SDH and Its Future Trends

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Abstract – SDH possess an international standard networking principle. It is synchronous by nature so name of the hierarchy is taken from multiplexing method. The evolution of this system improving the economy of operability and reliability of a digital network SDH evolution meets the requirement of the customer with respect to the different band width requirements and different services.SDH standard defines the transmission rate developed to 155.52 mbps. In multiplexing process payloads are layered in to lower order and higher order virtual container, each including a range of over head functions for management and error monitoring. frame has a repeative structure and consists of nine equal length segment .Each segment in STM-1 possess the information structure .The flexibility of SDH can be used to best advantage by introducing a network topology.

Keywords- CCITT: Comite Consult if International de Telegraphique et Telephonique STM: Synchronous Transport Module ADM: Add Drop Multiplexer, POH: Path Over Head SOH: Section Over Head

I. INTRODUCTION

In February 1988 an agreement was reached at CCITT for a Synchronous Digital Hierarchy representing a single worldwide standard.

For transporting the digital signal .For smooth transformation from existing PDH it has to accommodate three different standards ***SYNCHRONOUS***- *One master clock and all element synchronise with it* ***DIGITAL***-*Information in binary,* ***HIERARCHY***- *set of bits rates in a hierarchical order. SDH defines a set of hierarchical structures, standards for the transport of suitably adapted payload over physical transmission network*

As SDH is introduced more widely, the management capability of network gradually increases because of the comprehensive monitoring and high capability management throughout the network. The control of bandwidth on a time scale of seconds for other multiplexing techniques that have switching capabilities so SDH as their transport mechanism. The first attempt to formulate standards for optical transmission started in U.S.A as SONET(Synchronous Optical Network) The aim of this standards was to simplify interconnection between network operators by allowing inter connection of equipment from different vendors to extend that compatibility can be achieved

SDH has provided transmission networks with a vendor independent and sophisticated signal structure that has a high feature set. These resulted in a new network applications, the deployment of new equipment in new network topologies, and management by different operation system of greater power from previously seen in transmission network

II. SYNCHRONOUS DIGITAL HIERARCHY DESCREPTION

A. Merits of SDH Evolution

a) Synchronous networking: SDH supports even multipoint Configurations where as asynchronous networking supports only point to point configurations.
b) Direct access to lower speed tributaries, makes unnecessary need to multiplex / demultiplex the entire high speed signal.
c) Easy growth to higher bit rates enhances operations, Administration, Maintenance and provisioning capabilities.
d) Capability of transporting existing PDH signal steps to evolution of transmission signals
e) Transporting future broad band channel makes bit rate faster.
f) Multi vendors use proprietary non standard techniques for transporting information on fibre only way to interconnect was convert to copper transmission standards.
g) It provides Network transport services like LAN to LAN (local area network) Interactive multimedia, video conferencing.
h) There is no limit in increasing the optical fibre bandwidth it gives a greater advantage in using SDH.
i) Even though SDH circuitry is highly complicated, it is possible to have circuitry because of VLSI technique.
j) The requirement of customers with respect to different bandwidth requirements could be easily meet without additional requirements.

B. SDH Standards And Principles

SDH standard provides sampling rates of audio signal as 125 micro seconds duration the frame structure of SDH is represented by using matrix of rows in byte units As the speed increases the number of bits increases and the single line is insufficient to show the information on the frame. The frame structure contains 9 rows and number of columns depending on the synchronous transfer mode (STM-1) there are 9 rows and 270 columns .For PDH signal there are 25 bytes in 125 microsecond for 1.544Mbit which is 9 rows x 3 columns similarly for 2.048 M bits per second signal there are 32 bytes in 125 micro seconds when some additional bits are added it holds 27 bys and 36 bytes

STM-1 frame structure is 9 rows and 270 columns among them 9 rows and 9 columns accommodate section overhead 9 rows x 261columns accommodate payload which accommodates the main information The interface speed of STM-1 is 155.52 mbps.STM-0 which is 1/3 of the STM-1frame is used As the present basic rate.STM-0 frame structure is 9 rows x 90

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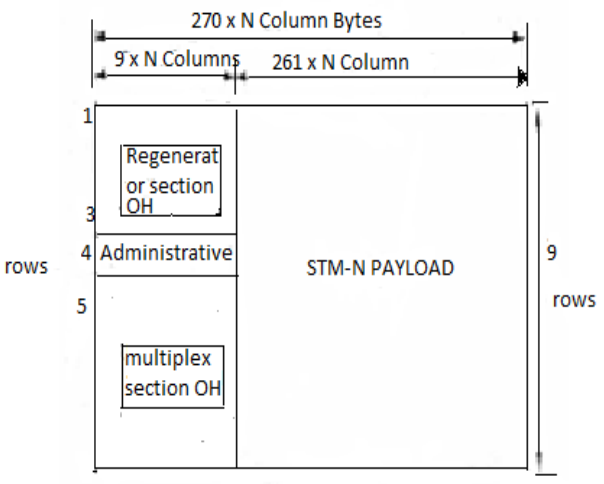
columns out of 9 rows x3 columns consists of section overhead, and 9 rows x 87 columns consists of payload .The interface speed is 51.840 per bit rate across this section

