FINAL YEAR PROJECT REPORT

NETWORK ASSETS MONITORING AND SECURITY USING SNMP

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This report is submitted as required for the project in accordance with the rules laid down by the Federal Urdu University for Arts, Science & Technology as part of the requirements for the award of the degree of Masters of Computer Science (MCS). We declare that the work presented in this report is our own effort where due reference or acknowledgement is given to the work of others.

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Primarily, we are thankful to Allah for giving us the strength and ability to complete this project successfully; Our Parents for their support, encouragement and cooperation in every walk of life.

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It was with the help, guidance and cooperation of these people that we were able to achieve our objectives successfully.

ABSTRACT

Learning is the process whereby people acquire new skill or knowledge to enhance their working and academic performance. The important role of education towards the success of the economy cannot be underestimated as it brought about a new arena of Digital Learning, which is solution to training problems and challenges to the organizations.

This Project is about Network Assets Monitoring and Security Software using SNMP. We developed a client sever based application which mainly performs the following tasks:

Monitors the networking devices-switches and routers etc.
Does the asset management of networked devices—PCs, printers, scanners, networking devices and any SNMP enabled device may it be even a refrigerator or a heating system.
This application facilitates the job of the network administrator, who does not necessarily need to have an awareness of using such tools by providing user-friendly interface, which can easily be related to the way in which such tasks are performed.

Network Assets Monitoring and Security Software using SNMP can also be used in various other industries where the security of networked equipment is necessary.

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Chapter 1

Introduction

The major issue of administrator in big organization is hardware management. The work force of any organization includes hardware, if management of hardware not done properly then the work force may effect badly. Companies are investing lot of money on hardware management but they still not getting good results. Why? Because they do not automate it, if they automate it there will be less chances of error.

Inventory management is one of the main issues of mature industry. We also solve this problem by introducing auto registry. This system will register the workstation automatically as it plugged in to the network. If configuration of any hardware changes it will update it after the authentication of the administrator.

If the location of workstation is changed then administrator can update the system description, contact information etc. from server.

This report covers all the phases involved in the development of this software. Explaining each separately, chapter wise. Consists of 7 chapters, covering different aspects of the project.

Analysis and designing are considered the major phases in the development of any software. If not done properly, can result in a bad product and non conformance to requirements. Analysis and designing is given proper attention to avoid major bugs in later stages of development. Chapter 2 of this report highlights project planning done through data collection and various other techniques and designing steps for developing the software.
This is followed by chapter 3, which explains aims and objective followed by analysis phase in chapter 4. Another important area that is usually not paid attention to is feasibility analysis in terms of technical and operational feasibility has been covered in chapter 5.
Chapter 6 gives the task break up in implementing the software and explains each. Every software / product is incomplete with out thorough testing. Chapter 7 of this report explains

the various important pieces of the software, which were tested, their expected and actual results. Conclusion and future work in the end terminates the report.

References in the end give the reader, a list of websites, books and people referred in completing this report / product. The report has been written in a form, which would help the reader of technical or non technical background in clearly understanding the software and also as a guide in further enhancing its features.

1.2 Background of Snmp

The background study that has been carried out for proper analysis of SNMP (Simple Network Management Protocol) is as follows.

1.2.1 SNMP Overview

The Simple Network Management Protocol (SNMP) was introduced in 1988 to meet the growing need for a standard for managing internet protocol (IP).SNMP provides its user with a "simple" set of operations that allows these devices to be managed remotely. Many kinds of devices support SNMP including routers, witches, servers, workstations, printers, modem racks and uninterruptible power supplies (UPSs). The way you can use SNMP range from the mundane to the exotic: it's fairly simple to use SNMP to monitor the health of your routers, switches and other pieces of network hardwares, but you can also use it to control your network devices and even send pages or take other automatic action if problem arise.

SNMP usually associated with managing routers, but it's important to understand that it can be used to manage many types of devices. While SNMP predecessor, the Simple Gateway Management Protocol (SGMP) was developed to manage Internet routers, Snmp can be used to manage UNIX systems, Windows systems, printers, modem racks, power supplies, and more. Any device running software that allows the retrieval of SNMP information can be managed. This includes not only physical devices but also software, such as web servers and databases[1].

Another aspect of network management is network monitoring; that is, monitoring an entire network as opposed to individual routers, hosts, and other devices. Remote Network Monitoring (RMON) was developed to help us understand how the network itself is

functioning, as well as how individual devices on the network are affecting the network as a whole. It can be used to monitor not only LAN traffic, but WAN interfaces as well.

1.2.2 Before and After SNMP

Let us say that you have a network of 100 machines running various operating systems. Several machines are file servers, a few others are print servers, another is running software that verifies credit card transactions (presumably from a web-based ordering system), and the rest are personal workstations. In the actual network going. A T1 circuit connects the company to the global internet, and there is a private connection to the credit card verification system.

What happens when one of the file servers crashes? If it happens in the middle of the workweek, it is likely that the people using it will notice and the appropriate administrator will be called to fix it. But what if it happens after everyone has gone home. Including the administrators, or over the weekend?

What if the private connection to the credit card verification system goes down at 10 p.m. on Friday and isn't restored until Monday morning? If the problem was faulty hardware and could have been fixed by swapping out a card or replacing a router, thousands of dollars in web site sales could have been lost for no reason. Likewise, if the T1 circuit to the internet goes down. It could aversely affect the amount of sales generated by individuals accessing your web site and placing orders.

These are obviously serious problems – problems that can conceivably affect the survival of your business. This is where SNMP comes in. Instead of waiting for someone to notice for fixing the problem (which may not happen until Monday morning, if the problem occurs over the weekend), SNMP allows you to monitor your network constantly, even when you are not there. For example, it will notice if the number of bad packets coming through one of your router's interfaces is gradually increasing, suggestion that the router is about to fail. You can arrange to be notified automatically when failure seems imminent, so you can fix the router before it actually breaks. You can also arrange to be notified if the credit card processor appears to get hung – you may even be able to fix it from home. Moreover, if nothing goes wrong, you can return to the office on Monday morning knowing there will not be any surprises[1].

There might not be quite as much glory in fixing problems before they occur, but you and your management will rest more easily. We can't tell you how to translate that into higher salary – sometimes it's better to be the guy who rushes in and fixes things in the middle of a crisis, rather than the guy who makes sure the crisis never occurs. But SNMP does enable you to keep logs that prove your network is running reliably and show when you took action to avert an impending crisis[1].

1.2.3 SNMP and UDP

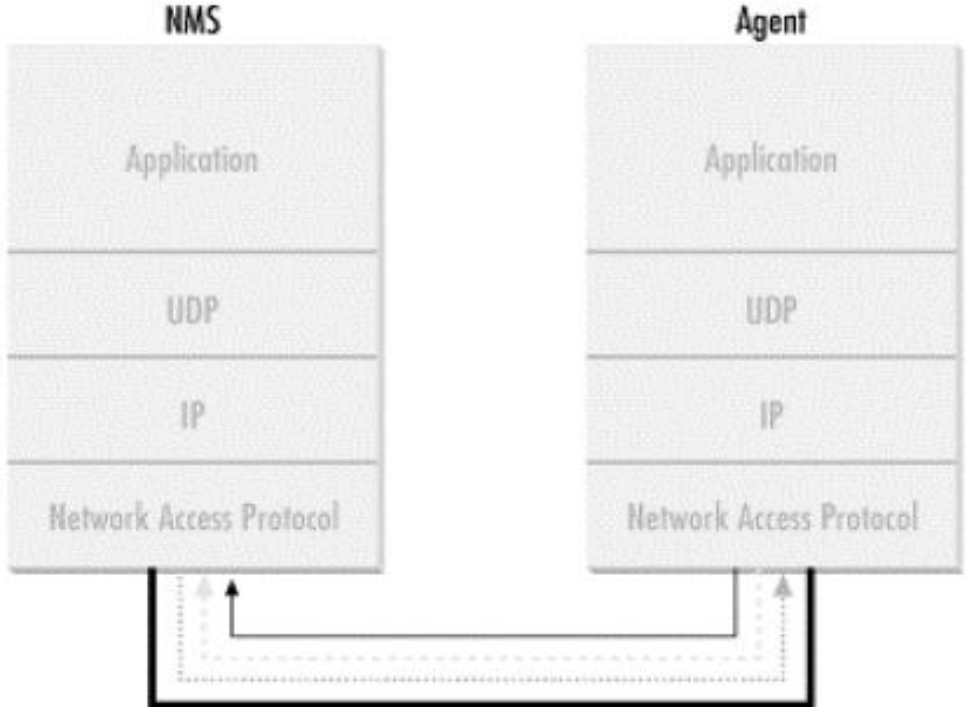
SNMP uses the User Datagram Protocol (UDP) as the transport protocol for passing data between managers and agents. UDP, defined in RFC 786, was chosen over the Transmission Control Protocol (TCP) because it is connectionless; that is, no end-to-end connection is made between the agent and the NMS when datagrams (packets) are sent back and forth. This aspect of UDP makes it unreliable, since there is no acknowledgement of lost datagrams at the protocol level. It's up to the SNMP application to determine if datagrams are lost and retransmit them if it so desires. This is typically accomplished with a simple timeout. The NMS sends a UDP request to an agent and waits for a response. The length of time the NMS waits depends on how it's configured. If the timeout is reached and the NMS has not heard back from the agent, it assumes the packet was lost and retransmits the request. The number of times the NMS retransmit packets is also configurable[2].

At least as far as regular information requests are concerned, the unreliable nature of UDP isn't a real problem. At worst, the management station issues a request and never receives a respond. For traps, the situation is somewhat different. If an agent sends a trap and the trap never arrives, the NMS has no way of knowing that it was ever sent. The agent doesn't even know that it needs to resend the trap, because the NMS is not required to send a response back to the agent acknowledging receipt of the trap.

The upside t the unreliable nature of UDP is that it requires low overhead, so the impact on your network's performance is reduced. SNMP has been implemented over TCP, but this is more for special-case situations in which someone is developing an agent for a proprietary piece of equipment. In a heavily congested and managed network, SNMP over TCP is a bad idea. It's also worth realizing that TCP isn't magic, and that SNMP is designed for working with networks that are in trouble – if your network never failed, you wouldn't need to monitor it. When a network is failing, a protocol that tries to get the data through but gives up

if it can't is almost certainly a better design choice than a protocol that will flood the network with retransmissions in its attempt to achieve reliability.

SNMP uses the UDP port 161 for sending and receiving requests, and port 162 for receiving traps from managed devices. Every device that implements SNMP must use these port numbers as the defaults, but some vendors allows you to change the default ports in the agent's configuration. If these defaults are changed, the NMS must be made aware of the changes so it can query the device on the correct ports.



---------- Response to Snmp request sent from the agent to port 161 on the NMS

Figure 1 A SNMP Architecture[3].

Shows the TCP/IP protocol suite, which is the basis for all TCP/IP communication. Today, any device that wishes to communicate on the Internet (e.g., Windows NT systems, UNIX Servers, Cisco routers, etc.) must use this protocol suite. This model is often referred to as a protocol stack, since each layer uses the information from the layer directly below it and provides a service to the layer directly above it.

When either an NMS or an agent wishes to perform an SNMP function (e.g., a request or trap), the following events occur in the protocol stack[1].

1.2.3.1 Application

First, the actual SNMP application (NMS or agent) decides what it's going to do. For example, it can send an SNMP request to an agent, send a response to an SNMP request (this would be sent from the agent), or send a trap to an NMS. The application layer provides services to an end user, such as an operator requesting status information for a port on an Ethernet switch.

1.2.3.2 UDP

The next layer, UDP, allows two hosts to communicate with one another. The UDP header contains, among other things, the destination port of the device to which it's sending the request or trap. The destination port will either be 161 (query) or 162 (trap).

1.2.3.3 IP

The IP layer tries to deliver the SNMP packet to its intended destination, as specified by its IP address.

1.2.3.4 Medium Access Control (MAC)

The final event that must occur for an SNMP packet to reach its destination is for it to be handed off to the physical network, where it can be routed to its final destination. The MAC layer is comprised of the actual hardware and device drivers that put your data onto a physical piece of wire, such as an Ethernet card. The MAC layer also is responsible for receiving packets from the physical network and sending them back up the protocol stack so they can be processed by the application layer (SNMP, in this case).

This interaction between SNMP applications and the network is not unlike that between two pen pals. Both have messages that need to be sent back and forth to one another. Let's say you decide to write your pen pal a letter asking if she would like to visit you over the summer. By deciding to send the invitation. You've acted as the SNMP application. Filling out the envelop with your pen pal's address is equivalent to the function of the UDP layer, which records the packet's destination port in the UDP header; in this case it's your pen pal's address. Placing a stamp on the envelope and putting it in the mailbox for the mailman to pick up is equivalent to the IP layer's function. The final act occurs when the mailman comes to your house and picks up the letter. From here the letter will be routed to its final destination, your pen pal's mailbox. The MAC layer of a computer network is equivalent to

the mail trucks and airplanes that carry your letter on its way. When your pen pal receives the letter, she will go through the same process to send you a reply[4].

1.2.4 SNMP Communities

SNMPv1 and SNMPv2 use the notion of communities to establish trust between managers and agents. An agent is configured with three community names: read only, read-write, and trap. The community names are essentially passwords; there's no real difference between a community string and the password you use to access your account on the computer. The three community strings control different kinds of activities. As its name implies, the read-only community string lets you read data values, but doesn't let you modify the data. The read-write community is allowed to read and modify data values; with the read write community string, you can read the counters, reset their values, and even reset the interfaces or do other things that change the router's configuration. Finally, the trap community string allows you to receive traps (asynchronous notifications) from the agent.

Most vendors ship their equipment with default community strings, typically public for the read-only community and private for the read-write community. It's important to change these defaults before your advice goes live on the network. When setting up an SNMP agent, you will want to configure its trap destination, which is the address to which it will send any traps it generates. In addition, since SNMP community strings are sent in clear text, you can configure an agent to send an SNMP authentication-failure trap when someone attempts to query your device with an incorrect community string. Among other things, authentication-failure traps can be very useful in determining when an intruder might be trying to gain access to your network.

There are ways to reduce your risk of attack. IP firewalls or filters minimize the chance that someone can harm any managed device on your network by attacking it through SNMP. You can configure your firewall to allow UDP traffic from only a list of known hosts. For example, you can allow UDP traffic on port 161 (SNMP requests) into your network only if it comes from one of your network-management stations. The same goes for traps; you can configure your router so it allows UDP traffic on port 162 to your NMS only if it originates from one of the host you are monitoring. Firewalls aren't 100% effective, but simple precautions such as these do a lot to reduce your risk[4].

1.2.5 SNMP OPERATIONS

The Protocol Data Unit (PDU) is the message format that managers and agents use to send and receive information. There is a standard PDU format for each of the following SNMP operation.

