Design and Testing of 155 Mbps Link Between STM-16 SDH System Along With Protection

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Abstract—

Synchronous Digital Hierarchy (SDH) is a standard for telecommunications transport formulated by the International Telecommunication Union (ITU). It is deployed at all levels of the network infrastructure including the access network and the long-distance trunk network. It is based on synchronous multiplexed signal onto a light stream transmitted over Optical fiber. SDH improves the configuration flexibility and bandwidth availability over the conventional Telecom transmission system.

The thrust of this project is on SDH technology and to create the awareness to the service provider's network architecture, principles of OFC, concept on SDH and STM-16 Tejas SDH system .This project gives the complete details about the theoretical background to various SDH system technologies in addition to the practical knowledge on STM-16 Tejas SDH system

This project involves practical familiarization to STM-16 Tejas Equipment and Configuration of 155 Mbps bandwidth between Two stations with STM-16 (SDH) systems along with protection path Practical configuration of STM-16 Tejas Equipment, 155 Mbps bandwidth and its protection path. Testing of 155 Mbps path on STM-16 systems between two stations in local & through mode with SDH analyzer.

Keywords—SDH,ITU,OFC,STM System

I. INTRODUCTION

It 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.

SDH, like PDH is based on a hierarchy of continuously repeating, fixed length frames designed to carry isochronous traffic channels. SDH was specifically designed in such a way that it would preserve a smooth interworking with existing PDH networks.The developers of SDH also addressed the weaknesses of PDH. They recognised that it was necessary to adopt not only a Synchronous frame structure but one that also preserves the byte boundaries in the various traffic bit streams. Because SDH is synchronous it allows single stage multiplexing and de-multiplexing. This eliminates hardware complexity. You don't need multiplexer. In February 1988, an agreement was reached at CCITT (now ITU-TS) study group XVIII in Seoul, on set of recommendations, for a synchronous digital hierarchy representing a single worldwide standard for transporting the digital signal. These recommendations G-707, G-708, G-709 cover the functional characteristic of the network node interface, i.e. the bit rates and format of the signal passing over the Network Node Interface (NNI).For smooth transformation from existing PDH, it has to accommodate the three different country standards of PDH developed over a time period.

The first attempt to formulate standards for Optical Transmission started in U.S.A. as SONET (Synchronous Optical Network). The aim of these standards was to simplify interconnection between network operators by allowing inter-connection of equipment from different vendors to the extent that compatibility could be achieved. It was achieved by SDH in 1990, when the CCITT accepted the recommendations for physical layer network interface. The SONET hierarchy from 52 Mbit per second rate onwards was accepted for SDH hierarchy.

II. LITERATURE SURVEY

With the introduction of PCM technology in the 1960s, communications networks were gradually converted to digital technology over the next few years. To cope with the demand for ever higher bit rates, a multiplex hierarchy called the Plesiochronous digital hierarchy (PDH) evolved. The bit rates start with the basic multiplex rate of 2 Mbit/s with further stages of 8, 34 and 140 Mbit/s. In North America and Japan, the primary rate is 1.5 Mbit/s. Hierarchy stages of 6 and 44 Mbit/s developed from this. Because of these very different developments, gateways between one network and another were very difficult and expensive to realize. The Plesiochronous Digital Hierarchy (PDH) signals have the essential characteristics of time scales or signals such that their corresponding significant instants occur at nominally the same rate. The prefix plesio, which is of Greek origin, means “almost equal but not exactly,” meaning that the higher levels in the CCITT (ITU today) hierarchy are not an exact multiple of the lower level. Any variation in rate is constrained within specified limits. The PDH systems belong to the first generation of digital terrestrial telecommunication systems in commercial use. Before SDH transmission networks were based on the PDH hierarchy. 2 Mbit/s service signals are multiplexed to 140 Mbit/s for transmission over optical fiber or radio. Multiplexing of 2 Mbit/s to 140 Mbit/s requires two intermediate multiplexing stages of 8 Mbit/s and 34 Mbit/s. Multiplexing of 2 Mbit/s to 140 Mbit/s requires multiplex equipment known as 2nd, 3rd and 4th order multiplexer.

