Network Management Solution for the Next Generation Networks

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Abstract: - The rapid development of the Information Technology (IT) and the introduction of new technologies have provided new possibilities for Telecommunications and Networking (T&N). Next Generation Networks (NGN) are characterized by increasing complexity, intelligence, heterogeneous technologies, multitude of vendor products and increasing user expectations from the networks. Simple and empirical Network Management (NM) of the previous years was replaced by homogeneous standards using the Manager/Agent (Client/Server) approach proposed by International Standards Organization (ISO). Afterwards new principles of management by delegation, peer-to-peer management and Web-based approaches emerged. However, carrying out the Fault, Configuration, Accounting, Performance and Security (FCAPS) functional areas for Network Management in NGN will require new approaches. In this paper, we have presented Network Management Solution for the Next Generation Networks. The goal is to develop a solution for Operations and Business Support Systems (OSS/BSS) based on Telecommunications Management Network (TMN) architecture with flexible, intelligent, and brilliant capabilities in Network Management, Customer Care and Billing (CC&B), Provisioning, Ordering, Service Level Agreements (SLAs), and Business Level Strategic Management for the existing and Next Generation Networks.

Key-Words:- Information technology, Network management solution, Telecommunication management network, Next generation networks, Operations support systems, Business support systems

1 Introduction

Network Management (NM) used to be simple and empirical when most networks were homogeneous i.e., in ancient times (about 10 years back [1], [3]). The situation prevalent today with ubiquitous heterogeneous networks, calls for more involved, standardized, ordered and acceptable ways to manage these rapidly changing, converging and evolving Next Generation Networks (NGN).

Given the plethora of networks that exist today, and the associated difficulty in managing them, Network Management (NM) has gained lot of importance. Apart from NM, Operations and Business Support Systems (OSS/BSS) is also viewed as an emerging area. OSS gives the ability to create, deploy, manage and maintain network-based systems such as billing, Network Management (NM), customer handling service management and ordering. Thus, besides the NM, the future management services need to handle the vastly increased requirements of OSS and BSS as well [6].

The transition from hostcentric and homogeneous computer networks to Local Area Networks (LAN) (Client-Server and Peer-to-Peer), Metropolitan Area Network (MAN), Wide Area Networks (WAN), and Global area Networks (GAN)/Internet and the recent convergence of data networks with telecom networks, has thrown open a major challenge for creating their management infrastructure and control structures. The problem is further compounded by connection of products from multitude of vendors operating with diverse protocols [7]. Also, the computer in the new millennium technology

has expanded to include PCs, Workstations, Laptops, palm-held computers, and other computing devices with intelligence and ability to communicate with each other.

The scope of this paper is to state a policy for the management of Computer network related parameters to achieve the ultimate goal of Business Level Management (BLM). The aim is to bring the business interests of any business that has a supporting Computer Network into a common framework. In this paper we will be analyzing the various strategies that can be used to do the same.

2 Network Management Solution - Perspective

Network Management System (NMS) solution can be implemented in any network environment consisting of various network elements and IP-Subnets. The solution consists of four modules namely Agent, Manager, Database, and Graphical User interface (GUI). NMS will be discovering all the Network Elements (NEs) on the basis of IP-Address. Once all the NEs are discovered, NMS will find the value of SNMP [2] and Operating System (OS) related parameters from the agent and store the same into the database. NMS has the Monitoring Manager to allow the user to set the policies for various parameters and keep a watch on those. NMS will be generating reports as specified by the user. Invocation of discovery and Inventory and Reporting modules will be logged on to the Application Log Manager by the module itself. Every event fired will be logged into NMS on will reach the lower layer of the TMN framework and will act as the framework for the development of SLAs.

3 Network Management Solution - Architecture

TMN [4] is being developed by the ITU-T [8] as the framework to support the *open* management of networks and services, exploiting the capabilities of emerging broadband technologies and harnessing their power. It projects a hierarchical distributed paradigm in which interactions are object-oriented (O-O) in information specifications terms. On the other hand, it is mainly a *communications* concept, and, as such, it does not address software realization aspects. TMN has become a necessity with the advent of a new generation of telecommunications services that break away from basic telephony. The important aspect that makes TMN important is the proliferation of advanced services supporting multimedia, multi-party and mobility features, which need comprehensive service management facilities and Quality of Service (QoS) control, especially as they may be sold according to QoS agreements. The TMN architecture provides a framework that tries to address these issues through a management model based on hierarchical decomposition and abstraction and through the deployment of object-oriented information specification and access principles that result in reusability and generic ability. The TMN architecture [5] is specified as a five layered system as described below.