- Get
- Get-next
- Get-bulk
- Set
- Trap

1.2.5.1 The get operation

The get request is initiated by the NMS, which sends the request to the agent. The agent receives the request and processes it to best of its ability. Some devices that are under heavy load, such as routers, may not be able to respond to the request and will have to drop it. If the agent is successful in gathering the requested information, it sends a get-response back to the NMS, where it is processed. This process is illustrated in Figure.

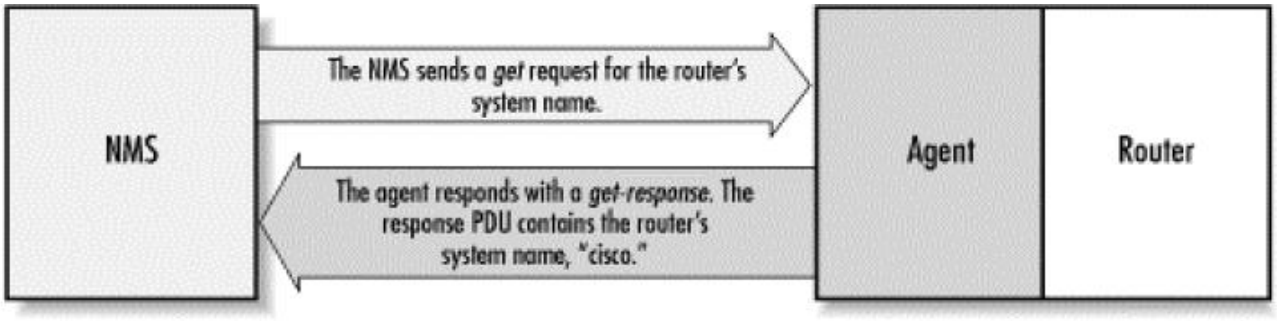


Figure 1 B: Get Operation

How did the agent know what the NMS was looking for? One of the items in the get request is a variable binding. A variable binding, or varbind, is a list of MIB objects that allows a request's recipient to see what the originator wants to know. Variable bindings can be thought of as OID=value pairs that make it easy for the originator (the NMS, in this case) to pick out the information it needs when the recipient fills the request and send back a response[11].

1.2.5.2 The get-next operation

The get-next operation lets you issue a sequence of commands to retrieve a group of values from a MIB. In other words, for each MIB object we want to retrieve, a separate get-next request and get-response are generated. The get-next command traverses a subtree in lexicographic order. Since an OID is a sequence of integers, it's easy for an agent to start at the root of its SMI object tree and work its way down until it finds the OID it is looking for. When the NMS receives a response from the agent for the get-next command it just issued, it issues another get-next command. It keeps doing this until the agent returns an error, signifying that the end of the MIB has been reached and there are no more objects left to get.

The get-next sequence returns seven MIB variables. Each of these objects is part of the system group as it's defined in RFC 1213. We see a system object ID, the amount of time the system has been up, the contact person, etc.

Given that you've just looked up some object, how does get-next figure out which object to look up next? Get-next is based on the concept of the lexicographic ordering of the MIB's object tree. This order is made much simpler because every node in the tree is assigned a number. To understand what this means, let's start at the root of the tree and walk down to the system node.

To get to the system group (OID 1.3.6.1.2.1.1). We start at the root of the object tree and work our way down. (Figure 1 C) shows the logical progression from the root of the tree all the way to the system group. At each node in the tree, we visit the lowest-numbered branch. Thus, when we are at the root node, we start by visiting ccitt. This node has no nodes underneath it, so we move to the iso node. Since iso does have a child we move to that node, org. the process continues until we reach the system node. Since each branch is made up of ascending integers (ccitt (0) iso (1) join (2), for example), the agent has no problem traversing this tree structure all the way down to the system (1) group. If we were to continue this walk, we'd proceed to system.1 (system.syslocation), system.2, and the other objects in the system group. Next, we'd go to interfaces (2), and so on[1].

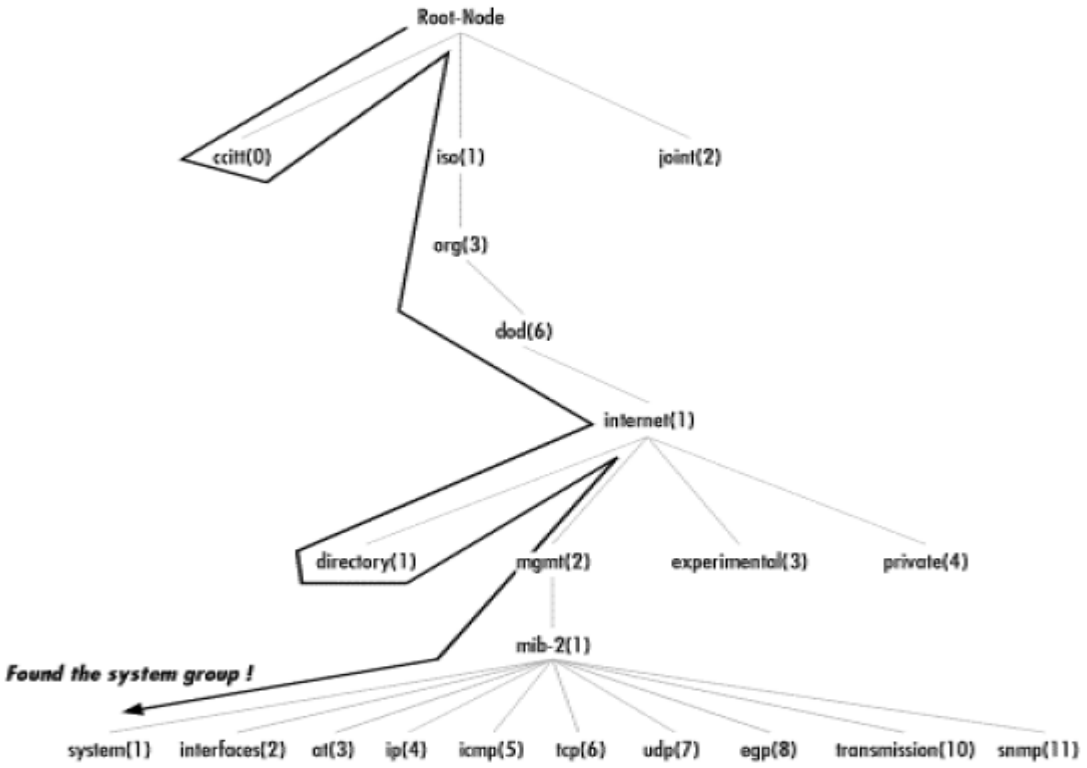
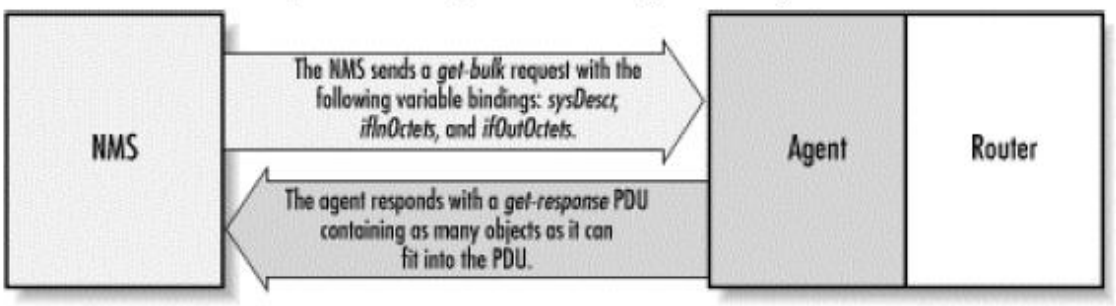


Figure 1 C: Get Next Operation

1.2.5.3 The get-bulk operation

SNMPv2 defines the get-bulk operation, which allows a management application to retrieve a large section of a table at once. The standard get operation can attempt to retrieve more than one MIB object at once, but message sizes are limited by the agent's capabilities. If the agent can't return all the requested responses, it returns an error message with no data.

The get-bulk operation, on the other hand, tells the agent to send as much of the response back as it can. This means that incomplete responses are possible. Two fields must be set when issuing a get-bulk command: nonrepeaters and max-repetitions. Nonrepeaters tells the get-bulk command that the first N objects can be retrieved with a simple get-next operation. Max-repetitions tells the get-bulk command to attempt up to M get-next operations to retrieve the remaining objects. Figure 1 D shows the get-bulk command sequence[1].



1.2.5.4 Get-bulk request sequence

In figure, we are requesting three bindings: sysDescr, ifInOctets, and ifOutOctets. The total number of the variable bindings that we have requested is given by the formula N+ (M * R), where N is the number of nonrepeaters (i.e., scalar objects in the request – in this case 1, because sysDescr is the only scalar object), M is max-repetitions (in this case, we have set it arbitrarily to 3), and R is the number of non scalar objects in the request (in this case 2, because ifInOctets and ifOutOctets are both non scalar). Plugging in the numbers from this example, we get 1+ (3*2) = 7, which is the total number of variable bindings that can be returned by this get-bulk request.

Since get-bulk is a SNMPv2 command, you have to tell snmpgetbulk to use a SNMPv2 PDU with the –v2c option. The nonrepeaters and max-repetitions are set with the –B 1 3 option. This sets nonrepeaters to 1 and max-repetitions to 3. Notice that the command returned seven variable bindings: one for sysDescr and three each for ifInOctets and ifOutOctets.

1.2.5.5 The set Operation

The set command is used to change the value of a managed object or to create a new row in a table. Objects that are defined in the MIB as read-write can be altered or created using this command. It is possible for an NMS to set more than one object at a time.

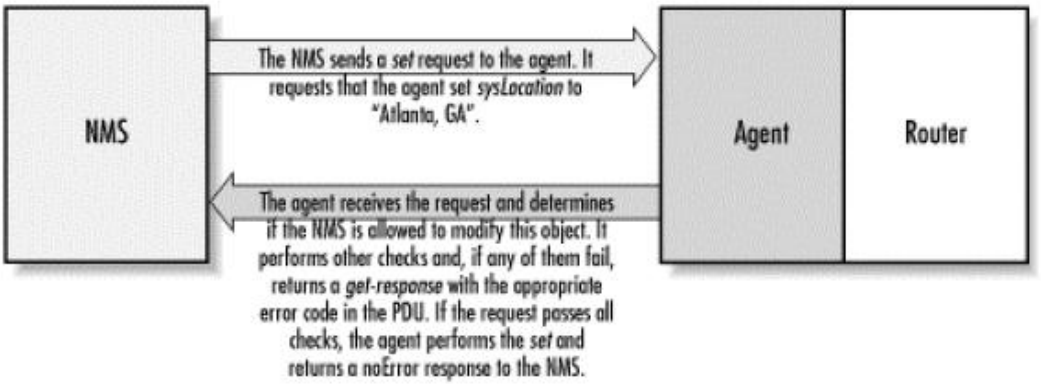


Figure 1 E: Set Operation

1.2.5.6 Set request response

Figure shows the set request sequence. It's similar to the other command, but it is actually changing something in the device's configuration, as opposed to just retrieving a response to a query. If we look at an example of an actual set, you will see the command take place.

1.2.5.7 SNMP Traps

A trap is way for an agent to tell the NMS that something bad has happened. Figure shows the trap-generation sequence.

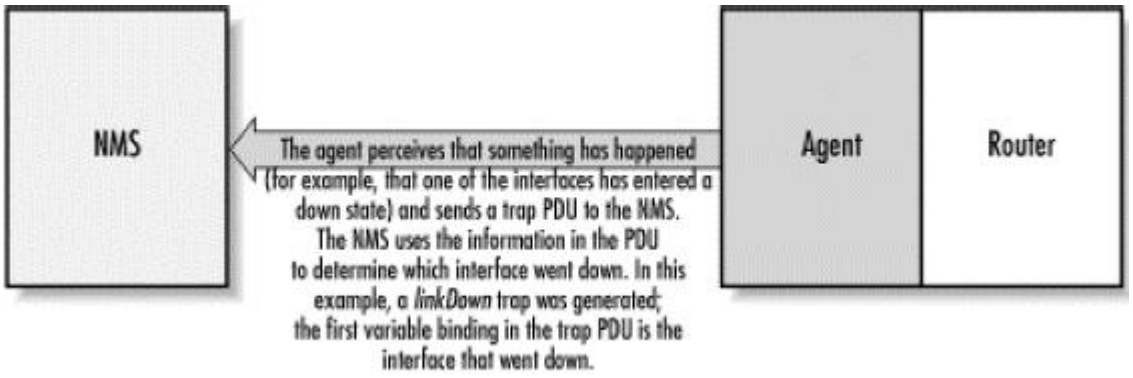


Figure 1 F SNMP Trap

1.2.5.7.1 Trap generation

The trap originates from the agent and is sent to the trap destination, as configured within the agent itself. The trap destination is typically the IP address of the NMS. No acknowledgment is sent from the NMS to the agent, so the agent has no way of knowing if the trap makes it to the NMS. Since SNMP uses UDP, and since traps are designed to report problems with your network, traps are especially prone to getting lost and not making it to their destinations. However, the fact that traps can get lost doesn't male them any less useful; in a well-planned environment, they are an integral part of network management. It's better for your equipment to try to tell you that something is wrong, even if the message may never reach you, than simply to give up and let you guess what happened. Here are a few situations that a trap might report[5]:

- **A network interface on the device has gone down.**
- **A network interface on the device has come back up.**
- **An incoming call to a modem rack was unable to establish a connection to a modem.**
- **The fan on a switch or router has failed.**

When an NMS receives a trap, it needs to know how to interpret it; that is, it needs to know what the trap means and how to interpret the information it carries. A trap is first identified by its generic trap number. There are seven generic trap numbers (0-6). Generic trap 6 is a special catch-all category for "enterprise-specific" traps, which are traps defined by vendors or users that fall outside of the six generic trap categories. Enterprise-specific traps are further

identified by an enterprise ID (i.e., an object ID somewhere in the enterprises branch of the MIB tree, iso.org.dod.internet.private.enterprises) and a specific trap number chosen by the enterprise that defined the trap. Thus, the object Id of an enterprise-specific trap is enterprise-id.specific-trap-number. For example when Cisco defines special traps for its private MIBs, it places them all in its enterprise-specific MIB tree iso.org.dod.internet.private.enterprises.cisco), you are free to define your own enterprise-specific traps; the only requirement is that you register your own enterprise number with IANA.

A trap is usually packed with information. As you'd expect, this information is in the form of MIB objects and their values; as mentioned earlier, these object-value pairs are known as variable bindings. For the generic trap 0 through 5, knowledge of what the trap contains is generally built into the NMS software or trap receiver. The variable bindings contained by an enterprise-specific trap are determined by whoever defined the trap. For example, if a modem in a modem rack fails, the rack's agent may send a trap to the NMS informing it of the failure. The trap will most likely be an enterprises-specific trap defined by the rack's manufacturer; the trap's contents are up to the manufacturer, but it will probably contain enough information to let you determine exactly what failed (for example, the position of the modem card in the rack and the channel on the modem card)[1].

