"In the name of God, most Gracious, most Compassionate".
EVALUATION OF VOD BY USING MPLS NETWORK

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Preface

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**Declaration**

This thesis is a presentation of my original research work. Wherever contribution of other are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of research and discussions.

This work was done under the guidance of Prof. Dr. rer.nat.Thomas Möbert at University of applied sciences Leipzig Germany.

Candidate signature
Abstract

Over the last decade, the growth of satellite service, the rise of digital cable, fiber and the birth of HDTV have all left their mark on the television landscape. But with this evolution the demand for the time saving and fast delivery of the required data is also increasing.

My project aims to develop the solution in iptv for Video-on-Demand to provide users with a world of choices - for more channels to view along with the ability to enjoy what they want, when they want, according to their desires and time constraints. This contribution briefly proposes areas that need familiarity and implementation of network technology that brings forward the requirements of the bearer network for the IPTV service VOD.
1.1 IP TV (VOD) Experiment Components Setup

My goal for progress of IP TV (VOD) consists of following experiment components.

1.1.1 IP TV Viewer

The client view IP TV and the channels. These channels can be in the media type of audio, video and any other type. The viewer of IP TV has a unique interface in which the subscriber can use any of the programs which needs to use. And can browse the running program which is offer. The content manager is used for serving of different channel. As content manager functionality explain below. It runs on windows XP, 98, NT and 2000 only.

1.1.2 IP TV Content Manager

Content manager is available as software which is access point for browser. The system administrator is used for set up program handling between IP TV server and content manager.

1.1.3 IP TV Server

Server is used to store and send on demand video to the viewer. Content manager is responsible for the IP TV server enabling. Usually unicast is used for on demand programs; multicast is used for stored programs in the server.

1.1.4 Routers

Routers are a device that forward data packet to their next hop, destination, based on there IP address. IP TV router supporting the MPLS and Multicast data through the network.

1.1.5 Switch

Switch is also called as Intelligent Hub. It does not allow traffic automatically to every other port. Each time it save the physical address (MAC Address) and the port it’s come from in its MAC address table. It then checks the destination MAC address in the table. If it recognizes it then send the frame to required port. If the address is the broadcast then
its send the frame through every port except the originating port. In IP TV network
switch are used by clients to receive on demand video.

1.1.6 Features Included

It is the consumer’s wish to fulfill his desired demand of data in short period of time with
secure delivery. IP TV branch VOD has made it possible to deliver data of the user
request both by reserving the bandwidth of the network and the time, from the server to
end-user.

1.2 DESIGN ISSUES (Short Implementation Detail)

To accomplish its scalable features for delivering high-quality video over enterprise,
networks IP TV (VOD) has the following turnkeys:

Codec’s

Codec’s like MPEG-2 and MPEG-1 are used for TV and MPEG-4 is for high quality at
low bandwidth.

IP multicast (with source-specific multicast [SSM])

IP multicasting is required to facilitate delivery over multicast networks, to manage the
number of receiver transmissions in large-scale Web Presenter and deployments to
minimize bandwidth for live and scheduled video.

Quality of Service

RSVP used by QoS for allocation of bandwidth for video delivery. Ability to deliver IP
TV network services with consistent & predictable quality e.g. service availability, delay
variation/ jitter, throughput, packet loss. In IP TV it allows a service provider to prioritize
traffic, to control bandwidth and network latency.

Question Manager

This allows clients to send text queries to a moderator during a broadcast delivery.

Media synchronization tools

To provide Web Presenter, Screen-Caster, and Slide-Cast integrated synchronization
tools for the ability to deliver presentations (in the form of HTML pages, screen captures,
or .jpg files) with video content.
Enhanced Program Guide

An EPG automatically generate and update the program listing at the client. The scheduled programs are accessible similarly like content manager from web browser.

MPLS (Multi-Protocol Label Switching)

In MPLS configuration of the router to allow transmission of data in time, over the built tunnel setup to the registered consumer.

IP/TV Content Manager Security

Username and password authentication are needed to IP TV Content Manager to prevent unauthorized access to IP TV configuration through a web browser. Only one time logged in and successive access the similar browser session will not require the password again and again.

On-Demand (VOD) Programs

VOD is the delivery of video content over broadband IP networks to the individual viewer initiated by him/her at a time of his/her choice. Most commonly, it is a streaming unicast service delivered to one user per stream. Variations are Push VoD, where the video data is (partially) downloaded before viewing, or peer-to-peer exchange, where the content is downloaded and distributed among the users.

Ref: www.cisco.com
CHAPTER 2  IPTV AN OVERVIEW

2.1 Relevant technologies for IP TV

Internet Protocol Television (IPTV) is different from Internet video and TV that simple allows users to watch video but no services for the end users. As the integration of various technologies like DSL, VDSL, ADSL with IPTV provides interaction with users. It also provide services to the end users like text, voice and video (so called as triple play).

2.1.1 Introduction of IP TV

IP TV is a modern TV which you can watch with fully control, any contents, any time, any place. TV that you can take anywhere. Unlimited visual interactive applications. In a simple way, you can say IP TV is a next generation TV.

