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Design of Communication Manager Application for Element Management Layer

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Abstract: **The telecommunications industry has experienced rapid growth in data networking. There is a need for high-bandwidth services with high data transmission rates, and end-to-end network reliability. Optical networks replace the traditional networks with the growing bandwidth demand and thus have revolutionized the telecommunication industry. The optical management system (OMS) is a network management system which supports several management layers that can accommodate and grow with a customer's optical network. As the network elements increase in the network, managing the network becomes difficult and there is a need to develop an optical management system. This paper focuses on designing Communication Manager Application which is used for centralized monitoring and management of operations on Network Elements (NEs) in a telecommunication management network (TMN).**

Keywords: **Telecommunication Management Network (TMN), Network Element (NEs), Optical Management System (OMS).**

I. INTRODUCTION

The telecommunication industry has seen rapid change since there origin. We see new technologies every now and then. The telecommunication companies have to face new challenges because customer demands are increasing day-by-day. As new technologies emerge they should be able to merge it with legacy systems.

A. Historical Perspective:

TMN and related concepts are of major focus of telecommunication operations since 1990. The emerging operations strategy is moving from traditional physical architecture to a multilayer model as shown in Fig. 1. The Telecommunication Management Network is a protocol model defined by International Telecommunication Union (ITU) for network management of telecom networks. It is part of the ITU Recommendation series M.3000 and it follows open systems interconnection (OSI) standards management specifications in ITU Recommendation series X.700.

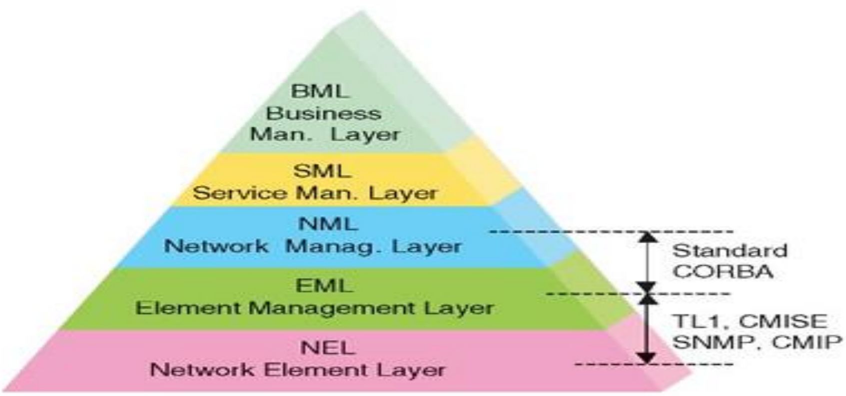

Fig. 1: TMN Layers

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TMN provides a framework for achieving coherence and communication across heterogeneous operations systems and telecommunications networks.

Main functions of TMN layers:

Business Management Layer (BML) – It includes the functions related to business aspects, analyzes trends and quality issues, for example, provide a basis for billing and high-level planning, budgeting, goal setting, executive decisions, business level agreements, financial reports.

Service Management Layer (SML) – It handles services in the network such as definition, administration and charging of services. Uses information presented by NML to manage contracted service to existing and potential customers. This is the basic point of contact with customers for provisioning, accounts, quality of service, and fault management.

Network Management Layer (NML) – It distributes network resources, performs configuration, control and supervision of the network. NML has visibility of the entire network, based on the NE information presented by the EML operational systems.

Element Management Layer (EML) – It deals with individual network elements including alarm management, trading of information, backup, logging, and maintenance of hardware and software.

Network Element Layer (NEL) – The network elements are physically located in this layer. It provides agent services and draws the physical aspects of the equipment into the TMN framework.

In the days before the deregulation and privatization of the telephone industry, there were fewer issues to deal with. In general, the network was composed of equipment from fewer vendors, thus there were fewer multivendor management issues. Also, the introduction and integration of new technologies and services proceeded at a slower pace.

Traditionally, the various services such as easy access, manipulation, storage, and exchange of information, reliable data transmission were carried via separate networks: voice on the telephone network, data on computer networks such as local area networks, video teleconferencing on private corporate networks, and television on broadcast radio or cable networks.