1.2.6 RFCs and SNMP Version

The Internet Engineering Task Force (IETF) is responsible for defining the standard protocols that govern Internet traffic, including SNMP. The IETF publishes Requests for Comments (RFCs), which are specifications for many protocols that exist in the IP realm. Documents enter the standards track first as proposed eventually approved; the RFC is given standard status – although there are fewer completely approved standards. Two other standards-track designations, historical and experimental, define (respectively) a document that has been replaced by a newer RFC and a document that is not yet ready to become a standard[6].

1.2.6.1 SNMP Version 1

(SNMPv1) is the current standard version of the SNMP protocol. It's defined in RFC 1157 and is a full IETF standard. SNMPv1's security is based on communities, which are nothing more than passwords: plain-text strings that allow any SNMP-based application that knows

the strings to gain access to a device's management information. There are typically three communities in SNMPv1: read-only, read-write and trap.

1.2.6.2 SNMP Version 2

(SNMPv2) is often referred to as community string-based SNMPv2. this version of SNMP is technically called SNMPv2c. It's defined in RFC 1905, RFC 1905, and RFC 1907, and is an experimental IETF. Even though it's experimental, some vendors have started supporting it in practice.

1.2.6.3 SNMP Version 3

(SNMPv3) will be the next version of the protocol to reach full IETF status. It's currently a proposed standard, defined in RFC 1905, RFC 1906, RFC 1907, RFC 2571, RFC 2572, RFC 2573, RFC 2574 and RFC 2575. It adds support for strong authentication and private communication between managed entities[3].

1.2.7 Structure Management Information

The Structure of Management Information (SMI) provides a way to define managed objects and their behavior. An agent as in its possession a list of the objects that it tracks. One such object is the operational status of a router interface (For example, up, down, or testing). This list collectively defines the information the NMS can use to determine the overall health of the device on which the agent resides.

1.2.7.1 The Structure of Management Information

The first step toward understanding what kind of information a device can provide is to understand how this data itself is represented within the context of SNMP. The Structure of Management Information Version 1 (SMIv1, RFC 1155) does exactly that: it defines precisely how managed objects are named and specifies their associated datatypes. The Structure of Management Information Version 2 (SMIv2, RFC 2578) provides enhancements for SNMPv2.

The definition of managed objects can be broken down into three attributes:

NAME

The name. Or object identifier (OID), uniquely define a managed object. Names commonly appear in two forms: numeric and "human readable." in either case, the names are long and inconvenient. in Snmp applications, a lot of work goes into helping you navigate through the namespace conveniently.

1. **TYPE AND SYNTAX**

A managed object's datatype is defined using a subset of abstract syntax notation one (ASN.1). ASN.1 is a way of specifying how data is represented and transmitted between managers and agents, within the context of SNMP. the nice thing about ASN.1 is that the notation is machine independent. This means that a pc running Windows NT can communicate with a SUN SPARC machine and not have to worry about things such as byte ordering[7].

2. **ENCODING**

A single instance of a managed object is encoded into a string of octets using the Basic Encoding Rules (BER). BER defines how the objects are encoded and decoded so they can be transmitted over a transport medium such as Ethernet.

1.2.7.2 Naming OIDs

Managed objects are organized into tree- like hierarchy. This structure is the basis for SNMP's naming scheme. An object ID is made up of a series of integers based on the nodes in the tree, separated by dots (.). Although there's a human-readable form that's more friendly than a string of numbers, this form is nothing more than a series of names separated by dots, each of which represents a node of the tree. So you can use the numbers themselves, or you can use a sequence of names that represent the numbers. (Figure 1 G) shows the top few levels of the tree.

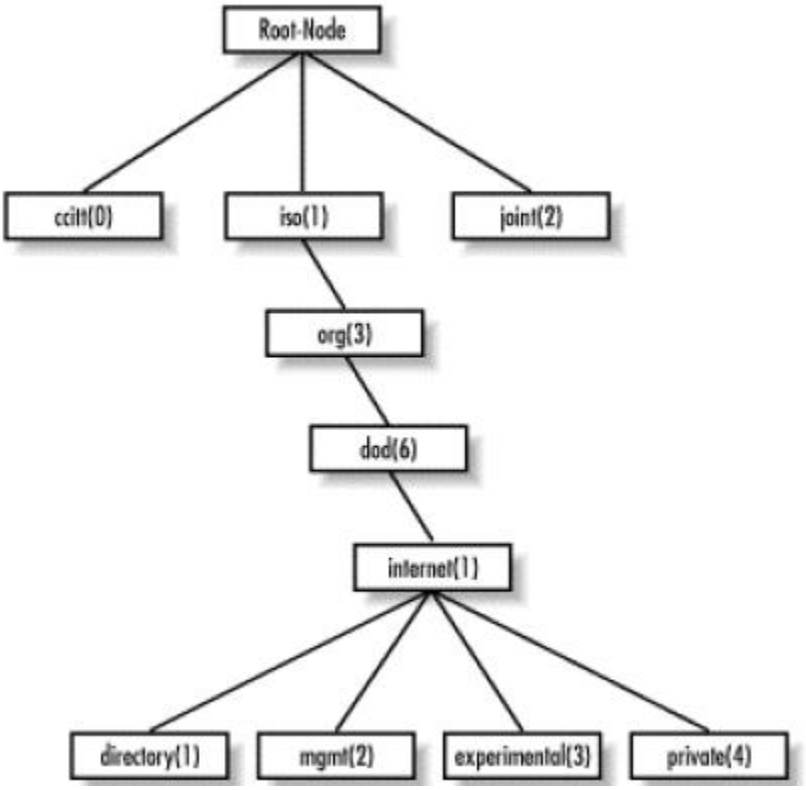


Figure 1 G: Naming OIDs[2].

1.2.7.3 SMI object tree

In the object tree, the node at the top of the tree is called the root, anything with children is called subtree, and anything without children is called a leaf node.

The directory branch currently is not used. The management branch, or mgmt, defines a standard set of Internet Management objects. The experimental is reserved for testing and research purposes. Objects under the private branch are defined unilaterally, which mean that individuals and organizations are responsible for defining the objects under this branch. Here is the definition of the internet subtree, as well as all four of its subtrees[4].

Internet	**OBJECT IDENTIFIER::= {iso org (3) dod(6) 1 }**
Directory	**OBJECT IDENTIFIER::= {internet 1 }**
Mgmt	**OBJECT IDENTIFIER::= {internet 2 }**
Experimental	**OBJECT IDENTIFIER::= {internet 3 }**
Private	**OBJECT IDENTIFIER::= {internet 4 }**

The first line declares internet as the OID 1.3.6.1, which is defined as subtree of iso.org.dod, or 1.3.6 (the:: = is a definition operator). The last four declarations are similar, but they define the other branches that belong to internet. For the directory branch, the notation {internet 1}

tells us that it is part of the internet subtree, and that its OID is 1.3.6.1.1. The OID for mgmt is 1.3.6.1.2, and so on.

There is currently one branch under the private subtree. It's used to give hardware and software vendors the ability to define their own private objects for any type of hardware and software they want to managed by SNMP. Its SMI definition is:
Enterprises OBJECT IDENTIFIER: = {private 1}

The Internet Assigned Numbers Authority (IANA) currently manages all the private enterprise number assignments for individuals, institutions, organizations, companies, etc.
As an example, Cisco system's private enterprise number is 9, soothe base OID for its private object space is defined as iso.org.dod.internet.private.enterprises.cisco, or 1.3.6.1.4.1.9. Cisco is free to do as it wishes with this private branch. It's typical for companies such as Cisco that manufacture networking equipment to define their own private enterprise objects. This allows for a richer set of management information than can be gathered from the standard set of managed objects defined under the mgmt branch[10].

1.2.8 MIB (Management Information Base)

The Management Information Base can be thought of as a database of managed objects that the agent tracks. Any sort of status or statistical information that can be accessed by the NMS is defined in a MIB. The SMI provides a way to define managed objects, while the MIB is the definition (using the SMI syntax) of the objects themselves. Like a dictionary, which shows how to spell a word and then gives its meaning or definition, a MIB defines a textual name for a managed object and explains it meaning.

An agent may implement many MIBs, but all agents implements a particular MIB called MIB-II [2] (RFC 1213). This standard defines variables for things such as interface statistics (interface speeds, MTU, octets [1] sent, octets received etc.) as well as various other things pertaining to the system itself (system location, system contact, etc.). The main goal of MIB-II is to provide general TCP/IP management information. It doesn't cover every possible item a vendor may want to manage within its particular device.

[1] An Octet is an 8-bit quantity, which is the fundamental unit of transfer in TCP/IP networks.

[2] MIB-I is the original version of this MIB, but it is no longer referred to since MIB-II enhances it.

What other kinds of information might be useful to collect? First, there are many draft and proposed standards developed to help manage things such as frame relay, ATM, FDDI, and services (mail, DNS, etc.). A sample of these MIBs and their RFC numbers includes[5].

- ATM MIB (RFC 2515)
- Frame Relay DTE Interface Type MIB (RFC 2115)
- RDBMS MIB (RFC 1697)
- Mail Monitoring MIB (RFC 2249).

But that's far from the entire story, which is why vendors, and individuals, are allowed to define MIB variables for their own use. For example, consider a vendor that is bringing a new Processor to market. The agent built into the router will respond to NMS requests (or send traps to NMS) for the variables defined by the MIB-II standard; it probably also implements MIBs for the interface types it provides. In addition, the processor may have some significant new features that are worth monitoring but are not covered by any standard MIB. So, the vendor defines its own MIB (sometimes referred to as a proprietary MIB) that implements managed objects for the status and statistical information of their new processor[2].

1.2.8.1 CLOSER Look at MIB-II

MIB-II is a very important management group, because every device that supports SNMP must also support MIB-II. RFC1213-MIB that defines the base OIDs for the mib-2 subtree looks like this:

Mib-2 OBJECT IDENTIFIER: : = {mgmt 1}
System OBJECT IDENTIFIER: : = {mib-2 1}
Interfaces OBJECT IDENTIFIER: : = { mib-2 2}
At OBJECT IDENTIFIER: : = { mib-2 3}
Ip OBJECT IDENTIFIER: : = { mib-2 4}
Icmp OBJECT IDENTIFIER: : = { mib-2 5}
Tcp OBJECT IDENTIFIER: : = { mib-2 6}
Udp OBJECT IDENTIFIER: : = { mib-2 7}
Egp OBJECT IDENTIFIER: : = { mib-2 8}
Transmission OBJECT IDENTIFIER: : = { mib-2 10}

Snmp OBJECT IDENTIFIER: : = { mib-2 11}

Mib-2 is defined as iso.org.dod.internet.mgmt.1 or 1.3.6.1.2.1. From here, we can see that the system group is mib-2 1 or 1.3.6.1.2.1.1, and so on. Figure shows the MIB-II subtree of the mgmt branch.

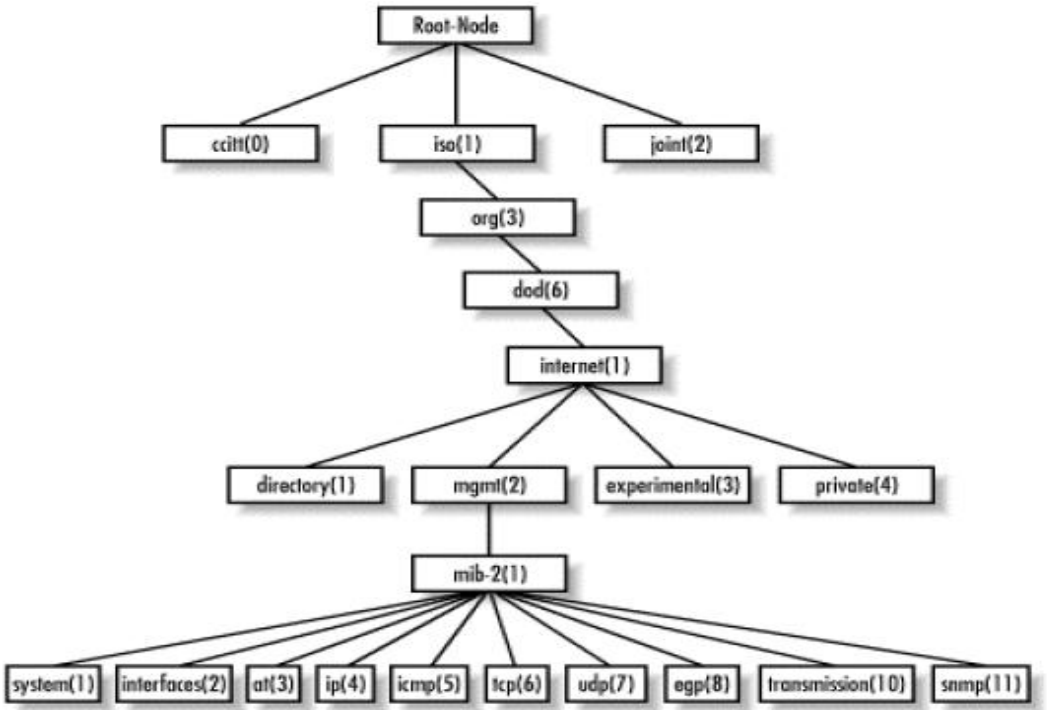


Figure 1 H: MIB II tree

Table briefly describes each of the management groups defined in MIB-II.

Table 1.2.8.1 MIB II

Sub Tree Name	**OID**	**Description**
System	1.3.6.1.2.1.1	Defines a list of object that pertain to system operation, such as the system uptime, system contact and system name.
Interface	1.3.6.1.2.1.2	Keeps track of the status of each interface on a managed entity. The interface group monitors which interfaces are up or down and tracks such things as octets sent and received, errors and discards, etc
At (Address Translation)	1.3.6.1.2.1.3	The address translation (at) group is deprecated and is provided only for

		background compatibility.
Ip (Internet Protocol)	1.3.6.1.2.1.4	Keeps track of many aspects of IP, including IP routing.
Icmp (Internet Control Management Protocol)	1.3.6.1.2.1.5	Tracks things such as ICMP errors, discards, etc.
Tcp (transmission control Protocol)	1.3.6.1.2.1.6	Tracks, among other things, the state of the TCP connection.
Udp (User Datagram Protocol)	1.3.6.1.2.1.7	Tracks UDP statistics, datagrams in and out, etc.
Egp (Exterior Gateway Protocol)	1.3.6.1.2.1.8	Tracks various statistics about EGP and keeps an EGP neighbor table.
Transmission	1.3.6.1.2.1.10	There are currently no objects defined for this group, but other media-specific MIBs are defined using this subtree.
Snmp	1.3.6.1.2.1.11	Measures the performance of the underlying SNMP implementation on the managed entity and tracks things such as the number of SNMP packers send and received.

1.2.9 ASN.1 (Abstract Syntax Notation One)

ASN.1 was the first formal notation (developed from the Xerox Courier specification) to provide a clear separation of the high-level message content from the encodings of those messages during transfer. This remains a major plank of ASN.1 today.

