute (delivery network) and consumption (user-end). An overview of typical IPTV architecture is presented on figure 1.

As IPTV is transmitted over IP it needs proper compression techniques to compress the video prior to its transmission depending on the available bandwidth. Researchers from ITUT have found MPEG compression the best possible solution for this challenge. ITU-T has standardized H.264 and that is equivalent to MPEG-4 (part 10) standardized by Moving picture expert group MPEG. In addition to this H.264/MPEG- 4 is used for HDTV, while older standard MPEG-2 is used for SDTV. Another solution is presented by Society of Motion Picture and Television Engineers (SMPTE) and implemented by Windows Media 9 (WM-9) is named VC-1. It has similar features to MPEG-4, but has better integration with PCs.

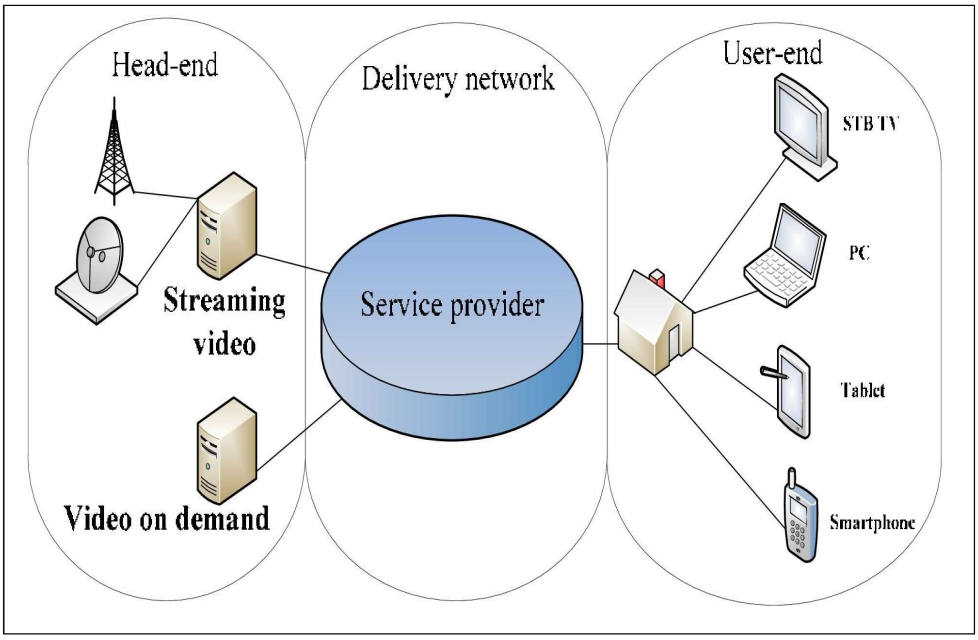

Figure 1. IPTV architecture

Some of the most popular video compression standards are shown in Table 1 below:

Published	Standard	Organization
1993	H.261/MPEG-1	ISO, IEC
1995	H.262/MPEG-2	ISO, IEC, ITU-T
1999	MPEG-4	ISO, IEC
2003	H.264/MPEG-4AVC	ISO, IEC, ITU-T
2006	VC-1/WM9V	ISO, Microsoft
2008	VC-2Dirac	ISO, BBC

Table 1. Video compression standards

Originally MPEG-1 is used for Video-CD (VCD) 120 mm optical disc and became the first format for distributing films.

MPEG-2 is internationally accepted standard for digital television and is widely used for digital video broadcast (DVB) systems.

MPEG-4 is used for Internet and mobile video, standarddefinition (SDTV) and high-definition television (HDTV). MPEG-4 uses up to 50 % less bandwidth than MPEG-2 with bit rates from 5 Kbit/s to 10 Mbit/s depending on quality and video screen resolution.

To deliver video content over IP network IPTV system needs interactive services. IPTV services can be divided in three main groups: streaming TV, video on demand (VOD) and time-shifted TV. According to ETSI specification [6] NGN integrated IPTV include following IPTV services: Broadcast TV; Content on Demand (nCoD, pCoD); Personal Video Recording (cPVR, nPVR); Pay Per View (PPV); Interactive TV (iTV); User Generated Content (UGC); Profiling and personalization; Content Recommendations (CR); Advertising (Ad) and Targeted Advertising (TAI); Messaging services; Notification services; Personalized channel; Bookmarks or Content Marking (CM).