(i) Network Element Layer (NEL) (Managed Objects)
(ii) Element Management Layer (EML) (Agent/Manager)
(iii) Network Management Layer (NML) (Manager)
(iv) Service Management Layer (SML)
(v) Business Management Layer (BML)

3.1 Architecture - Logical Layer and Functional

Network Management System (NMS) solution is focused on functionality development of lower three layers of TMN architecture. These layers are Network Element Layer (Agent) Element Management Layer (Agent/Manager) and Network Management Layer (Manager). The Logical Layer Architecture is shown in Fig.1. At the lowest layer, there are manageable objects collecting information, which can be used by upper layers. These managed objects can be terminals, hubs, routers, switches, servers, bridges, and applications, etc. At the next layer (i.e. Element management layer), Agent Software resides which in turn keeps track of various network elements. Finally, Manager software resides in Network Management Layer (NML), who in turn keeps track of various Agents. The functional architecture is shown in Fig. 2

Fig. 1 Logical Layer Architecture

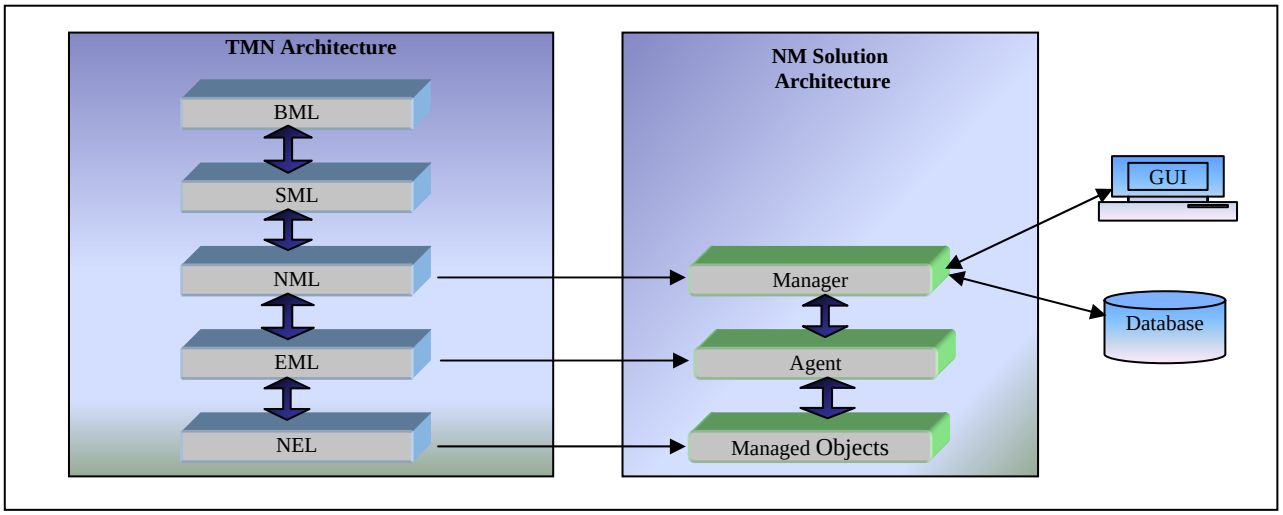
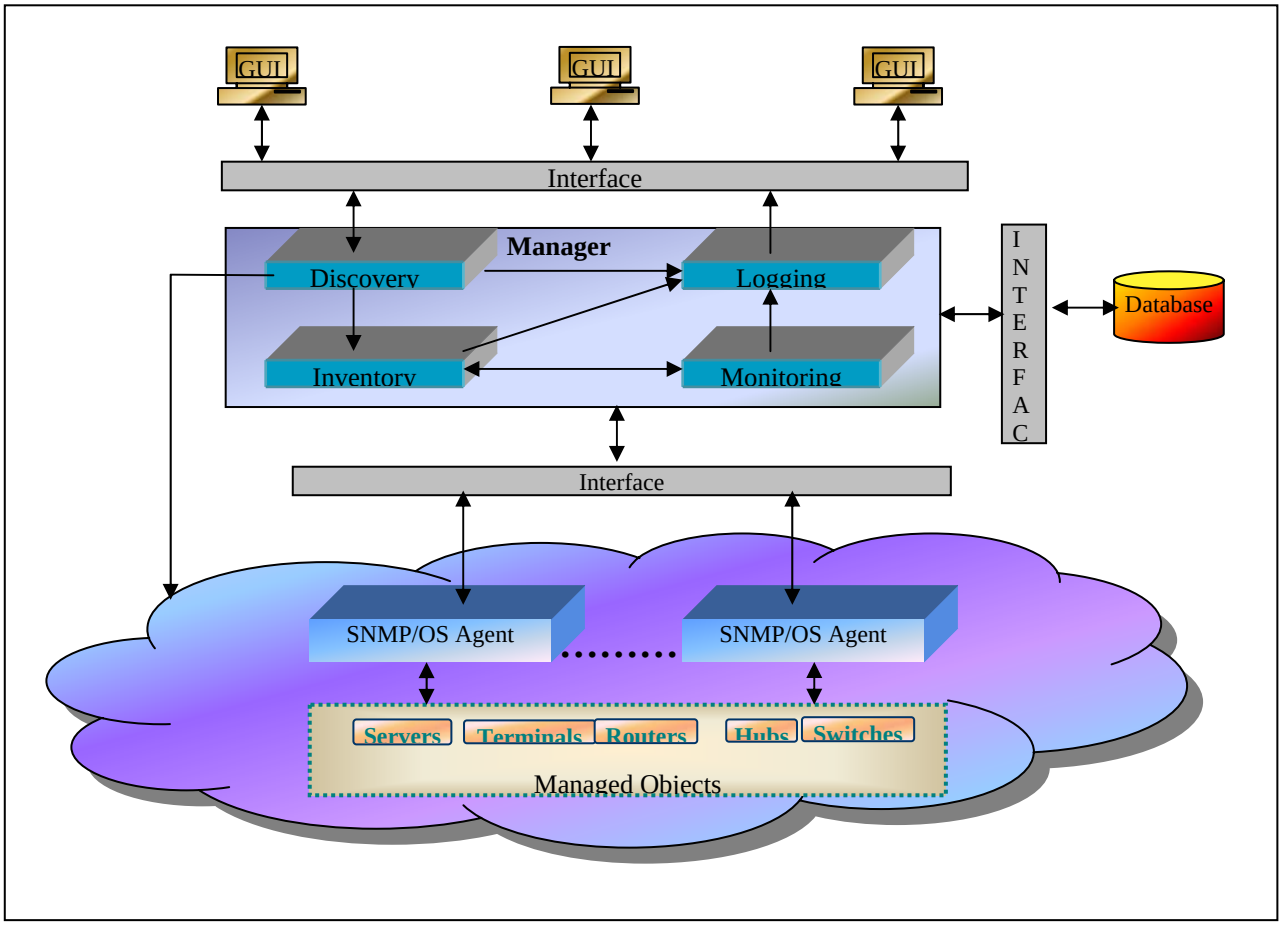


Fig. 2 Functional Architecture



3.3 Solution Description

This product provides the solution for the SML of TMN architecture where the network is treated like a "cloud" with a set of capabilities that are available for any business. The aim of this product is to hide the implementation details of the network and yet produce accurate information that is readily available to the user so that one can take a decision based on the same. Solution consists of the following :

- Managed Objects
- Agent (OS Agent , SNMP Agent)
- Manager
  - Discovery Manager(Configuration Management)
  - Inventory Manager(SNMP Security)
  - Monitoring Manager (Fault, Configuration, Performance and Security)
  - Event Log Manager (Fault, Configuration and Performance Management)
  - Application Log Manager (Fault and Performance Management)
- Database
- Graphical User Interface

3.3.1 Agent Module

Agent Module resides at two lowermost layers of TMN architecture and responsible for managing one or more than one network elements. Agent module can be categorized into two types:

- OS Agent
- SNMP Agent

OS Agent is responsible for picking up Operating System (OS) parameters (UNIX/Linux and Windows 2000/XP/NT 4.0) from the managed objects and passing them to the Manager on request. Agent is OS dependent and can provide only the information for the OS on which it is developed.