The platform-independent and (programming) language-independent notation is called an abstract syntax specification, giving rise to the name Abstract Syntax Notation One (ASN.1). It has enabled tools to provide easy mappings of ASN.1 specifications into many different programming languages, including today the popular C, C++ and Java environments, and making interworking between implementations on different platforms and in different languages a reality. It has also made it possible to embed use of ASN.1 into high-level modeling tools such as Specification and Description Language and test suite specification

languages such as Tree and Tabular Combined Notation (The linkage between SDL and ASN.1 and between TTCN and ASN.1 has proved a very powerful mechanism for full protocol specification using the range of ITU-T languages.)

Like ASN.1, both SDL and TTCN are still changing and expanding today. This is beyond the scope of this paper, but is partly addressed by other papers in this issue[8].

The separation of the high-level definition of message content (the abstract syntax of the messages) from the specification of the actual bits to be used to encode different values of the content was called the transfer syntax of the messages. This specification was typically done by application-independent encoding rules that could be applied to any ASN.1 specification. Whilst the abstract syntax concept made the mapping to programming language data structures possible, the concept of encoding rules enabled application-independent encode/decode libraries to be provided by tool vendors, making rapid and largely error-free implementations of the encoding aspects of a protocol to be easily produced[9].

Chapter 2

Project Planning & Management

2.1 Team Organization

Team will be Democratic Decentralized (DD). Team is decided on the basis of the factors given below:

1. **The difficulty of the problem:**
   Because decentralized teams generate more and better solutions than individuals therefore such teams have a greater portability of success when working on difficult problems.

2. **The time that the team will stay together: (Team lifetime)**
   The length of time that the team will live together affects team morale. It has been found that DD team structures result in high morale and job satisfaction and therefore good for teams that will be live together for a long time.

3. **The degree to which the problem can be modularized:**
   The problem is low modularity therefore DD team structure is best applied because of higher volume of communication needed.

4. **The degree of sociability (communication) required for the project:**
   DD required more time to complete a project and at the same time are best when high sociability is required.

5. **The required quality and reliability of the system to be built:**
   Because DD required more time to complete a project so it easily achieves quality and reliability in system.

6. **The rigidity of the delivery data:**

   It is obvious that in DD the time is enough to deliver the project (software) in specific time.

2.2 Resources

The following resources are used in the project.

- Arif Saulat (AS)
- Ali Hanzala Khan (AHK)

2.3 Team Structure

Team structure is depicted in the following figure (*see figure 2A*), which is showing how the communication is being done in various phases of the project development. Both the team members are equally involved in all phases of the project which results in implementing each member's skills and ideas in its respective area.

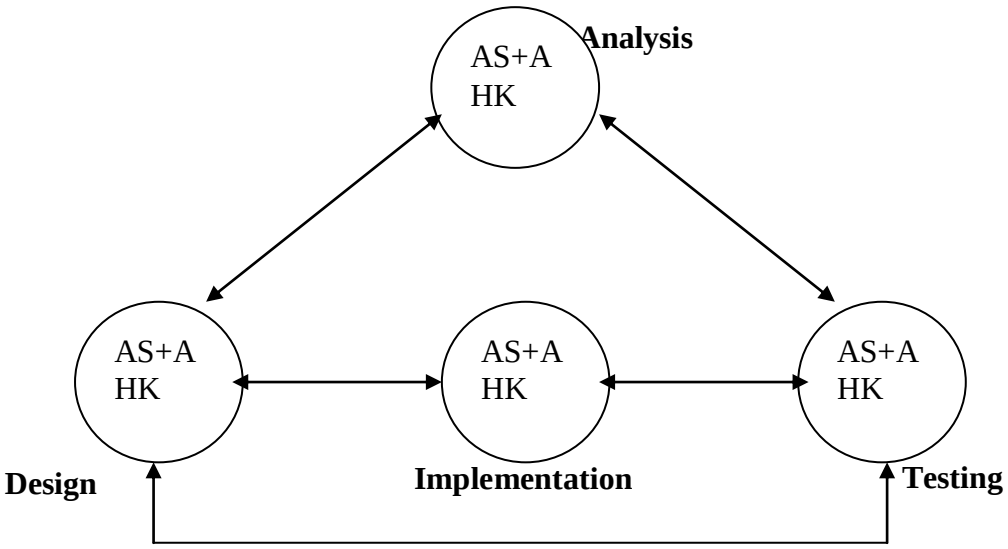


Figure 2 A. Team Structure Diagram

2.4 Network Diagram

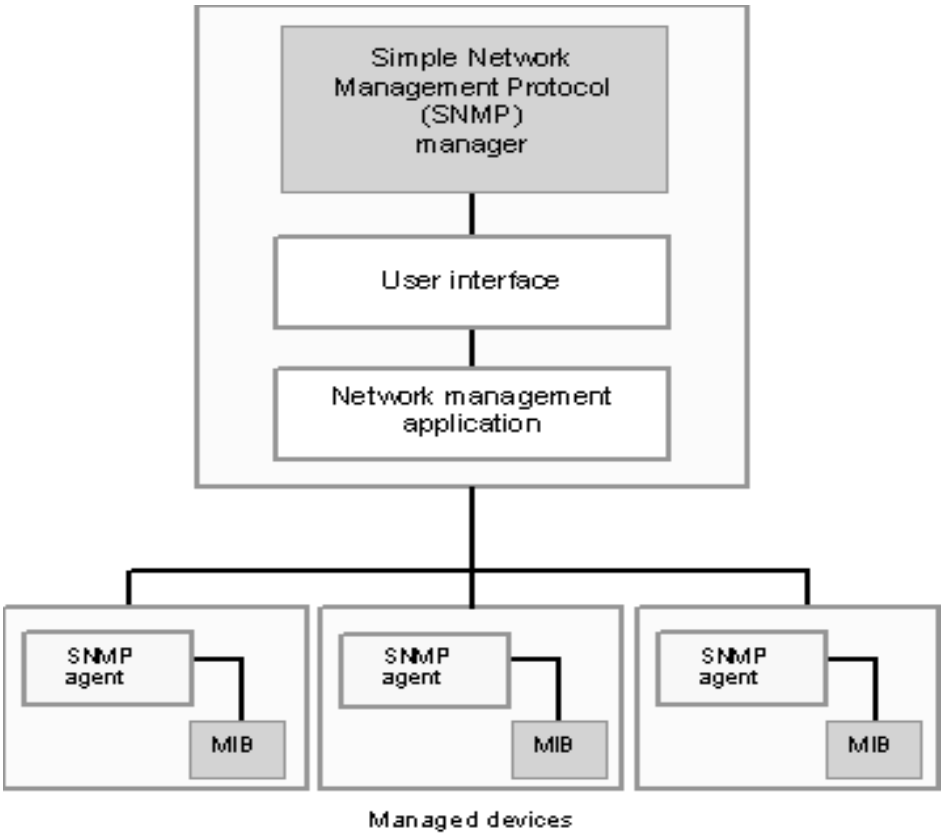


Figure 2 B Network Diagram

The above figure shows basic system architecture, here manager is the server side component and agent is client side component of our application, MIB is the management information base that contains the routine by following this routine agent populates the desired fields. User Interface is the main interface that displayed on server side, Network management application is backend routine, which is responsible for gathering information from agents and data storage.

2.5 List of Task

Project development has been divided into 4 major phases. These have been further divided into subtasks, which on completion mark the end of the phase. Analysis, design, implementation and testing are those four major phases, which are essential in project development.

Phase-I (Analysis)

- Establish list of tasks
- Specify scope and feasibility
- understand problem and outline requirements
- How to do? /what to do?

  Analyze problem, limitation, constraints in current systems and definite detail Requirement
- Plan project
    1. prepare a schedule for design and implementation
    2. decide process model
- Research technical criteria and options

Phase -II (Design)

- Design preliminary report
- Design prototype screen
- Design feasibility analysis
- Decide HD(Hardware)/SF(Software) requirements
- Develop prototype model/Approval
- Design methods and procedures
- Resource allocation
- Algorithms design
- Design flow chats
- DFD(Data Flow Diagram)
- ERD (Entity Relationship Diagram)
- Design intermediate report
- Design computer program specification

Phase -III (Implementation)

- Plan for Programming
- Write and computer program test
- Design installation guide & user manual
- Design presentation

- Install files and database

Phase - IV (Testing)

- Test all features separately.

2.6 Project Planning:

The following steps are followed in planning for the completion of the project on the basis of time allotted and resources available.

STEP-1:

Find the total time available for project completion:

Project Duration **(PD)** = 9 months

(Total number of months assigned by the supervisor.)

Total Number of Weeks **(TNW)** In Project Duration (Pd) = 38 weeks

Total Number of Days **(TND)** In Project Duration (Pd) = 266 days

STEP-2:

Find the total number of days with each team member out of the time available:

Total Number of Days **(TND)** = 266 Days

Total Number of Holidays **(TNH)** = 80 Days

AWD $\rightarrow$ Actual Working Days

AWD = TND – TNH Days

= 186 Days

N = 186

No. of team members = m =2

N/m = 186/2 = 93 (each members working day)

Chapter 3

Aims and objectives

Network Assets Monitoring and Security using SNMP targets big organizations where number of workstation is very large and network assets security is major issue. This software will monitor the hardware whenever the configuration of hardware changes it will give alert to administrator. The software is divided into two major modules

1) **Monitoring**

   If configuration of any hardware changes than this system will detect these changes automatically, question arises how? The answer is whenever the hardware is plugged first time this system collects all hardware related information from that machine and stored it in database. Whenever the hardware information changes this software scans that hardware in normal routine and collect the desired data then it compares that data with data that is stored in database if conflict arises than this is the indication of problem in hardware configuration and if this changes is in the knowledge of administrator then he may proceed for updating.

2) **Inventory Management**

   If new hardware comes in organization then it should registered in inventory. Nowadays inventory management is also very big issue we also solve this problem by introducing the feature of auto registry in our software, now you only have to plugged the network cable then this system will automatically registered the hardware in database.

   If the location or contact person of workstation changed then administrator can update its description or contact person from server.

3.1 System Diagram

The block diagram shown below (see Figure 3A), is showing the working of the system graphically. That is, the system's flow of what output is occurring on each input.

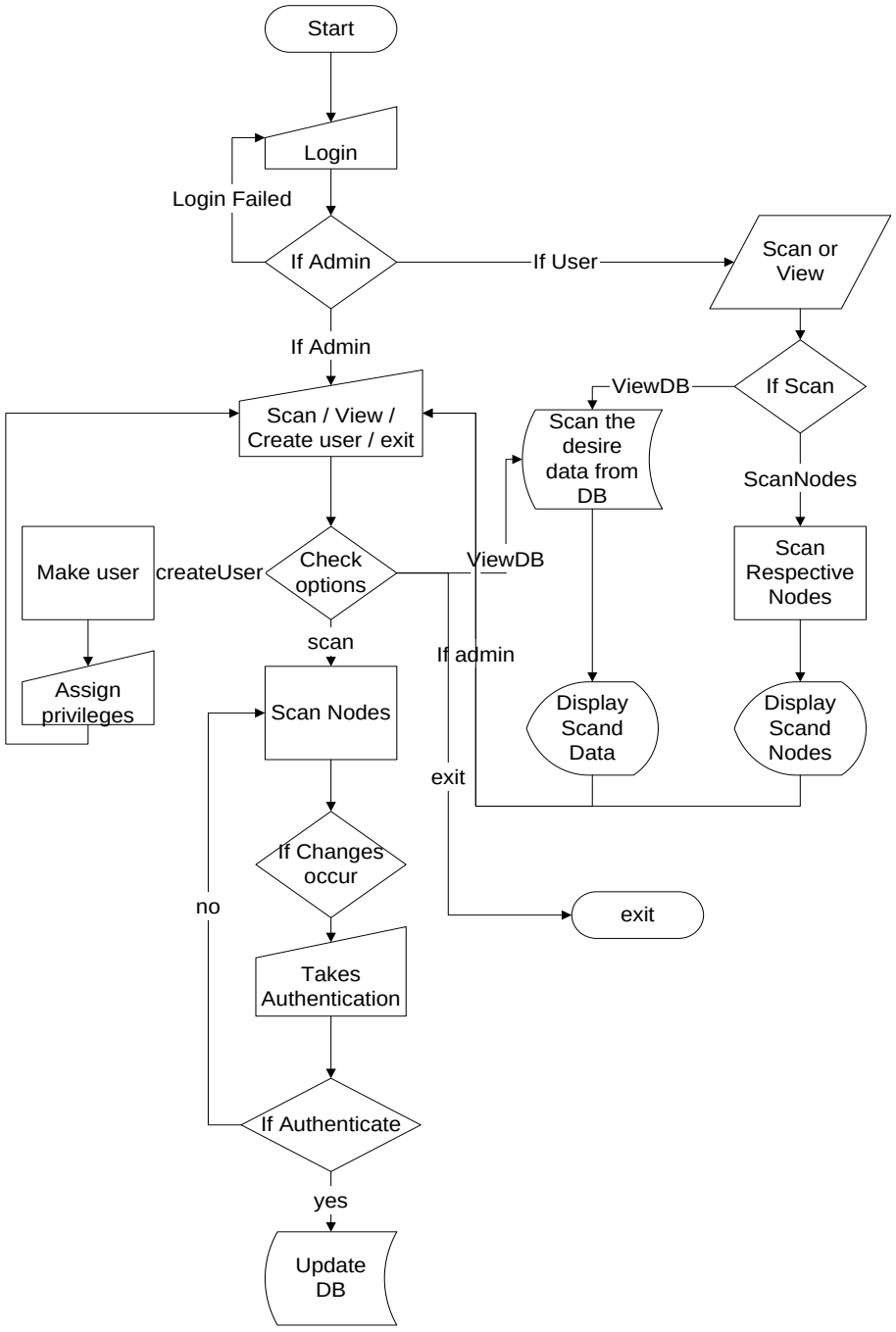


Figure 3A System Diagram

By the figure above it is clear that the two features are working separately. The explanation of the above in terms of working of the system has been explained in aims and objectives.

3.2 Scope of Project

The scope of this project is the configuration and asset management of networked devices is very vast where network assets security is basic need. This software can use in any organization where number of workstation is very large. If number of workstation is large then there should be some system that maintained the inventory of hardware. Monitoring involve workstation monitoring, these workstation can be PC (personal Computer), switch or some network enable heavy or light machinery of industry. This software will get information of all hardware which have IP address and have SNMP service enabled for e.g. if you are designing industrialist and you have to know how much design have been made from last two days then you don't have to go at your plant for counter reading you may just sit on server and see the counter reading there. This software has various applications in similar fields.

We briefly tested our software on PNSC (Pakistan National Shipping Corporation) network, which comprise of 300 workstations. This proved the utility of our software.