These networks were largely integrated for a specific application and are not suited to other applications. For example, the traditional telephone network is too noisy and inefficient for bursty data communication. On the other hand, data networks which store and forward messages using computers had limited connectivity, usually did not have sufficient bandwidth for digitized voice and video signals, and suffer from unacceptable delays for the real-time signals. Television networks using radio or cables were largely broadcast networks with minimum switching facilities.

B. Optical Networks.

In fiber optic networks, it uses a connection for data transmission between source and destination nodes via light paths. The optical signal transmitted along a light path requires optical cross-connect switches (OXCs) and telecommunication carriers to switch high-speed optical signals. As signal travels from source to destination, the signal quality deteriorated continuously by optical network components and impairments.

Optical network technology provides enormous capacity to transport data. It has led to the development of optical network elements. Management of optical transport networks typically includes fault, configuration, accounting, performance, and security (FCAPS) management. To manage network devices and services various organizations have developed standard management platforms using different management protocols.

II. BACKGROUND

The management frameworks were designed keeping in view the requirements of specific technology or network. These traditional systems such as Simple Management Network Protocol (SNMP) are more technology oriented, network centric, centralized and weakly distributed management schemes. The SNMP architecture is based on manager-agent model and it has five basic components - manager, agent, managed device, database of Management Information Base (MIB) and network management protocol as shown in Fig.2

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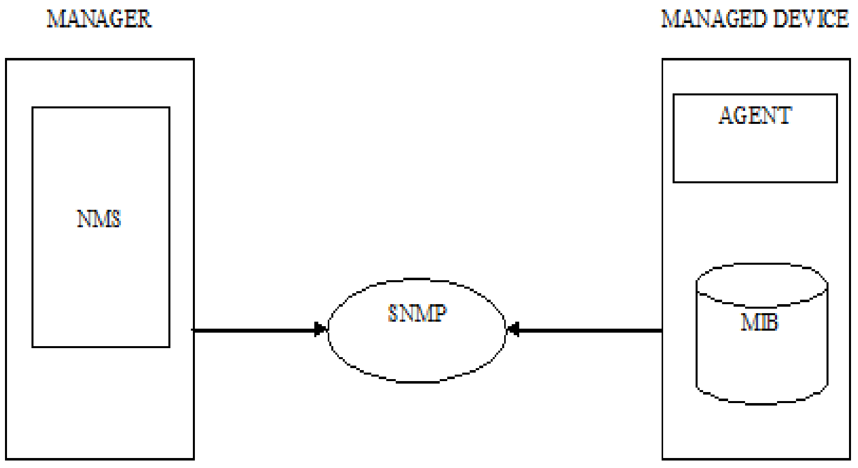

Fig. 2: SNMP Architecture

The manager provides an interface between the human network manager and the management system. The agent provides an interface between the manager and the actual device(s) being managed, such as bridges, hubs, routers or network servers. These managed objects might be hardware, configuration parameters, performance statistics, and so on… These objects are arranged in what is known as a virtual information database, called a Management Information Base, also called MIB. SNMP allows managers and agents to communicate for the purpose of access to these objects.

An SNMP-managed network consists of three main components:

- Managed device
- Agent — software which runs on managed devices
- Network management station (NMS) — software which runs on the manager

A *managed device* is a network node that implements an SNMP interface that allows unidirectional (read-only) or bidirectional (read and write) access to node-specific information. Managed devices exchange node-specific information with the NMSs.

An *agent* is a network-management software module that resides on a managed device. An agent has local knowledge of management information and translates that information to or from an SNMP-specific form.

A *network management station* (NMS) executes applications that monitor and control managed devices. NMSs provide the bulk of the processing and memory resources required for network management. One or more NMSs may exist on any managed network.

