IPTV service

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***Abstract* —After a brief overview of video Coding Standards we will deal with IPTV services market , together with an example concerning Bosnia and Herzegovina.**

***Keywords* — Internet protokol TV (IPTV), IP packet, DSL technology, Broadband Internet access**

I. INTODUCTION

The term IPTV usually includes a broad range of programs or TV channels provided by one or multiple service providers. Additionally, it might include some specialized programming like concerts, special events and movies, provided only when requested by the user; i.e., video on demand (VoD).

The delivery of Internet protocol TV (IPTV) using DSL is an emerging and exciting technology that offers new business opportunities to service providers. ADSL2+ and VDSL2 data rates make it possible to easily integrate voice, video and data services over a single telephone line, commonly denominated triple-play services. With all these technological developments, it is now practical and economical to simultaneously provide multiple standard and high-definition television channels (SDTV and HDTV) to the residential user [1] .

In general, video service providers first perform the coding and compression of the video signal typically using MPEG-2, MPEG-4 or WM9/VC-1 (it is at this stage that a trade-off between quality and required bandwidth occurs). Then, the video content is ready to be distributed by streaming IP packets using the user-datagram protocol (UDP), which is the preferred method of IP packet delivery when offering video due to its low latency. Once at its final destination, the subscriber's house, the video stream is decoded by a set-top box (STB) and played on the TV.

The rest of the work is organized as follows. We start with a brief overview of Quality of IPTV including mean factors affecting IPTV Quality of service. Next, we will deal with IPTV video Coding Standards . The forth part includes IPTV services market , together with an example of invoking IPTV access in Bosnia and Herzegovina.

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II. QUALITY OF IPTV

On any ADSL-based deployment, the quality of the consumer's video is not just a function of the network bandwidth (ADSL2+/ADSL) or the data stream, as there are a number of parameters that contribute to the customers' perception of good vs. bad quality. As the video stream arrives to the settop box and ultimately the television, it has gone through various protocol layers (e.g., physical ADSL layer, ATM layer, IP layer, transport layer, etc.). It is the interaction between these layers and the effect of external influences that affect the quality of the video perceived by the consumer; this is often referred to as quality of experience (QoE). Some of the parameters that influence the customer's QoE include image pixelization and tiling, picture blurring and edge distortion, as well as audio dropouts and channel-change latency (also known as zap time). Typical IPTV over DSL network is shown in Fig.1.

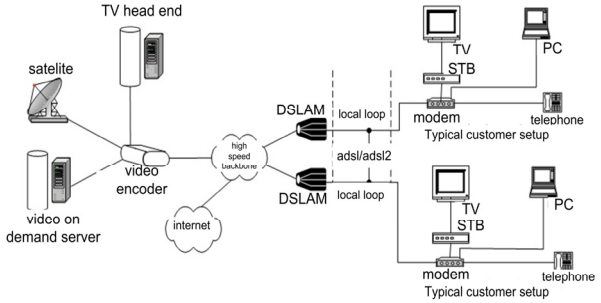

Fig.1. Typical IPTV-over-DSL network

A typical IPTV configuration from the digital subscriber line access multiplexer (DSLAM) to the customer premises is shown in Fig.2.

As shown, the video stream is delivered using ADSL2+ from the IP based DSLAM to the user's ADSL2+ broadband router. The router, while supporting voice and Internet service, passes the video stream to the STB for decoding. The STB converts the video stream into required signals for displaying on the consumer's TV.