3.3 Project Overview

Table 1 PROJECT OVERVIEW

Project Title	Network Assets Monitoring and Security Using SNMP(Simple Network Management Protocol)
Team Organization	Democratic Decentralized (DD)
Programming Environment	Microsoft Windows XP/2000
Programming Methodology	Object Oriented Approach
Project Management Techniques	GANTT Chart
Programming Language	
Front End	Visual Basic .Net
Back End	SQL Server 2000
CASE Tools/Supporting Tools	MS Visio, ERWIN
Software Process Model	Spiral Model

Chapter 4

Analysis & Design

4.1 Data Collection

For data collection, we downloaded and installed various network inventory softwares. The major data collection is done by RFC 1213 and RFC 1257, which was referred by our supervisor Mr. Mohiuddin, and as far as software flow and data presentation are concerned we take full advantage of our senior faculty member Mr. Iqbal who enlightened us with his views and gave us ideas and showed great interest in our project. He gives us introduction of monitoring software, which monitors network traffic namely "SNMPc", from which we get knowledge about all components of network. Our supervisor Mr. Mohiuddin gave whole project requirements.

Besides this, we visited various websites relevant to our project for reference (see Reference section).

4.2 External Interface Requirements

The External Interface Requirements for this project is one or two workstation as a server and access of organization network. The workstation at which server component is install and all components that will be monitored by this application should be SNMP enabled.

4.3 Use Case Model

A Use Case is a procedural definition of functional requirements written in prose. It defines a way in which a computer might be used by a user. It is made up largely of interactions across the system boundary which defines an outside-in black box view of what the system will do from a user's perspective. Use cases were defined by Ivar Jacobson in 1992 and have since become an integral part of UML. Use cases are easy to understand for non-technical users but hard to write properly. They can also be used for modeling business processes**.**

4.4 System level use-case diagram

The functional requirements of a computer system can be shown on a set of use case diagrams which summaries all the system will do. It shows what use cases are used by what

external user roles and all systems and users with whom the system will interact. As such it graphically defines the functional boundary of the system

The figure below (*Figure 4 A*) is a system level use case, showing that administrator and user are two

Actors of the system, both have different privileges.

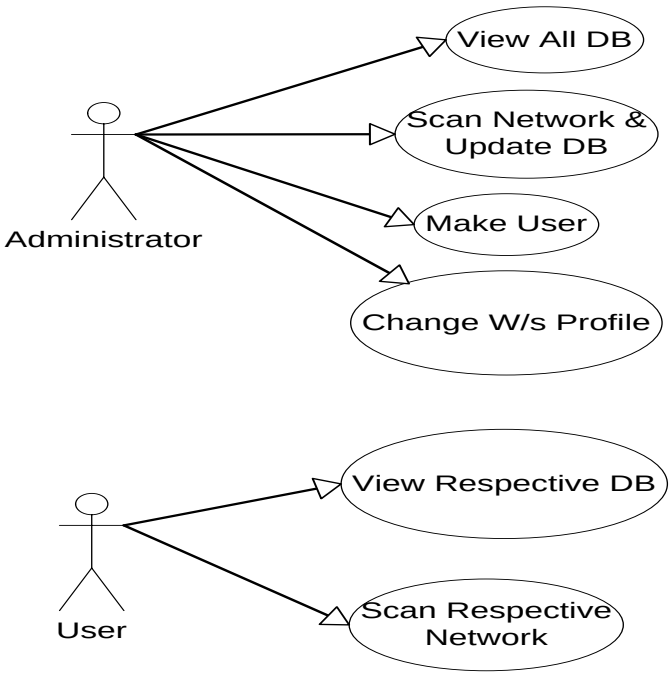


Figure 4 A Use Case Model

4.5 Use Cases

The system can be broken down into six separate use cases are as follows.

4.5.1 Use Case: view all Database

This use case describes the process of viewing all Database of the system. On completion, success message will be displayed. Table 4.5.1 describes different steps that are taken to view all database.

Table 4.5.1: View Report

Use Case Name	View Reports

Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** actors want to view database first he has to select criteria and view Database and press OK button	**System Response** **Step 2:** System generates and displays all the details
Pre-Condition	None	
Post-Condition	Display all the details of the particular Database	
Assumptions	None at this time.	

4.5.2 Use Case: Scan Network and Update Database

This use case describes the process of Scanning Network and Update Database of the system. On completion, success message will be displayed. Table 4.5.2 describes different steps that are taken to Scan Network and Update Database

Table 4.5.2: Scan Network and Update database

Use Case Name	Scan Network and Update database	
Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** Retrieval of live data in database	**System Response** **Step 2:** Start Manager Scan all workstations If scan data has conflict with data in database Then approval of administrator required If admin approve then update database
Pre-Condition	Data Already Exit compare with this	
Post-Condition	Display all the details of the particular Database	
Assumptions	None at this time.	

4.5.3 Use Case: Make User

This use case describes the process of the add User of the system. On completion, success message will be displayed. Table 4.5.3 describes different steps that are taken to add User.

Table 4.5.3: Make User

Use Case Name	Make User	
Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** initiated when the actor create new User. **Step 2:** Actor enter the new member information.	**System Response** **Step 3:** The system save the member information into the DB.
Alternate Courses	**Step 3A:** If there is an error in the entries of the field, error message is displayed. **Step 3B:** Cursor comes on the incorrect field.	
Pre-Condition	Data does not already exist.	
Post-Condition	Data saved into the DB.	
Assumptions	None at this time.	

4.5.4 Update Member

This use case describes the process of the update member of the system. On completion, success message will be displayed. Table 4.5.4 describes different steps that are taken to update the member.

Table 4.5.4: Update Member

Use Case Name	Update Member	
Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** This use case is initiated when the actor selects the edit button. **Step 2:** Actor change the information	**System Response** **Step 3:** The system save the change information into the DB.
Alternate Courses	**Step 3A:** If there is an error in the entries of the field, error message is displayed. **Step 3B:** Cursor comes on the incorrect field.	
Pre-Condition	Data already exists.	
Post-Condition	Data is saved into the DB.	

Assumptions	None at this time.

4.5.5 Delete Member

This use case describes the process of the delete member of the system. On completion, success message will be displayed. Table 4.5.5 describes different steps that are taken to delete member.

Table 4.5.5: Delete Member

Use Case Name	Delete Member	
Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** This use case is initiated when the actor selects the change password option. **Step 2:** Actor change the password.	**System Response** **Step 3:** The system save the change password into the DB.
Alternate Courses	**Step 3A:** If there is an error in the entries of the field, error message is displayed. **Step 3B:** Cursor comes on the incorrect field.	
Pre-Condition	Data already exist.	
Post-Condition	Data is saved into the DB.	
Assumptions	None at this time.	

4.5.6 Use Case: Change workstation profile

This use case describes the process of changing workstation profile of the system. On completion, success message will be displayed. Table 4.5.6 describes different steps that are taken to changing workstation profile..

Table 4.5.6: Change Workstation Profile

Use Case Name	Change Workstation Profile	
Actor(s)	Administrator	
Typical Course of Events	**Actor Action** **Step 1:** actors want to change the user profile like sysName etc.	**System Response** **Step 2:** Scan agent from Manager View info of agent from manager Change profile of

		workstation/agent.
Pre-Condition	You don't have enough rights to change it	
Post-Condition	Profile change successfully	
Assumptions	None at this time.	

4.5.7 Use Case: View Database

This use case describes the process of viewing database of user of the system. On completion, success message will be displayed. Table 4.5.7 describes different steps that are taken to viewing database of user.

Table 4.5.7: View Database

Use Case Name	View Database	
Actor(s)	User	
Typical Course of Events	**Actor Action** **Step 1:** actors want to view database first he has to select criteria and view Database and press OK button	**System Response** **Step 2:** View respective data from Database Select the criteria then view Database
Pre-Condition	You don't have enough rights to change it.	
Post-Condition	Display all the details of the particular Database	
Assumptions	None at this time.	

4.5.8 Use Case: Scan respective Network and Update Database

This use case describes the process of scanning respective network and update Database according to the privileges of user of the system. On completion, success message will be displayed. Table 4.5.8 describes different steps that are taken to viewing database of user.

Table 4.5.8: Scan respective Network and Update Database

Use Case Name	Scan respective Network and Update Database	
Actor(s)	User	
Typical Course of Events	**Actor Action** **Step 1:** Retrieval of live data in database.	**System Response** **Step 2:** Start Manager Scan all workstations
Pre-Condition	You don't have enough rights to change it.	

Post-Condition	Display Live Data.
Assumptions	None at this time.

4.6 User Documentation

The documentation provided to the user along with the software includes:

1. User Manual (see Appendix B)

The **Format** of the documentation is MS Word based.

4.7 Algorithm

1 input user name and password

2 if admin then

2.1 input options scan network or view database or create user

2.1.1 If scan network

2.1.1.1 Then scans the network and gather information

2.1.1.2 Compare gathers information with information in database

2.1.1.3 If conflict occur

2.1.1.3.1 Then ask for approval from administrator

2.1.1.3.1.1 If approval given then update database.

2.1.1.3.1.2 If not then go step 2.1.1

2.1.1.4 if conflict not occur

2.1.1.4.1 Display the scan output

if view database then display all database records

if create user

make user and assign privileges and go to 2.1

3 if user then

3.1 input option scan network or view database

3.1.1 If scan network

3.1.1.1 Then scans the respective network and gather information

According to the rights.

3.1.1.1.1 If rights then Display the scan output

3.1.1.2 If not then go to 3.1

3.1.2 If view database then display all database records.

4.8 Data Flow diagram

The Data Flow Diagram – DFD shows the flow of data or information. It can be portioned into single processes or functions. Data flow diagram can be grouped together or decomposed into multiple processes.

The DFD is an excellent communication tool for analyst to model processes and functional requirements. One of the primary tools of the structured analysis efforts of the 1970's it was developed and enhanced by the likes of Yourdon, McMenamin, Palmer, Gane and Sarson. It is still considered one of the best modeling techniques for eliciting and representing the processing requirements of a system.

We have used DFD to show the relationships between the major components in the system. Network assets monitoring and Inventory Management are the two processes being carried out in the system the relationship are shown below (Figure 2 B)

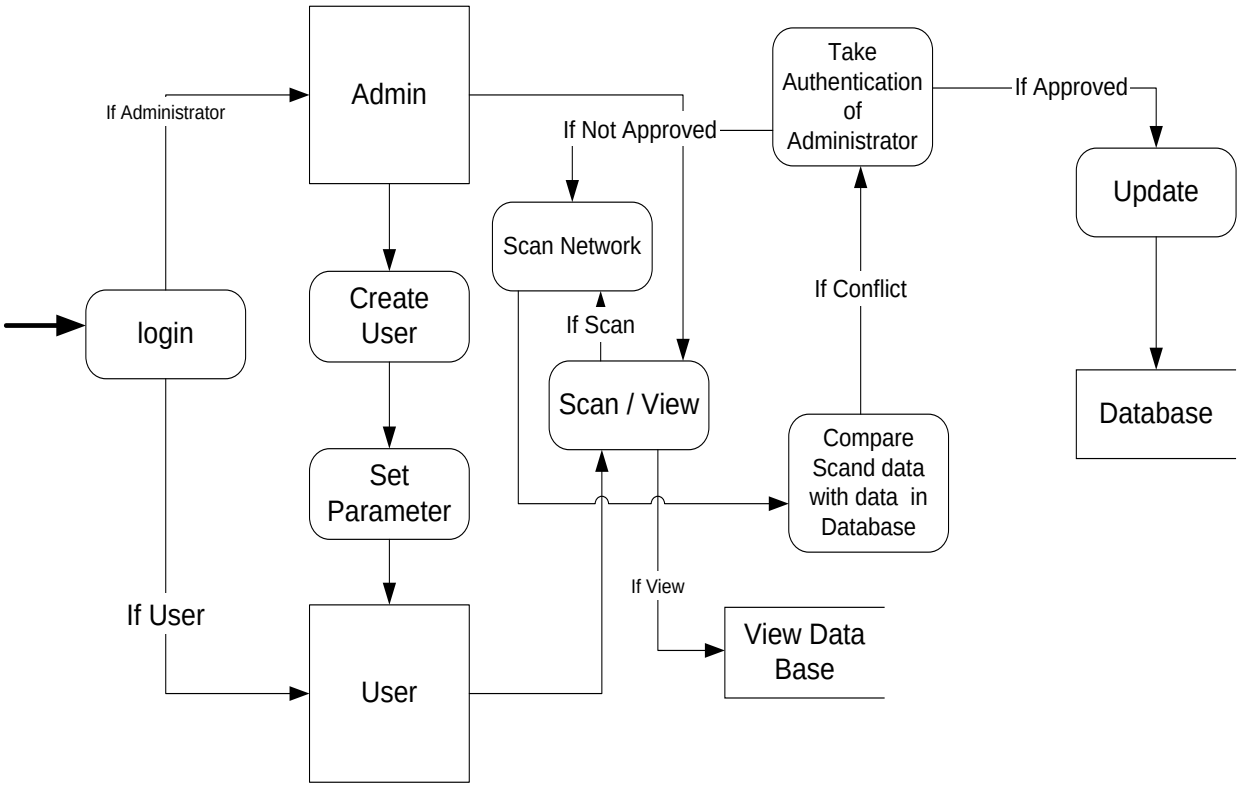


Figure 4 B: Data Flow Diagram

4.9 Entity Relationship Diagram (ERD):

Data models are tools used in analysis to describe the data requirements and assumptions in the system from a top-down perspective. There are 3 basic elements in ER models:

Entities are the things about which seek information. Attributes are the data we collect about the entities. Relationships provide the structure need to draw information from multiple entities.

