STUDY AND PERFORMANCE ANALYSIS OF SONET/SDH NETWORK

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ABSTRACT

SONET/SDH is an international standard networking principle and a multiplexing method. The name of hierarchy has been taken from the multiplexing method which is synchronous by nature. The evolution of this system will assist in improving the economy of operability and reliability of a digital network. SONET/SDH network has been designed only for voice traffic and it is leased line services. A huge amount of SONET/SDH services from small granularities are expected to migrate towards Ethernet based services and traditional voice platforms will be replaced voice over internet. This paper also covers the performance comparison of different SDH data standards using optisystem software.

Keywords*: ADM, *PDH, POH, Regenerator, SOH, STM.

I. INTRODUCTION

Synchronous Digital Hierarchy (SDH) and Synchronous Optical Network (SONET) refer to a group of fibre-optic transmission rates that can transport digital signals with different capacities. SDH is based on repeated hierarchy of fixed length frames that are designed to carry synchronous traffic channels. It eliminates group of multiplexers by allowing single stage multiplexing and de-multiplexing thereby reducing hardware complexities.

The term Plesiochronous Digital Hierarchy (PDH) is used to describe allsuch digital standards before the advent of SONET/SDH. This indicates asystem in which all parts operate on clock signals which have exactly thesame rate (within a bounded error), but may have different phases. Such acharacteristic is arguably not a design decision as much as it is an adjustmentto the realistically inevitable. The move to optical transmission systems wasaccompanied by a move to a synchronous architecture, which means thatSONET/SDH performs multiplexing in a strictly time division multiplexed manner.

II. SONET/SDH STANDARDS

The SDH standards exploit one common characteristic of all PDH networks namely 125 micro seconds duration, i.e. sampling rate of audio signals (time for 1 byte in 64 k bit per second). This is the time for one frame of SDH. The frame structure of the SDH is represented using matrix of rows in byte units as shown in Figure.1.

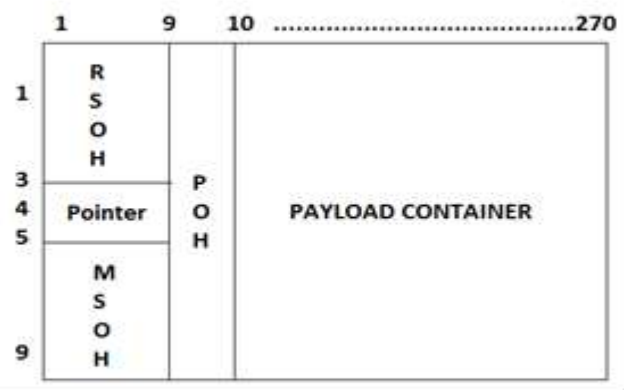


Fig.1. SDH frame structure

As the speed increases, the number of bits increases and the single line is insufficient to show the information on Frame structure. The Frame structure contains 9 rows and number of columns depending upon synchronous transfer mode level (STM). In STM-1, there are 9 rows and 270 columns. The first 9 rows and 9 columns contain Section Overhead and 9 rows and 261 columns contain main information called Payload. Section overhead containing information about the frame structure required by the terminal equipment. Each container pointer will added to form virtual container. The interface speed of the STM-1 can be calculated as follows:

(270 columns x 9 rows x 8 bits x 1/125 s) = 155.52 Mbps.

In SDH, a single level definition called Synchronous Transport Module (STM) is used. It is more appropriate to speakof STS frames at layers above the Photonic, and of OC signals at the Photonic layer. In this sense, the role of the Photonic layer is to map STS frames onto OC signals. Table 1 shows the commonly used rates, together withthe corresponding bit transfer rates, both raw and without overhead. One ofthe distinctions of SONET/SDH from the old PDH approaches is that thefractional overhead remains constant at all levels of the digital hierarchy inolder systems they usually increase at higher levels of the hierarchy.

