EAST WEST UNIVERSITY

INTERNSHIP REPORT ON

Microsemi PTP Grandmaster Clock

FONS BD LTD

Prepared By

Md. Zillur Rahman
ID: 2012-1-50-001

Supervised By

Dr. Nahid Akhter Jahan

07 September 2016

LETTER OF TRANSMITTAL

07 September 2016

To
Dr. Nahid Akhter Jahan
Assistant Professor
Department of Electronics and Communication Engineering
East West University

Subject: Submission of Project Report as Internship (ETE-498)

Dear Sir,

I am pleased to let you know that I have completed my Internship program at FONS BD Ltd, New Baily Road, and Dhaka. The attaché contain of the internship report that has prepared for your evaluation and consideration. The internship has given me a great opportunity to work with the networking system closely and also gave me the opportunity to apply the theoretical knowledge in real life situation which I have acquired since last four years from you and the other faculty of EWU, which would be a great help for me in future.

I am very grateful to you for your guidance throughout the internship period, which helped me a lot to acquire practical knowledge.

Thanking You.

Yours Sincerely

Md. Zillur Rahman

ID# 2012-1-50-001
Dept. Of ECE

East West University

DECLARATION

I, Md. Zillur Rahman, hereby declare that the presented report of internship titled **“Microsemi PTP Grandmaster Clock of FONS BD Ltd.”** is uniquely prepared by me under the course “Research/Internship (ICE-498)” after the completion of three months’ work at Alekharchar site in **Comilla.**

I also confirm that, the report is only prepared for my academic requirement not for any other purpose. It might not be used with the interest of opposite party of the corporation.

Md. Zillur Rahman
ID: 2012-1-50-001
Dept. Of ECE

ACCEPTANCE

This internship report is submitted to the **Department of Electronics and Communication Engineering, East West University** is submitted in partial fulfillment of the requirements for the degree of **BSc** in **ICE** under complete supervision of the undersigned.

Dr. Nahid Akhter Jahan
Assistant Professor
Dept. Of ECE

Jahirul Islam Shishir
Manager
FONS BD Ltd.

ACKNOWLEDGEMENT

At the very beginning I would like to express my deepest gratitude to almighty Allah for giving me the strength and the composure to complete my BSc. Engineering courses and prepare this report within the scheduled time.

I would like to thank **Dr. Nahid Akhter Jahan (Assistant Professor, Dept. Of ECE, EWU)** for guided me with lots of effort and time to perform the internship program.

I want to convey my gratefulness to **Jahirul Islam Shishir (Manager, FONS BD Ltd.)** who helped me greatly by providing valuable suggestion whenever required my internship report **"Microsemi PTP Grandmaster Clock of FONS BD Ltd."** They also gave the opportunity to hold that flagship of the topic.

I would also like give to acknowledgments every one of the IT Management Department of **FONS BD Ltd**. For providing suggestion on how to work and what is the procedure to work in a practical manner and also how to make the internship report in a better way. They helped me in many ways by allowing whatever assistance I needed. Otherwise it was not possible for me to complete my report.

ABSTRACT

This report focuses on the Precision Time Protocol system of a Telecom Company. This Protocol system is built with a Time Provider called microsemi. A GPS system connects it with a power cable and earthing cable. This Synchronizer system is connected to BSC and MSC and it confirms that the whole worldwide time system is connected to our country time. This system confirms and maintains same local time from one BTS to other. If this system does not work properly then we cannot connect on local distance and also worldwide connection through mobile. So this protocol is important for our telecom company and also seemed interesting to me. Therefore, I decided to intern on this project and through which I gathered valuable experiences.

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Chapter-1

Introduction

The continuing evolution of mobile network technologies has driven the need for increased accuracy and greater availability of timing and synchronization signals. Many organizations, including companies and governments, set up very accurate clocks which are synchronized to a globally set standard, for use within their organization or to the public. If your application requires time to be accurate to within milliseconds or microseconds then you'll want to use PTP and you'll want to synchronize your clocks to a nearby master.

I had an opportunity to work with IEEE 1588-2008 PTP Grandmaster Clock in FONS BD Ltd which is the most leading Optical Cable and Vendor Company in Bangladesh. I consider myself timely to get a chance to take a deep look to their development methods, working models, deals and industrial behavior. And I was intending to look into the Networking Industry and how it looks like practically, how they interact with their clients, how they design a system and what are their rules in their environmental work.

About FONS BD Ltd.

FONS BD (Fiber Optic Network Solution Ltd) is the only manufacturer in Bangladesh to Export Fiber Optic Product for last 18 years. It's a Joint Venture with USA & Danish Fiber Company. It is located at 143/1 New Baily Road, Dhaka- 1000 Bangladesh.

FONSBD Specializes with the Following Network Products and Components:

- Fiber Optic Patch Cords and Pigtails
- All Type Fiber Optic Connectors and Adapters
- Fiber Optic Cables
- ISP, NTTN, FTTX, FTTB Products
- Cable Management Products
- CATV Product
- Wireless & Wi-Il Products
- All Types of Switches & Routers

- OPGW Cable for Power sector
- Fiber Optic Signaling Products for Rail road
- After Sales Service
- Service & Installation
- LAN &WAN Products
- Test Equipments and tools (Splice machine, OTDR. Analyzers'. Monitoring Systems, etc.)
- Energy Storage

FONSBD emphasizes to PDCA (Plan, Do, Correct & Act) System to ensure all customers get the products with optimum cost efficiency and on time solutions of the highest quality of international standard by achieving zero defect in quality. It is an ISO**9001:2004** certified company for Quality and Environmental Management.

FONSBD is exporting products to Australia, Denmark. France, Germany, Ireland, the Netherland, USA and other Countries.

Manufacturing capacity

- FC/LC/MTRJ/SC/ST/E2000/ Lx, 5 Termination/year 850 000 pcs
- Connector (ST/SC) Assembly/ year 2,184 000 pcs
- Adapter (ST) Assembly/year 1248 000 pcs
- Adapter (ST) Assembly/year 168 480 pcs
- Light Guide/year 40000 pcs

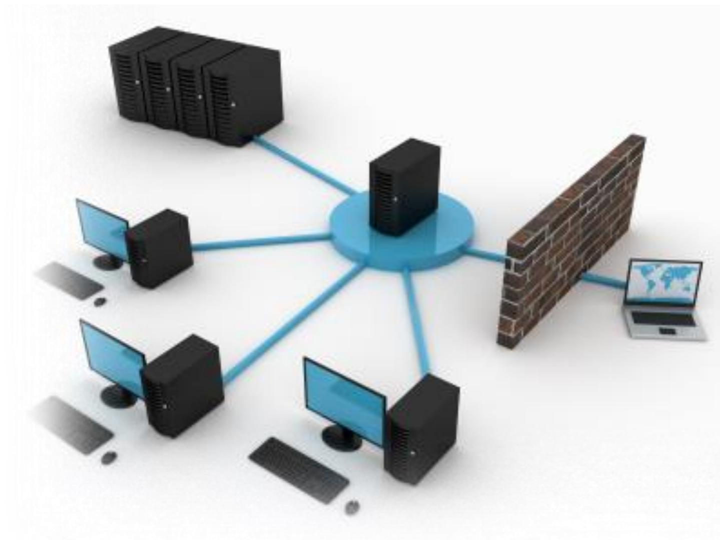
Service

Consultation:

Network design for enterprise and SOHO , Hotel network design, Apartment Network, Home automation, FTTH network, Network integration, ISP setup, Wifi network, RF network, Network audit, Project management, Core Network, Access Network, VPN Network, Network Security, etc.

Installation:

2G/3G/LTE/WiMax BTS Installation, RF & Wi-Fi network Installation, Underground & Overhead fiber Installation, SYNC-Server Installation, Broad band Installation, MPLS Network, Internet telephony Installation, Video Conferencing Installation, Router, Switch, Firewall, Bandwidth Manager, NTP Server, RACK installation, Auxiliary Power Installation, etc.



Maintanance:

Indoor & out door BTS, Structured Cable, Optical fiber network, Data Center, Auxiliary Power system, etc.

Network Tools Rental:

OTDR, Splice Machine, Spectrum Analyzer, Site Master, etc.

Training:

Installation of optical fiber, how to use of OTDR, Splice machine, spectrum analyzer and site master, etc.

Chapter-2

Cable Tester

A **cable tester** is an electronic device used to verify the electrical connections in a cable or other wired assembly. Generally a cable tester consists of: A source of electric current, A volt meter, A switching matrix used to connect the current source and the voltmeter to all of the contact points in a cable.

In addition to these parts a cable tester may also have a microcontroller and a display to automate the testing process and show the testing results.

A cable tester is used to verify that all of the intended connections exist and that there are no unintended connections in the cable being tested. When an intended connection is missing it is said to be "open". When an unintended connection exists it is said to be a "short" (assorts). If a connection "goes to the wrong place" it is said to be "miswired" (the connection has two faults: it is open to the correct contact and shorted to an incorrect contact).

Fig: LAN Cable Tester

Generally, the testing is done in two phases. The first phase, called the "opens test" makes sure each of the intended connections is good. The second phase, called the "shorts test" makes sure there are no unintended connections.

There are two common ways to test a connection:

A continuity test. Current is passed down the connection. If there is current the connection is assumed to be good. This type of test can be done with a series combination of a battery (to provide the current) and a light bulb (that lights when there is a current).

A resistance test. A known current is passed down the connection and the voltage that develops is measured. From the voltage and current the resistance of the connection can be calculated and compared to the expected value.

There are two common ways to test for a short:

A low voltage test. A low power, low voltage source is connected between two conductors that should not be connected and the amount of current is measured. If there is no current the conductors are assumed to be well isolated.

A high voltage test. Again a voltage source is connected but this time the voltage is of several hundred volts. The increased voltage will make the test more likely to find connections that are nearly shorted since the higher voltage will cause the insulation of nearly shorted wires to break down.

Patch Cable

A **patch cable** or **patch cord** or **patch lead** is an electrical or optical cable used to connect ("patch-in") one electronic or optical device to another for signal routing. Devices of different types (e.g., a switch connected to a computer, or a switch to a router) are connected with patch cords. Patch cords are usually produced in many different colors so as to be easily distinguishable, and are relatively short, perhaps no longer than two meters. Types of patch cords include microphone cables, headphone extension cables, XLR connector, Tiny Telephone (TT) connector, RCA connector and ¼" TRS phone connector cables (as well as modular Ethernet cables), and thicker, hose-like cords (snake cable) used to carry video or amplified signals. However, patch cords typically refer only to short cords used with patch panels.

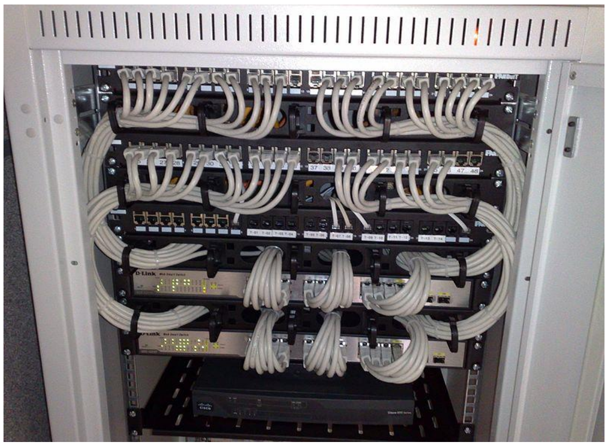


Fig: Patch Cable

Patch cord cable differs from standard structured cabling cable in that Patch cable is stranded for flexibility, whereas standard cable is solid copper. Because the patch cord is stranded copper construction the attenuation (signal loss) is higher on patch cords than solid cable so short lengths should be adhered to

Patch cords can be as short as 3 inches (ca. 8 cm), to connect stacked components or route signals through a patch bay, or as long as twenty feet (ca. 6 m) or more in length for snake cables. As length increases, the cables are usually thicker and/or made with more shielding, to prevent signal loss (attenuation) and the introduction of unwanted radio frequencies and hum (electromagnetic interference).