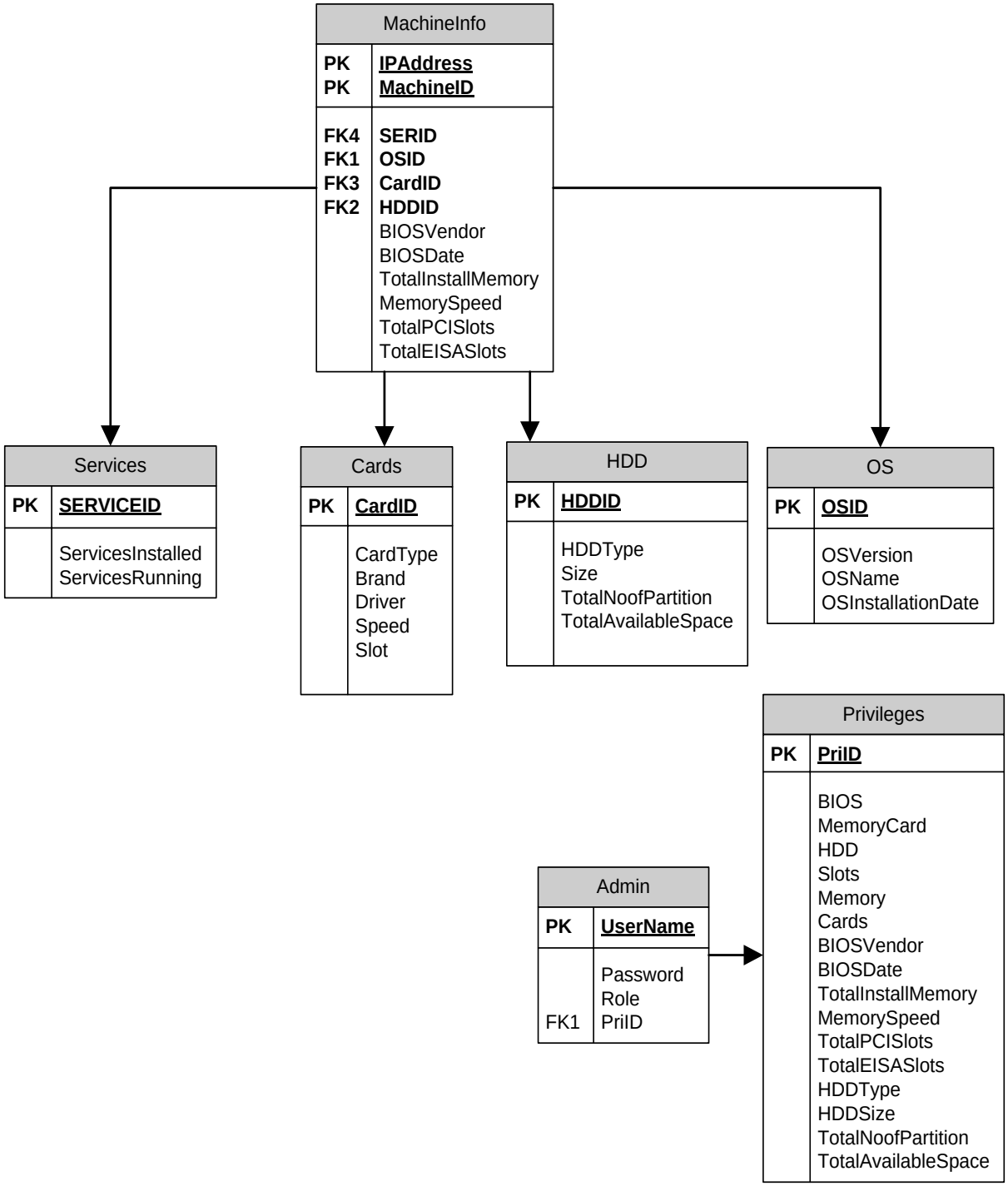


Figure 4 C: Entity Relationship Diagram

4.10 Software Process Model

We have used **Component Assembly Model** (see figure 7) as our Software Process Model. The reason behind this is that it follows Object Oriented Software Engineering.

We will make different components according to our need and these components will further be reused if required in any other relevant system.

Object Oriented Analysis is quite different from conventional analysis. There are number of methods which can be followed in this respect. Our selected method is "The COAD and YOURDON Method". Its modeling notation is relatively simple and guidelines for developing the analysis model are straightforward and uncomplicated.

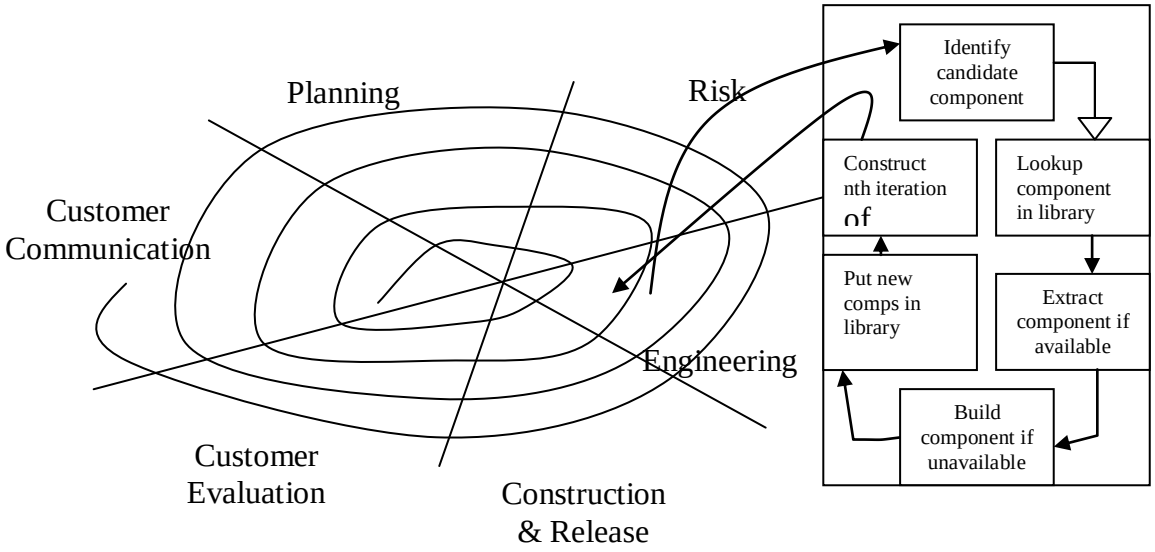


Figure 4D. Component Assembly Model Diagram

For Object Oriented Design, we have used the same method i.e. COAD & YOURDON Method. OOD includes the following steps:

Problem Domain Components

- We have grouped all domain classes.
- We have developed an interface with Data Management Components.
- Reviewed design to make some improvement.

Human Interaction Components

- Task scenarios will be developed.
- Hierarchy of user commands and GUIs.
- Integration of GUIs.

Chapter 5

Feasibility Analysis

It describes the technical, operational and economical feasibility of the system. The costing is done using two different methods, which are function point method and COCOMO

5.1 Technical Feasibility

The system will be technically feasible, as no highly sophisticated hardware will be needed

5.1.1 Feasible / Alternate Solution

Technical feasibility in terms of minimum hardware and software requirements is listed in the table below**.** Visual Basic.Net is easier and faster to use and above all is one of the most widely used programming language in the market today.

MS Visio has been used for scheduling such as Network diagram (see Appendices), provides an easy and quick development.

Table 2 Feasibility Report

HARDWARE REQUIREMENTS	
MACHINE (SYSTEM)	P-IV FULLY LOADED
STORAGE MEDIA	HARD DISK 40 GB
BACK UP DEVICE	ONE HARD DISK (10-20 GB)
NETWORK TOPOLOGY	NONE
OTHER REQUIREMENTS FOR NETWORKS	NONE
OTHER DEVICES/EXTERNAL INTERFACE	DOT MATRIX PRINTER/INKJET
SOFTWARE REQUIREMENTS	WINDOWS XP/200 WITH SNMP SERVICE ENABLED
APPLICATION TOOLS	
BACK-END FRONT-END	SQL SERVER 2000 VISUAL BASIC 6.0, VISUAL BASIC .NET
SUPPORTING TOOLS	MICROSOFT VISIO, ERWIN

5.2 Operational Feasibility

The Operation Feasibility means that a lay man should easily understand it. Our software has a user friendly GUI (Graphical User Interface) environment. Along with this, HELP (see Appendix B) would also be maintained which would guide the user, and it is a menu-designated project.