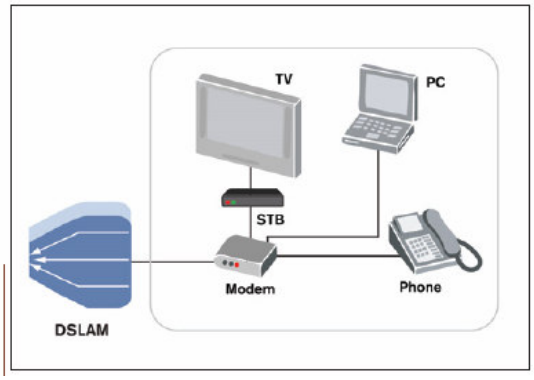

Fig. 2. Typical IPTV configuration

A. *Factors Affecting IPTV Quality of Service*

- **Packet Loss**

Loss of IP packets may occur for multiple reasons — bandwidth limitations, network congestion, failed links, and transmission errors. Packet loss usually presents a bursty behavior, commonly related to periods of network congestion. Depending on the type of transport protocol used for the video streaming, a packet loss will have different impact on the quality of the perceived video. When UDP is used, the lost packets will directly affect the image, as the information cannot be recovered and the image will simply be corrupt or unavailable. When using TCP, a packet loss will generate a retransmission, which can produce a buffer underflow and, consequently, a possible frozen image.

- **Packet Delay**

Every RTP packet is synchronized and time-stamped locally at the time of transmission. In a packet-based network, it is quite common that the route for transporting the packets is not always the same; packets may arrive at different times and out of order. The RTP protocol allows out-of-order arrival of the packets. Since every RTP packet has a sequence number, as long as the delay did not exceed the size of the receiving decoder buffer, the packet can be processed and placed in the right position for decoding. If the delay exceeds the buffer, the packet is dropped and considered lost. When testing for delays, the RTP packet measurement must be taken in real time, and any packet delay must be registered as it happens. Test results should display a maximum, minimum and average delay time.

- **Jitter**

A typical IP packet carrying MPEG-2 video-streaming data consists of seven MPEG transport stream packets, each containing 184 bytes of payload and 4 bytes of header. This results in 1316 bytes, plus the packet overhead – 8 bytes for the UDP header, 20 bytes for the IP header, 14 bytes for the Ethernet header and 10 bytes for ATM overhead – for a total frame size of 1368 bytes. (Fig.3.)

Jitter is defined as a short-term variation in the packet arrival time, typically caused by network or server

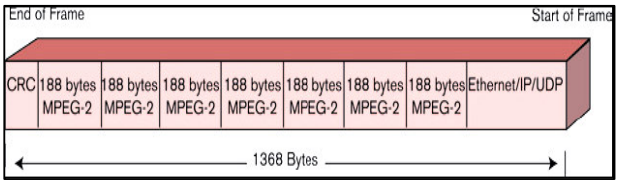

Fig.3. Frame for MPEG-2 video

congestion. If the Ethernet frames arrive at the STB at a rate that is slower or faster, as determined by the network conditions, buffering is required to help smooth out the variations. Based on the size of the buffer, there are delivery conditions that can make the buffer overflow or underflow, which results in a degradation of the perceived video. Similarly, knowing the characteristics of a specific STB, the service provider might be able to characterize the maximum jitter supported by the IPTV network before noticing a considerable video degradation. This value will be a decisive factor when analyzing the video QoS at the customer premises.

- **Limited Bandwidth**

The total amount of video-stream data that can be sent is limited ultimately by the customer's actual ADSL/ADSL2+ rate. Core IP infrastructure is usually based on optical networks with a low level of congestion; therefore, bandwidth limitations are commonly located only within the access network or the customer's home network. When traffic levels hit the maximum bandwidth available, packets are discarded, leading to video quality degradation. ADSL2+ rates may be temporarily affected by external factors, which in turn can generate pixelization of the image. Another situation might occur when, in addition to the IPTV service, a high amount of data is downloaded simultaneously to a PC and the traffic priorities have not been assigned correctly by the service provider; in these cases, video streaming packets are lost. A less common but important case is when video is streamed in variable-rate mode, in which considerable changes in the video sequences lead to an increase in the bandwidth requirement. This can generate packet loss and hence quality degradation. Bandwidth limitation is one of the main factors to be evaluated during the network design stage [2].

III. THE IPTV ENABLING TECHNOLOGY STANDARD

The need for an advanced video coding standard that evolves MPEG-2 and H.263 to the next level has been addressed over the last several years through a combined working group of the ITU-T and ISO/IEC organizations, who have previously produced the H.26x and MPEG-x standards, respectively. The new standard has emerged as H.264. It is also called MPEG-4 Part 10, or MPEG-4 Advanced Video Coding (AVC). The following table summarizes the development of these standards and their intended applications [3].