Patch cords are often made of coaxial cables, with the signal carried through a shielded core, and the electrical ground or earthed return connection carried through a wire mesh surrounding the core. Each end of the cable is attached to a connector so that the cord may be plugged in. Connector types may vary widely, particularly with adapting cables.

Patch cords may be:

Single-conductor wires using, for example, banana connectors (or pin plugs)

Coaxial cables using, for example, BNC connectors

Shielded or unshielded Cat5, Cat5e, Cat6 or Cat6A cables using 8P8C (RJ-45) modular connectors with straight-through T568A orT568B wiring. Modular cables wired to T568A at one end and T568B on the other are more commonly referred to as crossover cables.

A patch cord is always fitted with connectors at both ends. A pigtail is similar to a patch cord and is the informal name given to a cable fitted with a connector at one end and bare wires (or bare fiber) at the other. In the context of copper cabling, these cables are sometimes referred to as blunt patch cords and the non-connectorized end ("the pigtail") is intended to be permanently attached to a component or terminal.

Optical fiber pigtails, in contrast to copper pigtails, can be more accurately described as a connector than a cable or cord. A fiber pigtail is a single, short, usually tight-buffered, optical fiber that has an optical connector pre-installed on one end and a length of exposed fiber at the other end. The end of the fiber pigtail is stripped and fusion spliced to a single fiber of a multi-fiber trunk. Splicing of pigtails to each fiber in the trunk "breaks out" the multi-fiber cable into its component fibers for connection to the end equipment.

Fiber Optic

Optical fiber or fiber optic refers to the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fiber.

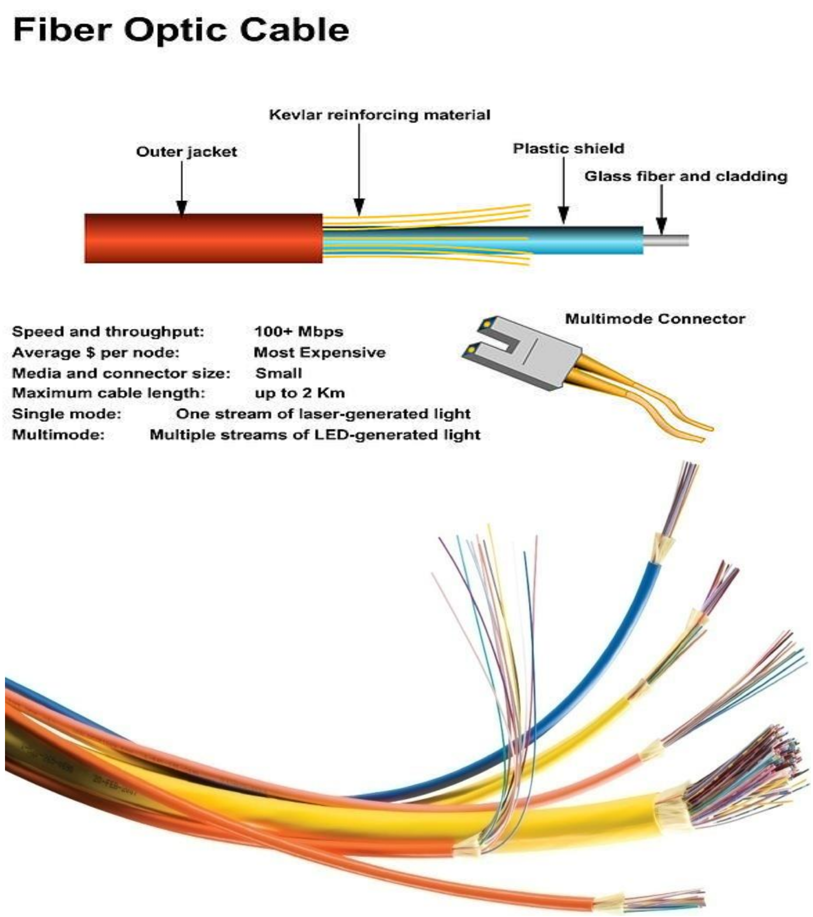


Fig: Optical Fiber

Advantages of Fiber Optic cable:

- Greater bandwidth than metal cables. Large carrying capacity.
- Less susceptible than metal cables to interference.
- Much thinner and lighter than metal wires.
- Data can be transmitted digitally rather than analogically.
- Fiber optic cables costs much less to maintain.

Chapter-3

NTP

Network Time Protocol (**NTP**) is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks. In operation since before 1985, **NTP** is one of the oldest Internet protocols in current use.

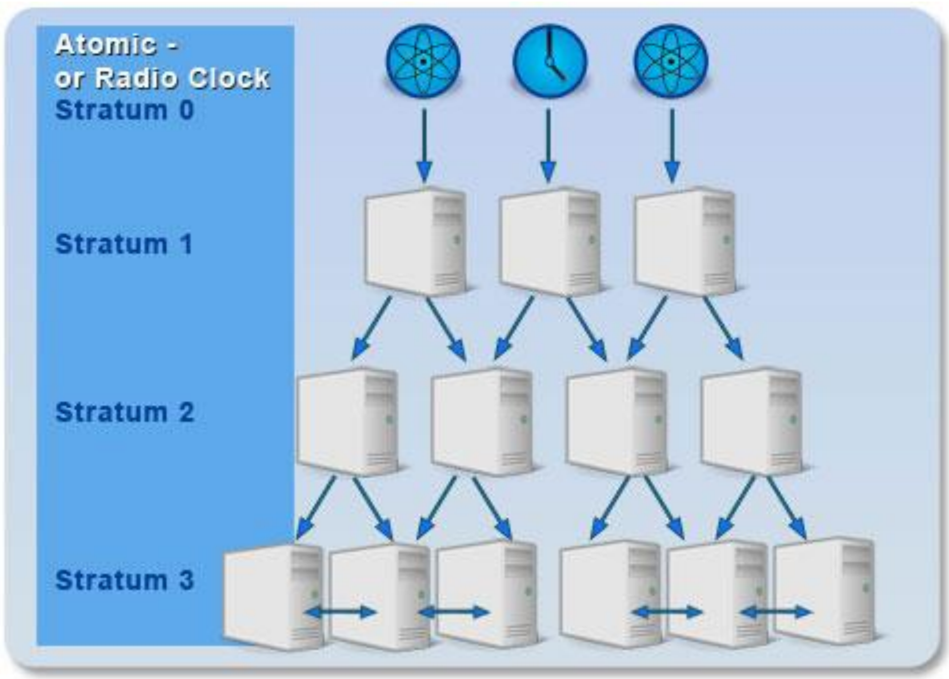


Fig: Network Time Protocol

NTP uses a hierarchical, semi-layered system of time sources. Each level of this hierarchy is termed a "stratum" and is assigned a number starting with zero at the top. A server synchronized to a stratum n server will be running at stratum n + 1. The number represents the distance from the reference clock and is used to prevent cyclical dependencies in the hierarchy. Stratum is not always an indication of quality or reliability; it is common to find stratum 3 time sources that are higher quality than other stratum 2 time sources. Telecommunication systems use a different definition for clock strata. A brief description of strata 0, 1, 2 and 3 is provided below.

Stratum 0

These are high-precision timekeeping devices such as atomic (cesium, rubidium) clocks, GPS clocks or other radio clocks. They generate a very accurate pulse per second signal that triggers an interrupt and timestamp on a connected computer. Stratum 0 devices are also known as reference clocks.

Stratum 1

These are computers whose system clocks are synchronized to within a few microseconds of their attached stratum 0 devices. Stratum 1 servers may peer with other stratum 1 servers for sanity checking and backup.[10]They are also referred to as primary time servers.

Stratum 2

These are computers that are synchronized over a network to stratum 1 servers. Often a stratum 2 computer will query several stratum 1 servers. Stratum 2 computers may also peer with other stratum 2 computers to provide more stable and robust time for all devices in the peer group.

Stratum 3

These are computers that are synchronized to stratum 2 servers. They employ the same algorithms for peering and data sampling as stratum 2, and can themselves act as servers for stratum 4 computers, and so on.

The upper limit for stratum is 15; stratum 16 is used to indicate that a device is unsynchronized. The NTP algorithms on each computer interact to construct a Bellman-Fordshortest-path spanning tree, to minimize the accumulated round-trip delay to the stratum 1 servers for all the clients.

NTP Synchronization:

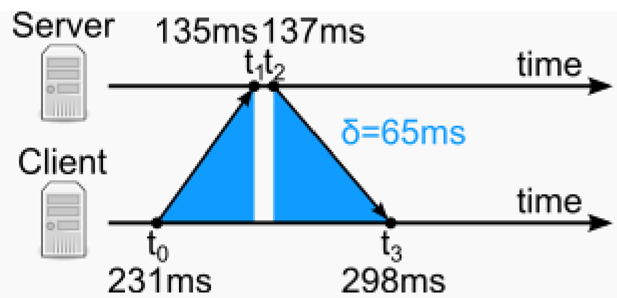


Fig: Round-trip delay time δ

A typical NTP client will regularly poll three or more servers on diverse networks. To synchronize its clock, the client must compute their time offset and round-trip delay. Time offset θ is defined by

$$\theta = \frac{(t_1 - t_0) + (t_2 - t_3)}{2},$$

and the round-trip delay δ by

$$\delta = (t_3 - t_0) - (t_2 - t_1),$$

where

t_0 is the client's timestamp of the request packet transmission,
t_1 is the server's timestamp of the request packet reception,
t_2 is the server's timestamp of the response packet transmission and
t_3 is the client's timestamp of the response packet reception.

The values for θ and δ are passed through filters and subjected to statistical analysis. Outliers are discarded and an estimate of time offset is derived from the best three remaining candidates. The clock frequency is then adjusted to reduce the offset gradually, creating a feedback loop.

The synchronization is correct when both the incoming and outgoing routes between the client and the server have symmetrical nominal delay. If the routes do not have a common nominal delay, there will be a systematic bias of half the difference between the forward and backward travel times.

PTP

The Precision Time Protocol, as defined in the IEEE-1588 standard, provides a method to precisely synchronize computers over a Local Area Network (LAN). PTP is capable of synchronizing multiple clocks to better than 100 nanoseconds on a network specifically designed for IEEE-1588. A Network Time Server with PTP is typically referred to as an "IEEE-1588 Grandmaster" or "PTP Grandmaster". This paper describes basic principles of PTP, information on using dual Grandmasters, and the requirements of the network to achieve sub-100 nanosecond time synchronization.

PTP Synchronization

The protocol defines synchronization messages used between a Master and Slave clock similar to the Server and Client mode used in the Network Time Protocol (NTP). The Master is the provider of time, and the Slave synchronizes to the Master. A Grandmaster is a Master that is synchronized to a time reference such as GPS or CDMA.