SNMP Manager

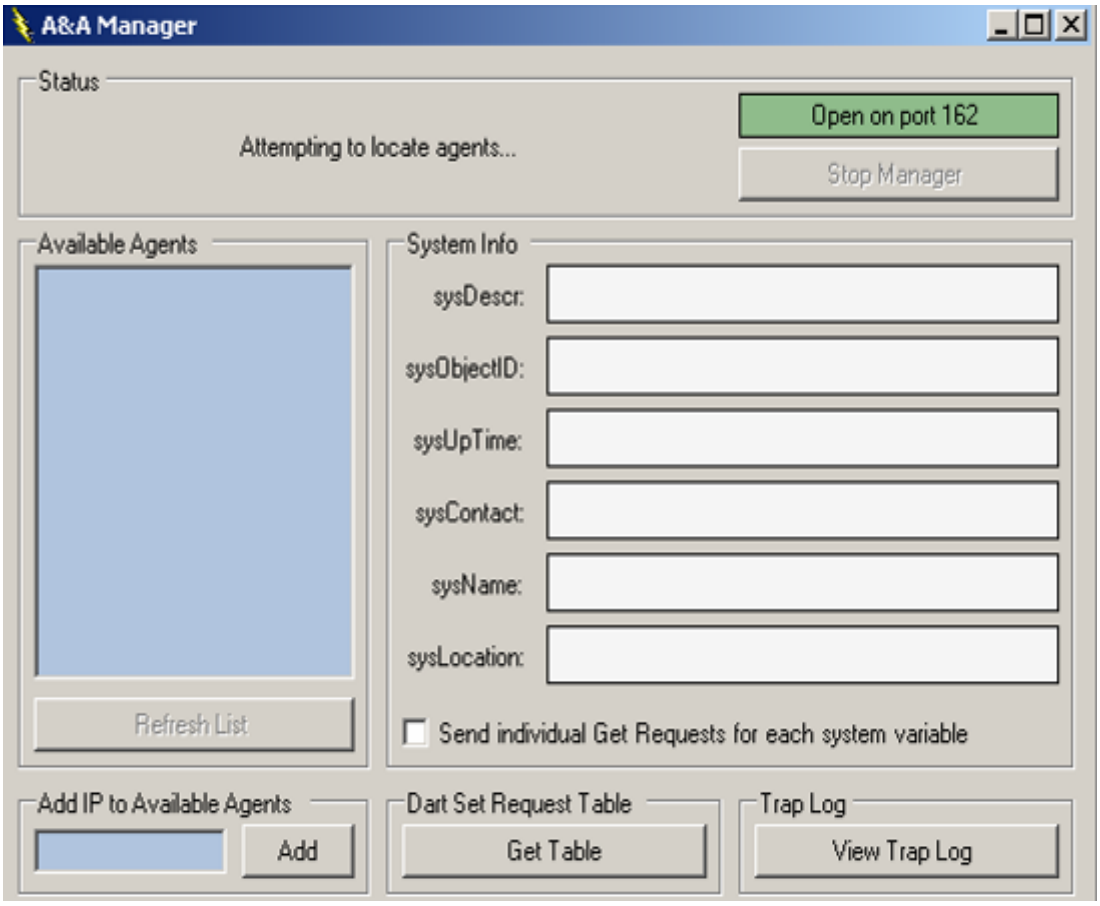


Figure 5 A SNMP Manager

SNMP Agent

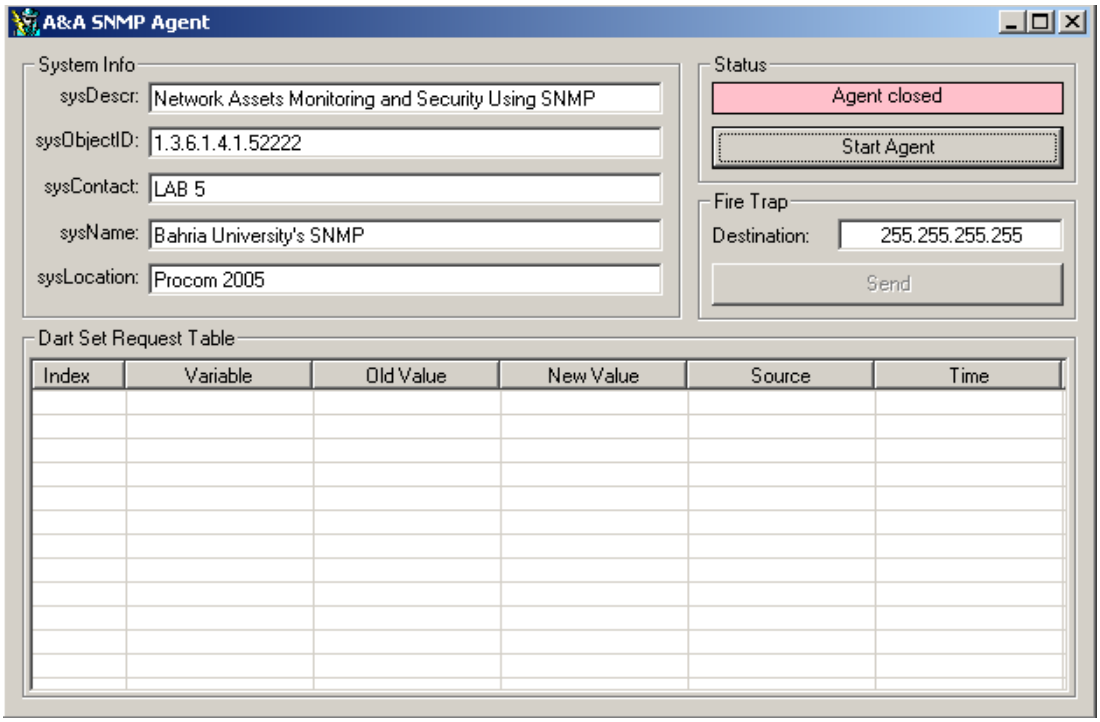


Figure 5 B SNMP Agent

SNMP Manager Explorer

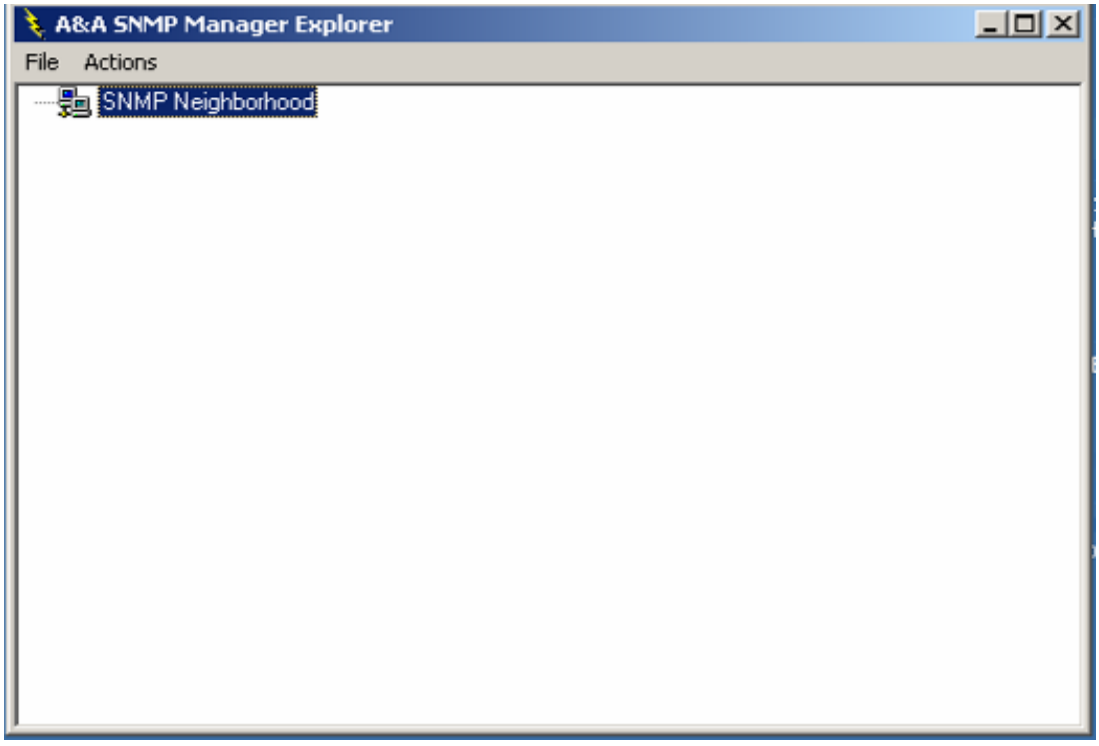


Figure 5 C SNMP Manager Explorer

Trap Catcher

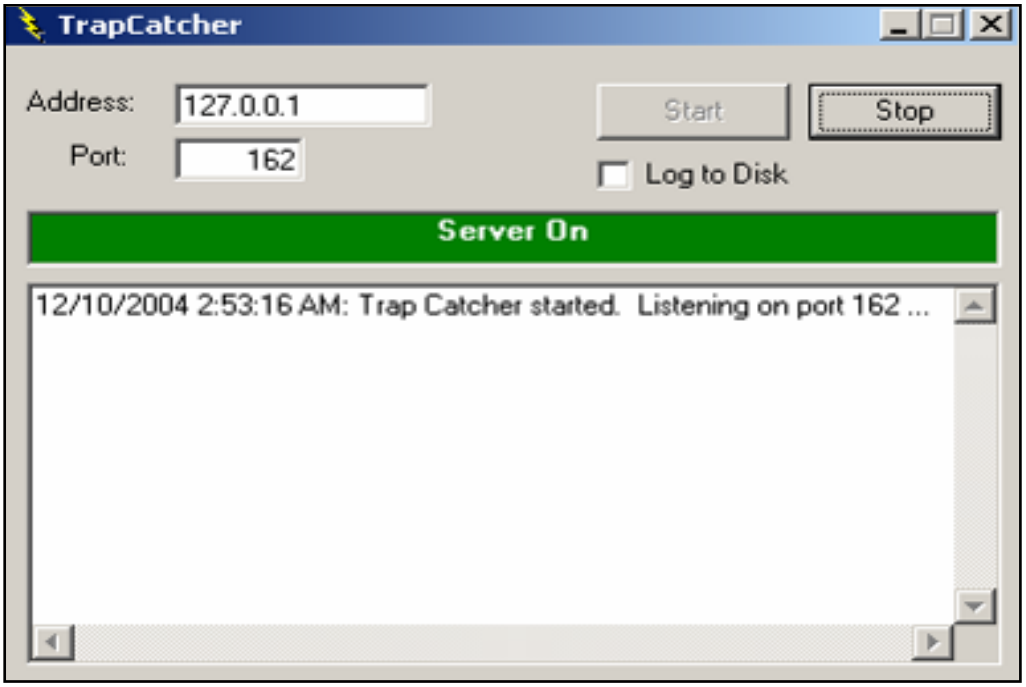


Figure 5 D SNMP Trap Catcher

Chapter 6

Implementation

This chapter does not include complete listing but description of key parts, how the system has been divided into various phases and then coded.

6.1 Tasks break up

This application may be treated as stand-alone application there are four different module whish may further divided in to following sub modules (see figure 6A).

1) SNMP Manager
2) SNMP Agent
3) SNMP Explorer
4) SNMP Trap Catcher

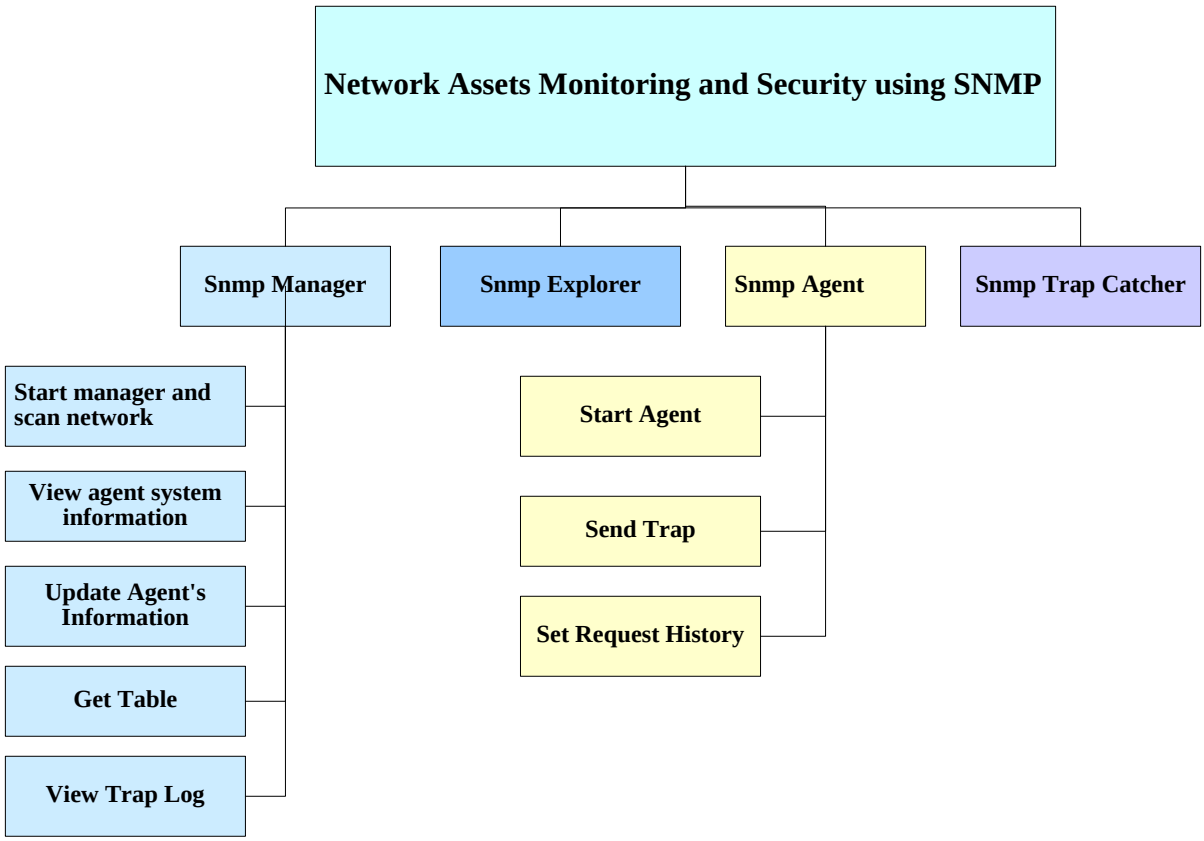


Figure 6 A: Different Modules of Implementation

6.1.1 SNMP Manager

This module will run on server and do main scanning of all SNMP enabled devices attached on network.

The major functions of SNMP Manager are as follows.

1) Start Manager and Scan Network

Make connection of this module with network by using UDP port 162. After establishing the connection, it will discover all the agents which is connected to network at that moment.

```
If cmdStart.Text = "Start Manager" Then
      Try
          Manager1.Open (162)
          UpdateInterface (True)
          DiscoverAgents ()
      Catch ex As Exception
          If ErrorNumber (ex) = 10048 Then
              ShowError ("Port 162 is already in use")
          Else
              ShowError (ex.Message)
          End If
      End Try
  Else 'If open, close manager
      Manager1.Close ()
      UpdateInterface (False)
```

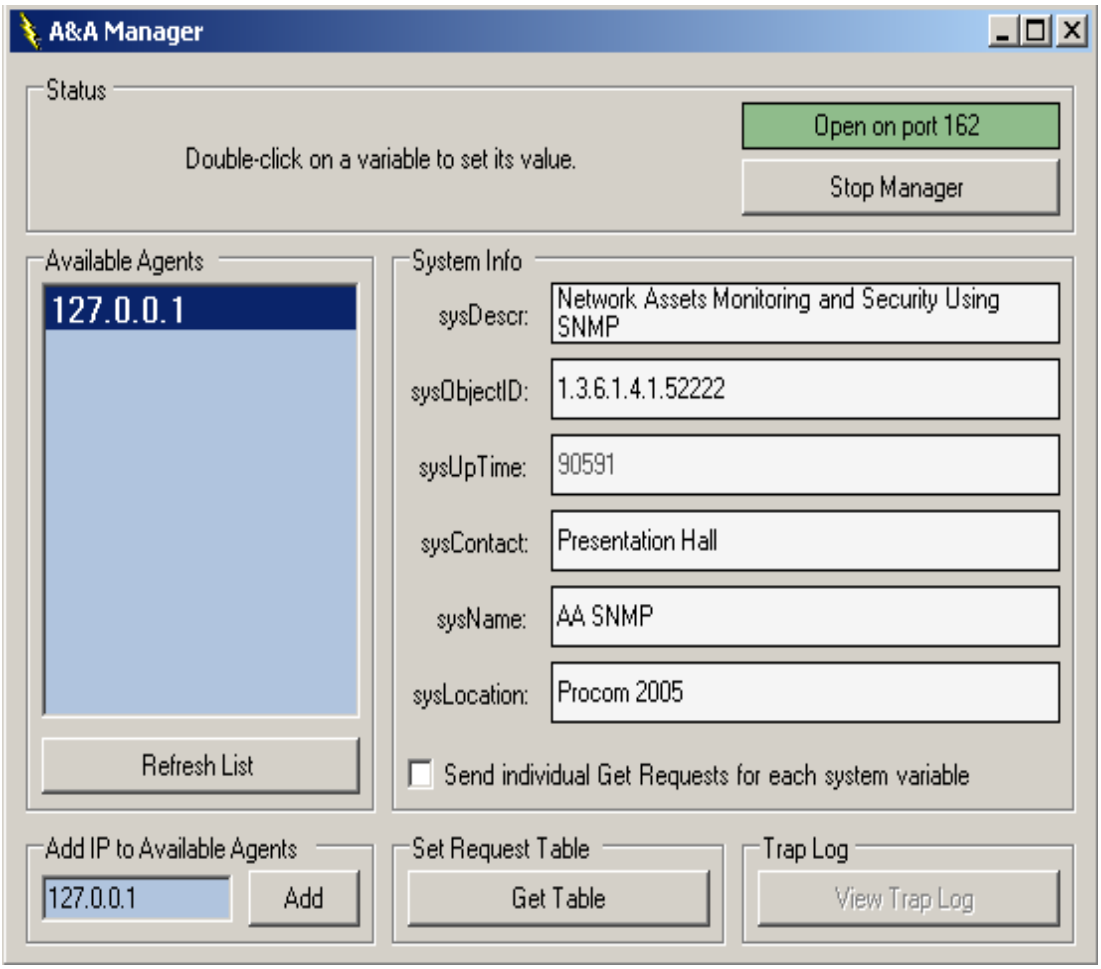


Figure 6.1.1: Snmp Manager

2) View Agent System Information

If you want to see the system information of particular agent you only have to select the agent from the agent discovered list. See Figure 5.1.1 for agent system information.

```
If lstAgents.Items.Count > 0 Then
   lstAgents.Enabled = True
   lblStatus.Text = lblStatus.Text + "added” +
   lstAgents.Items.Count.ToString () + “agents." + vbCrLf
   lblStatus.Text = lblStatus.Text + "Select an agent to get
   its system info."
  Else
   lblStatus.Text = lblStatus.Text + "no agents found."
End If
```

3) Update Information of Agent

Now if you want to update information of any agent, just select the desire agent from the agents list then click on the field witch you want to change. When you click the field the new form will load, in which you can edit information.

```
lblStatus.Text = "Double-click on a variable to set its value."
cmdTable.Enabled = True
DoGetRequest (lstAgents.SelectedItem)
```

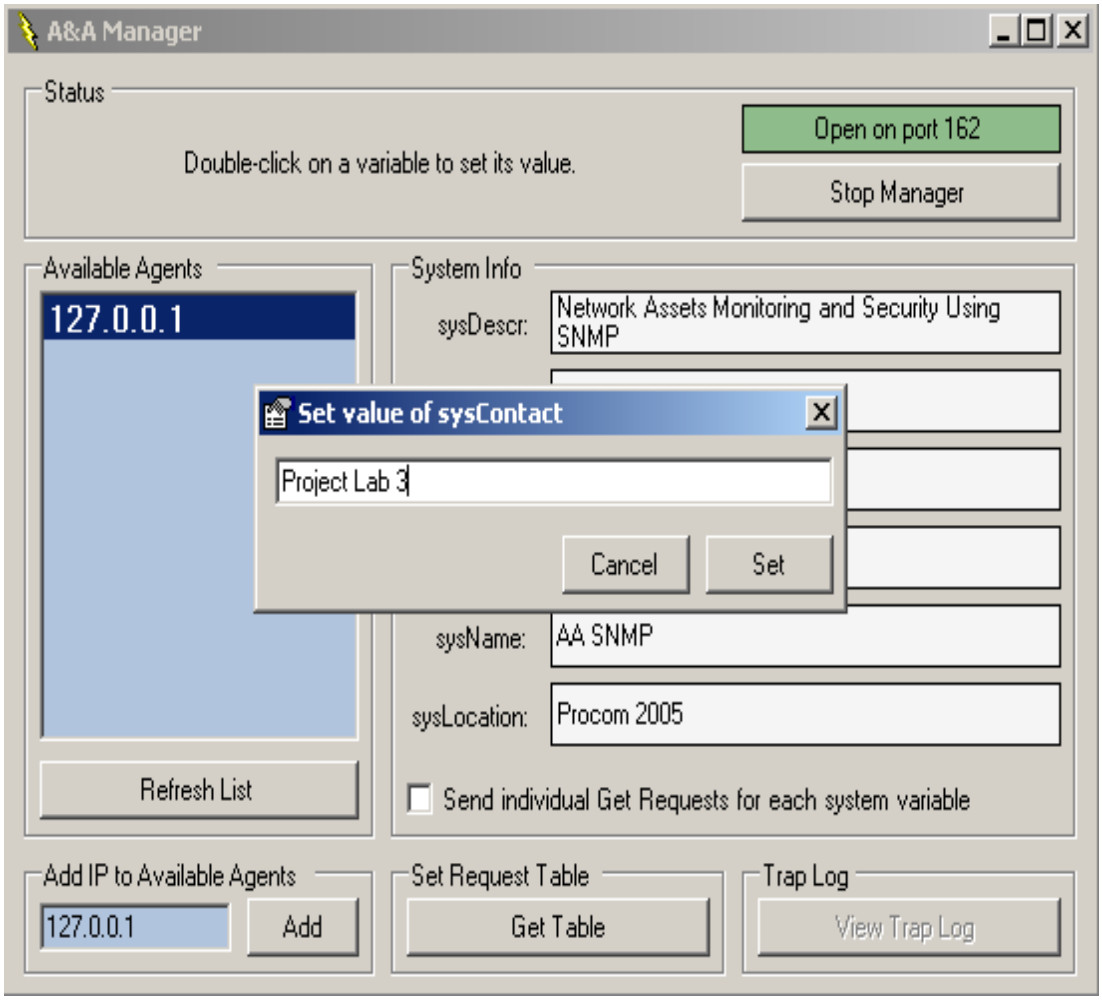


Figure 6.1.3: Snmp Manager

4) View Trap log

Click on the Trap log button to view trap log

```
Dim frm As New frmTrapLog ()
frm.DisplayLog (trapLog)
frm.ShowDialog ()
```

5) Get Table

If you want to know that your manager made how many update on which agents then you click GET Table

```
Manager1.Message.Reset ()
Manager1.AgentPort = 161
Manager1.AgentName = lstAgents.SelectedItem
Manager1.Message.Type = TypeConstants.snmpGetNext1
Manager1.Message.Variables.Add (v)
```

6.1.2 SNMP Agent

This part will install on client or agent side for viewing agent's own description and its second main function is to send traps to the server or broadcast it.