TABLE 1: VIDEO CODING STANDARDS

Standard/ Recommendation	Developer Organization	Applications
H.261, H.263, H.263+, H.263++	ITU-T	Video telephony, Video conferencing
MPEG-1, MPEG-4 SP/ASP	ISO/IEC JTC1	DVD, Video-on-demand, digital video broadcast via cable/satellite/DSL, video streaming for Internet and wireless
H.262/MPEG-2, H.264/MPEG-4 AVC	Joint Video Team (JVT) formed by ITU-T and ISO/IEC JTC1	Video-on-demand, digital video via cable/satellite/DSL, video streaming for Internet and wireless, IPTV

MPEG-2, a hardware-based technology, has been the industry standard digital video broadcast codec for many years for high bit rate applications. MPEG-2 requires 2 Mbps of bandwidth, which is available over coaxial lines and satellite airwaves, to deliver broadcast- quality, jitter-free, digital video.

MPEG-4 Simple Profile (SP) and Advanced Simple Profile (ASP) were developed for streaming video over Internet connections. MPEG-4 offers a software method to compress and decompress video over a network that provides only a best-possible connection with a wide range of data rates. The result is not what viewers have come to expect from their televisions, but enough to offer interesting services and enhance the richness of the Internet experience.

H.264/MPEG-4 AVC addresses the needs for greater compression, leading to lower data rates, while maintaining broadcast quality for video-on-demand (VOD) and high-definition television (HDTV) needs.

H.264 meets the needs of both broadcast and the Internet by cutting the MPEG-2 bit rates in about half for digital video transmission-without a loss in video quality. This advance has followed the evolution of video compression science toward higher quality and lower bandwidth, and it opens new doors for service providers operating over the local copper loop infrastructure. Using H.264/MPEG-4 AVC and new H.264-enabling technology platforms for encoding, transport, and decoding, telcos and ISPs can boost their average revenue per user (ARPU) with exciting and compelling new video-on-demand, HDTV distribution, and interactive TV services. The age of IPTV over DSL has arrived.

IV. IPTV SERVICES MARKET

IP video, viewable on TVs, STBs, and PCs, is expected to become a major part of any home's entertainment line-up. According to Multimedia Research Group, Inc. (MRG, Inc.), worldwide IP video services subscriptions are expected to more than quadruple, from under 2 million subscribers in 2004 to over 8 million users in 2006 .This growth indicates a significant trend [4].

With DSL technology, the telcos hold a significant advantage by delivering IPTV to more of the masses than cable operators. While cable and satellite Internet access is encroaching on the telcos long-held dominance, DSL is still the leading broadband technology that users subscribe to around the world. According to the DSL Forum (www.dslforum.org), 55 million Internet users worldwide use DSL; 25 million new subscribers alone were added from September 2002 to September 2003. The growth trend is expected to continue, with subscriptions reaching nearly 100 million users worldwide by 2006 (Fig.4.).

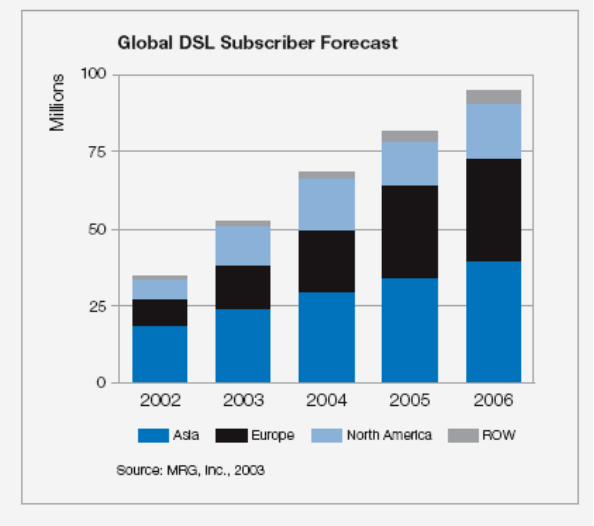

Fig. 4. The number of DSL users is expected to continue to rise through 2006 (Source: MRG, Inc., 2003)

V. IPTV SERVICE IN BOSNIA AND HERZEGOVINA

Bosnia and Herzegovina (BiH) must actively and promptly act to decrease technological development gap taking into account that transition process from industrial to informational society in developed countries has moved ahead significantly [5].