Messages in the protocol include Master sync message, Master delay response message, and the Slave clock delay request messages. In addition to the messages, the Best Master Clock (BMC) algorithm allows multiple Masters to negotiate the best clock for the network.

Clock synchronization on the LAN requires at least one Master and one Slave. Multiple Slaves can synchronize to a single Master. The Master clock provides synchronization messages that the Slaves use to correct their local clocks. Precise timestamps are captured at the Master and Slave clocks. These timestamps are used to determine the network latency which is required to synchronize the Slave to the Master. There is a sync message transmitted typically every two seconds from the Master, and a delay request message from the Slave less frequently, about one request per minute.

Four timestamps are captured between the Master and Slave clock. The timestamps are required for the Slave offset calculation. The timestamps are commonly referred to as T1, T2, T3, and T4 (see Figure 1).

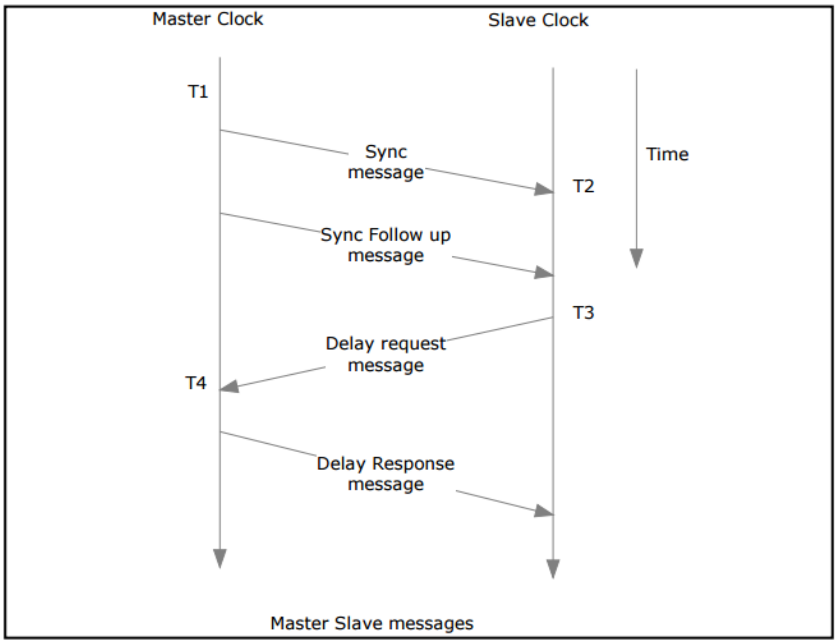


Fig: PTP Timestamps (T1 - T4)

Two delay paths must be calculated, the Master to Slave and the Slave to Master. First find the Master to Slave difference:

The first timestamp is T1. It is the precise time of the sync message from the Master. This timestamp is sent in the follow-up message since the time of T1 was sampled when the sync message was transmitted on the Ethernet port.

The second timestamp is T2. It is the precise time of the sync message as it is received at the Slave.

The Master to Slave difference can be calculated once T1 and T2 are available at the Slave:

Master to Slave difference = T2 - T1

Second, find the Slave to Master difference:

The third timestamp is T3. It is the precise time of the delay request message from the Slave. The fourth timestamp is T4. It is the precise time of the delay request message when received at the Master.

The Slave to Master difference can be calculated once T3 and T4 are available at the Slave.

Slave to Master difference = T4 - T3

The one-way delay can be calculated once the Master to Slave and Slave to Master difference is available at the Slave:

One way delay = (Master to Slave difference + Slave to Master difference) / 2

The offset is used to correct the Slave clock:

Offset = Master to Slave difference – One way delay

Or

Offset = ((T2 - T1) - (T4 - T3)) / 2

Therefore, the following statements are true with respect to this algorithm, assuming constant network propagation delays and gradually changing operating conditions such as temperature.

The Slave clock utilizes the offset to adjust the time to agree with the Master clock. Typically, the Slave clock will use a clock tuning algorithm that can account for network propagation delays affecting the offset and the Slave clock crystal temperature and aging effect on its stability

Chapter-4

TimePictra

The TimePictra is a web-based management system for time, frequency and synchronization network elements. It features a modular architecture that will scale and evolve with operational requirements. As timing and synchronization grow in importance in critical infrastructure networks, centralized visibility and control of this vital function has become essential to network operations. With a multi-tier architecture—server, client, and database— TimePictra can provide scalability and performance to meet growing network services and business needs.

The secure web browser client provides easy access and eliminates the complexity of client installation and VPN access. The application server, in conjunction with the database, provides comprehensive business logic to support management of network functions. TimePictra is server platform and database independent—allowing cost-effective deployment of the management system using any server or database platform meeting the specified requirements.

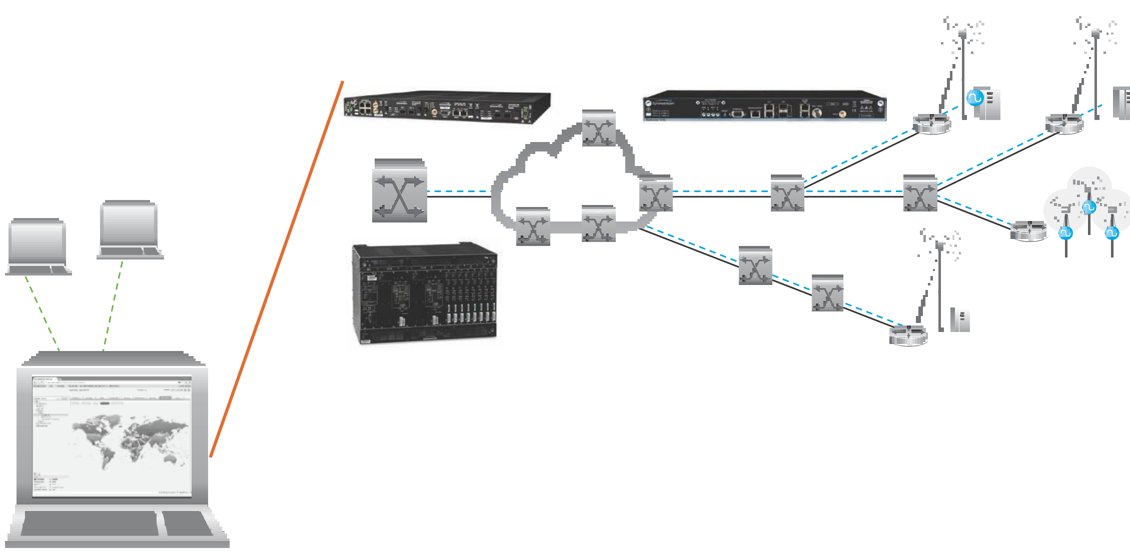


Fig: TimePictra Synchronization Element Management System

As an element management system, TimePictra provides comprehensive FCAPS functions for managing your network include; Fault Management, Configuration Management, Accounting (Inventory) Management, Performance Management, and Security Management. TimePictra is comprised of basic software and software options. The basic software includes the standard FCAPS functions as well as geographical topology map, navigation tree with domain hierarchy, dashboard reporting of alarms, inventory, user login, and license installation information. Software options include advanced FCAPS functions. Each option is enabled by a software license key with no additional installation required.

Web–Based Graphical User Interface

Authorized users can have secure access to TimePictra, and manage their sync network from anywhere at any time. It enables connectivity to the mission-critical sync network from remote locations. The low bandwidth requirements of a thin client web- based GUI implies no special client-side installation. The thin clients can be invoked over a dial-up connection or a Virtual Private Network.

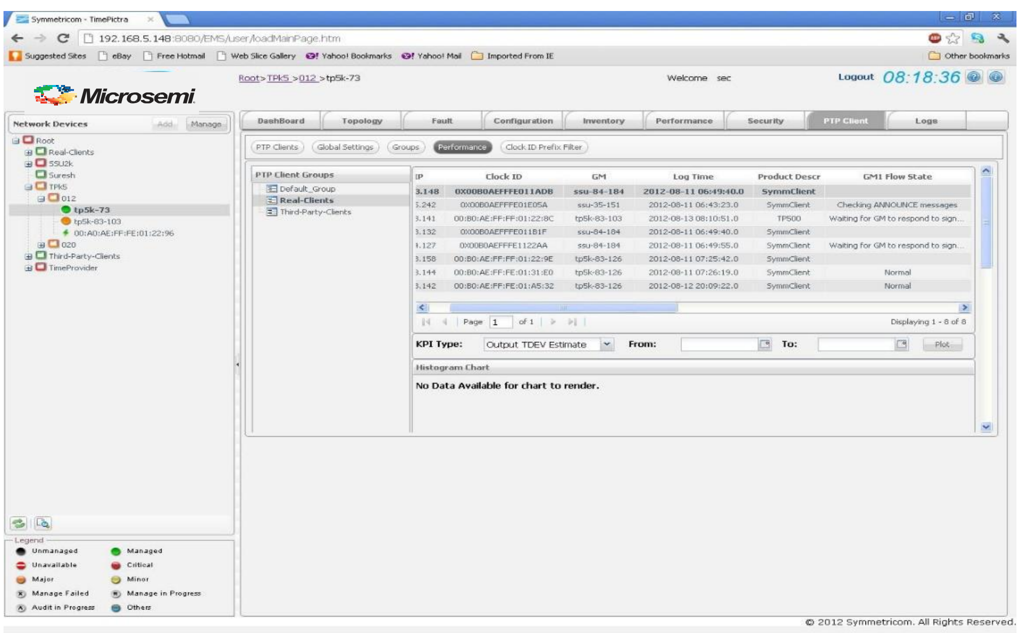


Fig: Web–Based Graphical User Interface

With increased reliance on accurate timing and synchronization in critical Ethernet networks such as in the communications, power utility and financial services industries, the IEEE .1588-2008 Precision Time Protocol (PTP) has emerged as the protocol of choice. TimePictra provides end-to-end PTP management including device auto discovery, navigation tree display with hierarchy domain, sync flow monitoring, and key performance index monitoring. This end-to-end management enables network operators to have full visibility of PTP timing.

TimePictra monitors and trends IEEE 1588-2008 (PTP) remote clients and boundary clocks, located throughout the network—including clients not supplied by Microsemi. TimePictra will automatically add new PTP clients and ensure they maintain connection to a Grandmaster and with the possibility to collect PDV and performance statistics from every client in the Network, TimePictra provides to only end to end monitoring solution for PTP clients.

Dashboard

A user dashboard simplifies the display of network health, including alarm counts with severity, network element inventory, logged in users and license information. With the Group Pack option, the dashboard can be customized with user preferences.