SNMP Agent is responsible for deploying the complete SNMP framework (Manager Agent architecture). It provides SNMP communication and is responsible for fetching the information from SNMP MIB (Management Information Base) [9], [10] and [11] installed on the managed objects. This information will be passed to the manager on request.

3.3.2 Manager Module

The various sub-modules within main Manager module are described below :

Discovery Manager (Configuration Management):
Discovery is a basic function provided by any framework for network management. It provides the information about configuration of the network like identification of IP addresses present in the network and subnet classification.

Inventory Manager (SNMP Security):
Inventory Manager collects statistics from the network, stores them in a database, and presents the statistics in a GUI. Information can be gathered in response to the user query.

Monitoring Manager (Fault, Configuration, Performance and Security)
Monitoring Performance Manager monitors the network for performance and fault for a policy. It may store the information in the database if policy demands so.

Event Log Manager (Fault, Configuration and Performance Management) :

The Event Log Manager is responsible for the logging of events generated such as traps into the event log.

Application Log Manager (Fault and Performance Management) :

The Application Log Manager is responsible for logging of information about Discovery, Monitoring, and Inventory in the application log.

3.3.3 Database Module

The database module is responsible for storing the information gathered by all the modules of NMS. Database module provides integrated data for the trending purpose. This module categorized the information in the following manner:

- Discovery Database
- Inventory Database
- Monitoring Database
- Logging Database

3.3.4 Graphical User Interface

This module shows the data retrieved from the manager. The main screen is divided into the following:

- Menu Bar
- Network Tree View
- Tabbed pane
- Status bar

3.3.5 Interfaces

Interfaces handle the communication between various modules of NMS. Every module interacts with another either by exposing the interface or by using the interface provided by the other. Following list depicts the various interfaces.

- Manager Interface
- Agent Interface
- GUI Interface

3.3.5.1. Manager Interface

Manager module interacts with GUI, Database and Agent modules. Manager module only exposes the interface for GUI (RMI interface) while it uses the interfaces provided by the Database and Agent. The communication between SNMP agent and manager is done via SNMP/UDP transport mechanism.

3.3.5.2. Agent Interface

Agent module only interacts with Manager module. It works in the passive mode i.e. it cannot initiate the communication, it can only respond to the request. It doesn't use any interface other than the interface exposed by itself.

3.3.5.3 Database Interface

Database module only interacts with manager module and it exposes the interface for the use of Manager module. It doesn't need any other interface.

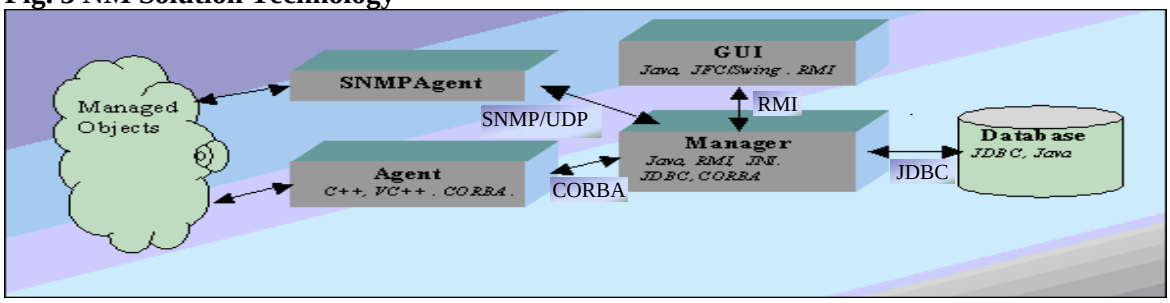
3.3.5.4 GUI Interface

GUI module only interacts with Manager module in two-way communication. It exposes the interface to the Manager as well as uses the interface provided by the Manager.

3.4 Technology

Technology used in each module for the NM solution shown in Fig.3.

Fig. 3 NM Solution Technology



4 Conclusion

In this paper, we have highlighted the NM solution for the existing and next generation networks. This solution is expected to provide significant new value for service providers by creating the first integrated end-to-end software suite for key telecom processes, including Business Support Systems (BSS), Operations Support Systems (OSS), Service Delivery Platform (SDP) and enterprise applications.

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