2.1.2 Main Component of IPTV

Internet Protocol (IP) assigns format of packet & addressing scheme. Most network combine IP with higher level protocol like UDP. The protocol establishes a virtual connection between a destination & source.

IP allow you to address a package of information & drop it in the system, but there is no direct link between you and the recipient.

Television (TV) provides the medium of communication that operates through the transmission of pictures and sounds. We all know TV, but here we are referring to the services that are offered for the TV, like linear and on-demand.

IP/TV specifies the medium of communication of picture & sound that operate over IP network.

2.2 IP TV Platform

An IP TV has four general major parts. All are generic and common to any vendor’s (or combination of vendors’) infrastructure.
2.2.1 The Video Head End

The video head end is a point at which broadcast and on-demand content is captured and formatted. Each individual channel is captured by head end which encodes it into digital video format, like MPEG-2 or MPEG-4, which has lower bit rate. It saved the large storage. After encoding the channel is encapsulated into IP and sent over the network. The channel can be multicast and unicast as well. The major advantage of IP multicast is that thousand of users can watch simultaneously at the same time.

2.2.2 The Service Provider Core/Edge Network

The encoded video streams, is transported over the service providers IP network. Multiple vendors’ equipment is used. The networks can be a mix of well-engineered IP networks and built for the video streaming. At the network edge, the network connects to access network.

2.2.3 The Access Network

The link between the service providers to the customer is called access network. The broadband connection can be accomplished using various technologies. For this the service providers use DSL to serve customers. Variety of ADSL and VDSL are used for the suppose bandwidth. A customer premises equipment at customer end to deliver Ethernet connection to the home network.

2.2.4 The Home Network

The home network distribute the IP TV services at home. For IP TV we need a robust bandwidth. Home network. For this purpose we require to connect TV with a set-to box (STB).

2.3 IPTV Network Elements (Enterprise Level)

2.3.1 The Video Channel Source

From the source received video continent have different types.
1: Non-Encrypted
2: Encrypted
3: MPEG-2 encoded
2.4.2 The Video Head End

The video head end consists in the following four major blocks.
1. Video Acquisition
2. Video Processing
3. Video Encoding
4. Video Management

Integrated Receiver Decoder or Descrambler (IRD) and Encoder and Transcoder appliances

The IRD demodulates and decodes QPSK modulated MPEG signal via satellite transmission. The IP data and analog audio both are received via the receiver decoders which are used for directly connected equipment like PC or TV. The IP data channels for output signal decoding, selecting and configuration for audio are upgraded by online software.

Encoder and Transcoder

These devices are design for coding stored content. These are recognizer of different coding and implement required coding for optimal quality. These devices have capability to encode satellite TV channels, cable TV, Terrestrial TV. For real time it converts all media type to IP stream.

2.3.3 Middleware Platform

Middleware is used to enable the functionality on the subscriber’s set-top box. These functionalities for subscriber are video services, television, VOD, Internet packages. It must not be limited to individual operation but it should be capable of communicating directly with each and every component to provide these solutions.
Software architecture lies in the center of middleware. Which provide application-programming interfaces (APIs) which is used for passing of data among the systems. Middleware provide the facilities of creation of subscriber in a service provider’s Subscriber Management System (SMS).

2.3.4 VOD (Video on Demand) and DRM (Digital Rights and Management) Server

The old Television system broadcast the services but the services operated by the VOD is totally different it provide the subscriber with a unicast stream programming with VCR-like functionalities like pause, stop, play, forward etc. IPTV middleware is used to controls the user interface and commercial details of VOD.
The content providers face the challenge of delivering of audio and video contents due to the increase popularity of internet. Internet as an open network challenges regarding to protect the content of unauthorized use. Therefore content provider use secure technologies for delivering of on demand content to the customers. Such technology must be addressed in multiple digital rights management (DRM) issues, like secure content distribution, protection, copy, control of play:

Live channel contents (OR) video content storage ---> VIDEO SERVER.

### 2.3.5 Streaming Server

Due to Digital media and codec’s it possible for broadband services providers to start streaming live and on demand television for users. The windows media platform (Media encoder, media services, and media player) and other are used to provide a framework for (IPTV). The following features in Windows Media Services make it ideal possibility for delivering a high-quality experience to IP TV viewers.

**Unicast, multicast, video on-demand (VOD) and broadcast**  
By using unicast and multicast protocols, Windows media can deliver live and on demand streams.

**Intelligent streaming**  
Intelligent streaming makes use of multiple-bit-rate streams. Windows media server adjusts the stream for maximum quality then delivers to destination.

**Fast Start**  
When user play on a steam, in the starting seconds data is sent at a high bit rate. It eliminate buffer time while play a single piece of content.

**Fast Cache**  
While streaming content to cache, Windows Media Player as fast as the network will allow. The server sends a stream to user at high bit rate as possible.

**Fast Reconnect**  
It restores automatically live or on-demand Player/server and server/server connections if disconnected while delivering stream.

