DESIGN AND IMPLEMENTATION OF A WEB-BASED INTERNET/INTRANET MAIL SERVER

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Abstract—Electronic mail service is one of the mostessential and well-known Internet/Intranet application services. Users expect their electronic mail service to be reliable and efficient, while administrators demand reliable and efficient tools to satisfy users' expectations. Mail server management system is a good solution for such requirements from different user groups. We have designed and implemented an SNMP manager and SNMP agent system that can manage Internet/Intranet mail server systems. This project entitled with "Quick Mail" is developed for Mail Transactions and Greetings Transactions through Intranet. This project has two navigations. The first one is user navigation and next one is Administration navigation. Before the user uses our services, the user must register their username and password. By entering the correct username and password, they can use our Quick Mail services.In our Quick Mail, user can add, remove and modify their friend's addresses by the Address Book option. The main purpose of this project is Mail and Greetings transactions. The user can send any mail to any Quick Mail user by the Compose option. The user can resend a message and can forward a message from the Inbox folder.Finally the user can Logged out safely from his Account. The system has been integrated with WWW technology such as Java and CGI. The Java-based GUI system enables human users to manage mail server systems from anywhere with friendly, easy-to-use Web browser interfaces. The system architecture is also general enough so that it can be easily extended to manage any other Internet/Intranet application services.

IndexTerms—Internet, Intranet, SNMP manager, Quick Mail, WWW technology.

I. INTRODUCTION

The rapid growth of the Internet and World-Wide Web (WWW) [1] has allowed more people access to global computer network and network applications. Internet Service Providers (ISP) profit by offering many kinds of Internet services such as electronic mail, WWW, FTP, and others.

II.

Some closed computer user groups such as companies, research centers, or a universities, have opted for smaller, Internet-like network environments called 'Intranets'. Intranets provide integrated network services using Internet technologies that are, technically, the same as Internet's. Intranet services, however, are more integrated and task-specific services with consistent user interfaces. Intranet is gradually replacing old proprietary messaging systems such as Bulletin Board Systems (BBS) and document processing systems.

III.

Electronic mail service is one of the most popular and essential services in both Internet and Intranet. There could be no Internet/Intranet services without the electronic mail service. Mail server is a computer system that sends and receives electronic messages for a number of users in a certain management domain. Mail servers are connected to networks and should reliably process incoming and outgoing mail messages. Sending and receiving tasks are actually processed by a special software called mail server program running in the mail server. The most widely-used Internet mail server program is sendmail, which was first developed in 1982 for 4.1 BSD UNIX system [2].

IV.

Since electronic mail service is booming, mail servers are handling more and more user messages. The mail server's and reliability do not always satisfy user requirements. Even when the mail server runs normally, the administrator of mail server need to know the current status of servers. They need to know how many mail messages their system processes, how many errors occur when the system handles messages, how much hardware resources their system needs, and more. Systematic management of electronic mail servers naturally has evolved so mail server administrations may satisfy expanding market demands.

V.

Systems and services management has become very important area of research and development, coinciding with the need and establishment of international standards. For example, ISO/ITU-T has developed the OSI management framework [3]. The managing complexity of the OSI model, for Internet-based systems and services, motivated Internet Engineering Task Force (IETF), to create a simple and light management framework called Simple Network Management Protocol (SNMP) [4]. For our research, we have chosen SNMP as the mail server management framework.

VI.

There is another big trend in the systems and services management. As WWW technologies are rapidly evolving, those technologies such as Java [5] and Common Gateway Interface (CGI) [6] are applied to many computing areas. Systems and services management is one of such areas that WWW technologies can be adopted to increase the efficiency and usability of management systems.

VII.

Web-based management has a lot of benefits [7]. It is hardware independent. Web technologies are general enough to be applied in any hardware platforms. It is a cheap and ubiquitous solution in most computing areas. Users access management systems using Web browsers. No other additional investment is needed. Using Web browser is trivial and very easy to learn. It is also location independent. Wherever you are, you can connect to the management server and check the current system status anytime.

VIII.

In this paper, we present the design and implementation of an Internet/Intranet mail server management system. The system integrates two different technologies – the SNMP and the Web. Our system combines advantages from both technologies so people may remotely

manage their mail server systems easily and effectively. We have made our design general enough to be extended to manage any Internet/Intranet service such as WWW, FTP, or gopher.
 IX.
   The remainder of this paper is as follows. Section 2 explains SNMP and Mail Monitoring MIB. Section 3 presents the design of our management system in detail. Section 4 presents the implementation details of our Web-based Internet/Intranet mail server management system. Section 5 summarizes our work. While creating a mail id, the user has to register himself as a member of the mail system. For that, the user has to provide his personal information such as member name, member id, address those which are required by the system. Our system validates all those information, save their details and registers the user as a member of this system. The system will automatically update the member details whenever he modifies the data and it will display the account information.

