ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2016

Triple Play Services in Multi Dwelling Units and VDSL

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ABSTRACT: Triple Play services offer a unified solution that can support any no. of subscribers. It is a combined solution of data, voice and video services that helps to deploy services in a very cost effective manner improving the profitability and speeding up the network recovery. The most general way of providing these facilities is Digital Subscriber Line (DSL), which is a broadband access technique that makes enable high-speed data transmissions over the available copper telephone wires ("local loops") that link subscriber's offices or homes to the local Central Offices. The current version of DSL technique (VDSL2) is able to obtain up to 100Mbps data transmission. Multi Dwelling Unit (MDU) is a required solution for linking several houses within the same multi floor building with a single Reflector/Antenna to obtain Direct-to-Home facilities. MDU is a centralized network composed of multi amplifiers and switches for distributing the signal obtained by one or two Dish antennas. This paper presents a review of IPTV architecture, standers, VDSL and Multi dwelling Units with their advantages.

KEYWORDS: ADSL, IPTV, VDSL, MDU and CPE

I. INTRODUCTION

Over the past few years, obvious that conventional telecommunication companies that have been offering data and/or voice services are being interested in providing TV entertainment too [1]. Triple play is a marketing term utilized for the providing three facilities: television (Video on Demand or regular broadcasts), high-speed Internet, and telephone over a single broadband connection. High speed Internet involves the bandwidth of 256 kbps (0.256 Mbit/s) or more. With respect to triple play, video is generally known as Internet Protocol Television (IPTV), which explains a system where a digital television facility is provided utilizing Internet Protocol throughout a network infrastructure. At last, the voice part of triple play is generally called Internet Protocol Telephony (IP Telephony) or Voice over Internet Protocol (VoIP). This service includes the routing of voice chat throughout the Internet or over any other IP-based network. [2] Triple play services need broadband with high bandwidth capability. However, all broadband techniques were not planned for this use and, only some support the voices, data and video transmission. The necessary question is whether DSL, the broadband technique with the largest user base worldwide, can be utilized for triple play services? However, mostly DSL plants are of good quality; enabling 512 Kbit's to 90% of users and 6Mbit/s to 60% of users who utilized ADSL [3]. ADSL2 obtain higher bit rate as compared to ADSL which involve more DSL facilities with 12Mb/s, the bandwidth can be further increasing with ADSL2+ technique which is maximum 24 Mb/s [4]. Thus, the ADSL2+ network can support triple play facilities with higher data rate. Another need that will select for this research is associated to QoS which is not a simple topic. The IP platform is efficient and robust, however is not appropriate for the time-critical data streams transmission. Delay time between packages and package loss are among the most eminent characteristics of an IP network and that lead a problem for the video and audio communication. To avoid these issues will be enforced in higher protocol layers techniques to support and monitor the QoS measurement.

II. IPTV SYSTEM OVERVIEW

Internet Protocol Television (IPTV) is a frequently maturing technique for the delivery of broadcast TV and other media-rich facilities over a protected, end-to-end operator maintained broadband IP data network. IPTV widely covers a rich service that ranges from the acquisition, decoding and encoding, management and access control of video

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content, to the digital TV, movies on demand, seeing of stored programming, personalized program guides, and a host of multimedia and interactive facilities delivery. IPTV is clearly different from "Internet Video" that simply permits subscribers to see videos i.e. movie previews and web-cams, throughout the Internet in a "best effort" way with no quality of service considerations and end-to-end service management. Fig 1 shows a generic IPTV system architecture to support applications i.e. Video on Demand (VoD) and digital (broadcast) television. This architecture depends on the comprehensive architecture and facilities model mentioned in ITU Recommendation H.610 and on the IPTV platform provided by industry leaders i.e. Microsoft® Corporation. The generic IPTV architecture is used in this paper as a baseline reference to talk about IPTV distribution in-home networks.

The important functional elements of the IPTV architecture are:

Content Sources - 'Content Sources' show a service that obtains video data from producers, and other sources, encode the data and, for VoD, save content in an acquisition database.

Service Nodes - The 'Service Nodes' shows a service that obtains video streams in several formats, then reformats and encapsulates them for transmission with suitable Quality of Service (QoS) indications to the WAN for delivery to users. Service Nodes interact with the Customer Premises Equipment (CPE) for service management and with the IPTV facility for the session, subscriber and digital rights management. Service Nodes may be distributed or centralized in a metro area network (such as at the Central Offices).