III. TECHNICAL REQUIREMTS

The following components are required for the implementation of this work such as

- STM-16 system
- Optical cable

A. *STM-16 SDH SYSTEM*

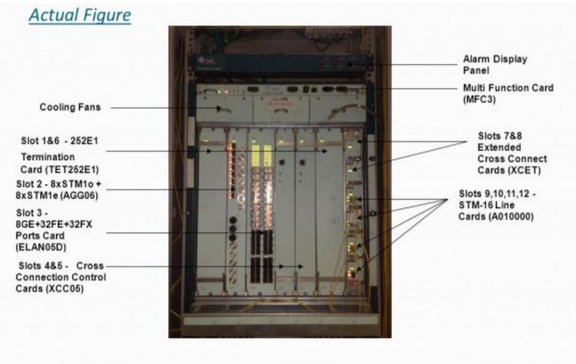

FIG 1: STM-16 SDH SYSTEM

This figure consists of a STM-16 SDH system which consists of slots with STM-16 and cross connect slots,chords,alarm ports,NMS port.

Synchronous digital Hierarchy (SDH) is based on synchronous multiplexed signal onto a light stream transmitted over optica fiber.SDH improves the configuration flexibility and bandwidth availability over the conventional telecom transmission system.
It is an international standard networking principle and a multiplexing method.
STM-1/4/16, 10/100/1000 Mbps (Layer 1 & Layer 2) Ethernet interfaces in the base. It has a traffic slot where a wide variety of traffic modules can be accommodated. These traffic modules are usable across the product family. Moreover it comes with different cross size options, power supply redundancy & extended temperature operation for additional flexibility.

B. *Specifications of STM-16*

Network Topology

- Linear, Ring, Mesh

Network Element Configurations

- Add-Drop Multiplexer (ADM)
- Terminal Multiplexer (TMUX)
- Regenerator

Aggregate Interfaces

- ½ x STM-1
- ½ x STM-4
- 1/2xSTM-16
- S4.1, L 4.1, L 4.2, S16.1, L16.2 (ITU-T G.957 SFP optics)

Tributary Interfaces

- 21x E1/DS1 on base
- 63xE1/DS1, 3xE3/DS3
- 8 x STM-1o / STM-1e
- 2xSTM-4o

Ethernet Interfaces

- FE and GE L1 on base
- Line-rate GE over SDH/SONET
- Carrier Ethernet switching
- MEF EPL/EVPL/ELANservices

Cross-Connect

- Non-blocking at VC-12/VC-3/VC-4
- Line-to-Line, Line-to-Tributary, Tributary-to-Line, Tributary-to-Tributary

Network Maintenance

- Element Management System: TejNES supports full FCAPS functionality
- In-band control support using SDH/SONET Overhead Bytes
- E1 management channel with drop facility
- Alarm signaling indicators and External Contacts
- 10/100 Base T (RJ45) Management Interface

FIG 2: View of upper part of STM-16 system

This figure consists of ethernet ports,alarm ports,NMS (network management system) porand also indicators of power,transmission and receving ports.

Maintenance

- Higher-order and Lower-order POH, SDH/SONET Level alarms and performance monitoring as Per ITU-T Rec. G.826 and G.784
- Software Downloads
- Local and remote loop-back

Timing & Synchronization

- Timing & Synchronization of System as per ITU-T Rec. G.813
- Internal oscillator capable of supplying a G.813 compliant Stratum–3 SEC
- Support of SSM byte
- Internal & External Timing interfaces: Two E1 BITS interfaces (as per ITU-T G.703)

Alarms and User Data Channel

- F1 byte for user data channel
- Four potential-free outputs and seven potential-free inputs

Physical Dimensions

- Dimensions (H x W x D): 44 mm x 445 mm x 250 mm

Environmental

- Operating Temperature: 0ºC to 50ºC
- Extended Temperature: -20ºC to 70ºC (to be ordered separately)
- Relative Humidity: 10% to 90%, non condensing

Power Supply

- -48 V DC nominal, -40 V to –58 V pull-in range
- Power consumption – 45W for base configurations and 75W for fully loaded configurations

C. *OPTICAL CABLE*

FIG 3: This is a optical cable

This figure consists of Fiber optic cables carry communication signals using pulses of light generated by small lasers or light-emitting diodes (LEDs).