Principles of SDH involve a number of containers. Each container has a path over head which provides network management capabilities. The first point of PDH signal is the container in which the signal is prepared. In container-3 34.368Mbits increased to 756 in 125 micro second. In container-4 139.264 M bits signal is increased to 9x 260 bytes container with path overhead from a virtual container

In virtual container the path over head is organised in the form of block structure in 125 micro seconds. It contains information of only 1 byte in VC-1 for 125 micro seconds. In VC-3 POH is 1 column of 9 bytes. In VC-4 POH 1 column of 9 bytesVC-1,VC-2 are lower order virtual container VC-3,VC-4 are higher order virtual container. Tributary unit 1 for VC-1and tributary unit 2 is for VC-2 and tributary unit-3 is for VC-3 which is mapped for VC-4 tributary group-3.TU-3 consists of 3 bytes out of 9 bytes. These three are H1, H2, H3and remaining bytes are fixed bytes one or more tributaries are contained in tributary unit group.AUG-2 contains TU-1 orTU-2 TUG-3 contains TUG-2s.The interface of a network node which is used to interconnect with another node. Pointer defines a frame offset of a VC with respect to the frame reference of

Transport entity. AU is the information structure which provides adaptation between higher order and multiplexer section layer .it consists of information payload and a AU pointer which indicates the offset of the payload frame start relating to the multiplex section frame .AUG contains a homogenous of AU-3 or AU-4.Concatenation is a procedure which the multiple virtual container are associated with one another

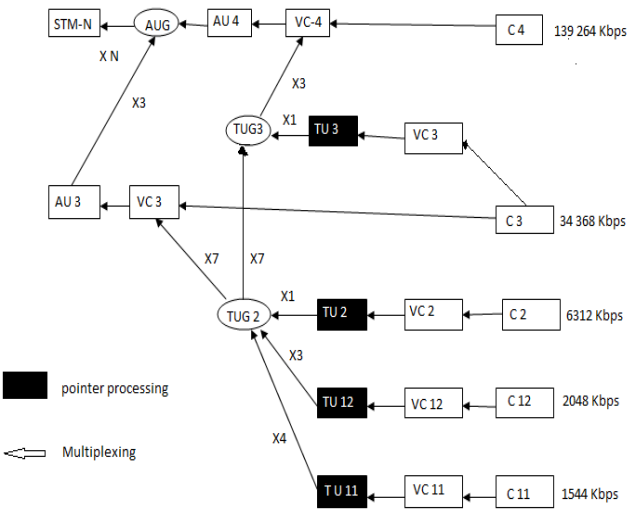


C. Multiplexing And Section Overhead

Multiplexing techniques can be process from stage to stage C-11 is mapped with C-12 container where the entry is 2.048Mbit/sec .In C-2 container the entry 6.312 mbps. It is multiplexed with TUG-2 it can either be 4VC-11 with VC-11 or 3VC-12 with TU-12 with TU-2.The C-3 container takes the input 34 Mbps through VC-3 and withTU-3 goes to TUG-3 3No's .VC-3 with AU-3 can directly goes to the AUG and enter STM frame similarly 7 TUG-2 can go to one TUG-3 and 3TUG are mapped in to one VC-4.A139.264 M bits/sec signal can be mapped in to one VC-4 through C-4.VC-4 with AU-4 goes to AUG and then to STM frame

Section over had portion of the STM-1 frame with the relevant bytes it can be known that 4th row 9 bytes are reserved for AU pointers .The top 3 rows.9 columns of STM-1 frame reserves for Regeneration Section Overhead(RSOH) .From 5th row to 9th column are reserved for Multiplexing Section Overhead (MSOH)

1) A-1,A-2 are framing bytes these bits form 16 bit alignment word defines the transmitter sequence with reference to each signal rates. There are 3A-1 bytes in STM-1 and 3 A-2 bytes in STM-1.In higher order STM this numbers may increases with STM order. In STM-4 there will be 12A-1 bytes and 12A-2 bytes
2) There is a single C-1 byte which is used to identify each of inter-leaved STM'S and in an STM-N signal
3) D-1or D-12 This bytes are for data communication In this D-1,D-2,D-3 are for Regeneration Section D-4 to D-12 are for Multiplex Section
4) E-1 is for regenerator section order wire, E-2 is for multiplex section order wire
5) F-1 is used for fault control purposes
6) B-1 byte are called bit interleaved parity-8 which is used for error monitoring in the regeneration section
7) B-2 bytes these are used for error monitoring in the multiplex section
8) K-1, K-2 bytes are used for coordinating the protection switching across a set of multiplex section organised as protection group
9) Z-1, Z-2 are located for functions and yet defined as per CCITT recommendations



