RESEARCH ARTICLE OPEN ACCESS

Real Time Implementation of Data Communication using Ipv4Telecom Network through Sdhstm-4 Digital Transmission Wan

SharadaOhatkar*, Sanjay Thakare**, RachnaChavan*,
Mugdha Kulkarni *, KajolMehetre*
*(MKSSSs CCEW Department of ETC, Pune, SPPU)
**(BSNL RTTC, Pune)

Abstract:

With tremendous increase in number of telephone and the internet users, network providers find it challenging to provide services to increasing demand. This data is transported through optical fibre cables and microwave links using Ple-siochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH). PDH has bandwidth limitation and it only provides point to point configuration, therefore PDH cannot suffice the increasing traffic. SDH provides greater bandwidth, multiplexing can be done with efficient delivery of data and is adaptable to economical network management system. This project deals with real time SDH system which is applied on Wide Area Network (WAN) using ring topology. Real time analysis of data transmission is carried out using Internet Protocol version 4 (IPv4). For the future increase in traffic the use of Internet Protocol version 6 (IPv6) is analysed. The real time analysis of data rate and traffic is carried out. It is found that IPv6 can suffice more traffic in future.

Keywords — **SDH, IPv4, IPv6.**

I. INTRODUCTION

Now-a-days with development in telecommunication systems the demand for new services is increasing, such services like data, video calls requires higher communication speed. This increases network complexity.
These in turn, requires high design accuracy and perfect synchronization techniques for data signals. PCM (Pulse Code Modulation) was introduced later, which allows a single line to be used by multiple signals.

With the introduction of Pulse Code Modulation (PCM) for telephony,using a single line by multiple signals became possible. Network communications changed to digital technology for a digital time domain multiplexing where the analogue telephone signal is sampled, quantized and transmitted.

With increase in number of users demand for bigger bit rate also increased. To cope up with the increasing demand of higher bit rates a new technology Ple-siochronous Digital Hierarchy (PDH) by ITU-T 702 was introduced.

A. Ple-siochronous Digital Hierarchy

Ple-siochronous Digital Hierarchy (PDH) is a telephone network standard. It uses time division multiplexing (TDM) and it is nearly synchronous. Different standards in PDH made it difficult to connect different networks.The T-1 carrier system was developed; which uses 24 voice channels which uses TDM framing with the PCM standard. One more signalling channel of 1 bit is used and speed of T-1 is 1.544 Mbps.
PDH has some limitations:

- PDH is not flexible:Because of the higher multiplexing stages down through all multiplexing stages for higher bit rate, it requires more multiplexing cost.
- It is inefficient:In PDH, it is complex to get smaller tributaries from higher bit rates.
- Lack of performance:It is difficult to accomplish the performance of PDH system

we cannot able to provide good performance.

- PDH lacks standards: PDH has its own standards. Because of its uncommon multiplexing hierarchies it difficult to combine networks together.
- Not efficient to high bandwidth connections: PDH is not convenient to high bandwidth connections.

As PDH system is inefficient to high capacity bandwidth. It does not support traffic growth. Synchronous Digital Hierarchy (SDH) was proposed to support the increasing traffic growth. SDH provided a vendor independent structure that resulted into the development of new applications, new network equipments and management flexibility than PDH.[1]

B. *Synchronous Digital Hierarchy*

SDH eliminates number of multiplexers by allowing single stagemultiplexing and de-multiplexing, resulting reduce the hardware complexities. The SDH is an internationalstandard that is used for its high speed datatransfer ofthetelecommunication and digital signals. To provide a simple and flexible network SDH was designed. This system has brought a considerable amount of change in the telecommunication networks that were based on the optical fibre as far as performance and cost were concerned. SDH is standardized protocol that transfers multiple digital bit streams synchronously over optical fibre using lasers or highly coherent light from Light Emitting Diodes (LEDs).SDH is not a communications protocol in itself, but a transport protocol. [2]

Some of the features of SONET and SDH include:

- SONET and SDH uses Time Division Multiplexing.
- It uses octet multiplexing.
- It uses very precise timing.
- SDH provides support for operation maintenance and administration.
- SONET and SDH fits in the physical layer. [3]

TABLE I
ITU STANDARDS

STANDARDS	DESCRIPTION
International Telecommunications Union, ITU-T G.707 1996	Synchronous Digital Hierarchy (SDH) Bit Rates
International Telecommunications Union, ITU-T G.708	Sub STM-1 Network Node Interface for Synchronous Digital Hierarchy
International Telecommunications Union, ITU-T G.709	Interface for the Optical Transport Network (OTN)
International Telecommunications Union, ITU-T G.783 2004	Characteristics of SDH Equipment Functional Blocks

1) *SDH Network Elements:*

The different network elements in SDH includes

Synchronous Multiplexer:

The synchronous multiplexer can perform both the line transmitting functions and multiplexing, it replaces line transmitting equipments and Ple-siochronous multiplexers.

