

DESIGN OF ELEMENT MANAGEMENT SYSTEMS

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ABSTRACT

Element Management System (EMS) is a system to manage network element (NE) for Ethernet Passive Optical Network. This allows the user to manage all the features of each network element (NE) individually. Network element (NE) exposes one or more management interfaces that the EMS uses to communicate with and to manage them. EMS has been design to fulfill FCAPS criteria which consist of fault management, configuration management, accounting management, performance management and security management. EMS is an emerging access network technology that provides a low-cost method of deploying optical access lines between a carrier's central office and a customer site.

KEYWORDS - Element Management System, Network element, Ethernet Passive Optical Network, International Telecommunications Union (ITU) standard, full-services access network.

INTRODUCTION

This paper contains information on the features, functions and description that would available in each module developed in EMS. EMS manages one or more of a specific type of network elements (NEs). An EMS allows the user to manage all the features of each NE individually, but not the communication between NEs - this is done by the *network management system (NMS)*.

NEs expose one or more management interfaces that the EMS uses to communicate with and to manage them.

EMS web based application will be reside in windows based environment which will fulfill the

Following basic requirement for:

1. Real time monitoring for equipment(s)
2. Controlling equipment(s) that will be depend on the equipment features
3. Setting and configuring equipment(s)
4. Management of the system
5. Store all the system and monitoring information in the database.
6. Comply FCAPS basic requirement for Fault or Alarm, Configuration, Accounting, Performance and Security

This paper is divided into several sections. Section 1 briefly introduces the background of EMS. Section 2 describes the EMS design. It is followed by requirements in designing EMS in Section 3. Section 4 wraps the paper. This paper focused on preliminary study and system design of Element Management System (EMS).

REQUIREMENTS IN EMS

This section contains all the details the system integrator needs to create a design. . The requirement in designing EMS is divided into two, which are functional requirements and non-functional requirements.

For *functional requirements*, EMS has to fulfill all FCAPS (fault, configuration, accounting, performance and security) functions. Function for fault is to detect and localize fault list in NE and services associated with it. The system shall be able to collect and display alarm information, set and update time rate and display alarm categories with proper *alarm color*. From there, system administrator shall be able to enable user to select only certain information to be displayed in *real-time monitoring* panel where users shall be able to view alarm information. Function for configuration is to manage service provisioning process, to manage and configure network element. The system shall be able to connect the database, retrieve and display customer and NE information from database, store customer and NE information to database and provide a search engine for equipment inventory. System administrator shall be able to perform database back up, restore, fine-tuning and optimization for system configuration, register new customer and NE account, edit and soft delete existing customer and NE account. Users shall only be able to update customer profile, which cover customer identification address; contact and service type subscription and generate report on NE available base on certain criteria. Function for accounting is to handle network resources and resources quota. The system shall be able to connect the database, handle network utilization, limitation bandwidth in network and provide report generation facility based on network resources and quota resources.

Function for performance is to collect network performance data and produce network performance analysis report. The system shall be able to provide report generation facility based on network resources and quota resources, calculate relevant statistics based on information captured and produce a summary report based on statistical figures obtained by selective period (daily, monthly or yearly). Function for security is to manage security policy, user authorization and password, to maintain trail of user activity and to escalate alarm to operational\ personnel. The system shall be able to connect the database, retrieve and display user's information and system accessibility form database, store user's information and system accessibility to database, provide a search engine for user account and log all activities in database. System administrator shall be able to register a new user account, manage registration of user group access, edit and soft delete existing user account, to set privilege level or system accessibility of a user and assign task to registered user based on alarm generated. Users shall be able to edit or update his/her account information.

The *non-functional requirements* for EMS are reliability, security, maintainability, portability and availability. The system is reliable where the language used is English, clear, informative, easy to use, convenient to the user and secure. The security features of the system are provide the users with different privilege levels, has activity log and access to the system resources shall be secured by using the database security mechanism. The maintainability features are it will be built by the rules and techniques of web based programming to achieve modular design and cater to the needs of the users over its lifetime. If an application can increase the number of users as needed, upgrade the features that users need, and add new features to the application as needed, and then the application is maintainable. The portability feature is able to work on the LINUX (Red Hat). The availability feature is it must be available 24/7 but still depending on software's deployment machine state such as restarting and shut down.