Multiplexing

D. SDH Network Elements

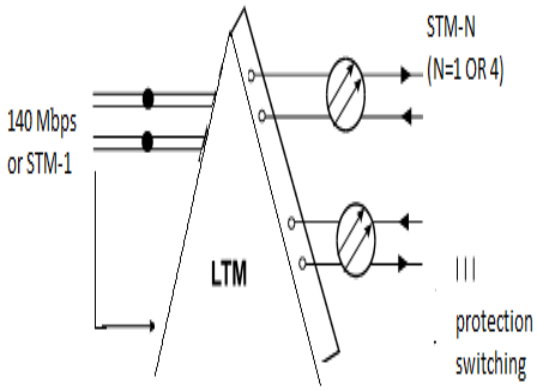
1) SDH regenerator
2) Line Terminal Multiplexer
3) Add Drop Multiplexer
4) Synchronous Digital Cross Connect Systems (SDXC)

1) Line Terminal Mux

PDH network to the SDH .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 provide for access to the order wire channel and the data communication channels .

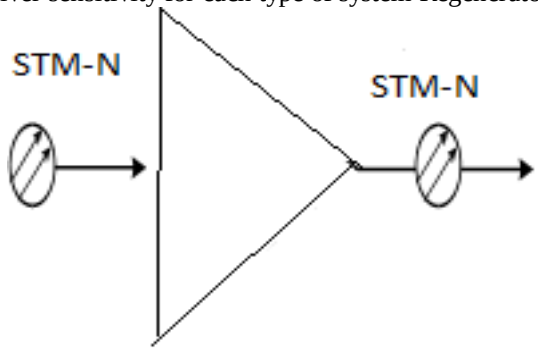


Line Terminal Mux

2) *Regenerator*

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 and the most sensitive receivers have to be. Certain standards define transmitted optical power and the receiver sensitivity for each type of system Regenerator

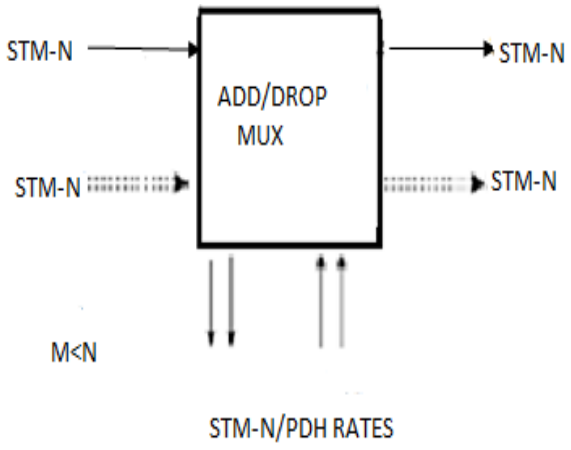


3) *Add/Drop Mux*

Add Drop Multiplexer (ADM): 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.

In contrast with normal multiplexer in which a high speed signal must be completely demultiplex to some intermediate stage ,at the minimum before access to the portion of signal can be achieved on ADD/DROP Multiplexer allow access to the high speed signal directly and select traffic channels. Access provided to 2.048 Mbps channels or mix of them TM Add/Drop Mux.



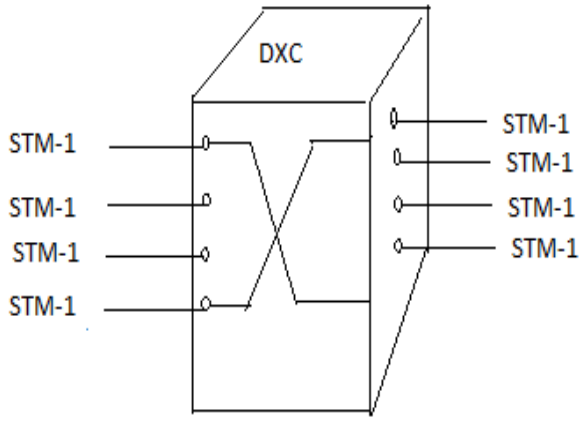
STM-N/PDH RATES

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 demultiplexing 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 demultiplexing.

The DXC device will be used extensively to replace the digital distribution frames which are used in present day digital exchanges. This will eliminate the network problems that results from faults in the wiring and rewiring of digital distribution frames.DXC devices are classified in terms of their line interface and switching level ,i.e. a DXC will have the interfaces at STM-1 and switch at the STM-1 level where as a cross connect at the 64 Kbps channel level.