**Advanced Fast Start**  
Reduce the amount of time to deliver stream to user. Allowing the Player to begin content as soon as its buffer receives a minimum amount of data.
**Advanced FF/RW**
Improves fast-forward and rewind ("trick mode") functionality for the video portion of encoded files and stabilizes network bandwidth availability by smoothing the rate at which data is sent. Potential server performance bottlenecks are reduced because the server must read less presentation data from the source content disk, while delivering a seamless experience to clients.

**Play While Archiving**
Archived files can be made available for on-demand requests or rebroadcast, even before a broadcast that is being archived has finished.

**2.3.6 DHCP Server**
The DHCP server provide a pool of IP addresses and information about client parameters such as default gateway, the domain name, the DNS servers and other servers. The DHCP client send a query after a network outage the query is used for requesting necessary information from the DHCP server. The query is typically made before the client initiate communication with other hosts.

**2.3.7 BRAS (Broadband Remote Access Service)**
The BRAS is the point which provides aggregation capabilities (e.g. IP, PPP, and ATM). It is also used for the policy management and IP QoS for the Access Networks. The BRAS provide a congestion management which allows the synthesis of IP QoS for downstream which are not QoS aware. In a simple its chain is following.

```
USER → DSLAM → ATM → BRAS → IP and MPLS
```

**2.3.8 DSLAM**
DSLAM is used for faster connection over old telephone lines. It uses multiplex technology for multiple customers. DSLAM used to separate voice-frequency signals from the data traffic and controls route digital subscriber line traffic between.

```
User → DSL → DSLAM → Internet or Telephone
```
2.4 Business Consideration

IPTV is the providing of television signals over a system that uses Internet protocols (IP). Telephone, cable, wireless, ISP and optical can be modified to provide IPTV services. This means a significant increase in the number of companies that will offer IPTV services. Aside from the basic IP protocols, there are many other standard protocols and systems that are available for transporting, initiating and controlling interactive television programs. Due to business reasons, the winners may not be the best overall technology or system.

A big challenge facing some executives in the television industry is the shifting of power. Just as telephone company executives have seen a significant decrease in the number of their dialup customers, television network providers are watching a shifting of viewing patterns from network programming to other programming choices. If the assets they control are not what the viewers want, this means that control (power) will shift to other companies and industries.

Companies will try to salvage investment in infrastructure and other resources by upgrading or adapting existing systems to IP TV capabilities. Initially, while this may enable companies to enter the IP TV industry faster, it may result in difficulty when these companies attempt to implement new features and services. For example, companies that focus on providing popular network television programming may limit or delay their experience in providing on demand programming.

Regulatory issues for IP TV include franchise restrictions, fair access to content, control of content distribution and taxes. Cable and television broadcasters have been commonly given franchise rights to exclusively distribute television services in geographic areas and these franchise agreements may be interpreted to limit the ability for IP TV providers to offer services customers. IP TV system operators need to have fair access to local and network programming and it may not in the business interests of other broadcasters to provide access to their content. Certain types of content such as programs that contain pornography, gambling or violence may have distribution restrictions in geographic regions and broadband TV providers may have difficulty controlling where people watch the programs. New taxes are likely imposed on IP TV operators and how these taxes are assessed and collected may be hard to perform.

Ref: www.cisco.com
CHAPTER 3  

3.1 Tag Switching Terminology

In IP TV data packet switching area has various options of IP Switching, Tag Switching, and MPLS. But for delivery of our data packet, MPLS is more significant. So Tag switching distribution protocol has been replaced with the Multi Protocol Label Switching. Because MPLS support the Tag Switching features. Tag switching Interface command line Interface command.

3.1.1 Label Functions

Label is a fixed length entity with no internal structure. Label switching forwarding component can support multiple network layer protocols as well as multiple link layer protocols. Label is used in MPLS for layer 3. The analysis of layer 3 done once. Different headers can also be mapped to the same label. A forwarding equivalence class is represented by label. The initial choice of label can also be based on policy. At each subsequent hop, the decision is made by looking up the label.

3.1.2 Distribution of Label Bindings

The label switching router makes some decision that the label value is used to represent which forwarding class. This association is known as label binding. Label binding is informed by LSR about its neighbors. When a packet sent from one LSR 1 to LSR 2. “The LSR 2 assigned some label value to packet to represent the packet forwarding equivalence class” The value changes as the packet travels across the network.

3.2 MPLS ARCHITECTURE

MPLS architecture is divided into two parts. Control Plane: take care of routing information and label propagation. For exchanges of labels, control plane require protocol such as TDP(MPLS), BGP(MPLS/VPNs), RSVP(Traffic engineering), LDP(MPLS). There are lot of routing protocol which are used in the control plane such as OSPF, IGRP, EIGRP, RIP, IS-IS, BGP etc.

Data Plane: which take care of forwarding either based on labels or destination address. Data plane is independent of the type of routing protocol or label exchange protocol.
3.2.1 MPLS MODES OF OPERATION

MPLS technology is intended to be used anywhere regardless of layer two protocol and layer one media. There are two types of MPLS modes of operation. Frame Mode: is used on all frame-based media. MPLS insert a thirty-two bits label between layer two and layer three headers. Layer two encapsulation are frame-based. Cell Mode: is used for ATM network. Label can not insert on each cell. In cell mode fix length cell are used and used VPI VCI field in the header as a label.