Table 1. SONET/SDH Data Rate

SDH Level	Data Rate
STM-1	155.52Mbps
STM-4	622.08Mbps
STM-16	2.4883Gbps
STM-64	9.95328Gbps
STM-256	39.8131Gbps

III. SDH NETWORK ELEMENTS

3.1 Line Terminal Mux

It can accept a number of tributary signals and multiplex them to the appropriate optical SDH. The input tributaries can either be existing PDH signals such as 2, 34 and 140mbps or lower rate SDH signals The line terminal multiplexer takes the range of input either 2, 34, 140, mbps and multiplex to the higher rate optical carrier. Depending on the required regenerator spacing, optical interfaces of both 1310 nm and 1550nm are generally available as the option, a line terminal interface for internal protection switching. Additional option on line Terminal Multiplexer equipment provides for access to the order wire channel and the data communication channels.

3.2 Regenerator

Regenerators are required with spacing dependent on the transmission technology these are not just simple signals regenerators but have alarm reporting and performance monitoring capability a fault can be quickly isolated to the individual transmission section.The most basic element in the regenerator is when the transmission is needed more than 50 km they terminate and regenerate the optical signal. wavelengths of 1310nm and 1550nm are preferred because glass fibre is peculiar transparent to light at these wavelength fibre is even more transparent at 1550n than 1310 and so lower regenerators are needed the further the signal has to go the greater the transmitter power.

3.3 Add/Drop Mux

ADM'S are generally available at the STM-1 and STM-4 interface rates and signals with in ADM. it is possible to add channels to, or drop channels from the through signal. The ADM function is the one of the major advantages resulting from the SDH where the PDH network requires banks of hardwired back-back terminals Add/Drop Mux is a network element which allows configurable of a subnet of a payload from a higher rate data stream. It is the basic SDH building block for local access to synchronous networks. it generally offers STM-1 interfaces and operates in the thru-mode fashion .A wide variety of tributary signals, such as 2mbps can be added. This capability is one of the key benefits provided by synchronous systems since ADM elements supports a function the previously took banks to back-back equipment.

3.4 Synchronous DXC

Synchronous Digital Cross Connect function as a semi-permanent switches for transmission channels and can switch at any level from 64kbps up to STM-1.DXC can be rapidly reconfigured under software control to provide digital leased lines and other services of varying bandwidth. It is capability without need for de-multiplexing makes the digital cross connect such a powerful tool, allowing rapid configuration of the transport network to provide digital leased lines and other services. The synchronous DXC functions as a semi-permanent switch for varying bandwidth transmission channels i.e. 2 Mbps under software control, the cross connect devices can pick out and reroute one or more lower order channels from transmission signals without the need of de-multiplexing.

IV. BLOCK DIAGRAM AND RESULTS

The main block diagram for SDH network is shown in the figure 2. The results are obtained based on this architecture.

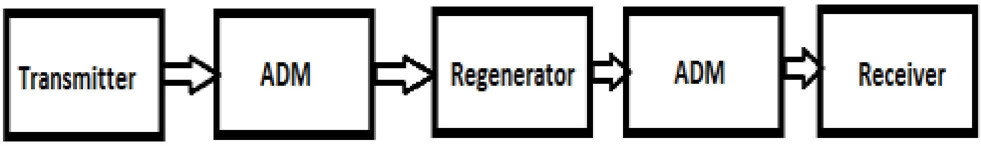
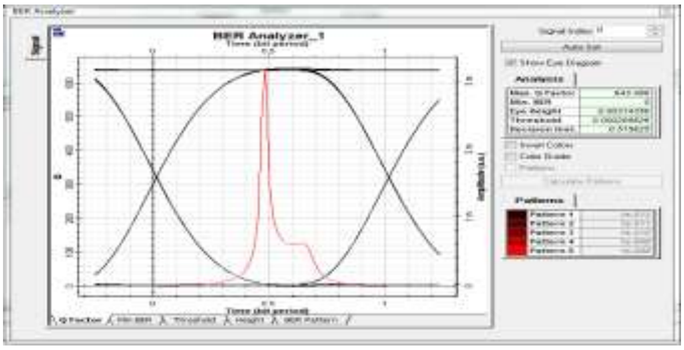


