

A Study on Sonet and SDH with their Defects in Optical Network

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Abstract

Background Objectives: Data transmission over a communication channel, should provide important facilities to be added, including data framing, error checking and to manage the channel. **Methods/Stastical Analysis:** This is a complete review paper and theoretically we intend to explain the basics of SONET/SDH, Architecture, Bit rates, Network configurations etc. All these are standardised and approved by ANSI. **Conclusion:** One would get to know what Synchronous Optical Network/Synchronous Digital Hierarchy (SONET/SDH) is all about and how exactly are they used through this paper. Also, the merits and de-merits are completely analysed.

Keywords: Network Elements, Network Configuration, Optic Fiber, PDH, SDH, SONET, Versions of Network Cable

1. Introduction

In today's fast moving world with uncountable use of telephones and hike in total number of internet users, network providers find it challenging to efficiently manage the increase in telephone traffic. In this growing market, since, telephone connections and users increase, propotionally we have technologies that were developed over the past 60 years to be addressed in the markets of data providing and it is made as economical as possible.

This process resulted in Introducing FDM called Frequency Division Multiplexing System where every channel of telephones is modulated with unique carrier frequency. This would then be converted into different ranges and transmitted over telephone channel. An innovation of semiconductor circuit with the communication line tried to increase the transmission capacity over the telephone line with Pulse Code Modulation (PCM) in 1960.

PCM method firstly samples the analog signal at 3.1 kHz Bandwidth. After quantization and encoding

the signals are transmitted at 64 kbps bit rate. A 2048 kbps of tramission is achieved with 30 coded channels, all collected into a frame along with all the necessary signalling information. 2048 kbps is considered the primary rate and is followed across the world except for countries like USA, Canada and Japan where the primary rate is 1544kbps. With greater demand for bandwidth, more stages of multiplexing is required throughout the universe.

SDH is an ideal and particular network especially for network providers, with efficient delivery and economical network management system that can easily be adapted to accommodate the demands on BANDWIDTH for applications and services¹⁻³.

2. SONET and SDH

Synchronous Optical Network and Synchronous Digital Hierarchy are standardized multiplexing protocols which is used to transfer multiple digital bits over the communication channel ment optical fiber by laser

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lights or by Light Emitting Diodes (LEDs). SONET was established and introduced in United States by ANSI T1X1.5 committee. ANSI works started in 1985 with the help of CCITT called as ITU by initiating a standardization in 1986. The United States seeks for the data rate to close with 50Mbpa and Europeans wanted data rates to be around 150Mbps. US data rates were finally issued as subset to ITU specification and was called as Synchronous Digital Hierarchy (SDH).

SONET and SDH are variant terms which are used often to represent and explain the same features and functions. This may leads to dilemmatic situation and elaborate their differences and with some exception SDH is ment to be a super set of SONET, and this type of technicalities called as protocols. The displayed figure.1 shows where SONET and SDH are placed in core networking areas and how the data is transmitted over the Optical fiber^{1,2}.

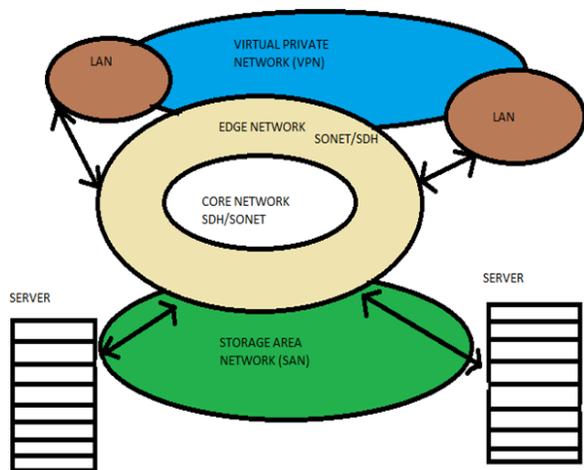


Figure 1. Diagrammatic Representation of SONET and SDH.