3.2.2 MPLS Label Function and Format

Label is a fixed length entity with no internal structure. Label switching forwarding component can support multiple network layer protocols as well as multiple link layer protocols. Label is used in MPLS for layer 3. The analysis of layer 3 done once. Different headers can also be mapped to the same label. A forwarding equivalence class is represented by label. The initial choice of label can also be based on policy. At each subsequent hop, the decision is made by looking up the label. MPLS support multiple label in a single packet (Label stack). MPLS label is inserted between layer two frame headers and layer three packet headers. Its format contain 32 bit label field. The explanation is as fallow Eight bit time-to-live field has the same purpose as the TTL field in the IP header. Bottom of stack bit has one bit. This shows the last label in the packet. Experiment bit has three bit. This shows the class of service. Actual label has twenty bit label.

3.2.3 MPLS Network Devices and Their Architecture

Label Switch Router (LSR): Forward the packets based on 32 bits labels. LSR enabled all interfaces for MPLS. LSR performs the falling function. Exchange labels, Forward packets. Exchange layer three routing information. Edge LSR insert label or remove label on IP packets. Edge LSR has some interfaces for MPLS. Also forward packet based on destination address. Edge LSR can behave falling function. An IP packet can be forwarded which based on IP destination address and sent as an IP packet. An IP packet can be forwarded which based on IP destination address and sent as a label packet. An IP packet can be forwarded which based on label. In this case the label is changed and the packet is sent.

3.2.4 MPLS APPLICATION

Application of MPLS has falling features.

- Unicast IP routing
- Multicast IP routing
- Quality of Service
- Traffic Engineering
• MPLS/VPNs

Different application can have different scenario in the control plane. But all have same label forwarding in the data plane.

3.3 Distribution of Label Binding

The label switching router makes some decision that the label value is used to represent which forwarding class. This association is known as label binding. Label binding is informed by LSR about its neighbors.

3.3.1 MPLS Traffic Engineering

MPLS is the hybrid of layer 2 and layer 3 technologies. MPLS enables traffic engineering. So you can achieve by overlaying layer 3 networks on layer 2 network. The tunnel across backbone is established automatically by MPLS traffic engineering. The required and available resource (constraint-based routing)” measures the tunnel path. The packet travels on the tunnel to connect the ingress point to the egress point using MPLS traffic engineering backbone. A mesh tunnels are define from every ingress device to egress device. “The IGP determines which traffic should go to which egress device” and put that traffic into the tunnel. Multiple tunnels can be configured for large flow of data.

3.3.2 Mapping Traffic into Tunnels

IS-IS is link state protocols which use shortest route hierarchy to all nodes in the network. Ordered sets of last and first hop information are kept in the routing table. The explicit routes are calculated via traffic engineering algorithms. These explicit routes are referred to as traffic engineering tunnels (TE tunnels).which is controlled by the router. TE tunnels are used to avoid loops. But loops can occur in two or more then two tunnels.

3.3.3 Enhancement to the SPF Computation

“During each step of SPF computation, if a router is directly connected to the calculating router, the information is derived but if the node is not directly connected then the node inherits the information from the first hop”. For traffic engineering a list of TE tunnels are maintained by the router. When a new path is finding out by the router the path list is updated. The router must have the information of first hop. There are three ways which are fallowing.

1: The first way is by examining the tail end list of router which is directly connected. If tunnel exist for this node, the TE tunnel is used as first node.

2: First hop information is used from adjacency database in case if there is no tunnel.
3: If a destination node X has many TE tunnel paths to reach, traffic flows over the tunnel whose tail end is closest to node X.

### 3.4 MPLS VPN

Layer three VPN backbone services are administered by MPLS virtual private network in Cisco environment. “VPN” is mainly used for security in IP-based network. In VPN there is no need of one to one relationship. In some cases a site can be associated with several VPNs. But a site can be connected with “VRF”. In VRF we have tables of routing and forwarding which is used to define VPN association with customer. VRF contains the following:

- IP routing table.
- Cisco Express Forwarding (CEF) table.
- Set of interfaces that use the CEF forwarding table.
- Set of rules and routing protocol parameters to control the information in the routing Tables.

### 3.5 MPLS Forwarding

MPLS is used for labels the packet and delivery of packets. MPLS use information collected from VRF IP and VRF CEF tables. When a packet is forward to CE router from a PE router from the network. The correct CE router is chosen by the label pops which is done by the PE router. Label forwarding is done by dynamic label switching or by traffic engineering paths. There are two levels of label which carries the customer data.
Label one is used for the direct delivery of packet to the correct PE router.
Label two is used for forwarding of PE router to CE router.

#### 3.5.1 MPLS Class of Service

MPLS use Class of service like Classification, congestion avoidance, and congestion management. It is also used for replicate Cisco IOS IP CoS layer 3. MPLS CoS drawing almost one for one on IP CoS.