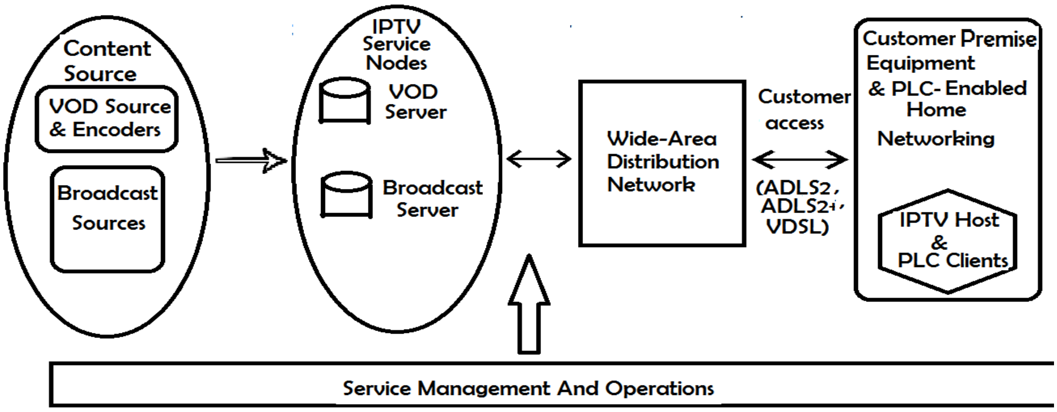

Figure 1: IPTV System Architecture

Wide Area Distribution Networks– This offers the distribution capability, quality of service, capacity and other capabilities i.e. multicast, essential for the timely and reliable distribution of IPTV data streams from the Service Nodes to the Customer Premises. The access and Core Networks involve the optical distribution backbone network and several Digital Subscriber Line Access Multiplexers (DSLAMs) positioned at the central office or remote distribution points.

Customer Access Links- Customer delivery of IPTV is offered over the available loop plant and the phone lines to homes utilizing the higher-speed DSL techniques i.e. VDSL and ADSL2. The distance restrictions and bandwidths achievable for these DSL techniques are summarized in Table 1. Service suppliers may utilize a combination of DSL and Fiber-to-the Curb (FTTC) technologies or implement direct Fiber-to-the-Home (FTTH) access based on the richness of their IPTV service given.

Customer Premises Equipment (CPE)– Related to IPTV, the CPE device positioned at the customer premise offers the broadband network termination (B-NT) service at a minimum, and may involve other combined functions i.e. set-up box, routing gateway and home networking abilities.

IPTV Client- The IPTV Client is the functional unit, which ceases the IPTV traffic at the user premises. This is a device, i.e. a set-top box, that does the functional processing, which involves establishing the link and QoS with the Service Node, decoding the video streams, channel change service, user display control, and links to subscriber appliances i.e. a standard-definition TV or HDTV monitors.

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Table 1: Summary of Some Key IPTV Technologies and Standards

Codecs	MPEG-1 provides a video quality (such as VHS-quality) with typical bandwidth needs of 1.5 Mbps, MPEG-2 provides a higher (such as DVD) quality with typical bandwidth needs of 2 to 6 Mbps and High Definition TV quality at bandwidth needs of about 20 Mbps or higher. MPEG-4 permits video quality and bandwidth needs to be scaled and can provide HD and DVD quality streams at lesser bandwidth.
Architectures	**Full Service VDSL – System Architecture and Customer Premises Equipment** Describes a standard high-level architecture for data, video and voice services ("triple play") delivery throughout a VDSL access network. The several service interfaces, link and management message flows for the video and other facilities are mentioned. The architecture is suitable to other broadband networks utilized for IPTV facilities.
Quality of Service (QoS)	**Quality of Service Standards (IEEE 802.1p QoS, IEEE 802.1q VLAN, CEA2007 VLAN Mapping)** Refers to the service nature with respect to specific parameters i.e., bandwidth needed, jitter, packet delay and loss rates. The IP protocols, Ethernet and ATM utilized to transport IPTV packets throughout the WAN specify techniques for obtaining the needed QoS levels.
Network Management	**DSL Forum Technical Report – CPE WAN Management Protocol**. defines capabilities for remote management of CPEs, involving performance monitoring, auto-configuration, diagnostics and other management services within a general Telco framework.
Multicast	**IP Multicast Standards (IGMP V1, IGMPv2) and IGMP Snooping** Internet Group Management Protocol (IGMP) messages i.e..join and leave messages may be used in the home network to maintain IPTV Clients that are active in a multicast group.