IPTV services provide users with more control over viewed TV channels and give them ability to make decision what TV content to choose and when to watch it. User can watch IPTV with a number of network-addressable devices like laptop, personal computer, set-top box and TV, smartphone, tablet, gaming consoles, etc.

3. Obtaining Video at Head-end

Service providers need to acquire and encode video content.

They can use several different video sources and analog, digital and IP technologies to do that. Streaming video can be obtained from following sources:

- Satellite - DVB-S (SDTV) / DVB-S2 (HDTV)
- Cable – DVB-C / DVB-C2
- Terrestrial – DVB-T / DVB-T2
- Analog TV - obsolete

Standard	Modulation schemes
DVB-S	QPSK,8PSK,16-QAM
DVB-S2	QPSK,8PSK,16APSK,32APSK
DVB-C	QAM:16-to 256-QAM
DVB-C2	COFDM: 16-to 4096-QAM
DVB-T	COFDM(OFDM): QPSK, 16QAM, 64QAM
DVB-T2	OFDM: QPSK, 16QAM, 64QAM, 256QAM
Analog	AM(VSB),FM,QAM

Table 2. Modulation Schemes

TV signal acquisition needs different equipment like satellite dishes, TV antennas, cables modems, DVB receivers, Set-top boxes (STB) depending on source type and technologies of distribution systems. There are also a variety of modulation methods and schemes, some of them are shown in Table 2.

Video on demand can be recorded live video stream for later review or uploaded video content from various sources to a dedicated VoD server or media library. Sources can be live TV, Video CDs, DVDs, Blu-ray discs, cameras and various multimedia devices.

After video acquisition it must be processed by video encoder device. Typically live video content is compressed using H.264/MPEG-4 AVC codec. Other codecs can also be used instead. The most common codecs used for VoD are MPEG-2, MPEG-4 and VC-1. In case video is acquired directly in older MPEG-2 or other video format transcoder device can be used to convert data into desired video codec.

VoD content can be encrypted, scrambled and embedded with a tag to avoid content piracy enforcing Digital rights management (DRM).

Then encoded video content is sent in an MPEG transport stream and depending on service it can be forwarded to service provider delivery network in case of live TV or stored on VoD server in case of video on demand service.

4. Distribution via IP Networks

Video originated at Head-end must be preserved and transported across IP network to reach end users. Broadband networks used for Internet (data) and voice services are ideal for adoption of IPTV. Physical layer (Layer 1) can be copper, fiber optic, combination of both types and even broadband wireless (IEEE 802.11n). Technologies used for data link layer (Layer2) are MetroEthernet, xDSL, FTTx, ATM, WiMAX, LTE, DVB-H, etc. Depending on cable types and physical topology IP networks include intermediate devices like routers and switches to forward user data across the network. Additional mechanisms and protocols are used to ensure reliable delivery of IPTV traffic. IPTV traffic is sensitive to losses and delay. Quality of Service (QoS) is responsible for prioritizing video over other traffic on the network. QoS Standards include IEEE 802.1p QoS, IEEE 802.1q VLAN, CEA2007 VLAN Mapping.

Additional control software (or middleware) is required to: gain user access privileges, manage video content, to protect intellectual property via Digital Rights Management (DRM), billing software and offer services like electronic programming guide (EGP), VoD catalog, web services, mobile applications, domain name system (DNS), Network Time Protocol (NTP), Dynamic Host Configuration Protocol (DHCP), nCoD, nPVR, advertising, etc.

IPTV is delivered via IP multicast in case of streaming TV or via IP unicast in case of video on demand. More complex distribution method is available with combination of both unicast and multicast delivery mode depending on underlying IP network topology of service provider delivery network. Internet Group Management Protocol (IGMP) is used to join and leave multicast streams. IP Multicast Standards include IGMPv1, IGMPv2 and IGMP Snooping.

According to ETSI specification [7] the transport streams should be encapsulated with Real-Time Transport Protocol (RTP). Real Time Streaming Protocol (RTSP) is responsible for control over delivery of video content. Real-Time Transport Control Protocol (RTCP) is used to send statistics and control information for QoS.

5. User-End

User devices for IPTV reception include: traditional set-top box (STB), IP STB, PC, smartphone, tablet and any internet browsing device able to play video content.

6. Conclusion

This paper describes current state of IPTV technology. Main goal is to deliver better video quality at the lower bit rate, offering virtually unlimited number of TV channels. Adding new features and services is very easy and straightforward. Services can be adopted with minimal investments and with use of existing IP network infrastructure delivered to users.

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