Ref:

CHAPTER 4  Multicasting

4.1 Overview

In the overview for multicasting we will discuss IGMP, CGMP, PIM and PGM and the inter domain protocols like MBGP, MSDP, SSM.

4.1.1 Basics of Multicasting

The flow of information to many corporate users at one time delivery using multicasting. IP multicasting is used to conserve bandwidth. Mostly multicasting is used for video conferencing, for distance communication and learning.

Low amount of traffic is used while using IP multicasting which put low load on the network. Multiple deliveries of data is achieved using PIM and Cisco routers or other routers with multicast ability.

In Application-level multicast source sends multiple copies of data to each individual receiver. IP multicasting is the only way for sending data stream to more then one receiver in cases like video streaming which require huge section of the bandwidth.

IGMP is used by receiver to send to signalize a router. PIM enable routers create and send video stream, data to the receiver. Routers make a distribution tree to route the traffic to the receiver.

4.1.2 Multicast Addresses

IP hosts that are the member of multicast group which concerned with the multicasting traffic. The IANA has the controls over the distribution of IP addresses class D is used for IP multicasting. The range of multicasting start from 224.0.0.0 and end at 239.255.255.255. Reserved local addresses range 224.0.0.0/24 is used for local network." Routers don’t forward packets with those IP addresses". Protocols use these IP addresses for discovery and for communication of routing information. OSPF is one example of this in which the link-state information uses 244.0.0.5 and 244.0.0.6 range. The range of globally scoped addresses is 224.0.1.0 to 238.255.255.255 mainly used for multicasting across the network. The range of 224.0.1.1 is used by multicast application like NTP. One to many communication is done by source specific multicast addresses (SSM) which is an extension of PIM it uses the range of 232.0.0.0/8. In the GLOP addressing already have AS number reserved used the statically define address which has the range of 233.0.0.0/8. This is called GLOP addressing.
4.2 MAC Address Mapping

The IP multicast range in hexadecimal 0100.5e00.0000 to 0100.5e7f.ffff is for Ethernet MAC. 23 bits in the range is allocated to Ethernet address. The mapping is done in the lower multicast 23 bits. For example if a user is a group member of group 1 and an other user is group member of group 2 both have IP addresses (224.1.1.5 and 225.1.1.5 respectively) both have the same layer 2 multicast address on switch. Both will receive 1 and 2 streams. This restricts the efficiency.

4.3 INTRADOMAIN MULTICAST PROTOCOLS

Multicasting is supported by intra domain multicasting protocols. As intra domain multicasting protocols are used inside of multicasting domain.

4.3.1 Internet Group Management Protocol (IGMP)

The desirable host which needs video streaming registered in IGMP group. IGMP send multicast messages report to local multicast user. Router listen IGMP messages and occasionally send queries for discovering the active and inactive group.

The following are the versions of IGMP

- IGMP v1 (RFC 1112)
- IGMP v2 (RFC 2236)
- IGMP v3 (RFC 3376)

**Cisco Group Management Protocol (CGMP)**

IGMP information is influence by Cisco switch which are also called catalyst switch. These switches use the information on the basis of CGMP which allow Cisco routers to make forwarding decisions. So only the desired hosts which are attached to the catalyst the IP multicast traffic is forwarded or delivered. Any other ports which have no desire for the streaming will not receive. IP multicast data packet must be forward to multicast router port.

4.4 MULTICAST DISTRIBUTION TREES

The path that multicast stream takes through the entire network to reach the hosts this is done with multicast distribution trees
4.4.1 Source Trees

This is the simplest form of multicast distribution trees. It takes the shortest path through the network. It is also called shortest path tree (SPT). Source tree has roots in its root and branches are around the network.

4.4.2 Shared tree

It uses one root at some point in the network. This point is called rendezvous point (RP).
Ref: www.cisco.com
5.1 Overview

Video on Demand application gains more acceptances. As MPEG-4 is slow on encoding and fast on decoding, MPEG-4 will be chosen solution for streaming application, due to better compension performance with respect to older MPEG standards. It’s widely believed that MPEG-4 type of format will build new standards for multimedia in the future. Except audio and video also computer generated 3D images and sound, still images text and speech will be more widely used together with the possibilities user interaction real time. In the future the amount of interactive multimedia and video shall increase and it is highly presumable that MPEG-4 will have a central role in the development.

5.1.1 Properties of MPEG-4 standard

MPEG-4 is back ward compatible with MPEG standards and targeted for IP network, streaming application. MPEG-4 has wide bit rate ranges from few bit rate kbps to 10 of mbps. It also allow user interaction with audio, video, and graphic object and support streaming of real time data. It operates on the level of authors, service provider and the end of users. It has better compression and quality compared with other standards. So MPEG-4 with its new streaming capabilities and QoS support can suit able option.

5.2 Structure of MPEG-4

Description of protocol and the interface between the protocols is analyzed.