III. TRIPLE- PLAY ARCHITECTURE

A Triple Play Architecture Overview (view Fig.) contains the core network, head-end (Service Provider Network), the access network where end subscribers reside and the resources at the users home (such as the IP set-top box, CPE, DSL modem and so on). A Triple Play solution can distribute 50 to 150 TV channels throughout an IP network with voice over IP and high-speed Internet. Facilities (voice, video and data) are forwarded from the IP head-end utilizing an IP core network throughout an optical backbone network to the central office (CO). The CO depends on the data to the access network (AN) in which digital subscriber line access multiplexers (DSLAMs). There we have distribution of the service (such as voice or video) which afterwards enters the users house via the modem. For the video facility specifically, an IP set-top-box (STB) is also utilized to unscramble the signal and show our movies on the TV set. [1]
In the subsequent paragraphs we briefly explain the basic elements of a triple play network which is illustrated in fig (2).
The head-end: One or two important data centres house that contains the infrastructure servers, i.e. RADIUS, NMS and log servers. Usually collocated at these same data centres are servers for IPTV, VoIP and VoD applications. These servers are linked to switches by utilizing 100BASE-T and 1000BASE-T electrical links, which are then fed into the core through optical fiber links.
The core network*:* Core network contains transmission lines and switching offices that link central offices. The core network, which is a high capability fiber backbone network, utilizes ATM or IP/Ethernet throughout SONET.
The DSLAM: DSLAMs are a terminate user copper local loops and offer a DSL modulation facility to the DSL Modem.
The customer household: is the network's demarcation point between customer and service provider. Facilities are provided to the demarcation point, which may be a equipment piece managed by the service supplier known as the Residential Gateway (RG), which is the Customer Premises Equipment (CPE). Mostly CPE are multi-play networks is

complicated pieces of equipment offered by the service supplier that combine a router and DSL modem. Sometimes only the DSL modem function is utilized.
STB*:* STBs take IPTV and VoD traffic coming from the network side and forward it to a TV linked through HDMI, composite, SCART or RF outputs. To let other devices link to the broadband network, DSL Modem have various Ethernet ports to link PCs, Macs, gaming consoles and other devices in the home.