All the protocols are fully weighted-multiplexed designed such that the header solves the data's into a complex and the encapsulated data is allowed its own rate for the frame. Multiplexing needs a physical medium to transfer or carry various signals. A SONET is a set of links between any other ends. I this SONET TDMA is used in case of calling through one line needs time division multiplexing concepts. Telephone lines are made or manufactured or designed to carry 1.5Mbps of data over a single line. Since it is SONET concepts there is no priority based data transfer is used.

SONET and SDH have their own frame structure of splitting while transferring the data from one end to another. The SONET by its nature called as Synchronous

Transport signal level and SDH by its nature called as Synchronous Transport Module Level. The rates over cable for SONET and SDH are shown in Figure 2. By technically there is no difference between SONET and SDH but to show the data rate of those technologies is displayed.

SIGNAL DESIGNATION			LINE RATE
SONET	SDH	OPTICAL	Mbps
STS-1	STM-0	OC-1	51.85
STS-3	STM-1	OC-3	155.52
STS-12	STM-4	OC-12	662.08
STS-48	STM-16	OC-18	2488.32
STS-192	STM-64	OC-192	9953.28

Figure 2. Table content on Signal rates of SONET and SDH.

3. PDH

Plesiochronous Digital Hierarchy(PDH) is a network for transmission which is not raised for synchronous operations but those signals entering a digital multiplexing may not be synchronous even though their bit rate of transfer is similar and they begin from distinct crystal oscillators and vary. The high order digital multiplexing was implemented for this situation called first generation of high order digital multiplexing. There are three standards available for Plesiochronous digital multiplexing situated in Europe, North America and Japan. It could not able to give the satisfaction of the customer in the terms of bandwidth, quality and etc. So it fails to the network provider.

4. SDH

Since the internet connection and cell phone has been increased the terms Bandwidth has been called for often for increase in bandwidth, reliability in connection and in high quality services. SDH has come up to a position in 1980s overtaking many demerits of PDH. This is the situation where network providers comes into economic

growth and in technological events. This technological raise up deals with major categories named as High transmission rate, Simplified add and drop function, High availability and capacity, reliability, interconnection and the synchronous digital hierarchy of layer model.

Above mentioned terms which helps the Synchronous Digital Hierarchy and optical fiber is the medium of cable which is used mostly to transfer data from one to another. The main advantages of these optical fiber cables are they can transmit the data in very faster speed which no other medium can pass the data and no distraction will takes place in the data and no damages. The main disadvantages of this optical fiber cable, cost of installation is very high. The regenerator is a section which is a path between regenerator is available for the signaling purpose through the cable for communication and it is mentioned as regenerator section overhead (RSOH). The multiplex section is over the PSOH layer which is used to link between the multiplexers. Carrier or virtual container is installed to proceed the process of payload at two of this section. The SDH layer representation is shown in Figure 3.

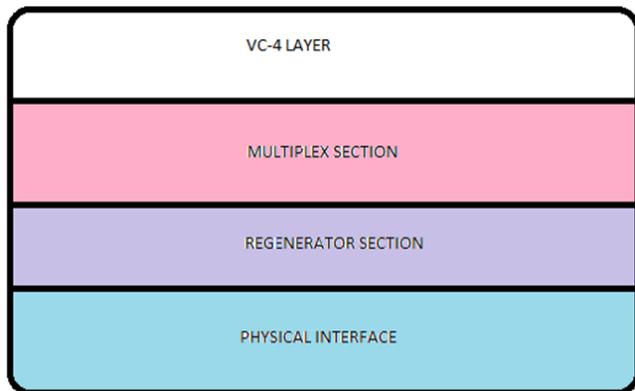


Figure 3. SDH Layer Representation.

5. SONET

SONET can be expanded as Synchronous Optical Network and is designed mainly to use in optical network cable for transfer the data at the faster speed than the other network medium. SONET was initiated and implemented by ECSA called Exchange Carriers Standard Association, which allows standardized and normalized connection between the fiber optics systems, though it has been schemed by different manufactures. SONET and SDH have been designed and implemented mostly for the same purpose and were designed for transport circuit mode communication from various

sources to various destination. The additional features which it is implemented for real time, uncompressed, circuit switched voice encoded in PCP format. The major struggle was in proceeding with SONET/SDH is the synchronization sources of these various circuit will differ in data rate transfer with different phases of circuit. SONET/SDH allow simultaneous transport of data over various circuit of various origins whose protocol uses a single frame. SONET and SDH is a transport protocol than it is a communication protocol.