5.2.1 Transmission / Storage Medium

Transmission or storage medium is totally independently logic of MPEG-4. It identify the physical layer, digital storage requirement. At this level data is consider as raw material. As usual it is task of upper layer (like ATM, MPEG-4 transport stream, IP/UDP layer) to handel the actual physical properties.

5.2.2 Delivery Layer

Media objects are transferred through multiple elementary streams. The stream conveys the media objects. These streams have different information like audio visual object data, scene description information, that describe the contents. Actually the task of delivery layer is to handle and relay these elementary streams.
The Sync. layer will pass the elementary streams to delivery layer through the DMIF application interface (DAI), which allow isolation of sync. layer from the transport layer. Sync layer does not know whether the peer is a remote interactive peer, broadcast or local media. DAI defines procedure for starting of MPEG-4. It establishes the connection for the stream with local host and also used for bringing broadcast material and local files. In such a way we define a single, uniform interface to access multimedia of delivery technology. Important feature offered by DAI is the possibility given to the user to send command with acknowledgements.

Flex Mux is an optional tool which multiplex multiple slower ES with low speed to a network channel that permit faster speed. In this way we can reduced possible delay. This simplifies the interface to the network layer.

The continents provider also need the QoS. The DAI allow the user application to satisfy it for the necessary stream. It is then up to the layer protocol to answer that requirement are full fill.
The stream are then packetized and delivered to the network to be transported. Next several Network transport possibilities /storage media are listed.

RTP\UDP\IP
PES\MPEG-2\TS
AAL2\ATM
H323\PSTN
Local files

5.2.3 Sync Layer
Sync layer provides buffering and synchronization of ES. This layer allows identification of type of media transported (video or audio stream description command). Sync layer doesn’t used for frame demarcation.

5.3.4 Multimedia Layer
Convert multimedia element into elementary streams. Difference between synthetic objects and natural objects visible at this stage. Object description. Identify the different types of information from elementary stream. Identify the different the group streams related to media objects.

- Media object carried in own elementary streams.
- The scene description information define the spatial and temporal position of the media object and there behavior over time.
- Scene composition describes with binary language for scene description called BIFS (Binary format for scene).

Describes any efficient binary representation of the scene graph similar to VRML. Difference VRML textual,BIFS binary. BIFS define for streaming mainly. Scene sending. Send initial image followed by time stamp modification to the scene. Upper element makes interaction application easy to be implemented.

5.3 Major Functionalities in MPEG-4
The functionalities includes in MPEG-4 are in the following sections

5.3.1 DMIF
The application and transport layer use the interface of DMIF (Delivery Multimedia Interface Frame work). In this case the MPEG-4 application layer doesn’t care about the transport layer. Several transport layer use one application layer when support by DMIF instantiation.
5.4 DELIVERY OF MPEG-4

The contents related to MPEG-4 can be pass on lots of dissimilar transport layers and can be move from one to another.

5.5.1 MPEG-4 on MPEG-2

The answer to the question when and how MPEG-4 will replace MPEG-2 is not very soon. Because there are millions of dollars invested on MPEG-2. But MPEG-4 contents are paid in account that it will be transported over MPEG-2 stream.

5.5.2 MPEG-4 over IP

Framework is used as an umbrella for MPEG-4 sessions over IP based protocols like RTP, RTSP and HTTP. It gives a strategy of MPEG-4 contents over IP networks

Ref:
http://www.edgesoft.co.kr/download/edgedata/MPEG-4%20Overview.pdf
CHAPTER 6 RTSP

6.1 Introduction:

The RSTP is developing for the ease of client who can remotely control the streaming data or media services like a VCR. Like it can play, pause, stop, rewind and forward the streaming data (video) most of the time. This was the joint venture of progressive networks, Netscape communications and Columbia University

6.3 PURPOSE

The Real time streaming protocol is not used for delivery of streaming of data itself. It acts like a remote control for multimedia servers. The RSTP use UDP for streaming of data. The continuous media don’t need transport mechanism which is used to by RSTP. How ever RSTP is differs in number of significant aspects from HTTP
CHAPTER 7 Window Media Server Configuration

7.1 Back end of Configuration

In the streaming networks we used mostly encoder. This enables to convert (recorded & live) audio and video to computer and Media player. The components of window media player are configure for the satisfaction of customer. Many process are involved in this procedure. First we entering the initial setting and continuously play back to check the processes. Following properties are considered through configuration.

Audio and video quality and bandwidth constraints.

Network quality and latency.

7.2 Encoder setting

On the encoder side we use following settings.

**KEY FRAME INTERVAL**

In the streaming of video, the key frame streaming value is 1 second. When a stream of video receives the player don’t show it until it receives a key frame.

**BUFFER VALUE**

Usually Buffer value is mainly used in compression and decompression process. For the client, deliver the audio and video stream to high quality.

**Custom packet size (applies to multicast broadcast)**

We can increase or decrease the packet size. As in Ethernet the maximum size is 1500 bytes. Mostly in manually we use maximum packet size.

7.2.1 Server setting

We are used following basic configuration for server.

**Large block data transmissions**

By using TCP server can send 1000 ms and UDP can send 500 ms. But sending large amount of data can overflow the server it can give problem to customers.
Following are the default setting for server.