DESIGN OF EMS

The EMS manages the different elements of the PON and provides the interface into the service provider's core operations network. Its management responsibilities include the full range FCAPS functions. Key features and functions of the EMS are Full FCAPS functionality via a modern GUI, capable of managing dozens of fully equipped PON systems, supports hundreds of simultaneous GUI users and has the Standard interfaces to core operations networks. There are basically two interfaces needed for EMS to interact with all the network elements which are physical and logical interface. Physical interface means EMS is connected to network elements (NE) using IP network as shown in *figure 1*. While, EMS logical interface is visual logically is software module or system setup as shown in *figure 2*. EMS application system interfaces is basically the internal module interface that inter-working each other to ensure the operation of the EMS can be carried out. Basically, there are three modules defined in the EMS system which are GUI module, server module and database module. Each of the modules consists of several sub-modules which carries its own task and processing logic. EMS GUI Application modules interfaces basically is a Web based application which written on top of Web server. EMS GUI module is designed to be user friendly interface which mean each of the task will be presented by graphical models such as exchanges and devices equipments. EMS GUI module has five sub-modules that are fault module, configuration module, accounting module, performance module and security module. EMS server modules provide mediation layer between GUI, Database server and network elements. EMS server will process all the command sent by GUI to network elements. Database module can be considered as different entity which part of the EMS system. The database package that will be used in the system is ORACLE 10G Release 2. This is because ORACLE has been acknowledged world-wide as high performance and scalable database and suitable in Telecommunication industry.