There are two types of synchronous multiplexers

- *Terminal Multiplexers(TM)*

TM accepts a number of tributary signals and multiplex them into appropriate signals.

- *Add Drop Multiplexers(ADM)*

ADM allows to “ADD” channels or “DROP” channels from “THROUGH CHANNELS”. It is SDH building block for local access to synchronous network. [4]

2) *SDH frame structure:*

The SDH frame structure is based on synchronous multiplexing of several building blocks. Such synchronous multiplexing elements are structured fixed size sets of bytes, which are byte-interleaved or mapped one into the other to eventually form (Synchronous Transport Module) STM-N frames. The STM-1 frame is the basic transmission format for SDH. The frame lasts for 125 µs, equivalent to 0.125 KHz. [4]

3) SDH Virtual Container Structure:

Virtual Containers (VCs) maps a payload that can be a PDH signal or other lower order synchronous multiplexing elements. Through the pointer information directly associated with VCs they are individually and independently accessible within SDH frames. [4]

4) Structure of SDH overheads:

The SDH overheads support monitoring, messaging, labelling, and switching control. Overheads allows monitoring of both ends from one end, for sector management (transit traffic) and central management via Data Communications Channel (DCC).

SDH can go up to 10 Gbps of transmission rate, it is possible to insert low bit rate channels to high bit streams. In case of failure SDH systems has auto backup and restore/repair mechanisms and if there is failure in one link or a single network element it does not result into the failure of entire network. [4]

C. Dense Wavelength Division Multiplexing

Basically in Dense Wavelength Division Multiplexing (DWDM) is optical signals are multiplexed within the 1550 nm band to satisfy the capabilities of Erbium Doped Fibre Amplifiers (EDFAs), as it is effective for wavelengths between 1525–1565 nm (C band) or 1570–1610 nm (L band). EDFAs were developed toreplace SONET/SDH optical-electrical-optical (OEO) regenerators. EDFAs can amplify any optical signal in their operating range, regardless of the modulated bit rate. EDFAs therefore allow a single channel optical link to be upgraded in bit rate by replacing only equipment at the ends of the link. Single wavelength links using EDFAs can be upgraded to WDM links.

DWDM has closer spacing of wavelengths. It provides maximum capacity therefore it is used at a higher level in the communication hierarchy. This factor of smaller volume and higher performance makes DWDM system more expensive than CWDM. [5]

II. METHODOLOGY

Methodology of SDH includes concepts about SDH. A two way ring topology is used in the SDH network; this provides a protection path because of which overall system never fails.

SDH is a synchronous digital transport system, aims to provide a simple, economical and flexible telecom infrastructure. The SDH equipment is divided in three parts i.e. optical interface, Tributary cards (Electrical tributaries such as E1 and Ethernet 10/100 Mbps) and base equipment (Consisting of Common cards, Control cards, Optical base card, Power supply card, Sub-rack, Other Hardware and Accessories required for installation of equipment i.e. Everything besides optical interface/SFP and Tributary cards).

Some of the recommendations for the development of SDH were:

- To define a structured multiplexing hierarchy.
- To define a proper protection and management mechanism.
- To define physical layer requirements.
- To define multiplexing of different sources over SDH.

A. SDHRates

SDH is a transport hierarchy based on multiples of 155.52 Mbps. The basic unit of SDH is STM-1.

Different SDH rates are given below:

STM-1 = 155.52 Mbit/s
STM-4 = 622.08 Mbit/s
STM-16 = 2588.32 Mbit/s
STM-64 = 9953.28 Mbit/s [6]

Each rate is an exact multiple of the lower rate therefore the hierarchy is synchronous.

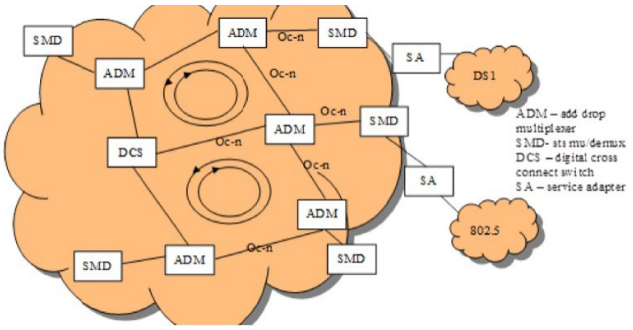

Fig 1: SDH System [4]

B. Network topologies[7]

1) Point-Point Link:

PDH system provides point to point connections. To avoid transmission issues PDH uses regenerators. It does not have routing or de-multiplexing.