- Buffering (uni cast broadcast).
- Bandwidth limits
- Unicast packet size

7.2.2 On the Windows CE client

Configure the default setting for CE 3.

Install the GFE updates which can be downloaded from [http://www.microsoft.com/windows/embedded/ce.net/default.asp](http://www.microsoft.com/windows/embedded/ce.net/default.asp).

**Registry setting**

Some player settings can be done in registry.

7.2.3 On the network

“Make sure the following configuration is made for multicast traffic”

7.3 Setting Up a Windows Media Server

“Perform the following procedures to set up Windows Media Services, and then configure the server for minimum latency”.

“To install and set up Windows Media Services 9 Series

- We use Window 2003 enterprise for this
- Add window media services to window 2003

[Ref: http://download.microsoft.com/download]

7.3.1 Configuring Broadcast Streaming

For broadcast streaming of window media components we use following procedures

Enter the Custom Encoding Settings box.

Set the audio format 64 kbps, 48 kHz, stereo CBR. If we need high quality.

Video Size: It must be same as video input.
Key Frame Interval: Key frame interval mainly used to reduce latency so check it on to 1.

Video bit Rate: For high quality we required the bit rate to 1200 Kbps.

Buffer size: If we need buffer of any size click it.

Video Smoothness: Enter a value as appropriate.

Foe Custom Encoding Settings: We use following settings.

Processing tab, Check the main interlacing option.

For multicast, Use the maximum packet size.

Skip the above step in case of unicast delivery.

Then click apply.

[Ref: http://download.microsoft.com/download]

7.3.2 Configuring the Server to Broadcast a Live Stream (Multicast)
The following step are used for creating of broadcast publishing points

7.3.3 To Enable Multicast on the Publishing Point

1. Click Multicast streaming.
2. Enter multicast IP address, use the default port setting.
3. Time-to-live (TTL) is use mainly for the last hop to reach the
4. OK
5. Enable the detail panel.

7.3.4 Configuring the Server to Host On-Demand Content
Publishing points can be created at the time of installation of window media services

To host files on a Windows Media server

6. Add Publishing Point (Advanced) in the console tree.
   Click On-demand option, make a file and give it a path like c:\Video files.
   In category click networking and enable buffering.
   The startup latency must be low for buffer content.
7. Give the IP address of the server.
8. In the Windows Media Player enter the path of the file. For example, enter 
   mms://WMServer/video /File1.wmv.

### 7.4 Configuring Network Routers for Multicast

IGMP latency can be reduced the latency which is introduced by router following IGMP setting will be used for reducing latency.

Ref: http://download.microsoft.com/download
Chapter 8  MPLS and MULTICASTING CONFIGURATION

8.1 INTRODUCTION

We approached the implementation of the network by designing the following network diagram.

8.2 Network Design and Implementations

The first step to connect the network components as shown in the above diagram. This includes connecting two routers by a serial V.35 serial cable. This cable provides a
default bandwidth of 1.544 Mbps. The Cient Side Router is connected to a switch that provides connectivity to end users in the network. The server side router RtServer connects directly to the IP TV Server in this diagram or it may be connected using another Switch.

8.2.1 Configuring Routers:

First Step in the configuration of the routers is to design an IP addressing Scheme for the routers and Interfaces. We chose the private Addressing ranges of 192.168.1.0, 192.168.2.0 and 192.168.3.0 for using in our network. The router interface is always assigned the first available host address from the address pool.

The Server side of our network is assign Network address of 192.168.1.0 with router interface having address of 192.168.1.1 and Server having address of 192.168.1.2.

The Network between the two routers is assigned the address of 192.168.2.0

The network address of Client side of network is 192.168.3.0 with router Fast Ethernet interface address 192.168.3.1.

8.2.3 Enabling Unicast Routing on the Network

The next step is to enable routers for unicast routing. We used EIGRP as the Routing Protocol in our Network with Autonomous System no of 10. Router Rt. Server does routing for network 192.168.1.0 and 192.168.2.0. Router Rt. Client does routing for network 192.168.2.0 and 192.168.3.0.

8.2.4 Multicasting Configuration on the Routers

Now our task is to configure routers for multicast routing. To do this we first enable multicast routing on the router

RtServer(config)#ip Multicast-routing

Then we enable IP multicast routing protocol PIM on each Router interface

RtServer(config-if)#ip pim sparse-dense-mode

We also enable IGMP on routers

Rtserver(config-if)#ip igmp version 2
8.3 Switch Configuration

By default a Switch Broadcast the Multicast traffic to all Switch ports. If we enable IGMP on the router this makes the switch to forward the traffic to only those ports that are interested in receiving the multicast traffic.

A switch can be configured for Cisco Group Management Protocol using following command

**IOS-based switch: (enabled by default)**

```
Switch(config)# cgmp
```

8.4 Conclusion

The above steps are performed for enabling the multicast routing in the network. After above configuration the network is now able to perform multicast routing. This will optimize the performance of the network and reduce latency in the traffic forwarding with minimum delay.
**Purpose**

The project provides solution for increasing demand of bandwidth and less delay and good Quality of Service. The project covers a vast range of technologies that can be used for improving Quality of Services and Quality of Experience. It covers multimedia technologies, broadband technology, fiber optic communications, multicasting, routing, switching and server’s implementation. The benefits and goals achieved during the implementation of this project are: described under following two headings.