The transport technology defined by SONET has multiple signals whose capacity varies through an optical synchronous hierarchy. Signals with byte interpolation are multiplexed to achieve the same. Multiplexing is simplified because of byte interpolation and also there are network admin at every point offered by byte interpolation.

The SONET multiplexing implies the generation of several lower level signals in the structure. The basic signal is abbreviated as Synchronous Transport Signal Level 1 (STS-1). These STS-1 are compacted by 810 Bytes spread over 9 rows with 90 bytes each. These mentioned set of bytes is transmitted in every 125 microseconds.

6. Network Elements of SONET

6.1 Terminal Multiplexor

Terminal multiplexor which concentrates tributary DS-1 signals as well as other signals which derives it and transforms the electric signal in optical signal and vice versa. Simplest of the SONET links are made by two ends of fiber optics joined multiplexor with or without signal regenerator.

6.2 Signal Regenerator

Signal regenerator is needed when the distance is too long between the two terminal multiplexor or the optic signal is too low. On receiving the signal, the signal regenerator closes and a header is added to the signal pattern before transmission. This way the information in the data is not affected.

6.3 Add/Drop Multiplexor (ADM)

ADM gives access to new traffic from a particular point or implement the same, in addition it also absorbs a section of data traffic. . On implementing ADM, it can download or insert into the main flow or on to other signals which can be altered.

7. SONET Network Configuration

7.1 Point to Point

Point to point setup is formed with two terminals multiplexor which is connected with fiber optics cable and with the feature of using a single regenerator. This single regenerator cable used whenever the user needs.

7.2 Point to Multipoint

This architecture includes ADM network elements to the network. ADM has been designed specifically for this work. This ADM avoids cross-connect connectors, remultiplexor and demultiplexor. ADM connects intermediate network points to the network channels.

7.3 HUB Network

A HUB deals with sudden data growth and network changes smoothly and efficiently over point to point networks. A HUB, distributes the signal traffic at the central point to various circuits.

7.4 RING Network

The most valuable and important element of ring network is ADM. Many ADM can be placed in a ring structure for single way or two way data traffic. The ring network is advantageous because of its security. The working ring nodes can distribute the data traffic in case of damage to any fiber optic cable of a multiplexor. The ring network is represented in Figure 4.

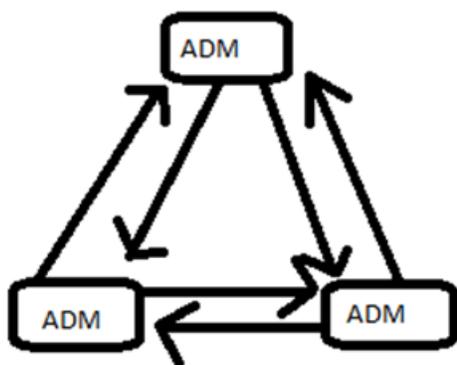


Figure 4. Ring Representation of ADM.

8. What Makes SONET Popular?

The fact that relies behind the SONET that allows different interface with asynchronous sources and existing

machines can be substituted by a new machine which is supported by SONET network. Flexibility in Bandwidth gives SONET a major advantage towards the telecom industries. It also indulge in multiplexing, traffic-injection and extraction in intermediate point of system reduce the cost of creating SONET implementation. The network reliability increases proportionally the users also increase and this make network and connection more efficient. It allows Header Bytes which allows administration of data bytes and the maintenance of system which will reduce significantly maintenance cost of SONET network infrastructure. The generic standard of the existing system allows interconnection of various products created by different manufacture has allows them to use SONET and support main network standard.

9. Structure of SONET

The structure of SONET is revealed in Figure 5.

10. Threads in SONET and SDH

This concentrates on the vulnerabilities on all optical networks which is called as AON contains and describes on SDH, SONET and all other branches to understand the possible attacks on optical networks. Here the attacks are most concerned with jamming and network defected signals. Device crosstalk is available in most of the devices where signal leaks from one portion of optical network device to another. Crosstalk can be used for service denial or eavesdropping attacks.