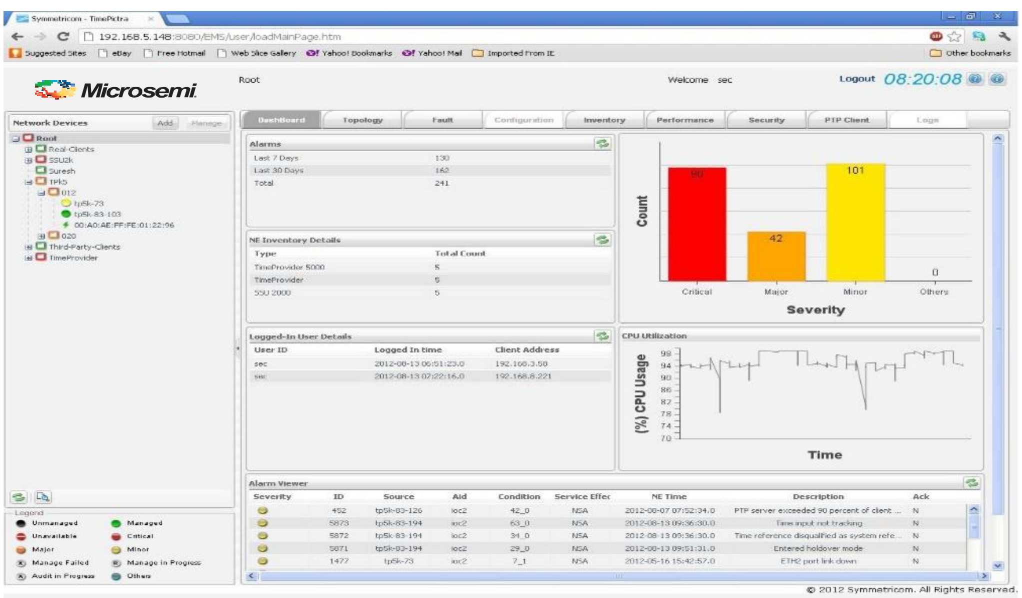


Fig: TimePictra Dashboard

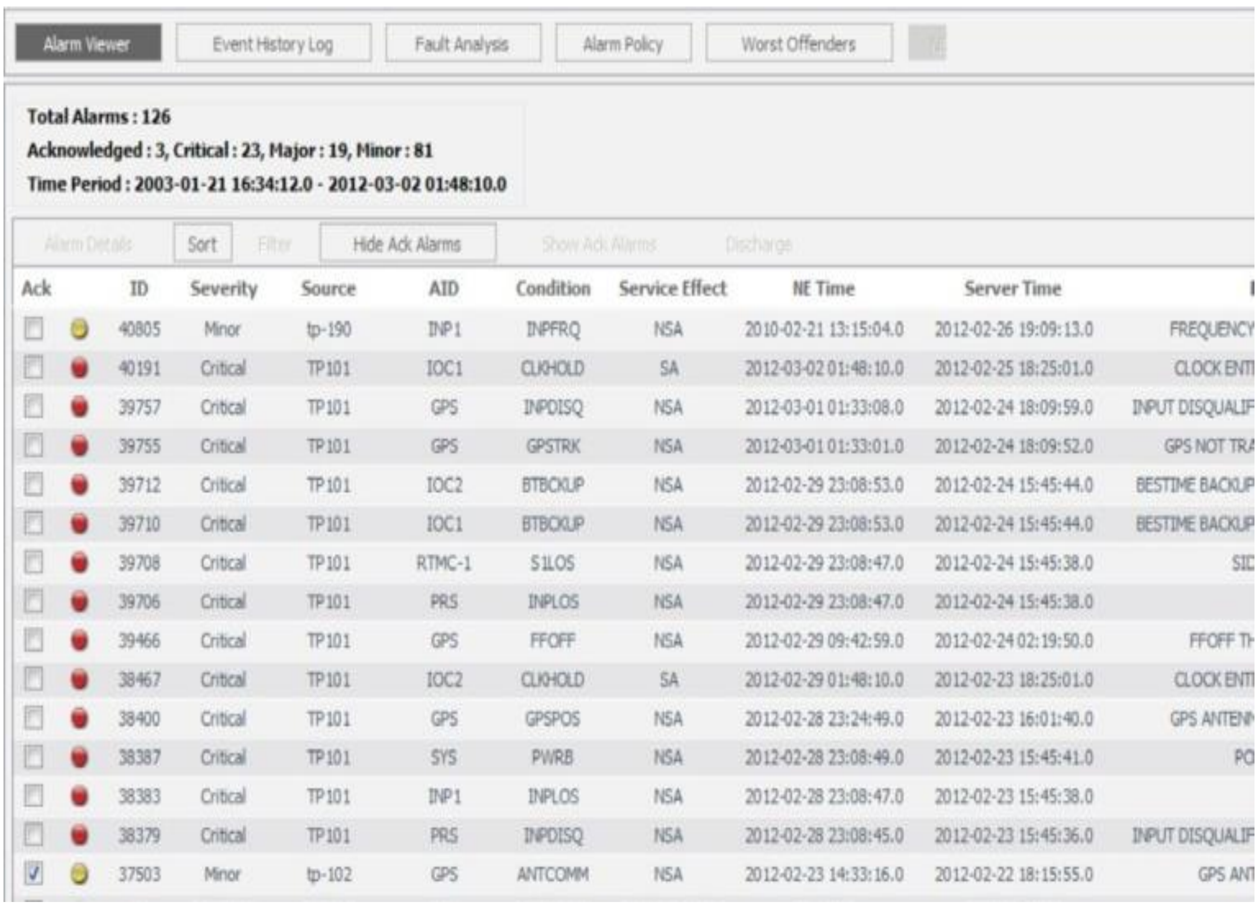
Network Operations Integration

Many network operators integrate element management with their operating systems for overall management of multi- vendor, diverse equipment environments. TimePictra enables integration of its northbound interface using SNMP for alarm integration and ASCII northbound for alarm and topology integration. TimePictra High Availability option supports two geographically diverse servers to replicate the database and synchronization management functions; removing any single point of failure. The convergence of formerly distinct network technology platforms – take telephony systems and LANs, for example – is precipitating a major networking operations transition, including alterations in IT organizational structure. Gartner recommends network managers adopt an ITIL approach, creating an organization centered around processes that deliver IT services. To enhance end-to-end IT service delivery, consider greater integration of the Network Operations Center (NOC) with IT infrastructure operations. This trend is driving complex IT organization changes, subordinating technology to processes, with the ultimate goal of seamless service delivery across all of IT.

Chapter-5

Fault Manager

The fault manager provides access to the entire network element. Events and alarms are displayed using a color-coded format complaint with ITU-T standards notifications are easily intelligible. Whether in the office or field network personnel have the ability to readily access the entire suit of information about any of the synchronization Network Elements.



Ack	ID	Severity	Source	AID	Condition	Service Effect	NE Time	Server Time	I
	40805	Minor	tp-190	INP1	INPFRQ	NSA	2010-02-21 13:15:04.0	2012-02-26 19:09:13.0	FREQUENCY
	40191	Critical	TP101	IOC1	CLKHOLD	SA	2012-03-02 01:48:10.0	2012-02-25 18:25:01.0	CLOCK ENTI
	39757	Critical	TP101	GPS	INPDISQ	NSA	2012-03-01 01:33:08.0	2012-02-24 18:09:59.0	INPUT DISQUALIF
	39755	Critical	TP101	GPS	GPSTRK	NSA	2012-03-01 01:33:01.0	2012-02-24 18:09:52.0	GPS NOT TRA
	39712	Critical	TP101	IOC2	BTBCKUP	NSA	2012-02-29 23:08:53.0	2012-02-24 15:45:44.0	BESTIME BACKUP
	39710	Critical	TP101	IOC1	BTBCKUP	NSA	2012-02-29 23:08:53.0	2012-02-24 15:45:44.0	BESTIME BACKUP
	39708	Critical	TP101	RTMC-1	S1LOS	NSA	2012-02-29 23:08:47.0	2012-02-24 15:45:38.0	SID
	39706	Critical	TP101	PRS	INPLOS	NSA	2012-02-29 23:08:47.0	2012-02-24 15:45:38.0	
	39466	Critical	TP101	GPS	FFOFF	NSA	2012-02-29 09:42:59.0	2012-02-24 02:19:50.0	FFOFF TH
	38467	Critical	TP101	IOC2	CLKHOLD	SA	2012-02-29 01:48:10.0	2012-02-23 18:25:01.0	CLOCK ENTI
	38400	Critical	TP101	GPS	GPSPOS	NSA	2012-02-28 23:24:49.0	2012-02-23 16:01:40.0	GPS ANTENN
	38387	Critical	TP101	SYS	PWRB	NSA	2012-02-28 23:08:49.0	2012-02-23 15:45:41.0	PO
	38383	Critical	TP101	INP1	INPLOS	NSA	2012-02-28 23:08:47.0	2012-02-23 15:45:38.0	
	38379	Critical	TP101	PRS	INPDISQ	NSA	2012-02-28 23:08:45.0	2012-02-23 15:45:36.0	INPUT DISQUALIF
✓	37503	Minor	tp-102	GPS	ANTCOMM	NSA	2012-02-23 14:33:16.0	2012-02-22 18:15:55.0	GPS ANT

Fig: TimePictra Fault Manager

Configuration Manager

The Configuration Manager allows network personnel to access NE data and update their configurations from within this single application. Information is provided graphically at system, port and card levels. The optional Group Management Pack increases efficiency by defining groups with common users, resources and policies for such things as configurations and alarm mapping.

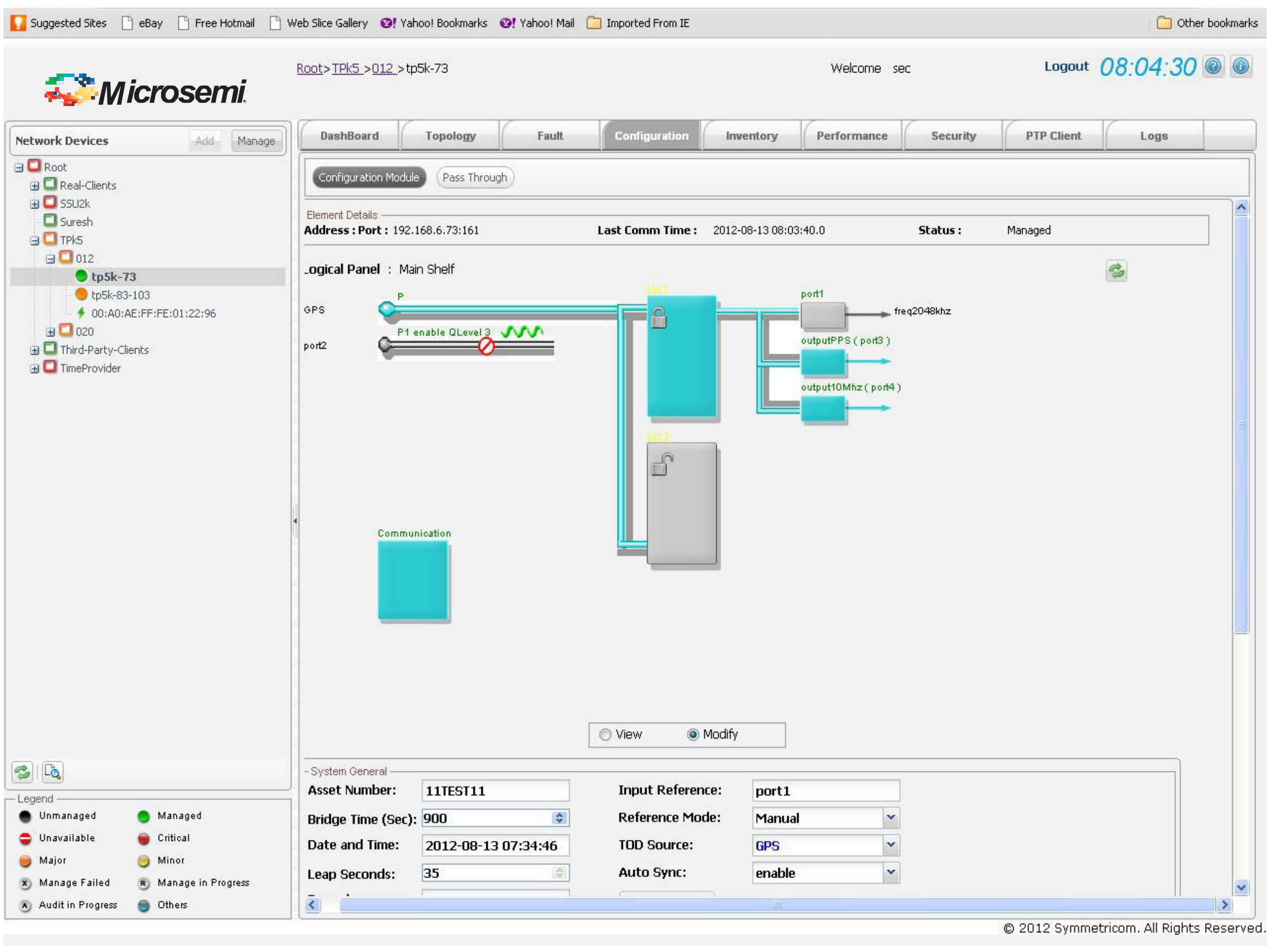


Fig: TimePictra Configuration Manager

Accounting (Inventory) Manager

This manager provides inventory information on any of the managed elements in the synchronization network. Information is provided down to the lowest level of granularity, including such information as location, serial number, part number, type of equipment, software and hardware revision levels.

