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Analytical comparison of SDH and PDH

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Abstract- In this project, we have started with the concept of multiplexing and its importance in telecommunication sector. We also learnt the some multiplexing techniques and the multiplex digital hierarchy .We also learnt the characteristics of PDH and SDH, their frame structure, their multiplexing procedures, their working etc. We also learnt the advantages and disadvantages of PDH and SDH.

I. INTRODUCTION

Multiplexing is a method by which digital as well as analog Stream of transmission can be easily processed over a single link. Multiplexing divides the channel into many parts (the number of parts being governed by the transmitting stream) and these parts are then shared by different streams. The practical application of multiplexing in telecommunication field can be described by a small example, when multiple users want to use to transmit some data on a single channel, multiplexer divides the channel and give one part to each user. Similarly there is a demultiplexer at receiver side which receives, identifies and sends the signal to different receiver. Multiplexing techniques can be divided into several types like Frequency Division Multiplexing (FDM), Code Division Multiplexing (CDM), Wavelength Division Multiplexing (WDM) and Time Division Multiplexing (TDM). In FDM, the channel bandwidth is divided into number of non overlapping sub frequency band which are used independently by different information stream. WDM is mostly used in optical communication system. Light has many wavelengths. In optical communication, different optical carrier signals are multiplexed by making use of different wavelengths. In CDM, unique codes are used to transmit particular signal utilizing full bandwidth of channel. In TDM, the channel is being shared by different time users on different time slot. It is a digital as well as analog multiplexing. Effective transfer of digital signals is done with the help of TDM and eventually WDM. Multiplex digital hierarchy is created with an intention of multiplexing all types of digital signal which may be audio, video, data etc. The two types of hierarchy which are used today are Plesiochronous digital hierarchy (PDH) and SDH (Synchronous Digital Hierarchy).

II PDH (PLESIOCHRONOUS DIGITAL HIERARCHY)

Plesiochronous digital hierarchy is a telecommunication network transmission technology designed for the transmission of large data over digital networks. As time division multiplexing was introduced. Plesionchronous means almost synchronous. It means that PDH works in a condition where all the components are almost synchronized but not completely. This is due to the fact that each equipment in PDH uses its own clock. This clocks are not synchronized. As the analog channels were digitized to a 64 kbps digital channel using PCM (Pulse Code Modulation), it was possible to use time division multiplexing to multiplex a number of voice channels on trunk line. This line is called as T carrier in

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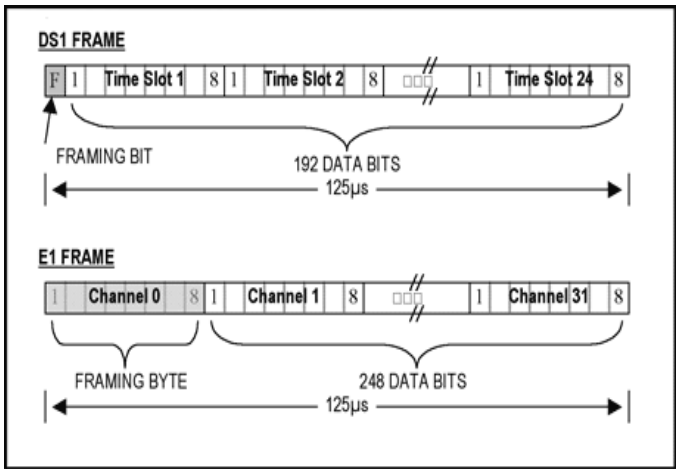
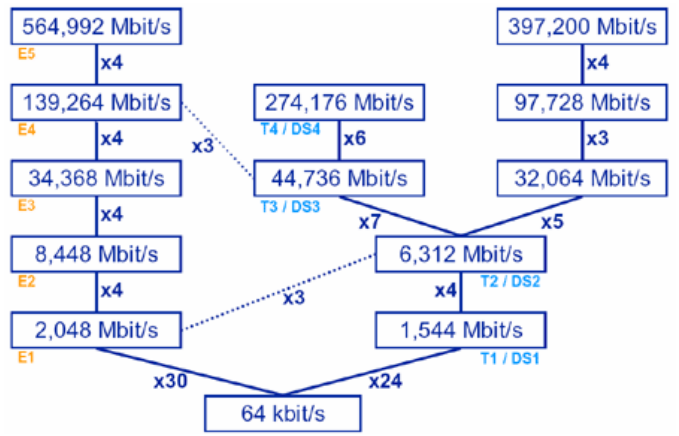
North America and Japan. It is called as E carrier in Europe which is used in rest of the world. The T1 carrier carries 24 digital voice channels. The bit rate of each channel is 64 kbps. Each TDM frame on T1 line carrier. 24 bytes of data (8 bits for 1 channel). And a single bit is used to facilitate synchronization between transmitter and receiver.



The collection of one sample from each channel is called a frame. The set of first samples of all channel is one frame, the set of second samples is called second frame and so on. The duration of each frame is 125 microseconds. Hence the frame rate is 8000 frames per second. The total bit rate of T1 line is (8000 x (24 x 8 bits) + 1 bit) = 1544000 bits per second (1.544 Mbps). This is called digital leveling signal1 or DS1. This was about Japanese standard and North American standard.

The E0 voice channel, similarly like T0 has a bit rate of 64 kbps. However it has 32 timeslots per frame. Again each frame duration is 125 microseconds. Hence the frame rate is 8000 frames per second. Each timeslot is made up of 8bits of a channel. Hence the total bit rate is (8000 x (32 x 8 bits)) = 2048000 bits per second or 2048 kbps. This rate is also called primary rate. In E1 also, one timeslot (TS0) is reserved for frame alignment word (FAW) and another timeslot (TS 16) is reserved for signaling information. European standard, four E1 are multiplexed to get E2.Again 4 E2 are multiplexed to get E3 and so n. In short, the European standard increases the number of channel by four at each level. But in reality the total bit rate of each level is slightly greater than 4 times the bit rate of previous level.