   Now the user becomes a member of the mail system. So that, he has the ability to utilize the mail services. The system provides the services such as composing mails, sending the mails and receiving the incoming mails.

   Whenever the user enters into the system for mail access and for mail transfer, the system asks the user to enter the member ID and the password. The System confirms that whether the user ID is valid or not and take necessary actions depending upon the validations. If he is the valid user, then he could allow to enter into the system.

   While composing the mail, the user has to enter the information such as the mail ID to whom the message has to be sent, and a collection of mail Ids to whom the same copy has to be transferred and the actual message.

   The user can also attach a file such an image file or an audio/video file along with the mail. While receiving the mail, the system will collect all the mails which are posted for your mail ID. These incoming mails can be opened depends upon the user's desire. The user has the rights to delete any unwanted message received by the system.

   The Deleted messages are stored in the Trash folder. Sometimes, there is a situation may arise such that the user want to recover the deleted messages. For that, the system provides the 'Recovery' option to recover the removed mails to its actual position.

   Our customers require a mail service that is interactive and user friendly. Our system satisfy the customers by sending their mails to the corresponding recipients and store the incoming mails in secured manner and display them to customers whenever they open the mail page. The facilities such as creating an 'Address Book' for every user like the telephone directory which provides quick will enhance your system.

II. SNMP and Mail Monitoring MIB

   Simple Network Management Protocol (SNMP) is a standard protocol suite for the Internet network management. Internet Engineering Task Force (IETF) first standardized the protocol and initiated SNMP-based management. The original targets for this effort were TCP/IP routers and hosts. However, the management architecture is inherently generic so that it can be used to manage various types of systems.

   The SNMP network management model consists of the following elements [8, 9]. SNMP management defines two network entities, managing system and managed system, and the communication methods between two entities. Managing system contains one or more processing elements called management applications, shortly, managers. Manager performs management functions over managed nodes it controls. Each managed system has a processing entity called an agent which gathers various management information from the managed system. SNMP itself is a set of communication methods between manager and agent. The protocol defines three basic operations, GET, SET, and TRAP. The GET operation is initiated by a manager for retrieving management information from an agent. When the manager needs to change management information in managed systems, the manager performs the SET operation on the specified agents. The TRAP operation is an unsolicited communication from agents to managers. Agents send TRAP information to specified managers when managed system initiates any events.

   Management information and events used in the SNMP management model should be clearly defined in predetermined formats. The Structure of Management Information (SMI) [10] includes the model of management information and events, the allowed data types, and the rules for specifying management information and events. It sets the rules for how management information is described and stored. Management Information Base (MIB) [11] is a set of related management information, events, and implementation compliance requirements following SMI rules. A MIB represents a collection of managed objects and each managed object can be managed remotely by managing MIB information via SNMP operations. MIB information is written in the subset of Abstract Syntax Notation ONE (ASN.1) [14]. When a networked system is to be managed by SNMP, the first thing to do is to define MIB for the system.

   There are many SNMP MIB modules developed by IETF working group for various kinds of network elements such as bridges, routers, hubs, printers, workstations, Internet service systems, etc. The MIB modules are standardized and published in RFC documents. In order to identify each MIB module SNMP uses object identifier (OID) found in ASN.1. OID values are organized in a tree structure so that each OID value is assigned to the unique object. This scheme is created by the ISO and ITU-T and SNMP MIB modules are located in a subtree of the OID tree.

   RFC 2249 [13] defines MIB for monitoring of Internet/Intranet mail server systems. It extends the basic Network Services Monitoring MIB defined in RFC 2248 [12] to allow monitoring of Message Transfer Agents (MTAs). MTA is a more general term representing the mail server system. RFC 2249 has OID, 1.3.6.1.2.1.28 which is located in SNMP MIB modules. **Figure** 1 shows the location of MTA MIB in the OID tree structure.

   Internet/Intranet mail server management system presented in this paper is based on the RFC 2249 MIB module. We haveextended the Mail Monitoring MIB to handle SNMP TRAP operations. SNMP agent system has been developed to monitor the MIB information in mail server systems and SNMP manager functions are defined to have access to the MIB information from agents.