SNMP Limitations:

The traditional network management architecture does not meet the requirement. Networks are in rapid expansion, more agents need to be added. It increases the amount of data resulting in complex heterogeneous network. SNMP protocol stack with less operational commands is not sufficient and not able to provide scalability. SNMP is based on connectionless protocol User Datagram Protocol (UDP) which makes it unreliable because one is never sure whether operations Set, Get or even Trap issued are received or not, moreover there is no means to be assured whether command issued is successful as per requirement. Managed objects stated in SNMP are modeled on variable oriented and does not have inherited properties. SNMP wastes bandwidth with unnecessary information carried out in each message like SNMP version, multiple lengths and data descriptors etc. SNMP does not provide any link between business requirements and technology, i.e., with changing business needs. SNMP framework cannot reconfigure managed elements automatically.

III. PROPOSED SYSTEM

The OMS helps to monitor numerous network elements at a time and reduces the need for manual intervention in managing global networks. The Optical Management System is a network management system that supports several management layers that can accommodate and grow with a customer's optical network. The development of optical management system software makes the monitoring and management of an entire customer's telecommunication network secure, simple and easy for a Network Operations Center (NOC) operator and also centralizes multiple network management functions in one unified management system reducing the operational costs, complexity enhancing the efficiency and customer satisfaction along with the various network management applications.

OMS is component based architecture. The component based architecture makes the components reusable so that they can be used in different scenarios in different applications and also makes it easily replaceable. The components also become independent as they have minimal dependencies on the other components. They also become extensible and also non context specific.

System Overview:

OMS follows a multi-layer architecture consisting of WEB, Network Management Layer (NML) and Element Management Layer (EML). As shown in below Fig. 3.

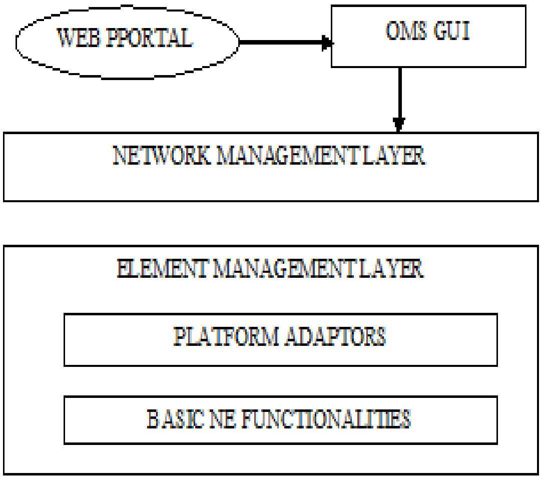

Fig. 3: OMS block diagram

Smart Network Adapter (SNA) is part of EML Layer. It manages NE's and reduces load on NE. Communication Manager (CM) is one of the components present in SNA which takes care of communication management services of NE. All the requests coming from Physical Network Management (PNM) are Common Object Request Broker Adapter (CORBA) requests. PNM acts as north bound interface/client to SNA. Then requests are internally converted to XML Over Socket (XOS) requests and sent to Network Adapter (NA) framework for further processing. Framework maps the correct feature and calls the CM feature class dynamically using a mapping between functions and features classes.

Communication Manager is a component in Smart Network Adaptor and provides the functionalities like:

1) Adding a NE,
2) Modifying NE parameters/variables,
3) Start/Stop Supervision on NE.
4) Detecting NE Isolations
5) Deleting a NE,

These functions are performed by only authorized clients. The authentication of clients is verified and validated by login credentials and IP address. From the higher layer request comes to SNA. SNA parses the request and constructs object. This object is sent to communication layer which intern will create command. This command is sent to NE. When response comes from NE, the next step SNA validates response sends to higher layer. The below Fig. 4 shows the block diagram of the system. Feature dispatcher block decides to which feature the request has to be sent. Notification handler block handles all the trap notifications and response notifications coming from network element. Communication layer block is responsible for sending the request to proper network element. The network may contain different types of NEs. Such as Transaction Language 1 (TL1) NEs, Command Line Interface (CLI NEs), SNMP NEs. Communication Manager Block handles different functions as discussed below.