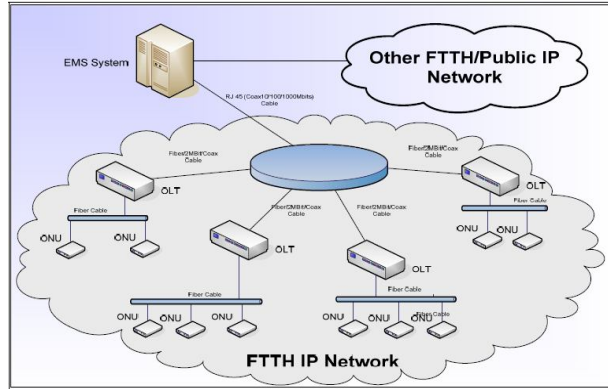


Figure 1: EMS Physical Interface

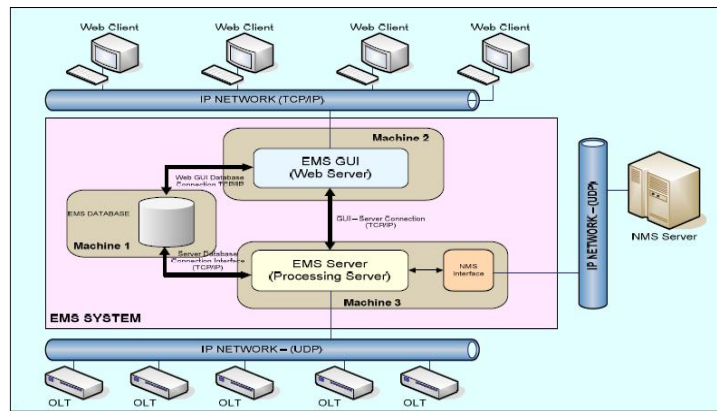


Figure 2: EMS Logical Interface

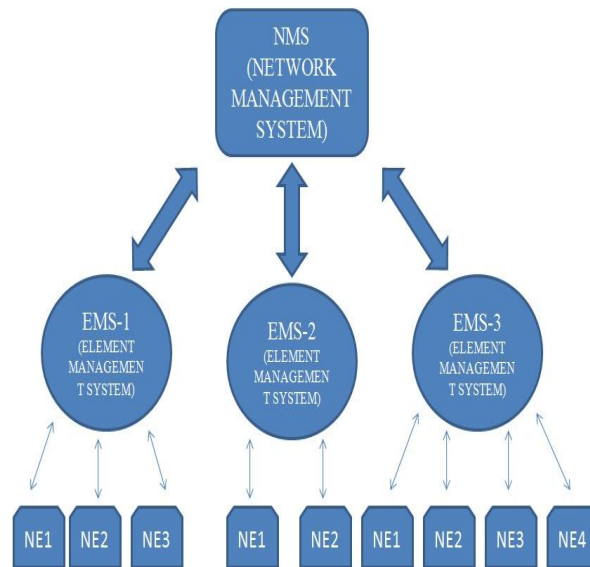


Figure 3: Block Diagram of Network Management System

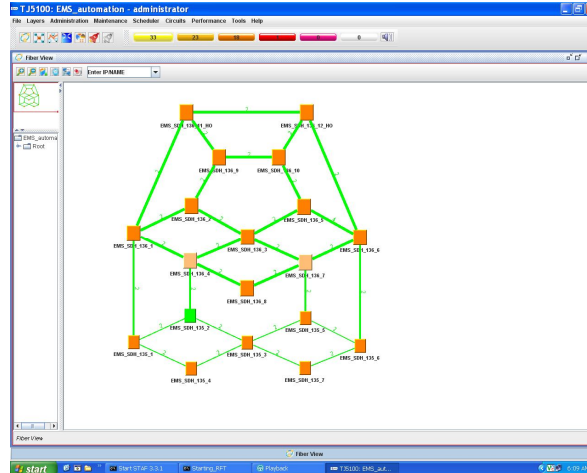


Figure 4 : Steps for performing Test Cases in EMS

Test Case 1: Augmenting a node in network

Purpose

To add the new node between set of nodes and no cross connects is present on the new node that is getting added

Procedure

Perform the following steps:

1. Right click the Node and select Node Augment. Node Augmentation window is displayed.
2. Select west port vs. east port mapping.
3. Click > Apply

RESULT

Following will be the expected result.

All the circuits which were previously passing through the directly connected fiber between the old adjacent nodes are updated with new node information. We can view through the option graphical view of the circuits.

Test Case 2: Capacity utilization of Node & trunk

Purpose

To view the capacity utilization of node and trunk in the form of chart

Procedure

Perform the following steps:

1. Right click the fiber view and select the desired Node.

2. Click > Capacity Utilization. The Node Capacity Utilization Chart window is displayed.
3. Right click the fiber view and select the desired Trunk and select Capacity Utilization. The Node Capacity Utilization Chart window is displayed.

RESULT

Following will be the expected result.

All the circuits which were previously passing through the directly connected fiber between the old adjacent nodes are updated with new node information. We can view through the option graphical view of the circuits.

Test Case 3: View and set the attributes of Network element

Purpose

View and change the attribute of the Network Element.

Procedure

Perform the following steps:

1. Click Layers > Fiber View.
2. Right click on the required node and select the attribute. The corresponding node attributes window is displayed.
3. Enter the name, location and Ethernet IP (LAN option) and mask length of the node and click apply.

RESULT

Following will be the expected result.

Node Attributes will be changed as per the entered values.

Test Case 4: Create cross connect in network element

Purpose

View and change the attribute of the Network Element.

Procedure

Perform the following steps:

1. Click Layers > Fiber View.
2. Right click on the required node and select the attribute. The corresponding node attributes window is displayed.
3. Click Provisioning > Create Cross Connects. The Cross Connect window is displayed.

4. Select the capacity(VC 12/VC3/ VC4) source port, source time slot, source protection mode, source réversion mode, source destination port, destination time slot, destination protection mode and destination reversions mode and click apply.

RESULT

Following will be the expected result.

Cross connect of desired attributes will create in Node.

Test Case 5: View the Current Alarms in the network based on the severity

Purpose

View the current alarms in the network.

Procedure

Perform the following steps:

1. Click on the Current Alarm icon of specific priority.

RESULT

Following will be the expected result.

A list of all the current SDH alarms in the network of the required severity is displayed.

Test Case 6: Acknowledge the Current Alarms

Purpose

Acknowledgement and Unacknowledgement of the current alarms in the alarm list and Network Element.

Procedure

Perform the following steps:

1. Click on the Current Alarm icon of specific priority.
2. Select the Alarm and right click and Select the Acknowledge and enter the Acknowledge message. The Alarm will appear in the Acknowledge banner.
3. Select the Acknowledge Alarm banner and select the alarm to be unacknowledged and right click and select Unacknowledged and enter the message. The Alarm will be disappear from Acknowledge banner
4. Select the Node in the Fiber View and right click and select the Alarms→Current Alarms. Pop-up window will be displayed with the current alarms of that particular node
5. Select the Alarm and right click and Select the Acknowledge and enter the Acknowledge message. The Alarm will appear in the Acknowledge banner

RESULT

Following will be the expected result.

After acknowledgment of particular alarm will appear in the Acknowledge banner with appropriate message & same will disappear from Acknowledge banner to respective alarm banner after unacknowledged.

Test Case 7 : View Historic Alarms at the network level**Purpose**

View the Historical alarms in the network.