2) Star Topology:

The traffic here passes through a central hub where the hub is a Synchronous Digital Cross Connect. When there is need of protection the linear bus topology is used, it provides great flexibility

3) Ring Topology:

This is the most used topology, in this topology, two or four fibre can be used and an ADM at each node. The ring network is a route back to itself that facilitates the development of protocols that can detect if there is a failure in the fibre and re-establish connection back quickly.

A ring network is a network topology in which each node connects to exactly two other nodes, forming a single continuous path for signals through each node i.e. a ring. Data travels from node to node, with each node along the way handling every packet.

Rings can be unidirectional, traffic travels either clockwise or anticlockwise around the ring, or bidirectional.

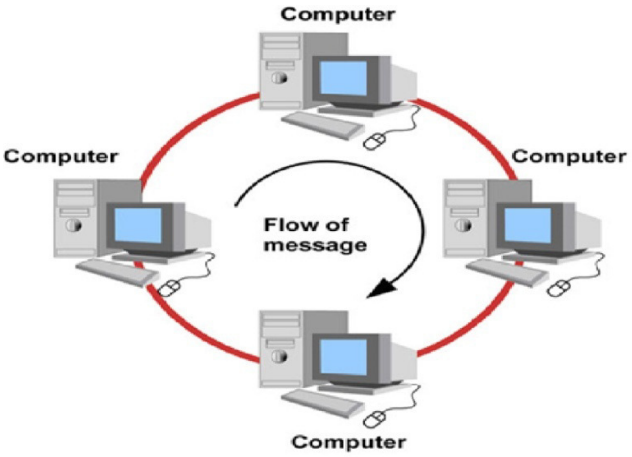

Fig 2: Ring Topology

In a ring network, packets of data travel from one device to the next until they reach their destination. Most ring topologies allow packets to travel only in one direction, called a unidirectional ring network. Others permit data to move in either direction, called bidirectional.

Ring topologies may be used in either Local Area Networks (LANs) or Wide Area Networks (WANs). In the past, the ring topology was most commonly used in schools, offices, and smaller buildings where networks were smaller. Ring topology provides improved performance and stability. [8]

C. IPv4 ADDRESSING

IPv4address is made up of 32 bits and it is divided into five classes as follow

Five classes of IPv4 addressing:

CLASS A (1 to 127)
CLASS B (128 to 191)
CLASS C (192 to 223)
CLASS D (224 to 239)
CLASS E (240 to 255)

IPv4 supports three different types of addressing modes:

- Unicast Addressing Mode:In this mode, packet is sent only to one destined host. The Destination Address field contains 32- bit IP address of the destination host.

- Broadcast Addressing Mode:In this mode, the packet is sent to all the hosts in that networksegment. The destination address field contains a special broadcast address, i.e.255.255.255.255. When a host sees this packet itprocess the packet. Here the client sends a packet, which is received by all the Servers.[9]

D. IPv6 ADDRESSING

IPv6 address is made up of 128 bits divided into 8-16 bit blocks. Each block is then converted into 4 digit hexadecimal numbers separated by colon. It is a hexadecimal number system. Second half of the address i.e. last 64 bits are used for interface ID.

IPv6 supports three different types of addressing modes:

- Unicast
- Multicast
- Anycast

Features of IPv6:

- Larger address space: IPv6 uses 4 times more bits than IPv4.
- End to end connectivity.
- Faster routing.
- No broadcast.
- Smooth transition.
- Extensibility.[10] [11]

III. RESULTS AND ANALYSIS

We have measured and tested the data rate of PCM through SDH and analysis of traffic using IPv4 and IPv6.

After hardware connections are done, we checked the PCM link using PCM Link Tester to check whether it is giving speed of 2 Mbps.

A. Steps to check 2 Mbps using PCM Link Tester

1. Connect Tx side of Tester to ADM-4 card of 1st SDH rack using PCM cable.
2. Connect Rx side of Tester to ADM-4 card of second SDH rack using PCM cable.

We can check the data rate between two SDH racks.

Fig.3 PCM Link Tester

• 2 Mbps is the data rate use by 3G standard. CDMA multiplexing technique is being used in 3G.

• As further standards have not being adapted completely in all areas, 3G standards are being used totally. Therefore we decided to work with 2 Mbps as it is a standard data rate.