   RFC 2249 Mail Monitoring MIB defines four tables. The first of these contains per-MTA information that is not specific to any particular part of MTA. The second breaks each MTA down into a collection of separate components called groups. The third table provides a means of correlating associations with specific groups within different MTAs. Finally, the fourth table provides a means of tracking any errors encountered during the operation of the MTA. The first two tables must be implemented to conform with this MIB; the last two are optional [13].

   Since defining MIB for managed system is the first step in developing a management system, RFC 2249 is the key basis of our system design. In the following section, we describe how we have modified the Mail Monitoring MIB for designing our Web-based mail server management system.

III. System Design

Our Internet/Intranet mail server management system has three architectural parts: SNMP agent, SNMP manager, and Java-based management application. SNMP agent is a process running on the mail server system that is supposed to be managed by SNMP manager. SNMP agent process keeps track of management information in the mail server system and provides the information to the SNMP manager. SNMP manager is a process running on the managing system that controls SNMP managed systems by communicating with the SNMP agent process. Java-based management application is a Java applet running on the human manager's Web browser. arious kinds of system management methods such as CMIP/CMIS, DMI, etc. However, SNMP is a lightweight, simple, and efficient management protocol among them. Also SNMP is widely used in many areas of management domains.

Use of Web technology: Web-based technology providesa lot of benefits in system and service management. Itenables developers to achieve easy, graphical, portable,and ubiquitous user interfaces. Management applicationswritten in Java programming language can be run onmany platforms without modifying the code. Both systemdevelopment and maintenance costs can be reduced whenthe Web-based technology is deployed.

Generic architecture for Internet/Intranet servicemanagement: We have designed our system not to bespecific to any hardware and operating systems so thatour system architecture can be used for developing any.

Internet/Intranetservice management system. Bymanagement system is illustrated in Figure 2. For each Internet/Intranet mail server process (called Message Transfer Agent or MTA), an MTA agent process is assigned to monitor management information defined in RFC 2249 MTA MIB module. MTA manager process should be able to handle one or more of MTA agent processes by sending and receiving SNMP messages with each agent process. Web technologies are used between manager system and management applications running in Web browsers.

Design Architecture

The design architecture of our Internet/Intranet mail server.

Management applications must be written in Java programming language so they can run on any Web browsers as Java applets. General Web servers are used for distributing the applet program, which has been stored in the applet storage, to Web browsers. Although **Figure** 2 shows Web server and MTA manager running in one system, the physical locations of Web server and MTA manager do not matter.

Management operations from human users are transferred to MTA manager which interacts with MTA agents using SNMP messages. Our design architecture is three-tier (i.e., user applications, middle layer manager, and agent) and highly flexible to be extended to manage other Internet/Intranet service systems.

IV. Implementation

In this section, the implementation details of our Internet/Intranet mail server management system are presented.

We have chosen Java as the main programming language of our system modules. Java which is developed by Sun Microsystems is a simple, object-oriented, interpreted, robust, secure, architecture neutral, portable, multithreaded, and dynamic programming language [15]. The language originally designed for controlling consumer electronics is now widely used in developing Web-based applications.

SNMP-based communication can be implemented easily by using Java. Java provides TCP/IP socket interfaces for such kinds of communication applications. However, there is much more efficient way of developing SNMP-based management system in Java. Java class package dedicated to SNMP communication is freely available from many organizations. Advent Net is one of such companies that provides SNMPv2c package written in Java [16]. It helps the developers of network management applications by simplifying SNMP interfaces. The library takes care of all the SNMP details underneath, so that programmers can concentrate on the implementation logic of management applications. Manager and agent modules for Internet/Intranet mail server management system are based on this SNMP package.

Implementation Architecture

The detailed implementation architecture of the proposed system is illustrated in **Figure** 3. Based on the design architecture presented in the previous section, we have realized the Web-based Internet/Intranet mail server management system. The implementation architecture is divided into three separate systems: Web browser, MTA manager system, and Internet/Intranet mail server system. MTA manager system includes Web server for downloading Java management applications. Internet/Intranet mail server system, which is to be managed via SNMP, contains MTA agent system and mail server process running in it.

Mail Server System

Internet/Intranet mail server system is the management target system. There are mail server process, SNMP agent process, and MIB updater in the mail server system. Mail server process is a general mail server process for sending and receiving user messages via Internet or Intranet. In our system, sendmail is chosen to be the managed mail server process because it is the most widely used mail server process in UNIX systems and is very flexible to be customized for management purposes. MTA agent system which includes SNMP agent process and RFC 2249 MIB module is responsible for agent parts of SNMP operations.