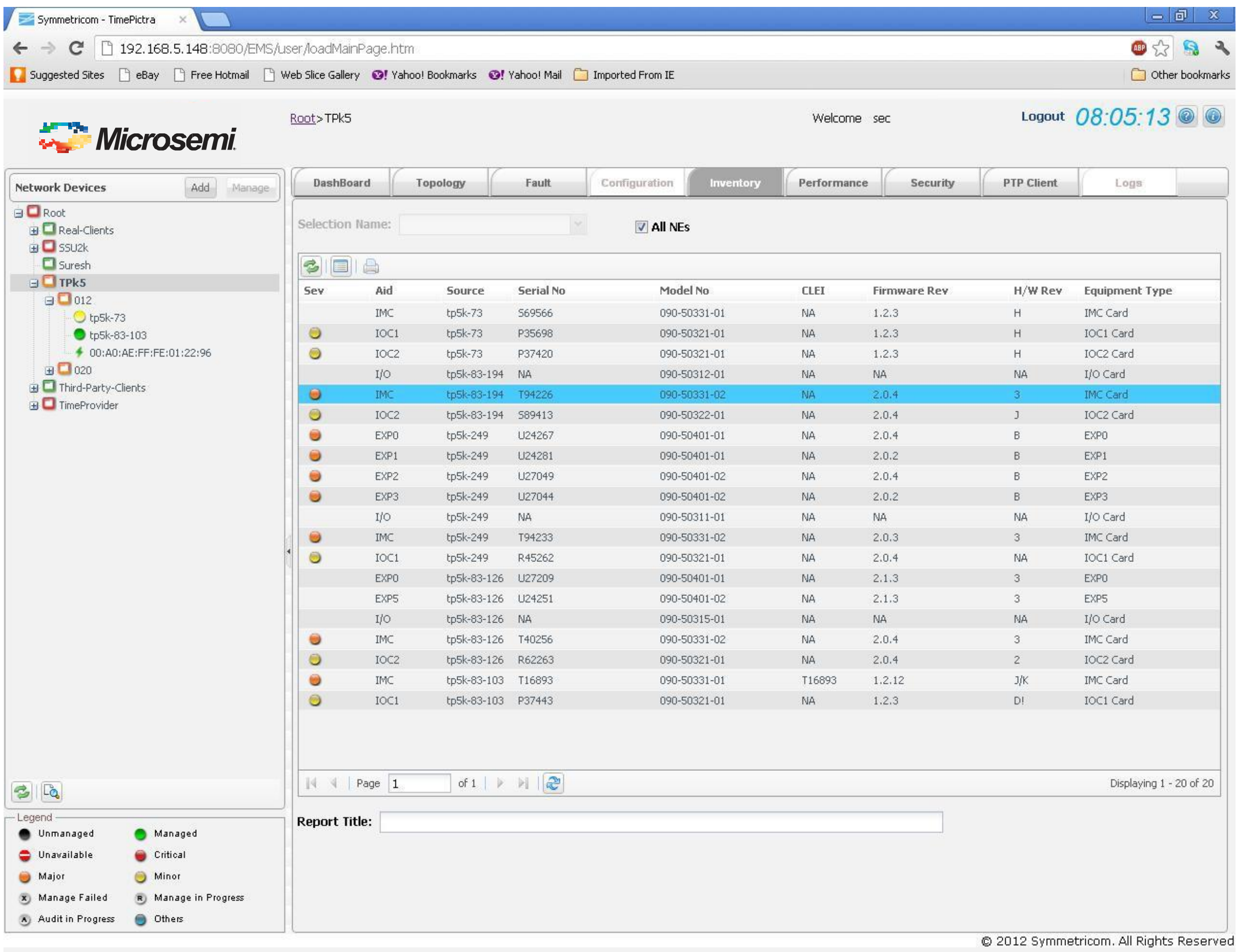


Fig: TimePictra Accounting Manager

Performance Manager

The Performance Manager graphically displays a variety of standard performance data such as MTIE, TDEV and phase, in order to proactively identify and correct problems in the synchronization network. TimePictra enables users to compare current readings to stored industry standard masks and previously stored data. With the Performance Pack option TimePictra will also display PTP performance metrics and PTP sync flow monitoring.

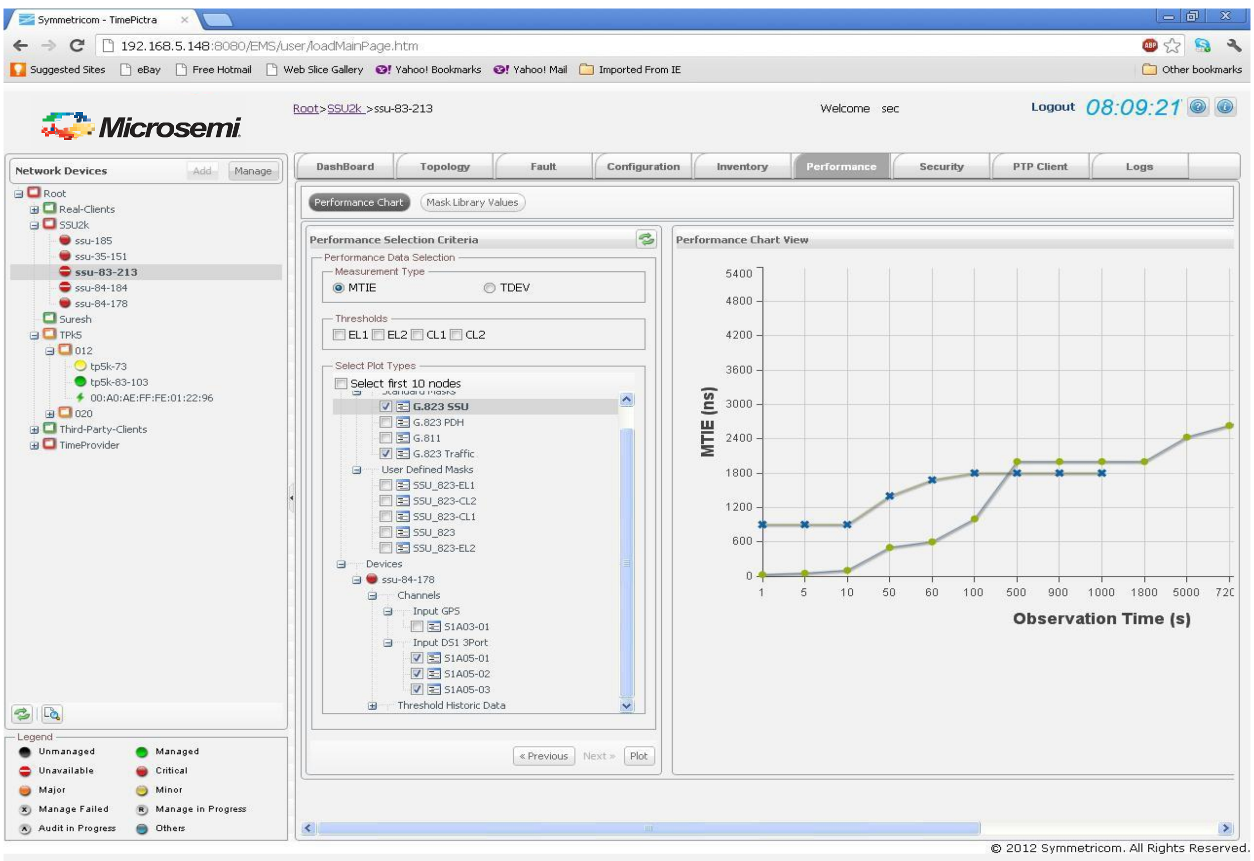


Fig: TimePictra Performance Manager

Performance Manager, PTP client visibility

TimePictra end-to-end PTP management includes visibility of slave clocks distributed throughout the network. When the slave is a Microsemi product, TimePictra will provide PTP performance metrics— delivering an advanced end-to-end value. Slaves from other vendors will also be monitored. If their sync flow disappears, an alarm will notify network administrators. These unique and valuable tools are included in the Performance Pack option