DSL technology offers unprecedented scalability for multimedia services. It is the basis for the point-to-point architecture that is the key to providing a combination of interactive and broadcast services. The implementation of multimedia services is a high priority for telecom providers. Delivering multimedia services across DSLs offers a lucrative opportunity for both established and emerging services.

ADSL service in BiH is provided by Internet Service Providers (ISPs) that are under three telecom operators: BiHnet (BH telecom), Teol (Telekom Srpske) and HT Mostar.

According to report of CRA at broadband services ADSL and cable Internet access are used the most. For example, in 2006. ADSL and cable access together included around 80 % of the total number of broadband Internet subscribers.

Table 2 gives a breakdown of number of subscribers by types and observed years in Bosnia and Herzegovina.

TABLE 2 : BREAKDOWN OF INTERNET SUBSCRIBERS BY TYPES FOR 2004, 2005 AND 2006

INTERNET ACCESS		Number of subscribers (total)					
		2004		2005		2006	
Dial-up	a) Dial-up						
	b) ISDN	**162,300**		**162,789**		**197,909**	
Broadband	c) Wireless	1,641		3,046		4,330	
	d) Cable access	2,394		4,751		11,863	
	e) ADSL	1,497	**6,637**	4,845	**13,702**	22,170	**39,751**
	f) Leased lines	1,101		1,054		1,241	
	g) Other	4		6		147	
Total number of subscribers		**168, 937**		**176,491**		**237,660**	

However, as table 2 demonstrates, it is apparent that a number of dial-up subscribers has declined throughout the years. At the same time, a substantial increase in users of broadband access in comparison with previous years was marked; their number reached almost 17% of total number of internet subscribers. When it comes to broadband connection, the access using ADSL technology and cable internet connection are most frequent. Namely, a total number of broadband internet subscribers has almost tripled in comparison to 2005, while the most noteworthy progress was achieved in raise of ADSL connections (22,170 subscribers, or 55.77% of total number of broadband internet subscribers), and cable access to internet (11,863 subscribers, or 29.8% of total number of broadband internet subscribers).

The biggest augmentation in 2006 was marked in the field of ADSL internet access. Having in mind a trend of price decrease for ADSL connection, it is obvious that in addition to package's access speed and traffic quality, price and accessibility are fundamental reasons influencing end-users in selection of internet access type.

The IPTV pioneer in former Yugoslavia (and in other parts of Central and Eastern Europe) is Slovenia's Siol TV (Slovenian Online TV), owned by Telekom Slovenia, the national telco. Slovenia's leading ISP launched the MPEG2 based service over ADSL in September 2004, offering its TV subscribers 110 television channels and the use of Internet and email via a television screen for EUR 14 a month. Technology suppliers include SkyStream for headend equipment, Amino for set-tops (model 110 set-top boxes) and Minerva Networks for middleware. The ADSL service has an estimated 40,000 subscribers.

Two of Bosnia's three state-owned telecom operators are planning to launch IPTV trials. BH Telecom was expected to have started IPTV trials at the beginning of 2006, but the project has been postponed until the second half of the year. Meanwhile, Teol Republic of Srpska, has announced that the operator is planning to introduce digital interactive IPTV and possibly VOD services. The launch date is yet to be announced.

VI . CONCLUSION

IPTV is set for exponential growth. The combination of near ubiquitous broadband access, consumer familiarity with a 'pull medium' – the Internet - and competitive dynamics among today's service providers all point to a rapidly developing market. The window of opportunity to achieve early entry into this marketplace is short. Gaining an early foothold will help ensure continued success as this multi-billion dollar market develops.

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