Plesiochronic transmission rates of European, North American and Japenese standard respectively.

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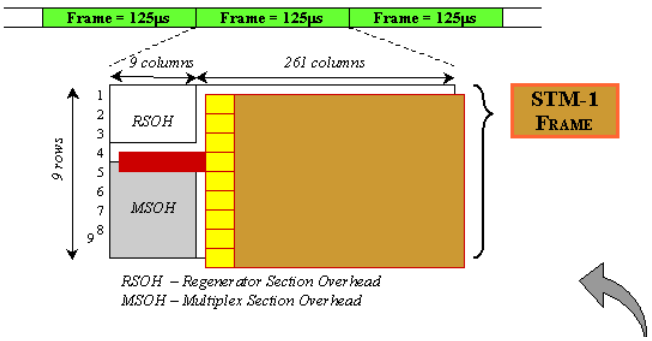
But PDH suffers from various disadvantages. They are as follows-

1. As Europe, North America and Japan were using three different standards, it restricts the formation of standardization between the PDH networks all over the world. Moreover very expensive conversion circuitry was required whenever there was communication between the three different PDH standards.
2. After the advent of optical fiber technology, the copper lines were replaced by optical fiber. But the lower lines were still copper lines. As a result, Optical Line Termination (OLT) was not standardized is basically a point to point topology.
3. PDH is a point to point topology.
4. PDH is not very flexible. It is very difficult to identify individual channels in a higher order bit stream. It is required to demultiplex the high rate channel down through all multiplexing levels to find a particular channel.
5. PDH is not a centralized managed technique. Hence more manpower is required.

III. SDH (SYNCHRONOUS DIGITAL HIERARCHY)

To overcome all the drawbacks of the PDH, SDH was developed. In SDH, there is only one master clock and all elements are synchronized with it. SDH equipment receives the optical signal and converts it to the electrical domain signal which can be used to process the frames. The electrical side of the SDH is known as the synchronous transport module *(*STM*)*. The optical side of a SONET/SDH signal is known as the optical carrier *(OC)*. SDH's basic rate is 155.52 Mbps (identified as STM 1)



The above figure shows the frame structure of SDH. It has nine rows and 270 columns .Hence total bytes are (9 x 270 = 2430 bytes). Like PDH, the duration of each SDH frame is 125 microseconds. Hence the frame rate is 8000 frames per second. The left part of the frame is called Transport Overhead (TOH) which consists of three parts- Multiplier Section Overhead (MOH), Regenerative Section Overhead (ROH) and
AU-4 Pointer(AU4P). The other part is called virtual container 4 payload which contains the actual information. The SDH multiplexing is as shown in figure-

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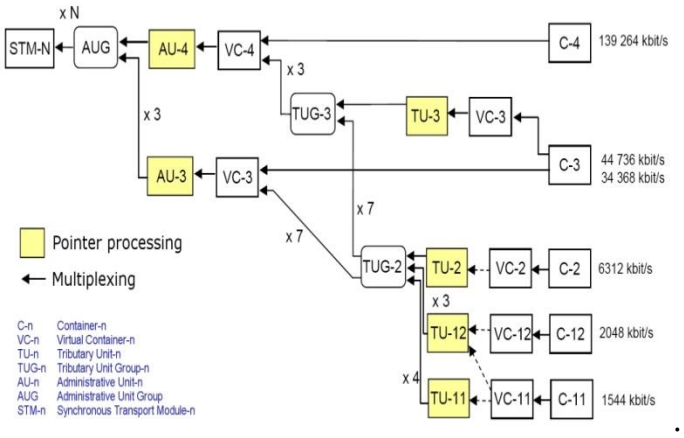

Virtual container is a container extended with a Path Overhead (POH).POH is used to control the transmission of information of the container. Tributary units TU are the units which are composed of VC11, VC12, VC2 and VC3 virtual containers along with a pointer. C11, C12 and C2 are inferior order containers. Superior order containers (C3 and C4) have the POH composed of a column of 9 bytes.

Administrative units AU are obtained from the VC-3 and VC-4 virtual containers by adding pointers to these structures. Administrative Unit Group AUG is composed of one AU4 unit or three multiplexed AU3 units;

Initially the PDH data is distributed to proper Container. Virtual containers are generated by attaching POH. Tributary Units and Administrative units are created by attaching the pointer and the containers are inserted at proper positions. In the final stage, basic transport frames are createdand they are multiplexed.

The advantages of SDH are as follows-

1. Simplified add and drop fashion - In SDH system, low bit rate channels can be easily selected from and inserted into the high speed bit stream .
2. It can work in ring and mesh topology.
3. The rate of transmission can go upto 10 gigahertz in this technology.
4. It also supports auto restoration of faults in no time. Various back up mechanism and error repair circuits are compatible with SDH
5. As compared to PDH, less manpower is required to control the SDH network.
6. Moreover the up gradation of the network is very easy.
7. Unlike PDH, standardization is provided to SDH. As a result any SDH equipment from any shop can be interconnected.
8. SDH network can be fully software control.
9. SDH is able to handle video on demand and other system like ATM.

IV. CONCLUSION

In this paper, we mainly tried to focus on various characteristics of SDH and PDH. We studied the frame and multiplexing of PDH and SDH. We also studied the various disadvantages of PDH and advantages of SDH which results in superseding of PDH by SDH.

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