Synchronous DXC

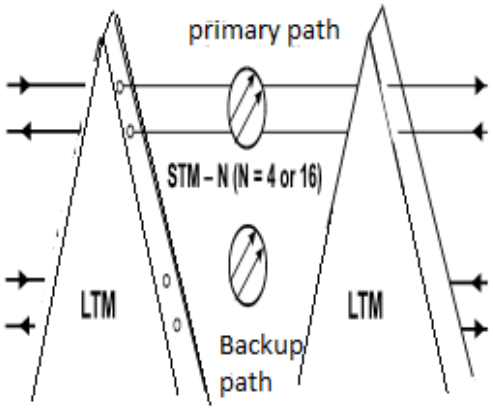
E. Network Topology

1) Point-Point link
2) Ring topology
3) Star topology
4) Mesh topology

Initially SDH technology will be deployed in new installations and then to replace or upgrade existing systems when they reach maximum capacity At the simplest level new point-point systems will use SDH terminal muxes will the ability to expand to more to more complex SDH constructions later we will now examine each possible topology in turn. Having identified and explain the current set of network building blocks, we will now look at the various at the various methods of constructing SDH networks in practice.

1) Point-Point Link

SDH line systems are natural successor's line systems currently deployed in backbone networks. In new installations these PDH capacities will commonly be replaced by STM-4 line systems. Since SDH systems will began to appear in specific routes or overlay networks within the existing transmission networks, this will have to cover the whole transmission network including both SDH and PDH parts the protection can be given with the stand by line for failure against fibre. Payload can be any of the PDH rate or SDH line lower rate.



Point-Point Topology

2) Ring Topology

Ring is a linear network looped back to itself. Ring network is self healing type rerouting or traffic when a link fails the simple fails topology of a ring facilitates the implementation of protocols that can detect the failure of a fibre segment of node and re-establish communication typically in timeframes on the order of milliseconds

3) Star Topology

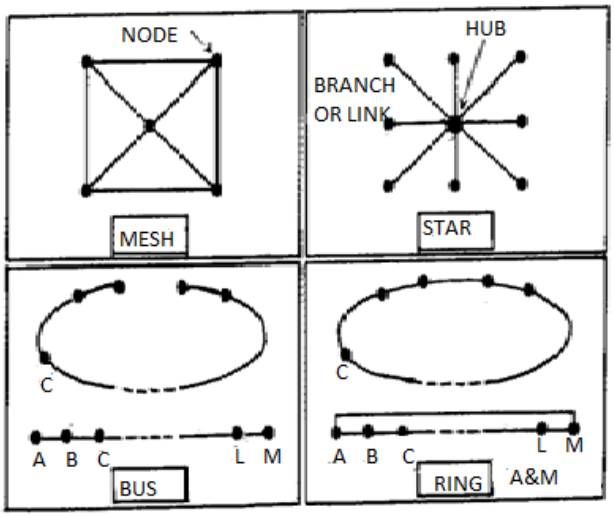
Traffic passes thru a central node called HUB where hub is a DXC if it fails traffic fails

4) Mesh Topology

The mesh topology allows even the most paranoid network manage to have a good comfort because of the flexibility and redundancy that it gives

5) Linear Bus Topology

The linear bus topology is used when there is necessary for protection and has great network flexibility.



ONE STATION=ONE NODE

III. FUTURE SDH

Next generation SDH enables operators to provide more data transport services while increasing the efficiency of installed SDH by adding the new edge nodes which is known as Multi service provisioning platforms which can offers a combination of data interfaces. Such as Ethernet, Multi Protocol Label Switching (MPLS) or Resilient Packet Ring (RPR) Without removing those from SDH Almost all new fibre transmission systems now being installed in public networks To meet this requirements equipment vendors know that they do far more than simple bolt packet data interfaces on to the outside of a SDH instead they have developed systems that span from customers to core, multi protocol traffic adaption, service multiplexing and end-end operations managements.

SDH is no longer spoken as "Legacy SDH" something to be replaced in the next big thing and that for at least next decade it represent future of telecommunication But to deliver on the future equipment manufacture must evolve their equipment that it conforms to the needs of the world's largest operators and those carriers are setting the bar high, demand affords standard based platforms that are standards compact and yet highly scalable and they deliver packets and TDM services both seamlessly and without manual configuration.

IV. CONCLUSION

With introduction of SDH solution to some of the problems like Universal standard hierarchy, transporting future broad band signal, increasing of optical fibre band width, operating in the multi vendor environment.SDH is very robust and reliable containing built-in-mechanism to provide 99.9 percent network availability. Even though it solves the major issues still some disadvantages are existing in SDH so further more these problems can be solved by next generation SDH. As NGSDH provides economical, technological feasible solution for transmitting both voice and data over carrier network NG SDH have the flexibility to manage the band width or the ability to quickly provision services and ensure network scalability and operational efficiency.

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