The SNMP agent processes answers SNMP SET and GET operations from SNMP manager and sends SNMP TRAP operation messages to SNMP manager.

The MIB module contains extended RFC 2249 MIB information for MTA process. In order to reflect status changes of mail server process to the MIB information, MIB updater process runs in background periodically. It reads the log files of sendmail process, extracts appropriatemanagement information from the log files, and stores the information in the MIB.

The SNMP agent is written in Java and the MIB updater is written in Perl programming language [18].

MTA Manager System

MTA manager system has several roles. It runs Web server for distributing Java-based management applications to Web browsers. The Web server is also used for showing static information pages in HTML. The manager system communicates with MTA agents via SNMP. It sends SNMP GET and SET operations to SNMP agent process and waits for SNMP TRAP messages from SNMP agent process. Finally, it summarizes and analyzes management information and reports the information to Java-based management applications.

Manager process consists of two different threads. SNMP manager is responsible for handling management operations from Java-based management applications. SNMP manager process sends SNMP GET or SET messages to the appropriate SNMP agent processes according to the management operations. Operation results or responses are manipulated by SNMP manager and transferred to Java-based management

applications.

The TRAP server process is a kind of daemon process constantly waiting for SNMP TRAP messages from SNMP agent processes. The process listens on the TRAP port and keeps the TRAP messages in files. The files can be retrieved by SNMP manager process regularly and SNMP manager process reorganizes the information to be displayed by Java-based management applications.

The Web server and MTA manager can be located on different computers. Since the Web server exists for distributing Java applet codes to Web browsers when requested by users, any Web server program can be installed for the purpose.
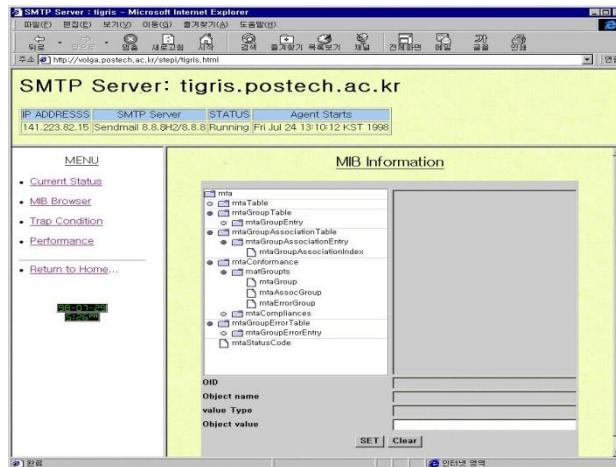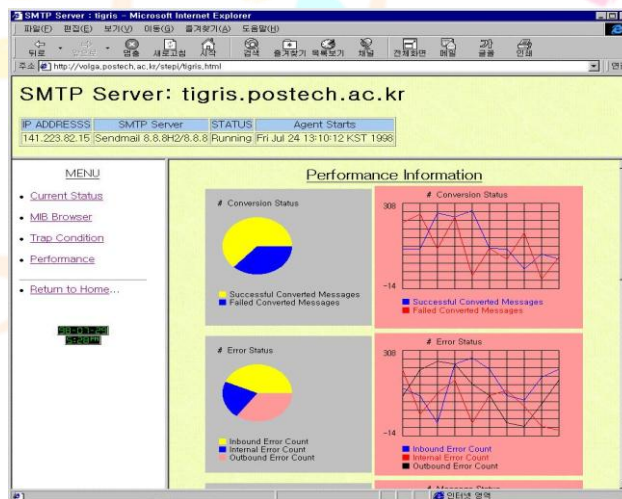

Figure 4. MIB Browser View Window

Figure 5. Performance View Window

· Performance view: This view (shown in **Figure** 5) illustrates statistical data of mail server system graphically, such as pie charts and history graphs. Pie charts can provide quantitative relations between management information, and history graphs can keep track of historical changes of statistical data.
· Trap condition view: This view controls trap condition parameters. Human user can increase or decrease TRAP condition threshold values in this view. TRAP condition history is also retrieved and analyzed in this view.

V. Conclusion

In this paper, we have presented the design and implementation of a Web-based Internet/Intranet mail server management system. We have used and integrated SNMP and Web technologies in developing our system. The SNMP management framework enables developers to create management applications easily and efficiently. We have defined SNMP MIB module for monitoring mail server process and have designed SNMP manager and agent system which can handle SNMP MIB information Web technology.

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