Procedure

Perform the following steps:

1. Click on the Historical Alarm icon (no colour).The Filter - History Alarms window is displayed.
2. Check the desired criteria field and enter/select the parameters against the fields to specify the filtering criteria. A list of all the historical alarms in the network that satisfy the criteria is displayed

RESULT

Following will be the expected result.

list of all the Historical SDH alarms in the network of the selected parameters is displayed.

Test Case 8: Generate node report**Purpose**

To generate the node report of Managed Network

Procedure

Perform the following steps:

1. Click Tools > Inventory Reports > Node Report. The corresponding reports window is displayed
2. Select the desired node by name and select the appropriate check box and generate report. The default file name and type is generated which can be saved in the desired location.

RESULT

Following will be the expected result.

The expected node report generated successfully.

Test Case 9: Generate circuit report

Purpose

To generate the circuit report of Managed Network

Procedure

Perform the following steps:

1. Click Tools > Inventory Reports > Circuit Report. The corresponding reports window is displayed
2. Select the desired appropriate check box and generate report. The default file name and type is generated which can be saved in the desired location.

RESULT

Following will be the expected result.

The expected circuit report generated successfully.

Test Case 10: Generate Network alarm report**Purpose**

To generate the Network Alarm report of Managed Network

Procedure

Perform the following steps:

1. Click Tools > Inventory Reports > Network Alarm Report. The corresponding reports window is displayed
2. Select the desired appropriate check box and generate report. The default file name and type is generated which can be saved in the desired location.

RESULT

Following will be the expected result.

The expected Network Alarm report generated successfully.

Test Case 11: Generate circuit performance report**Purpose**

Generate circuit performance report.

Procedure

Perform the following steps:

- Click Tools > Performance Reports > Circuit Report. The circuit generation reports window is displayed.
- Enter the circuit name, customer name and time range.
- Click >Generate report.

RESULT

Following will be the expected result.

The expected circuit performance report generated successfully.

Test Case 12: Create the circuit between two nodes**Purpose**

Is to create circuits in NE from EMS

Procedure

Perform the following steps:

1. Select the two desired nodes (Source and Destination) by pressing CTRL key and simultaneously clicking on the nodes.
2. Right-click the fiber view window and select Create Circuit. The Create Circuit: Step 1 of 3 windows is displayed. Select the required attributes present in the Create Circuit: Step 1 of 3 windows.
3. Click > Next. The Create Circuit: Step 2 of 3 windows is displayed.
4. Select the work path on the left partition of the window and click Work Path the Topological Link: a Work Path window is displayed with the details of the work path selected.
5. Click > OK. The work path selected will be highlighted in pink.
6. To select the protect path, click Work-Path-1 in the right partition to highlight the work path. Select the protect path.
7. Click > Protect Path the Topological Link: Protect Path window is displayed with the details of the protect path selected. Select the port in the Topological Link: Protect Path.
8. Click OK to proceed. The protect path selected will be highlighted in dotted line.
9. Click Next > The Create Circuit: step 3 of 3 windows is displayed with the details of the circuit created. The right partition of the window has the Lists of Paths: and the left partition will

display the nodes, work path and the protect path depending on the selection in the Lists of Paths.

10. Click > Create. The circuit can be created by clicking create or by configuring the circuit parameters to configure the circuit parameters,
11. Click Next > The Configure Circuit Parameters window is displayed.
12. Select the desired values.
13. Click > Create. The circuit is created.

RESULT

Following will be the expected result.

The desired circuit is created successfully.

Test Case 13: Adding profile and profile action

Purpose

Is to create the new partition in partition view

Procedure

Perform the following steps:

To add profile

1. Click Administration>Security>Profile Setting. The Profile Info window is displayed
2. Right click > Profile Info window and select New. The New-Profile Info window is displayed
3. Enter a name for the profile being created against the Profile Name field.
4. Click >Apply. The profile will be created.

To add profile actions

1. Click Administration>Security>Profile Setting. The Profile Info window is displayed
2. Right click profile to which the actions have to be added and select Profile Actions. The Profile Actions window is displayed.
3. Right click in the Profile actions window and select New to add new actions to the profile. You can add any number of actions for each profile.

RESULT

Following will be the expected result.

The profile is created and actions added successfully.