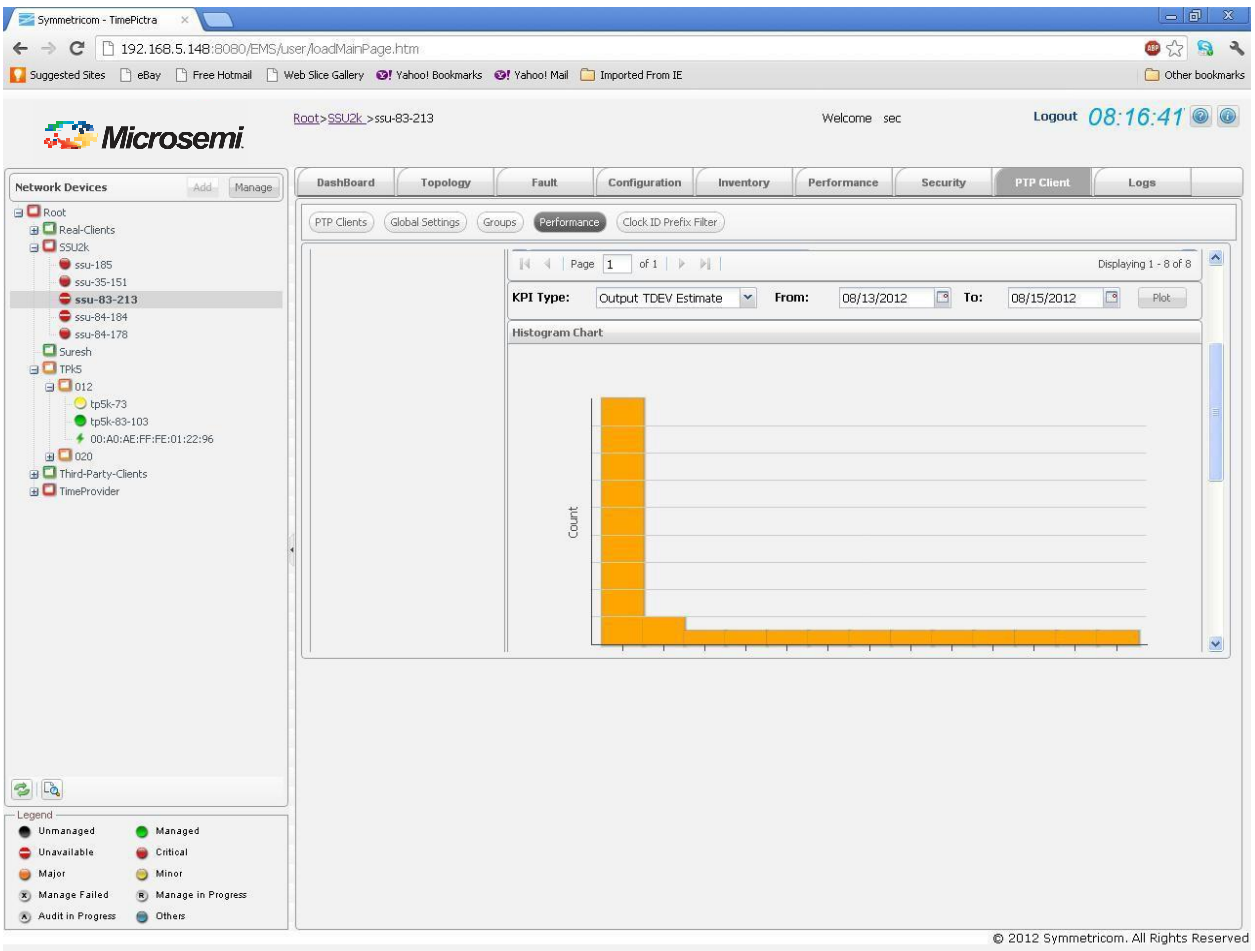


Fig: Performance Manager PTP client visibility

Security Manager

TimePictra offers several modes of security for managing synchronization networks. Multi-level, role-based access enforced by passwords and login requirements guarantees only authorized users can access the system. Securely administered permissions control access to domains and functionality. These management domains add both a level of security and organizational structure. SSL and data encryption communications ensures secure access over the Internet. Transaction logs ensure all activities by users are documented and logged.

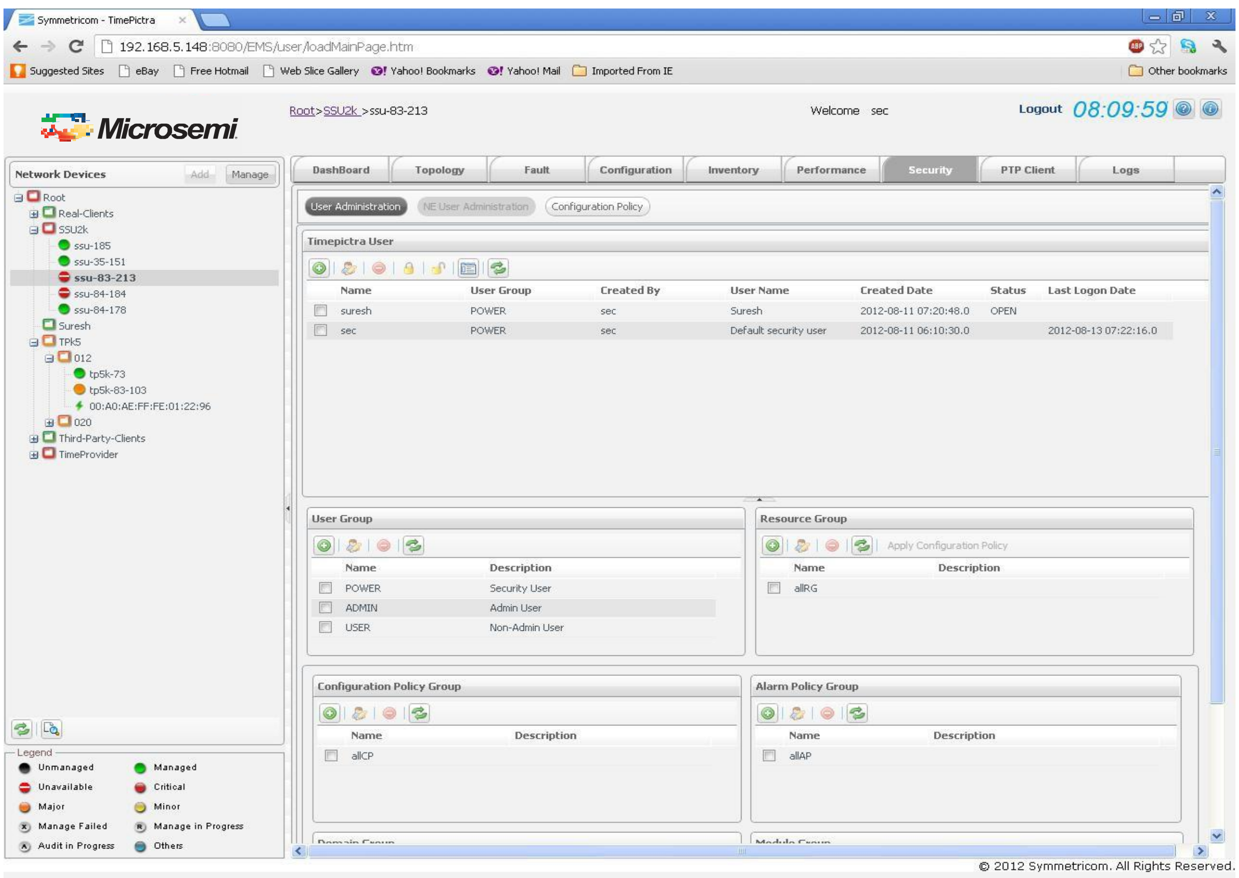


Fig: Security Manager

Chapter-6

IEEE 1588-2008 PTP Grandmaster Clock

Carrier grade, packet-based timing

The TimeProvider ® 5000 PTP IEEE 1588 v2 Grandmaster receives a GPS input as a primary reference for high-precision packet network synchronization. TimeProvider® 5000 is an IEEE 1588-2008 standard compliant grandmaster clock with a carrier grade design that provides high client capacity, hardware-based packet processing and redundant hardware to deliver scalable performance and maximum network availability. When locked to a GPS input, the TimeProvider 5000 meets the applicable performance requirements of the ITU-T G.8272 standard for a Primary Reference Time Clock (PRTC).

Fig: TimeProvider 5000

With dual input/output clock cards in active and standby mode, TimeProvider 5000 ensures there is no impact on client performance when failover occurs. Redundant cards provide protection far superior to “network redundancy” models where clients must re-acquire synchronization from a different grandmaster somewhere else in the network.

Protection of input clock source has become increasingly important. TimeProvider 5000's new IMC card has support for dual GPS inputs. In addition, TimeProvider 5000 supports auto-switching of input source between E1/T1 and GPS based on clock quality-level and user- priority settings.

With hardware-based time stamping and packet processing, TimeProvider 5000 delivers high client capacity at full rates up to 128 messages per second with the performance that does not degrade as the number of clients increases.

TimeProvider 5000 supports user configurable PTP profiles; the selection includes default, telecom-2008 (user configurable to support ITU-T G.8275.2 parameters), ITU-T G.8265.1, ITU-T G.8275.1, and hybrid profiles. Support for multiple standard profiles ensures full interoperability with clients in multi-vendor environments. Synchronous Ethernet output is also supported with full traceability and ESMC support.

With optional NTP server capability, TimeProvider 5000 supports multiple vendors and protocols found at mobile network base station sites. Both PTP and NTP protocols operate simultaneously with PTP- and NTP-based clients. The two ports of an IOC card can be separately configured, one for PTP and one for NTP, allowing the standby IOC card to protect for both protocols. NTP capacity is up to 20,000 transactions per second (TPS), and PTP capacity remains at up to 1000 clients.

TimeProvider 5000 serves as the initial unit in a “rack and stack” configuration with TimeProvider Expansion products. These units add capabilities to the TimeProvider portfolio. Each Time Provider Expansion10 adds 16 Ethernet ports that support SyncE as well as PTP, while each TimeProvider Expansion30 adds 12 E1 and 12 1PPS/ TOD ports.

High Performance for Carrier Grade Applications

TimeProvider 5000 combines the functionality of a highly accurate IEEE 1588 Grandmaster clock with E1/T1 and 10 MHz/1 pps I/O ports in a high-performance, yet compact 1RU footprint. It adheres to the latest IEEE 1588-2008 (PTPv2) standard including the provisioning of telecom profile extensions for telecommunications based applications, and meets applicable performance requirements of the ITU-T G.8272 standard for a Primary Reference Time Clock (PRTC).

Fully Redundant Equipment, High Network Availability

With redundant Input/Output Clock (IOC) cards, TimeProvider 5000 provides protection far superior to "network redundancy"• models that must re-acquire synchronization from a different Grandmaster located elsewhere in the network. Modular construction also yields better serviceability and a lower mean-time-to-restore than sealed, self-contained units.

High Client Capacity, High Message Rate

TimeProvider 5000, with hardware-based time stamping and packet processing, delivers high client capacity at full rates: up to 1,000 clients at up to 128 messages per second. The synchronization performance does not degrade with increases in the number of clients until this capacity limit is reached.

Improved QoS and Packet-Based Network Performance

The TimeProvider 5000 is designed from the ground up to handle the most stringent timing requirements of today's emerging packet-based, next-generation networks. It enables service providers to roll out feature-rich, lower-cost, packet-based services without sacrificing timing accuracy or quality of service.

Optional Quartz and Rubidium Oscillators

TimeProvider 5000 is available with both quartz and rubidium oscillator options enabling service providers and network equipment manufacturers to choose the optimal level of holdover based on network performance, applications requirements, and equipment cost targets.

NTP Server Option

The TimeProvider 5000 PTP Grandmaster offers a licensed software option to enable carrier-grade, hardware-based NTP server capabilities, allowing network providers to simultaneously support both PTP and NTP clients in the network. The NTP server is capable of supporting up to 20,000 transactions per second.

TimeProvider Expansion Capabilities

TimeProvider 5000 serves as the base unit in a “rack and stack" configuration with TimeProvider expansion shelves. Up to ten expansion units can be deployed in any combination. With two high-precision DTI ports for inter-shelf connections and redundant power connections, the expansion units also provide the performance and protection needed to ensure maximum service availability and network uptime.

TimeProvider Expansion 10

The TimeProvider Expansion 10 shelf adds up to 16 Gigabit Ethernet ports that simultaneously support PTP and SyncE. The PTP profile is aligned with the developing ITU standard for time and phase. With SyncE to frequency synchronize the transport network and PTP for time and phase to base stations, the TimeProvider Expansion 10 is a complete solution for mobile networks as they evolve to technologies such as LTE-TDD and LTE-Advanced.

TimeProvider Expansion 10 uses hardware-based time stamping and packet processing to support up to 400,000 PTP multicast clients. The SyncE implementation includes support for the Ethernet Synchronization Message Channel (ESMC).