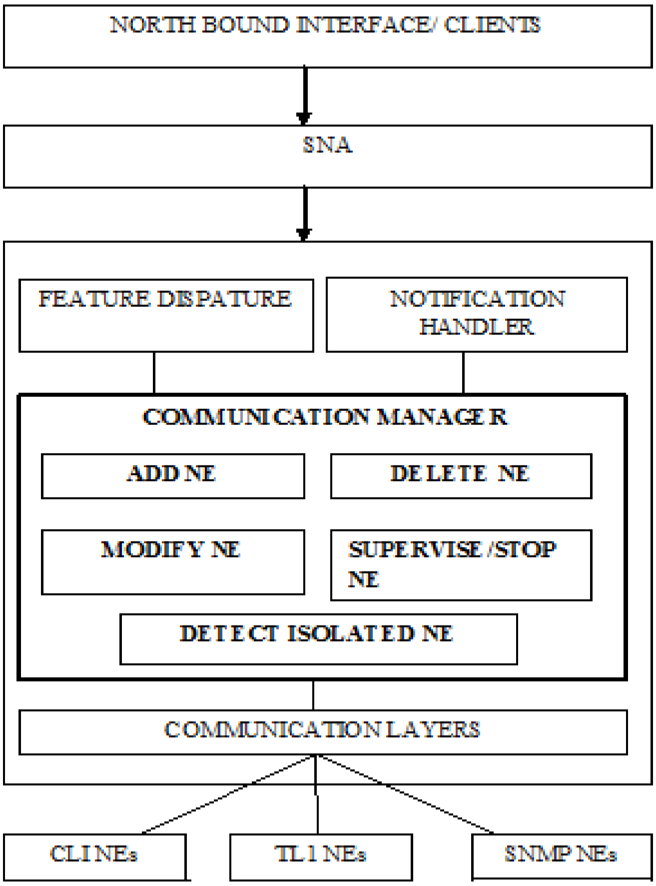

Fig. 4: Block diagram of system.

Addition of NE:

PNM user fills all the details in Graphical User Interface (GUI) form presented such as NE Type, NE release, user label, location, EML domain for adding a NE and upon submission the request reaches SNA pnm layer. After un-marshalling the XOS request, validations are performed and the NE is stored in SNA DB. Finally successful or failure response is sent to the caller.

Modifying NE parameters/variables:

After the addition of NE, modifications can be performed like user label, NE release, location can be changed by clicking modify NE parameter option in GUI. The NE Attributes will be updated accordingly in data base.

Start/Stop Supervision on NE:

Once the NE is added it needs to be supervised so that it can be monitored from OMS Graphical User Interface (GUI). To supervise the NE, first session has to be established with NE. Then using commands login into NE. As

ACT-USER:::log in id::password;

ACT-USER means activate user session. After successful login NE parameters are retrieved and validated with SNA database. If validation is successful then equipment synchronization, alarm synchronization, and parameter synchronization operations are performed. After receiving success message NE is moved to supervised state and its communication status is changed to reachable.

During the Stop supervision operation first whether NE is in supervised state or not is verified. If NE is not supervised then request is rejected and message is sent to client. If NE is in supervised state, then command is sent to NE as CANC-USER;

This command used for cancel user session. Upon successful execution of command NE is deactivated and response is sent to client. The NE communication status will be changed to unreachable.

Detecting NE Isolations:

The OMS performs Heart beat check on NE. Means OMS ping's NE for every 7 minutes. During this operation if response from NE does not come then application decides that NE is isolated. Then alarms will be generated to notify the operator through OMS.

Deleting a NE:

When the client wants to remove the NE from network, they perform delete NE operation. During this operation logout command will be sent to NE, and delete query will be executed based on NE ID. Upon successful execution of command, SNA database NE entry will be cleared. Then notification is generated and success response notification is sent to client

III. CONCLUSION

The OMS provides end-to-end optical network management of an entire transport network and reduces the need for manual intervention in managing global networks and also helps to monitor numerous network elements at a time. The communication manager application presented supports new network element release. It provides secure, simple and easy method for NE addition, parameter modification, deletion, supervision. This application helps customers to add the new element easily and configure it for monitoring continuously. The application also provides easy methods for detection of errors such as isolated NE by giving proper alarms to clients. OMS provides comprehensive and integrated network management from a single system and reduces complexity of the network and improve efficiency.

The CM application in the optical management system developed focuses on fault management, configuration management, performance management and security management. The Element management layer along with the network management layer monitors and manages the entire telecom network of a service provider.

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