B. Cisco 2811 ISR

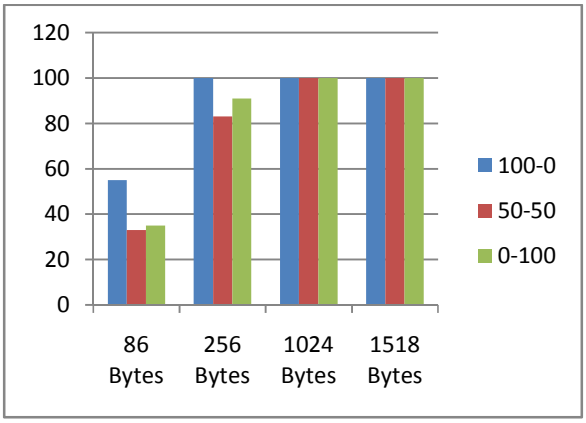

Fig.4: 2811Relative Throughput with Respect to IPv4& IPv6

100-0	100% IPv4 traffic
50-50	50% IPv4 & 50% IPv6
0-100	100% IPv6 traffic

When frame size is minimum i.e. 86 bytes relative max throughput of IPv4 is 86.1538%and

for IPv6 it is 40%.

When frame size is maximum i.e. 1518 bytes relative max throughput is 100% for both IPv4 & IPv6.

C. *Cisco 1841 ISR*

In case of router 1841 throughput is given as

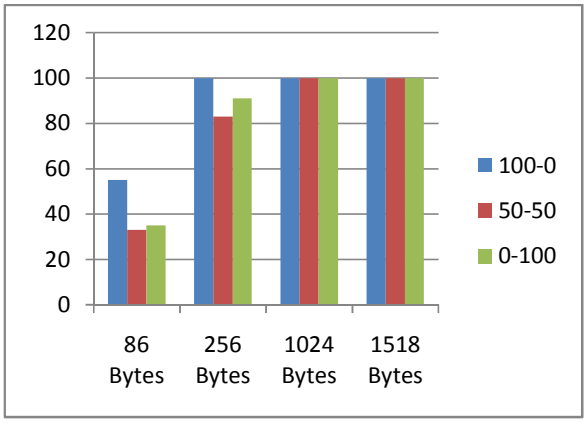

Fig.5: 1841Relative Throughput with Respect to IPv4 & IPv6

When frame size is minimum i.e. 86 bytes relative max throughput of IPv4 is 89.091% and for IPv6 it is 65.455%.

When frame size is maximum i.e. 1518 bytes relative max throughputis100% for both IPv4 & IPv6.

Therefore it is concluded that for both the routers, if we take smaller frame size then with increase in IPv6 traffic there is degradation in throughput.

IV. CONCLUSION

The demand for the availability of high speed networks is increasing and it is making optical fibre networks more and more important. SDH is a high speed transport system which guarantees the high performance levels that users will demand from current and future telecommunications systems. SDH overcomes most of the limitations faced in PDH. With SDH by increasing optical fibre bandwidth, it becomes possible to provide higher bandwidth services to the users. Bit rates can be increased by simply multiplying the bit rate of STM-1 system, which are STM-4, STM-16, STM-64 systems if multiplied by 4, 16, 64 respectively. So, the SDH communication is a better communication system over PDH.

With the wide variety of devices and upcoming technologies, IPv4 address spaces are becoming limited and are not capable to handle the current internet. IPv6 was developed to resolve the addressing issues which are lacked by IPv4. IPv6 provides large address space, support for real time audio and video streaming as well as greater security, extension headers etc.

REFERENCES

[1] S.M.Thakare, BSNL, "PDH.pdf", 2010.

[2]S.M.Thakare, BSNL, "*SDH INTRO.pptx",*2008.

[3]Kirandeep, KirtiHooda*"A Review on analysis bandwidth spectrum in SONET and SDH",* in International Journal for Research Publication & Seminar , Volume 08, Issue 05, April - June 2017.

[4] S.M.Thakare, BSNL, *"SDH concepts 2.pptx",* 2008.

[5]https://en.wikipedia.org/wiki/Wavelength-divisionmultiplexing.

[6]Dr.T.Ravichandra Babu1, Akki.Mamatha, Ch.Seetharam Reddy, DasojuDivya*"Design and Testing of 155 Mbps Link Between STM-16 SDH System Along With Protection*" in SSRG International Journal of Electronics and Communication Engineering, Special Issue, pp. 16 - 20, April 2017.

[7] FOROZOUN, "*Data Communication and Networking"*, 2013, published by McGraw Hill.

[8]https://www.scribd.com/document/48560477/SDHring.

[9] Kirandeep Kaur, Usvir Kaur*"A Review on IPv4 and Networking*", IPv6 in International Journal of Computer Science and Technology, Vol. 7, Issue 2, pp. 210 - 211, April - June 2016.

[10] Ramesh Chand Meena, Mahesh Bundele"*A Review on Implementation Issues in IPv6 Network Technology",* in International Journal of Engineering Research and General Science, Volume 3, Issue 6, pp.800 - 809, November - December, 2015.

[11] Cisco System, "*IPv6 Addressing White Paper*", Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134 - 1706 USA.