10.1 Safety Measure on Attacks

There are many reasons for which an AON should be secure when the data transmits over the optical network is,

- Every point of a network should be able to detect and identify the attack on its data.
- Attack detection speed should be proportional to the rate to data transmission, since with higher data rates of AON amount of data attacked can be huge.
- Identification of attacks at possible target locations, should occur irrespective of high AON data rate.

10.2 Attack Types and Methods

Attacks on a network can be widely sliced into six different areas based on aim of the attacker and hacker. The areas of attacker are mentioned below

- Traffic Analysis,

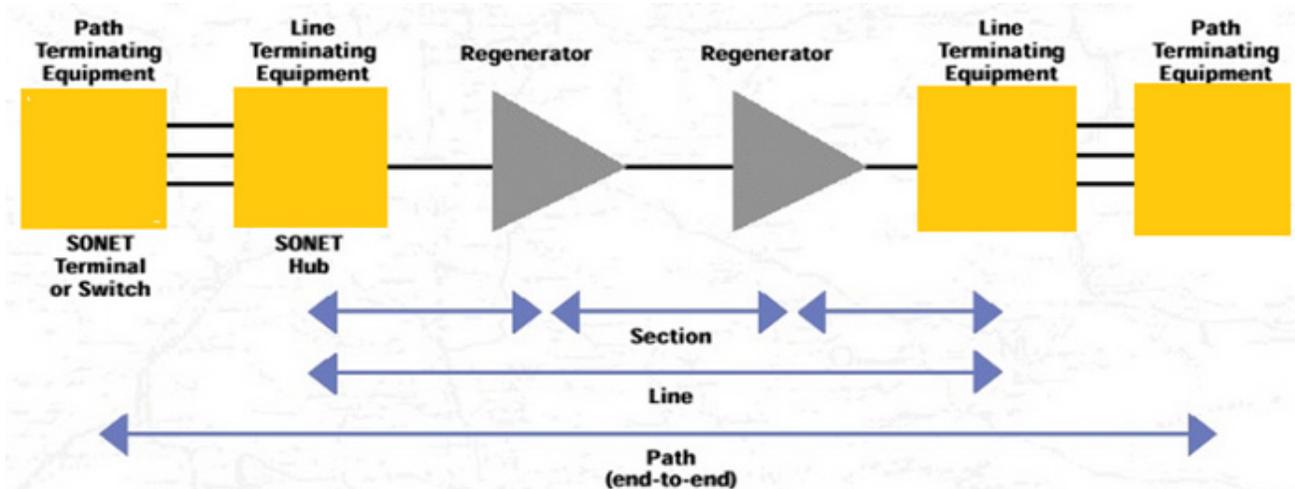


Figure 5. SONET Structure.

- Eaves dropping,
- Data Delay,
- Service Denial,
- Quality of Service Degradation and
- Spoofing.

There are some systems which already exist to find the attack detection in optical network. The system which are listed below are the finest system which is available for the attack detection and correction has been done with the help of the system.

- Wideband Power Detection Method.
- Optical Spectral Analysis Method.
- Pilot Tone Method.
- Optical Time Domain Reflectometry Method.

10.3 New Method for Detecting Defect's of all Optical Networks

This content explains a new method for detecting attacks upon optical network and with amplified links with transparent AONs. There are some methods which is used to recover the data infected data and retransfer the data to the respective end through the optical networks called AONs. The below mentioned techniques are the new arrival of attack detection methods, they are

- Amplitude Comparison.
- Phase and Amplitude Comparison.
- Important Detection Issues.

11. Conclusion

This huge raise in communication network supports infrastructure of network, traffic data transfer which flows all over the globe. PDH was the good transfer communication medium and finally it could not able to gain the advance features like fast data rate transfer and with fiber optics improvement in communication transfer cable. New standard was introduced after a great improvement in mentioning above additional functionalities and to fulfill the requirements of fast moving communication globe. Further improvement on network includes Ethernet over SDH and set of rules which allows Ethernet traffic with efficient and with flexible manner. This SONET and SDH is going to handle the communication channels all over the globe for maintenance of data rate transfer and more number of users to added efficiently.

12. References

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