Comparisons between Network Management System of Different Companies

<u>Tejas</u>	<u>Tellab</u>	<u>Cisco</u>
<p>Advanced Resource Management: TJ5500 manages a number of TJ5100 EMS and other third party EMS. From the NMS interface, you can create/manage Partitions and monitor partition level alarms. It supports network wide Topological Link (TL) view and creation/deletion/filtering of the TLs. TJ5500 supports end-to-end graphical circuit management across multiple EMS/Partitions. It provides auto discovery of network topology & network wide search option. ASON is supported from TJ5500.</p> <p>End-to-End Circuit Management: TJ5500 supports a large number of circuit creation & management options – including Point & Click Provisioning (PNCP), circuit discovery mechanism and bulk circuit editing. Enhanced circuit edit operations include features like changing the source/destination node, re-routing & adding/removing segment protection. The intuitive UI ensures less training & maintenance overhead.</p>	<p>Expertise : Tellabs engineers provide the comprehensive knowledge of software and hardware required to support Tellabs EMS/NMS products and enable consistent, proper configuration of OS, database and EMS/NMS software</p> <p>Faster deployment — deploy the system immediately, without the need to dedicate resources to learn how to deploy your management system</p>	<p>GUI-Based Management for Unparalleled Productivity :</p> <p>Cisco Transport Manager is a powerful GUI-based management system that makes advanced management</p> <p>Capabilities such as A-to-Z circuit provisioning easy to learn and use. Its explorer-style navigation and extensive use</p> <p>Of wizards, tool tips, legends, and online help allow operators to perform tasks quickly and efficiently. Many otherwise tedious, time-consuming, and error-prone tasks can be fully streamlined using these intuitive tools, lowering the cost</p> <p>of network operation.</p> <p>High Availability for Carrier-Class Management</p> <p>Cisco Transport Manager provides the same easy-to-use manageability features provided by the optical local craft tool, the Cisco Transport Controller. In addition to this, Cisco Transport Manager is designed for continuous operation. High availability deployment configurations are available to provide local and geographic redundancy options. Cisco Transport Manager can cope with heavy load</p>

<p>Comprehensive Fault Management: TJ5500 has a Centralized Fault Management system for network-wide alarm monitoring and management. Fault monitoring is facilitated by extensive filtering and probable cause analysis for network wide alarms.</p> <p>Performance Monitoring & Reporting: TJ5500 supports detailed performance monitoring, allowing for 15-minutes and 24-hour interval performance collection. It supports a comprehensive set of reports that are exportable to a user-friendly format for further analysis.</p> <p>Open Interfaces: TJ5100 supports standards compliant TMF814 south bound interface allows for easy integration with 3rd party EMS systems.</p> <p>High Availability & Scalability: TJ5500 supports 1+1 Hot Standby for high-reliability network management system. It has the capability to manage very large and complex networks.</p> <p>The key benefit for customer is savings on Capex & Opex by using one smart future ready NMS for a wide range of technologies</p>	<p>Flexibility— the modular nature of Tellabs Management System Deployment Services allows you to assign your staff to handle the activities for which they are qualified and to obtain assistance from Tellabs for tasks that require a more specialized level of expertise</p> <p>Economy — manage your deployment timeline and resources more effectively and leverage Tellabs expertise to keep your deployment on schedule and within your budgetary guidelines</p>	<p>scenarios such as high circuit-transaction rates, performance monitoring data collection, alarm storms, and numerous simultaneous clients (up to 100). Cisco Transport Manager plays a crucial role in the high availability of the network itself. Cisco Transport Manager's fault management and performance management capabilities help to ensure that network problems are discovered quickly and accurately, so they can be addressed often before a customer's service is noticeably affected.</p> <p>Northbound Interfaces for Operations Automation</p> <p>Industry-standard Simple Network Management Protocol (SNMP) and Common Object Request Broker Architecture (CORBA) protocols make Cisco Transport Manager a flexible building block in traditional as well as next-generation OSS infrastructures. Cisco Transport Manager not only captures and stores all relevant information from the optical transport domain, it also makes that information and its management available to higher-layer OSSs using open</p>
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		<p>communications protocols. For example, the TeleManagement Forum-compliant (TMF 814 v3.0) CORBA northbound interface of Cisco Transport Manager facilitates the implementation of the next generation of inventory management, provisioning, flow-through circuit management, and service assurance. The Cisco Transport Manager CORBA Northbound interface is used for validation with the Cisco Info Center.</p>
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CONCLUSIONS

This paper discussed on system requirements and design of Element Management System (EMS). The system requirements describe the functional and non-functional requirements of the system. The system design described the system physical interface and system logical interface, EMS application system interface and EMS module/sub module interfaces.

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