Fig.2. SONET/SDH architecture

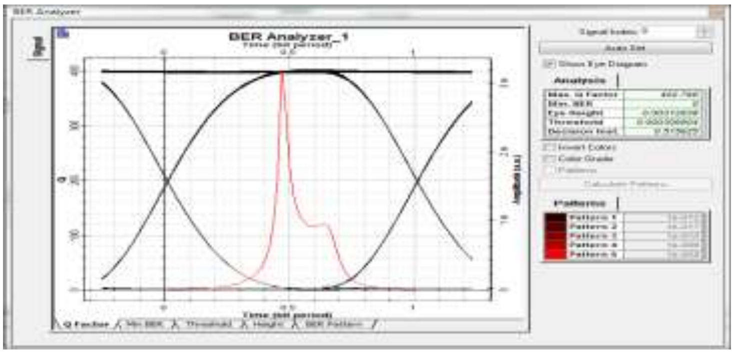
The simulation is carried out for different bit rates such as 155.52Mbps (stm-1), 622.08Mbps (STM-2), 2.4883Gbps (STM-3), 9.48Gbps (STM-4) and analysed Q factor for each data rates. The eye diagram for each data rates are shown below.

1. EYE Diagram for data rate 155.52Mbps(STM-1)



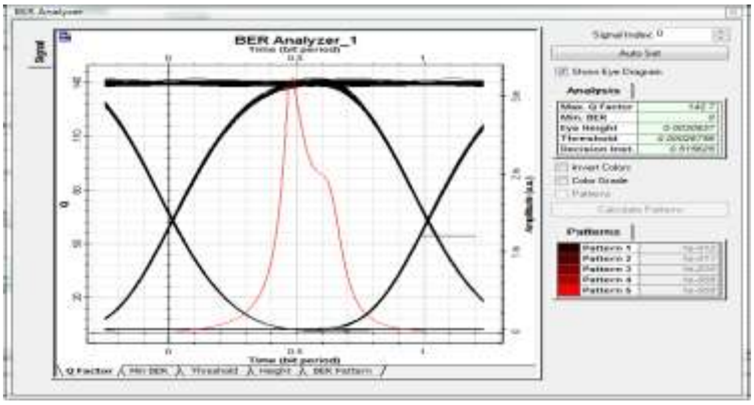
The Quality (Q) factor for STM-1 is 643.486

2. EYE Diagram for data rate 622.08Mbps(STM-2)



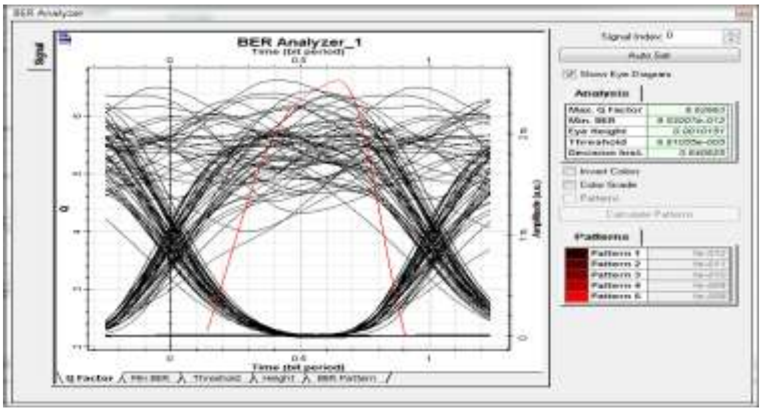
The Quality (Q) factor for STM-2 is 402.798

3. EYE Diagram for data rate 2.4883Gbps(STM-3)



The Quality (Q) factor for STM-3 is 142.7

4. EYE Diagram for data rate 9.95328Gbps (STM-4)



The Quality (Q) factor for STM-4 is 6.62663

V. CONCLUSION

The simulative analysis shows a gradual decrease in Q factor corresponding increase in data rate. The Q factor decreases from 643. 486 to 6.62663 for a bit rate 155.52Mbps to 9.95328Gbps. This shows that whenever the packet size or data rate increases the quality will be reduce. So in order to increase the quality of service operators can multiplex different data according to customer needs. The future works involves multiplexing the different data rates to utilize the bandwidth efficiently without sacrificing the quality of services.

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