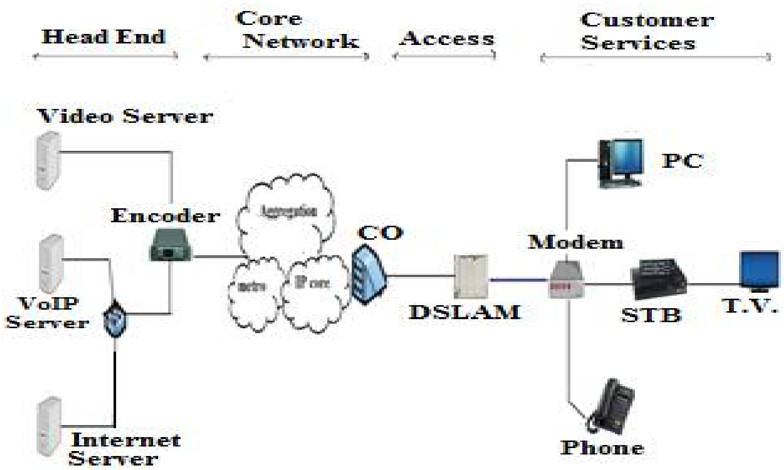

Fig 2: Triple - Play Architecture Overview

IV. IPTV WITHIN IMS

The most active SDOs operating towards an IPTV architecture within the IMS framework are the ETSI TISPAN and ITU-T. In fact, both SDOs are operating closely together and largely share an architecture. The ITU-T introduces three separate architectures for IPTV:
• Non-NGN networks, involving available networks
• NGN networks that are IMS based
• NGN networks but not IMS based
The three variations are explained for allowing for two variations of NGN systems and for legacy systems. The first explains IPTV largely as it available today. The other two permit IPTV to equip into the architecture illustrated above. Offering three variations with very same architectures make ease interworking among them. All three variations share the same high-level functional architecture. ETSI TISPAN is also in the process of explaining an NGN version of IPTV, but will precede the non-NGN version. The fig 3 indicates the high-level functional architecture of IPTV utilizing IMS [9]. The functional blocks are integrated together in logical classes:
• ***End-User Functions* -** performs mediation between the IPTV infrastructure and end subscriber.
• ***Application Functions* -** permits the end subscriber to choose and optionally buy content from the IPTV system.
• ***Service Control Functions* -** release and request the resources essential for providing the service.
• ***Content Delivery Functions* -** provide the content delivery from the application functions to the IPTV terminal, as well as providing the communication between the subscriber and the chosen content.
•***Network Transport and Control Functions-*** offers IP network connectivity between the IPTV service elements and the end subscriber functions, along with needed QoS for the facilities.
•***Management Functions*** - performs status monitoring, system management and configuration.
• ***Content Provider Functions*** – services offered by the entity that owns or is licensed to sell the IPTV content or content assets. IMS explains a architecture with open interfaces. Applications must help the protocols and interfaces to the suitable devices within the IMS network, and in doing so a wealth of IMS characteristics and services become existed.
The IMS core offers SIP-based session management for all kinds of applications, a central database in the HSS, anda common charging technique for all applications, a central database in the HSS, and a

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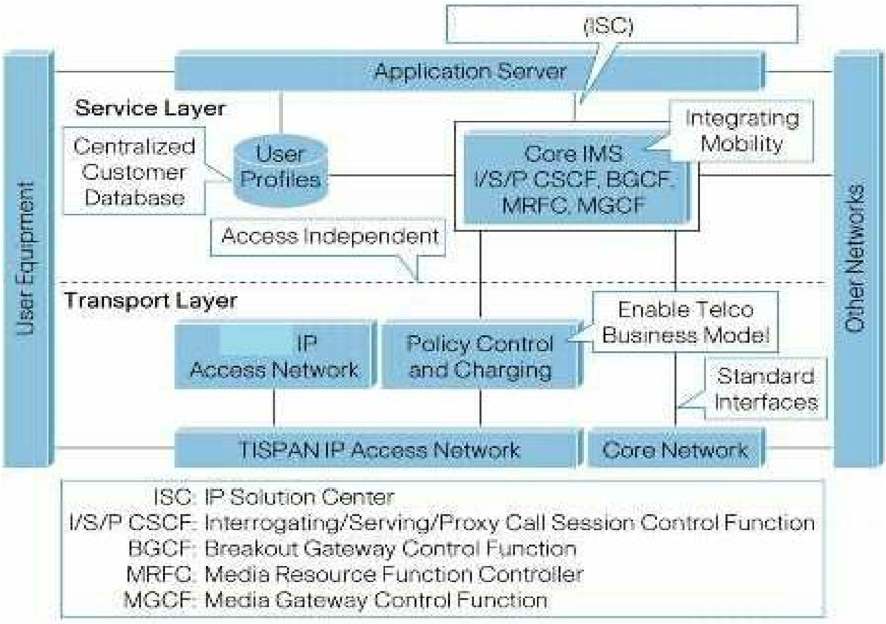

Fig3 : The high-level functional architecture of IPTV using IM

Common charging technique for all applications. Applications require not manage a separate database of user data, and there's no requirement to interface to or manage a separate billing and charging system. The QoS architecture for the delivery facilities, so significant in streaming applications i.e. IPTV, is manage by the NGN or IMS core. The most important difference between IMS and IPTV is that IMS utilizes SIP as a session management protocol, while IPTV currently utilizes IGMP for multicast/broadcast control and RTSP for streaming data control. It is still found how SIP will be utilized in the IPTV context, and if RTSP will still have a future. These matters should be explained and finalized in early 2008 by the ITU-T IPTV FG. The specification attempt for IPTV throughout IMS is still a work in continue. There are functional protocols and entities that still need precise definition.
IMS standards are being described by the 3GPP (3rd Generation Partnership Project). While some other SDOs are working on their own IMS variations, they are largely depends on the work being performed by 3GPP. SDOs utilizing the 3GPP work involve [6]:

V. VDSL2 SOLUTION

The telecommunications industry has endowed resources in the growth of several standards using twisted pair over the past two decades. Very-high-bit-rate digital subscriber Line 2 (VDSL2): The International Telecommunication Union (ITU), particularly the ITU-T, has explained a recommendation (standard) for very-high-bit-rate digital subscriber line 2 (VDSL2) for the utilization throughout the twisted pair phone lines. The standard was explained with the aim of support "super' triple play of internet, video and voice services at speeds up to ten times faster as compared to standard ADSL" in accordance of a press release from the ITU, May 27, 2005 [11]. The VDSL2 protocol is called ITU-T G.993.2, and was released in February, 2006. The VDSL2 standard constructs on prior ITU-T standards in the DSL technology area called ADSL, VDSL and ADSL2+. The backwards compatibility of these techniques may be vendor-dependent as some providers support what is called 'fall back', whereby a specific port VDSL2 port may support ADSL2+. The VDLS2 technology capacity changes broadly in vendor materials and published reports [4, 10]. In fact, in one published report, VDSL2 performance was shown at 910 Mbps, 825 Mbps, 700 Mbps, 390 Mbps, and 100 Mbps [14]. In some situations, the published reports of the data throughput rates may eliminate key elements that may determine the suitability in real-world environment and applications. The change in the published performance data is due to VDSL2 performance, same as all DSL technologies, is influenced by distance of copper wires between the CPE and DSLAM. In addition to, the usage of channel bonded copper pairs will also enhance the throughput numbers mentioned in published reports. Channel bonding is referred to in several network technology regions, i.e. T1, VDSL

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and DOCSIS. This is the phenomenon of integrating logical or physical channels to necessarily generate a larger pipe (data channel) by forwarding traffic over these channels at the same time. Since, channel bonding greater than two copper pairs may not be possible in real-world applications [14].

There are extra techniques that leading systems vendors in the VDSL space are growing to improve capacity as well. An example is called Phantom DSL by Nokia Siemens and DSL Phantom Mode by Alcatel-Lucent, integrating many technologies in bonding various copper pairs along with noise cancelling mechanisms that can increase VDSL data rates [14]. The capacity data from sub-system and system providers may grow and configure systems in ways beyond the published standards transmission data rates of the ITU-T [11]. In a press release from the ITU-T, G.993.2 is specified to support the transmission at a bidirectional net data rate (the sum of downstream and upstream rates) up to 200 Mbit/s on twisted pairs [11]. The analysis will consider a more conservative method in assessing the VDSL2 capacity. We will consider a single twisted pair to every unit and consider that the copper cabling distance between network elements will be not greater than 300-400 meters. We will further consider that the full frequency spectrum of up to 30 MHz is possible. There are many published findings that claim support for 100 Mbps symmetrical over similar distances and consider a single pair of copper wires [10]. The MDU designers will require understanding these seriously significant factors when assessing technologies, involving the physical situations of the network, distances, and the no. of twisted pairs to every unit.

VI. VDSL2 CAPACITY INCREASE

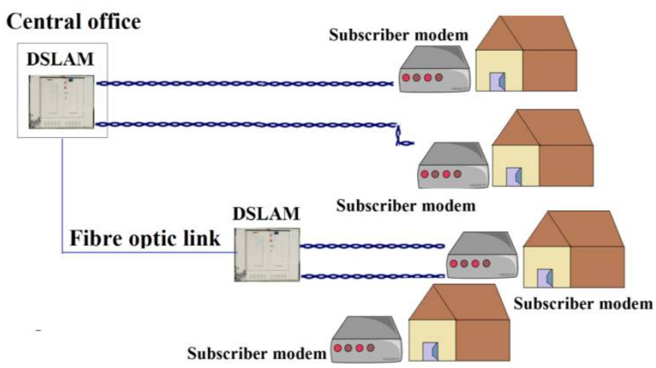

Fig. 4 : Hybrid fiber-copper architecture.

VDSL2 technology supports various mechanisms to increase capacity. These involve:

1. Decreasing the local loop (push fiber and the DSL access multiplexer DSLAM nearest to the users)
2. Increasing the frequency band
3. Bonding (the usage of many copper pairs nearly doubling the capacity)
4. VDSL2 vectoring
a. This is the usage of silent suppression or noise cancelling technique utilizing anti-phase signals that are employed to every pair of copper lines in a bundle to eliminate crosstalk interferers, which decrease capacity.
b. VDSL2 vectoring enables the cables bundle nearly a 3X increase in capacity for 24 cables and 400 meters, worst conditions studied by Alcatel-Lucent indicate the low rate of mid-30s Mbps without vectoring and with the low line yielding mid-90 Mbps.