The cable consists of one or more strands of glass, each only slightly thicker than a human hair. The center of each strand is called the core, which provides the pathway for light to travel. The core is surrounded by a layer of glass called cladding that reflects light inward to avoid loss of signal and allow the light to pass through bends in the cable.

FIG 4: Close view of optical cable end with ports

This figure consists of successor to the SC and ST types is the LC ,or Lucent, connector. It is so small, that if there is room for one Rj-45 connector, there will be room for two LC connectors, at the same place. Besides that, it is simple and stable, and it is produced by many manufacturers. The LC connector is available in multi mode (beige), single mode (blue) and furthermore, in a non-reflective design (green). The use of this connector type is becoming more and more widespread. But again, the biggest advantage of the LC is the small size. In a 43H rack there is room for 1920 LC connectors. There are some problems, though, with the outgo-ing patchcables, due to the many connectors.

An optical fiber is a thin, flexible, transparent fiber that acts as a waveguide, or "light pipe", to transmit light between the two ends of the fiber. Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher bandwidths (data rates) than other forms of communication. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference**.**

A **fiber optic patch cord** is a fiber optic cable capped at either end with connectors that allow it to be rapidly and conveniently connected to CATV, an optical switch or other telecommunication equipment. Its thick layer of protection is used to connect the optical transmitter, receiver, and the terminal box. This is known as "interconnect-style cabling"

IV. IMPLEMENTATION

CONFIGURING STM-16 SDH SYSTEM STEPS FOR ACCESING STM-16 SYSTEM:-

- Click on the Local Area Network on the computer and click on properties a window will appear on the screen choose "Internet Protocol Version TCP/IPv4" and go to properties then another window will appear on the screen.
- After clicking on properties change the IP address by clicking on it and the cursor will appear. Now change the IP address from 198.168.1.2 to 198.168.2.2 as we connected to stn-1 and click on ok button.
- Now open Internet Explorer and give the IP address give by the retailer in the address bar and press go. A window will appear displaying username and Password.
- Now enter the user name and password that is provided by the vendor .

  User name: tejas

  Password:j72c#05t
- After entering the username and password a window sill appear as shown below.Now click on the configuration which is present at the left side of the window.
- Now click on the Cross-Connect which is below the configuration.
- Now click on Add Cross-Connect.
- Now a window with different options will appear and then there need to fill the window as per the customer requirement as shown in the window.
- After entering the requirements submit it and confirmation window will appear and confirm it.
- Now the E1 at station A is created and summary with successful connections & failed connections is shown in the following window.
- As shown in the above steps 1-9 same procedure with another IP address is done so as to create E1 at station B.

  The following steps show the creation of E1 creation at station B.
- By following the above procedure E1 is created in the STM-16 and ring is formed by connecting with 2 ADMs with routers 198.168.5.99 and 198.168.4.9

V. RESULTS & DISCUSSIONS

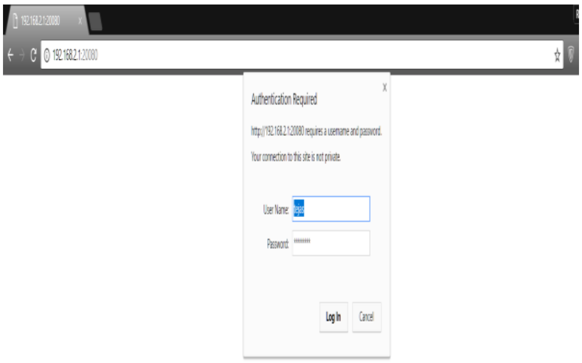

FIG 5: Login result

This above figure shows us the login page for the stm-16 system which is accesed only by peticular IP address.

FIG 6: Shows the Node view

After logging into the system we will see a node view of our STM-16 system,we will have all the information about our STM-16 system in that page like how many slots are introduced etc.