**Benefits for industry**

The industry can derive new benefits and improve services by using many of the approaches used in this project. The key benefits to industry can be summarized as follow.

- Multicasting can be used for reducing the load on the multimedia servers
- Multiprotocol Label Switching can reduce the delay in the delivery of video traffic
- Quality of Service and Quality of Experience can be improved
- Operator can offer more services by using the current infrastructure
- More users can be attracted for services thus increasing revenue for the operator

**Learning Benefits**

This project increased our knowledge in many prospects. Following were the most important technologies that we learnt during this project

- What is MPLS? (TDP,LDP)
- What is IPTV?
- Multicast routing and unicast routing?
- Triple Play and its Future?
- Video Encoding and Live Streaming?
- Protocols including RTP, RTSP, IP and PPPOE?
- Many of the multimedia technologies used in broadband networks
- Access network technologies? (DSL, VDSL, ADSL2+)
Overall this project provided us a great insight into the broadband technology, Multimedia, Networks and Communication. This will surely help us in our future career building in the field of Communication and networks.
LIST OF ABBRIVATIONS

AS     Autonomous System
ASIC   Application specific Integrated Circuits
ATM    Asynchronous Transfer Mode
BBNG   Broadband Network Gateways
BGP    Boarder Gateway Protocol
CAM    Content Addressable Memory
CATV   Cable TV
CE     Customer Edge
CEF    Cisco Express Forwarding
CGMP   Cisco Group Management Protocol
CGMP   Cisco Group Management Protocol
CO     Center Office
COS    Class of service
FEC    Forward Equivalence Class
FTTC   Fiber to the Curb
FTTH   Fiber to the Home
FTTN   Fiber to the Neighborhood
HDSL   High Digital Subscriber Line
HDTV   High Digital TV
IANA   Internet Assigned Numbers Authority
IGMP   Internet Group Management Protocol
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>IGP</td>
<td>Interior Gateway Protocol</td>
</tr>
<tr>
<td>IGRP</td>
<td>Internet Gateway Resolution Protocol</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>ISO</td>
<td>Internet Standard Organization</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>LDP</td>
<td>Label Distribution Protocol</td>
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<tr>
<td>LFIB</td>
<td>Label Forwarding Information Base</td>
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<tr>
<td>LSC</td>
<td>Label Switch Controller</td>
</tr>
<tr>
<td>LSP</td>
<td>Label Switch Protocol</td>
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<tr>
<td>LSPDB</td>
<td>Link State Database</td>
</tr>
<tr>
<td>LSR</td>
<td>Label Switching Router</td>
</tr>
<tr>
<td>MAC</td>
<td>Media Access Control</td>
</tr>
<tr>
<td>MBGP</td>
<td>Multi Protocol Boarder Gateway Protocol</td>
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<tr>
<td>MDF</td>
<td>Main Distribution Frame</td>
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<tr>
<td>MPEG</td>
<td>Media Photographic Expert Group</td>
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<tr>
<td>MPLS</td>
<td>Multi Protocol Label Switching</td>
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<td>MPLS</td>
<td>Multiprotocol Label Switching</td>
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<td>MSDP</td>
<td>Multicast Source Directly Protocol</td>
</tr>
<tr>
<td>NIC</td>
<td>Network Interface Card</td>
</tr>
<tr>
<td>NID</td>
<td>Network Interface Device</td>
</tr>
<tr>
<td>NSP</td>
<td>Network Service Provider</td>
</tr>
<tr>
<td>NTP</td>
<td>Network Time Protocol</td>
</tr>
</tbody>
</table>
OSI  Open System Interconnection

OSPF  Open Shortest Path First

PE  Provider Edge

PGM  Pragmatic General Multicast

PIM  Protocol Independent Multicast

QoE  Quality of Experience

QoS  Quality of Service

QQIC  Querier Interval Code

QRV  Querier Robustness Value

RD  Route Distinguisher

RGMP  Router Group Management Protocol

RIB  Router Information Base

RIP  Routing Information Protocol

RPF  Reverse Path Forwarding

RSVP  Resource Reservation Protocol

SDSL  Symmetric Digital Subscriber Line

SDTV  Symmetric Digital TV

SPT  Shortest Path Tree

SSM  Source Specific Multicast

STP  Set Top Box

TCP/IP  Transfer Control Protocol

TDP  Tag Distribution Protocol
TE  Traffic Engineering
TFIB  Tag Forwarding Information Base
TLV  Type Length and Value
TSC  Tag Switch Controller
TSP  Tag Switch Protocol
TSR  Tag Switching Router
TTL  Time to Live
TVC  Tag Virtual Circuit
UDP  User Datagram Protocol
VC  Virtual Connections
VPN  Virtual Private Network
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