VII.MULTI DWELLING UNIT

For Multiple Dwelling Units(MDUs) ,VDSL2 is a favorable technique for applications that need very large bandwidth in the downstream direction. MDU shows a unique issue to the distribution of internet, as several resident are linked by an ISP at one time. Copper twisted pair can be utilized for delivery of voice, data and video services in the MDU. Utilizing twisted pair will offer data access to the whole building offered that the units are within the specific distance of the chosen technique. For the cable operators market, the MDU market for advanced telecommunication facilities may increase a virus. The virus is coming from Telcos, Direct Broadcast Satellite (DBS) and also from competitors

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intending the high-density MDU market. The pulling fiber-to-the user/unit (FTTU) cost is still a MDU challenge. As the concentration is on MDU market with data, voice, video services, spreading VDSL2 technology may be favored network access layer technology over available twisted pair. For offering larger data network capacity, MDU are making investments to raise their access networks.

VIII. LITERATURE REVIEW

Nasser N. Khamiss etal. : Here authors examined the ADSL2+ broadband access network supporting Triple play facilities (video, voice and data) on last mile. In their work, researchers utilized OPNET simulator 14.5 to model MPEG4 video traffic with data and voice over ADSL2+ network with 7.290 (Mbps) Peak Rate, MPEG-4 Part 2 Codec, 0.637 (Mbps) Mean Rate and 8 as Minimum frame size. In accordance of authors simulation result, ADSL2+ technique can be utilized for removing last mile hazards, enabling global mass growth of Triple play Services. Also it presents that QOS needs of video and voice are better fulfilled with WFQ technology.
JamilM.Hamodi et al. : Here authors, examined the evaluation of performance IPTV (VoD) over WiMAX networks. In their work, authors utilized various Simulation parameters i.e. end to end delay, throughput, PSNR (db), Jitter delay. Result achieved from simulation shows that SVC video codec for video streaming throughout WiMAX. Also, the simulation results show that, the H.264/SVC video codec has been determined to provide enhanced visual quality and suitable codes for providing video in comparison of the prior standards.
Nasser N.Khamiss et al. : Here authors, measuring the performance of forwarding Triple play Services throughout hybrid networks. In their work, author's utilized OPNET simulator for simulation aim with taking several parameters i.e. delay, pocket loss, throughput and network's availability. Simulation Results also shows when there is existed bandwidth 100%, delay-variation for video and voice services are low. Since, when the network existence reduces, delay-variation increases exponentially.
IoanSorin COSMA et.al : Here authors, showed an architecture to measure the parameters of QOS for the IPTV heterogeneous network. In their work authors utilized QOS parameters i.e. Inter-pocket delay, traffic rate, Inter-packet jitter, no. of reordered packets and no. of packets dropped. According to author's results of simulation, traffic rate achieved was 0.7 Mbps, minimum Inter packet delay was 0.1774169 seconds. Simulation result clearly indicated that the power of general objective computers is restricted, when complicated manipulations of information, i.e. transcoding, are required. In that case particular hardware, are required. In that situation particular hardware (depending on FPGAs or ASICs) must be used, to assure a suitable quality for IPTV services.
JamilHamodi et al. : Here authors, measured the performance of Internet Protocol Television (IPTV) over static WiMAX system taking various digital modulation combinations. The performance was carried out of digital modulation. The performance was carried out utilizing OPNET simulator. The performance was performed with respect to packet jitter delay, average data droppers packet lost, end to end delay and network throughput. The simulation was done to measure the performance study of VOD over the static WiMAX networks under various parameters: path loss models, video codecs, classes services under static kinds of modulation and coding methods. Author's simulation results indicated that SVC outperforms other video codec techniques. Simulation results also shows that the free space path loss is the best propagation model for deploying A/D video application while vehicular model provides the worst performance providing the larger packet drop rate.

IX. CONCLUSION

Internet Protocol Television (IPTV) is a frequently maturing technique for the delivery of broadcast TV and other media-rich facilities over a protected, end-to-end operator maintained broadband IP data network. IPTV widely covers a rich service that ranges from the acquisition, decoding and encoding, management and access control of video content, to the digital TV, movies on demand, seeing of stored programming, personalized program guides, and a host of multimedia and interactive facilities delivery. This paper presents a review of IPTV architecture, standers, VDSL and Multi dwelling Units with their advantages.

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