TimeProvider Expansion 30

Even as networks transition to packet, the need to synchronize elements using the frequency and interfaces of the traditional TDM network remains. The TimeProvider Expansion 30 shelf is equipped with twelve E1/2.048MHz and twelve 1 PPS/TOD output ports, allowing carriers to provide synchronization for all of their equipment from a single TimeProvider stack.

Chapter-7

Microsemi Global Services

Microsemi provides synchronization services that assist customers with the planning, deployment and maintenance of synchronization infrastructure. Services are designed to help lower costs, streamline processes, ensure quality, and deliver the highest level of performance from your synchronization network. The Platform Maintenance service bundles together Microsemi's industry leading technical support along with all software maintenance. As part of Platform Maintenance, customer will receive all updates as well as all upgrades including all patches, point releases, maintenance releases and related documentation for your purchased version of software during the contract period.

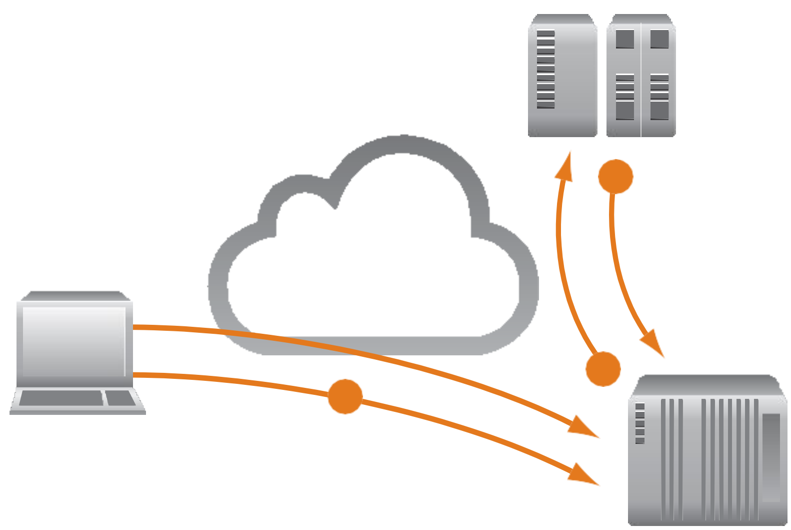


Fig: SSU 2000 with Radius Capable Communication Card

Synchronization

Typical wireless backhaul application utilizing the TimeProvider 5000 Grandmaster Clock with fully redundant, carrier-class architecture to provide precise timing and frequency for remote base stations over a packet-based Ethernet network infrastructure.

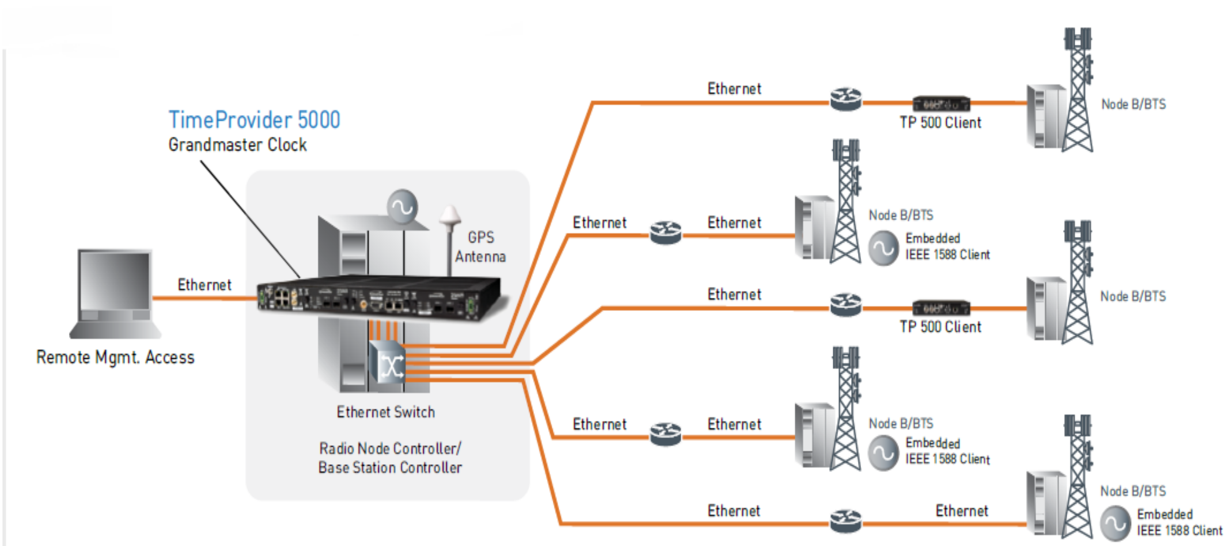


Fig: IEEE 1588 (PTP) Grandmaster Server Cards provide synchronization traceability over Ethernet to PTP client clocks in remote base station.

Ports Introduction:

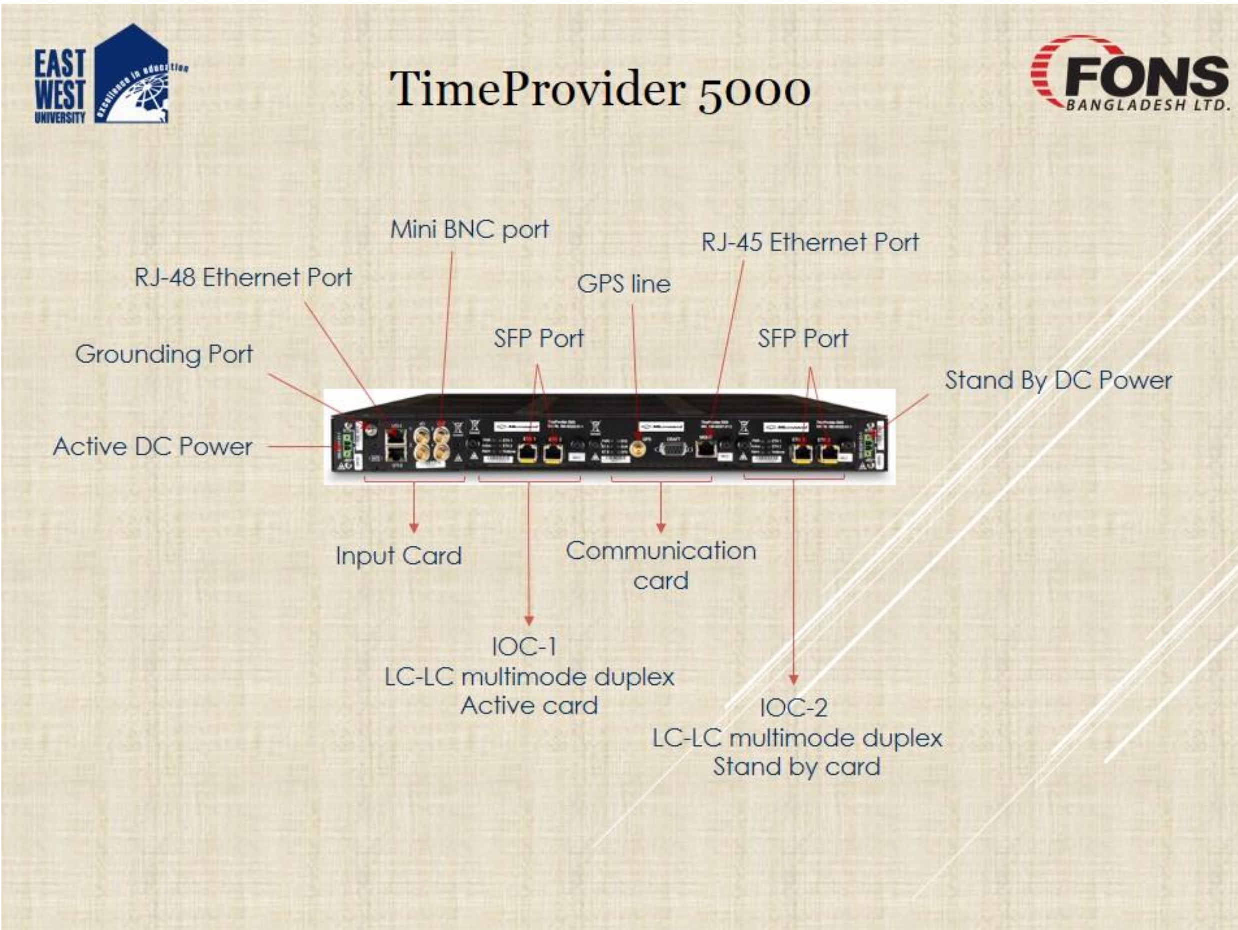


Fig: TP-5000 Ports Name

Specifications

GNSS Input Options

• 1 x GPS
• 1 x GPS and 1 x GPS/Beidou
• 2 x GPS
• All use antenna type: L1 band

Inputs

• 2 x E1 (2.048 Mbps and 2.048 MHz)
• 2 x T1 (1.544 Mbps and 1.544 MHz)
• 2 x 1PPS and TOD

Outputs

• 2 x GigE output per IOC (optical and electrical) supporting PTP, NTP, and SyncE
• 4 x E1 (2.048 Mbps and 2.048 MHz)
• 2 x T1 (1.544 Mbps and 1.544 MHz)
• 1 x 10 MHz
• 1 x 1 PPS

Physical Specifications

• Dimensions: 44 mm H x 483 mm W x 435 mm D (1.75” H x 19” W x 17” D)
• Weight: 4.4 kg (9.6 lbs)

Power Requirements

• - 38.4 VDC to -75 VDC (dual redundant) @ 43 W typical

Environmental Specifications

• Operating temperature: -5 °C to +45 °C
• Storage temperature: -40 °C to +70 °C
• Humidity: 5% to 100% w/condensation

Hardware Modules

- I/O Module (includes 4 x I/O ports)
- IMC Module
- IOC (Quartz) Module
- IOC (Rubidium) Module

Time Stamp Precision

- <10 ns rms typical

Frequency Accuracy

- Tracking to GPS: PRS/PRC quality
- Holdover (over constant temperature):
  - Rubidium (G.812 type II) <1x10-11/day
  - Quartz (G.812 type I) <1x10-10/day

Time Accuracy

- Tracking to GPS : <100 ns when locked to GPS

PRTC compliant

- Holdover (over constant temperature):
  - Rubidium (G.812 type II): 10 μsec over 5 days
  - Quartz (G.812 type I): 10 μsec over 1 day

Client Capacity

- PTP: 500 clients per port, 1000 per IOC card, at 128 messages per second rate (L3, unicast)

PTP with NTP option

- One port with PTP: 1000 clients
- One port with NTP: 20,000 transactions per Second

NTP Server Option

• Stratum 1 sever via GPS
• Up to maximum 20,000 transactions per second

PTP Probe Option

• PDV measurements
• Supports L3 unicast, L3 multicast, L2 multicast
Other SW License Options
• 500 VLAN license
• L2/L3 Multicast PTP and 2-step clock license
• NTP server with 20,000 TPS license
• NTP server with 120,000 TPS license
• TimeProvider Expansion10 16 port license (adds availability of ports 9-16 to standard 8 ports)

Protocols

• IEEE 1588-2008 (PTP)
• NTPv4 (option)
• IPv4
• DHCP
• SFTP, FTP
• DiffServ/DSCP
• VLAN (up to 16)
• TELNET
• SYSLOG
• RADIUS
• SSH

Management

• CLI
• SNMP v2c, v3 (optional)
• TimePictra (purchased separately)