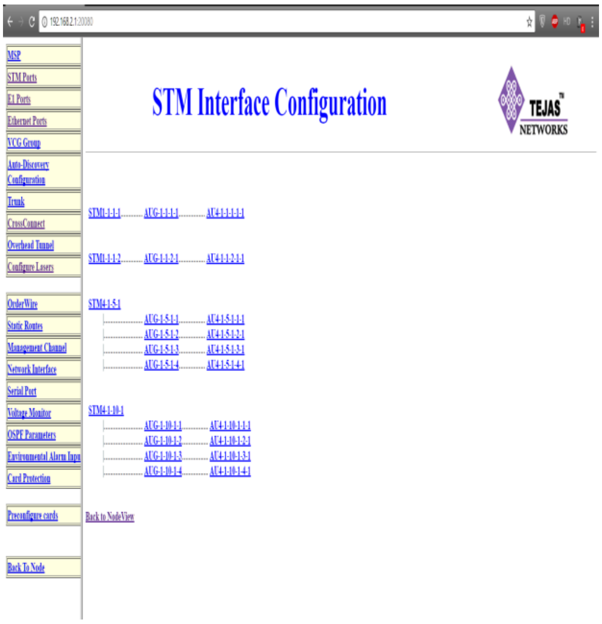

FIG 7: STM system configuration

This above figure depicts the interface configuration which means it shows the address to each and every port in each and every slot that we got in STM-16 system.

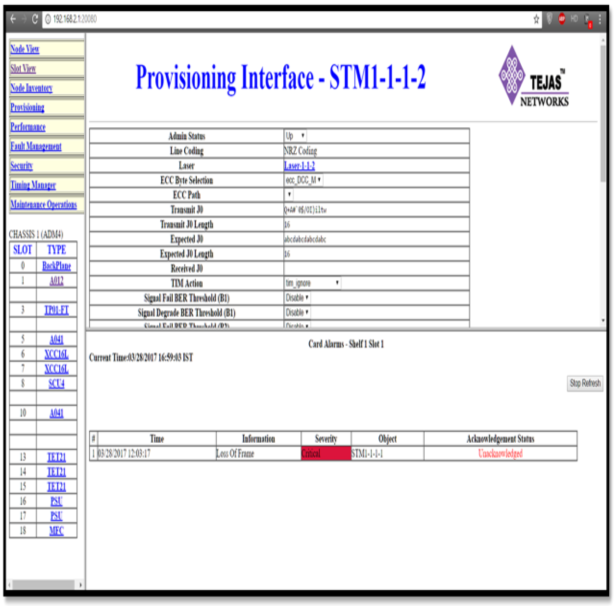

FIG 8: Activating the down port to up

Here this above picture shows the activation of a port through which we send data to the destination STM system.

VI. Conclusion & Future Scope

The 155mbps link between two STM-16 systems is established by activating the same ports in both the STM-16 systems.Data is transfered from one STM-16 system to another STM-16 system.

There is no question that fiber optic communication is our future. Fiber optic communication industry has been enjoying amazing growth for over 15 years. These are driven by both technology advance and market demand. There are some obvious trends in the development of new technology and market.
DWDM(Dense Wavelength Division Multiplexer) opens the door to multi-terabit transmission. The interest in developing multi-terabit networks is driven by the increasing availability of more bandwidth in fiber optic networks.One terabit network was achieved by using 10Gb/s data rate combined with 100 DWDM channels.
Four terabit networks can be achieved by combing 40Gb/s data rate with 100 DWDM channels too. Researchers move their target to even higher bandwidth with 100Gb/s systems. (This is not a reality yet, at least for now).

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REFERENCES

1. ITU-T Rec. G.707/Y.1322, Network node interface for the synchronous digital hierarchy (SDH)., *Geneva: International Telecommunications Union, January 2007, retrieved 3 November 2010*
2. ITU-T Rec. G.783, Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks., *Geneva: International Telecommunications Union, March 2006, retrieved 3 November 2010*
3. ITU-T Rec. G.784, Management aspects of the synchronous digital hierarchy (SDH) transport network element. *Geneva: International Telecommunications Union, March 2008, retrieved 3 November 2010*
4. ITU-T Rec. G.803, Architecture of transport networks based on the synchronous digital hierarchy (SDH). *Geneva: International Telecommunications Union, March 2000, retrieved 3 November 2010*
5. www.oriontelecom.com
6. www.ad-net.com.tw>blog>research