Industry Standards/Requirements

• ITU G.811, G.812, G.823, G.8261, G.8272
• G.703, G.704, ETSI 300/Class 3.1

Certifications

- CE certified
  - CISPR22
  - Safety – CB Scheme 60950-1 2nd edition
- EMC
  - FCC part 15 AS/NZS Class B, EN300 386, EN55022/24, CISPR22, KN55022/24
  - NEBS GR-1089 section 2 and 3
- Environmental
  - ETSI (EN55022/EN55024) EN300019, Class T3.2
  - NEBS w/exclusion of GR-63 4.2, 4.5
- Safety
  - UL/cUL 60950-1, IEC 60950-1 CB, EN60950-1 2nd edition
- RoHS
  - 6 of 6 RoHS

Chapter-8

TimeProvider 5000 Features

- IEEE 1588-2008 Precision Time Protocol Grandmaster.
- Support for PTP telecom profiles.
- Redundant hardware (inputs, outputs, clock, power).
- High capacity (up to 1,000 PTP clients).
- High PTP message rate (up to 128 messages per second).
- Compact 1RU footprint.
- Hardware-based packet processing.
- Single or dual GNSS (GPS) inputs.
- Stratum 1 traceable GPS.
- E1/T1 inputs and outputs.
- Input source priority switching.
- Optical and electrical interfaces (100/1000Base-T, 1000Base-SX, 1000Base-LX).
- 10 MHz/1 pps support.
- Quartz and rubidium holdover clock options.
- Up to 500 VLANs per port with licensed software option.
- Dynamic and static PTP reservations.
- NTP software license option (up to 20,000 transactions per second).
- Management via CLI, SNMP v2c/v3, TimePictra ®.
- PTP probe licensed software option.
- RoHS compliant.
- TimeProvider Expansion platform support.
- Compatible with TimeProvider 2700, TimeProvider 2300, TimeProvider 500, Microsemi embedded PTP clients, and standards-based 3rd party PTP clients.

TimeProvider Expansion Features

- Up to ten expansion shelves in any combination with a TimeProvider 5000 base unit.
- 16 Ethernet ports per TimeProvider Expansion 10 shelf with SyncE support.
- Twelve E1 and Twelve 1 PPS/TOD ports per TimeProvider Expansion 30 shelf.
- Redundant, high-precision shelf interconnection.
- Compact 1RU footprint.
- RoHS compliant.

Benefits

• Fully interoperable with standardsbased clients
• Highly scalable PTP grandmaster supports 1000 PTP clients at full 128 messages per second rate
• No performance degradation as client capacity grows
• Simultaneously supports both PTP and NTP elements in your network
• Capabilities grow with TimeProvider expansion products

Applications

• Wireless Ethernet backhaul
• 3G and 4G / LTE
• Circuit Emulation Services (CES)
• Passive Optical Networks (PON)
• Femto cells and small cells
• IPTV (NTP option)

Chapter-9

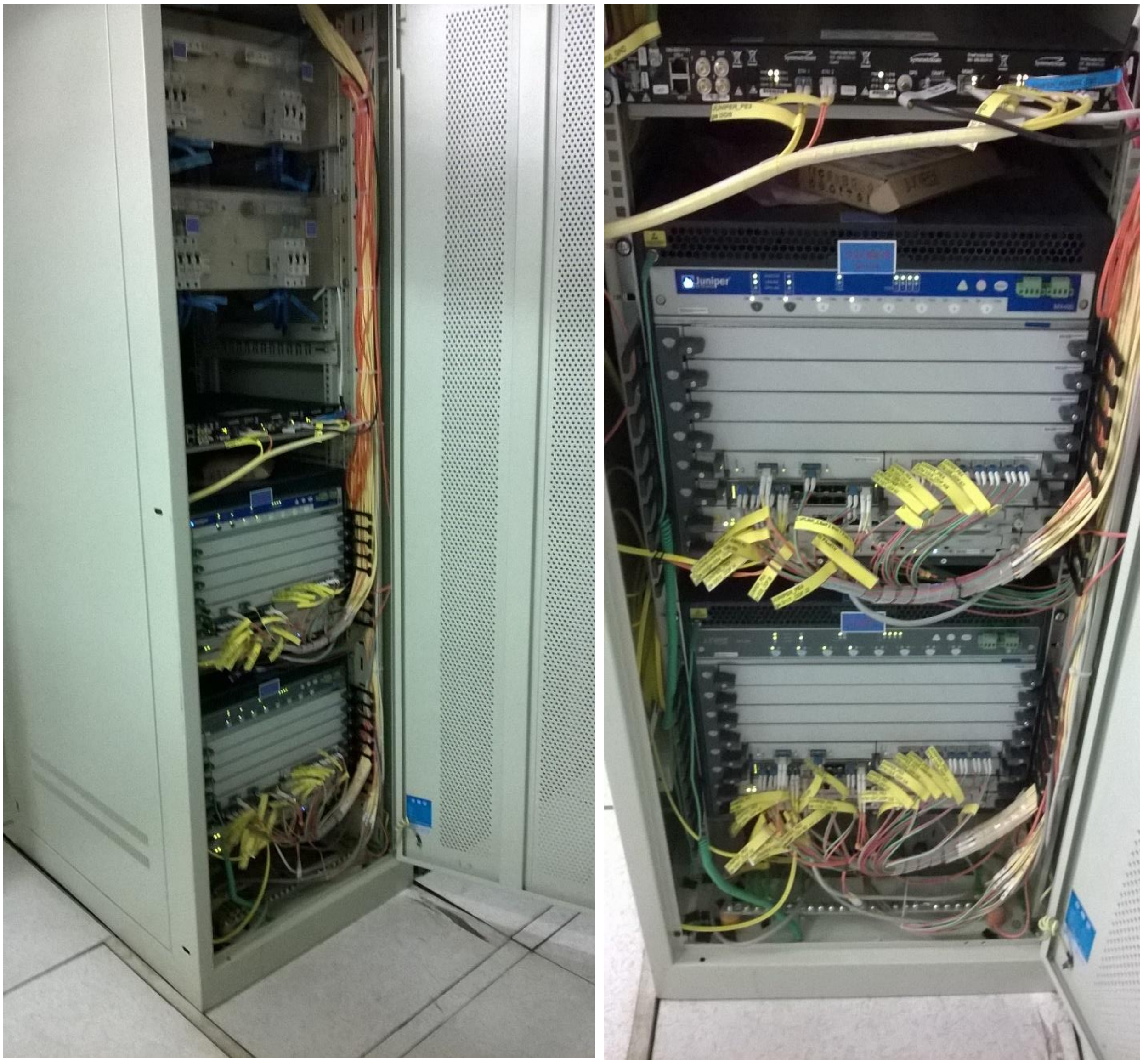
Conclusion

FONS BD Limited is the most leading Optical Cable and Vendor Company in Bangladesh. It is a great pleasure to me that I have got chance to work there as a Technical Support Engineer. Among four years what i have learnt from my university, I practically applied there. My main task was to work with IEEE 1588-2008 PTP Grandmaster Clock and to learn maintenance and management of the Network Time Protocol (NTP) for clock synchronization between computer systems over packet-switched, variable-latency data networks. By this internship, I have also learnt how to maintain a whole network system of a company as well as learnt to look into their development methods, working models, deals and industrial behaviour. Besides, I have learnt to work under pressure and also work with dedication which is so much important for any corporate life. I want to mention that this internship period was the great opportunity to gather fruitful knowledge for my future career. I hope, this experience will help to make my carrier a better and prosperous one.

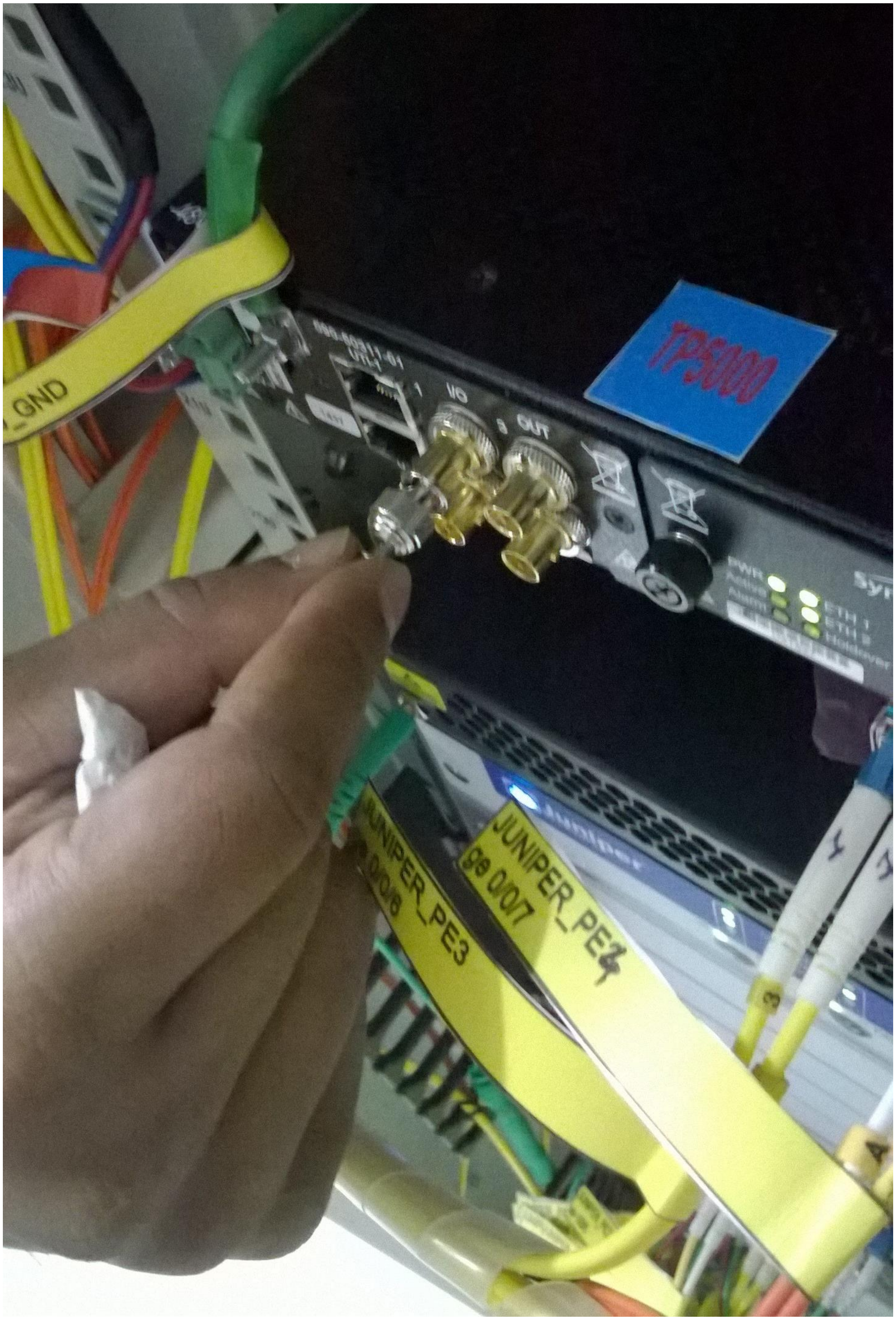
Gallery

Robi BTS at Alekharchar site in Comilla

Inside view of BTS Station



Installation Rack



Working on TP5000

Installed GPS

*********** THE END ***********