The major functions of SNMP Manager are as follows.

1) Start Agent

As you try to start agent if UDP port 162 is no busy agent will start, after it will gather all information of respective machine and display it

```
Agent1.Open 161
SetStatus "Open on port" & Agent1.LocalPort, True
startTime = GetTickCount 'for sysUpTime

'Open port for sending traps
On Error GoTo TrapError
cmdTrap.Enabled = True

txtDescr.Text = Agent1.Mib.Variables("sysDescr").value
txtObjectID.Text = Agent1.Mib.Variables("sysObjectID").value
txtContact.Text = Agent1.Mib.Variables("sysContact").value
txtName.Text = Agent1.Mib.Variables("sysName").value
txtLocation.Text = Agent1.Mib.Variables("sysLocation").value
```

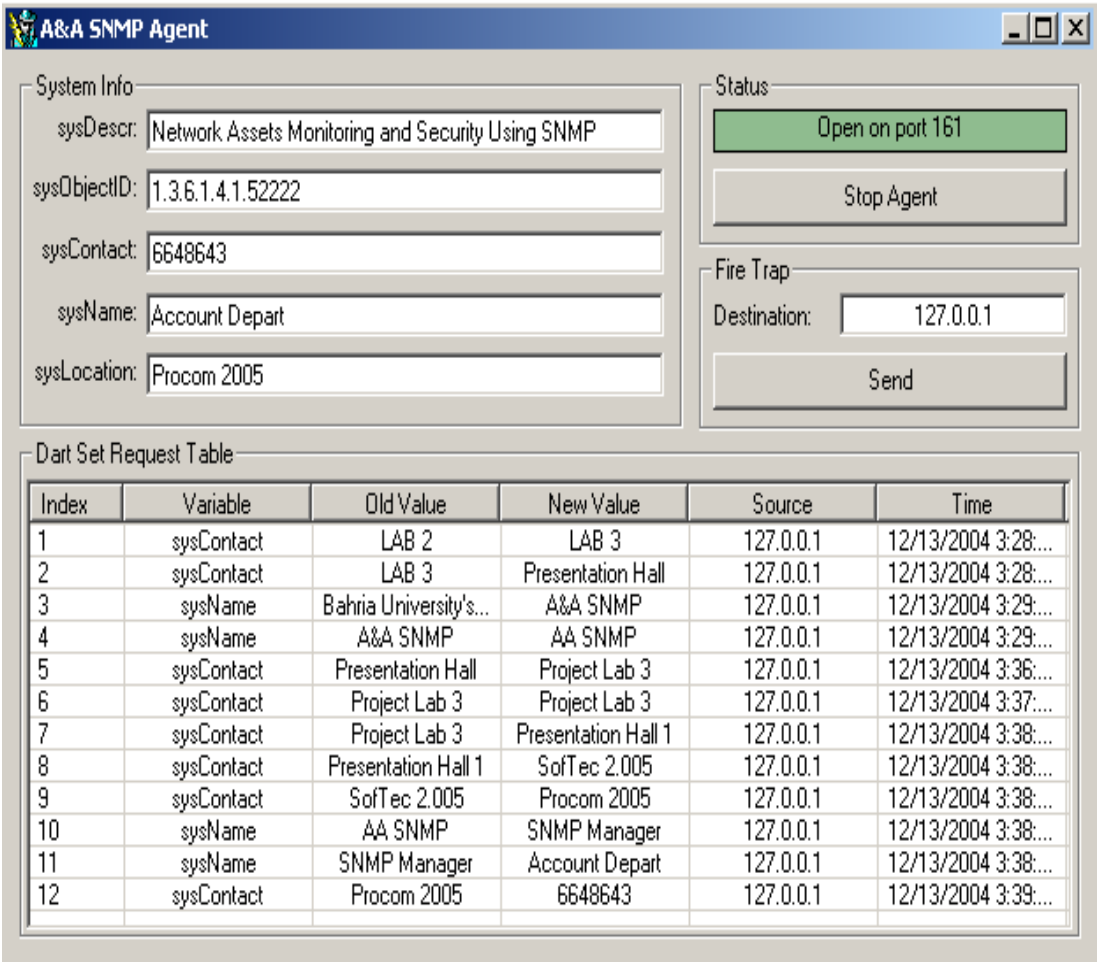


Figure 6.1.2: Snmp Agent

2) Send Trap

You may fire traps to any of the desire workstation just by clicking send button on main agent screen. See Figure 5.2 for sending trap.

```
Agent2.Message.Reset
Agent2.Message.Type = snmpTrap1
Agent2.Message.GenericTrap = snmpWarmStart
Agent2.Message.Enterprise = txtObjectID.Text

'Add Variable to Trap
AddVariable Agent2.Message.Variables,
Mib.Variables.GetOIDFromName("sysUpTime"), snmpTimeTicks,
GetUpTime

'Set destination and Send
Agent2.TrapManagers.Clear
```

```
Agent2.TrapManagers.Add txtDestination.Text
Agent2.Send

cmdTrap.Enabled = True
```

3) Set Request History

If you want to view the history of changes made by server then you should see set table history table

```
txtDescr.Text = GetRegSetting(gKey, "sysDescr", "Dart Sample
Agent")
txtObjectID.Text = GetRegSetting(gKey, "sysObjectID",
"1.3.6.1.4.1.52222")
txtContact.Text = GetRegSetting(gKey, "sysContact", "Fiona
Quartwhistle")
txtName.Text = GetRegSetting(gKey, "sysName", "Steve")
txtLocation.Text = GetRegSetting(gKey, "sysLocation", "A
little bit above the floor and far below the ceiling")
```

6.1.3 SNMP Explorer

It scans all the SNMP enable devices on the network and display it its description in tree format. It also catches the trap messages generated by any agent and display also its information in tree manner.

```
AddProp Node, "sysDescr", "1.3.6.1.2.1.1.1.0"
AddProp Node, "sysObjectId", "1.3.6.1.2.1.1.2.0"
AddProp Node, "sysUpTime", "1.3.6.1.2.1.1.3.0"
AddProp Node, "sysContact", "1.3.6.1.2.1.1.4.0"
AddProp Node, "sysLocation", "1.3.6.1.2.1.1.6.0"
AddProp Node, "sysName", "1.3.6.1.2.1.1.5.0"
AddProp Node, "sysServices", "1.3.6.1.2.1.1.7.0"
```

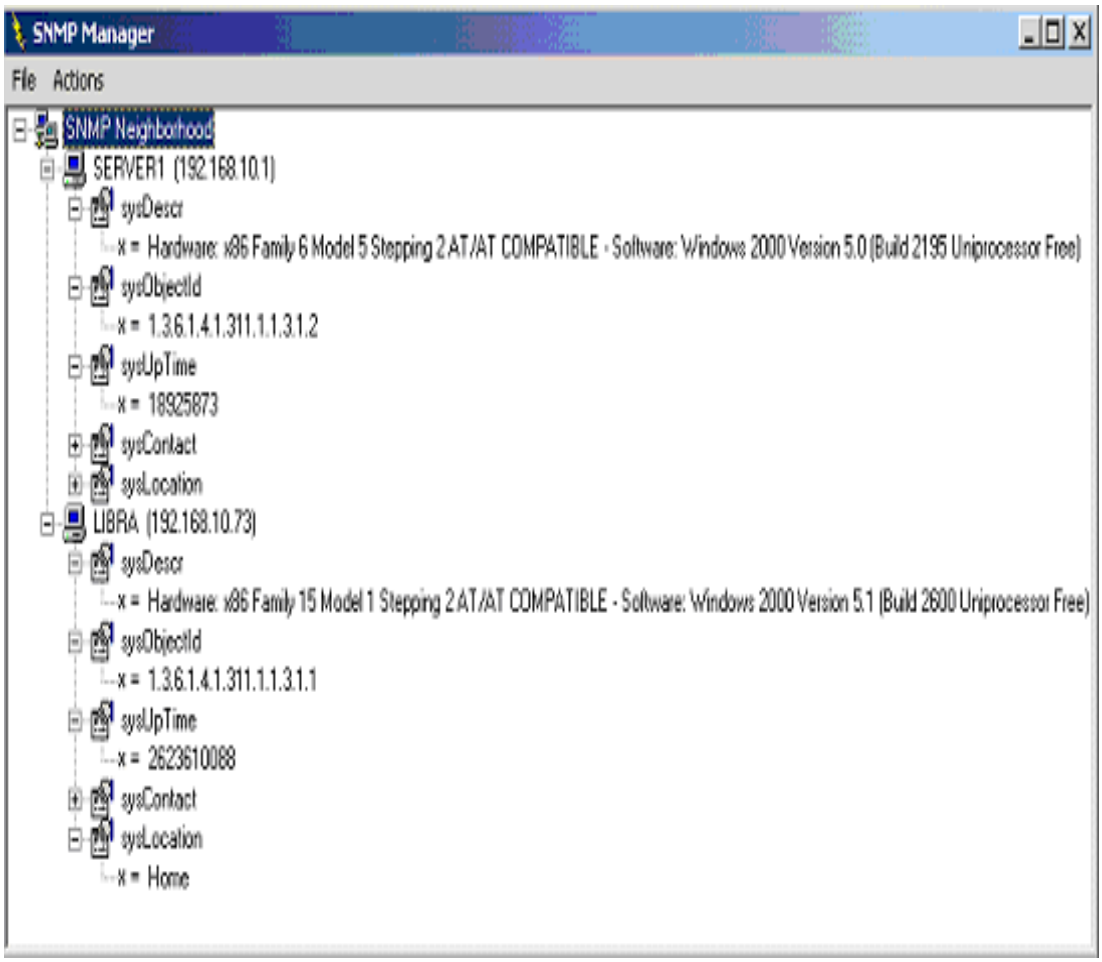


Figure 6.1.3: Snmp Explorer

6.1.4 Trap Catcher

It catches the traps, which are fired by an agent and display all information about that trap. It uses UDP port 162 for communication with agent.

```
Manager1.Open (Convert.ToInt32 (txtPort.Text),
txtAddress.Text)
UpdateStatus (True)
Dim entry As String = "Trap received from host" +
Manager1.AgentName
logFile.Write(System.Text.Encoding.Default.GetBytes(msg),0,
msg.Length)
```

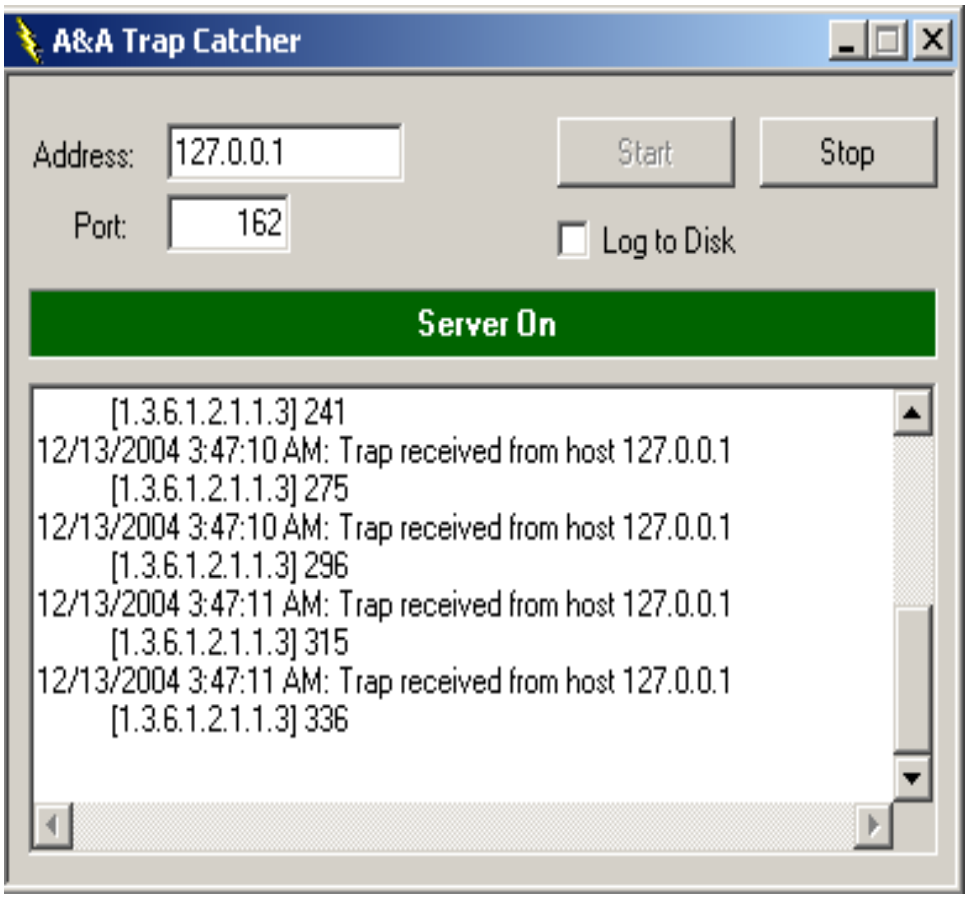


Figure 6.1.4: Snmp Trap Catcher

Chapter 7

Testing

This chapter includes the test cases developed for this system. Testing is that phase which explains the scope, approach, resources and schedule of the quality assurance and testing activities. Defines items/features to be tested, testing tasks to be performed, personnel responsible for each task and risks associated with the test plan.

7.1 Test cases

Test case is a document that describes ***an input***, an ***action***, or an event and an expected ***response***, to determine if a feature of an application is working correctly.

Testing is an extremely important phase and if not conducted properly can result into a bad product, not meeting requirements. The system was thoroughly tested, especially focusing the GUIs and determining the behavior. Following are test cases developed for this system:

7.1.1 Test Case 1- Login Screen

The following test case is for testing Login Screen. It takes the username and password as the input. The results are being verified and given authentication to the user or administrator according to their rights.

Table 3: Login Screen Test

Fields	Input	Expected Result	Remarks
Ok	Some Field Still null	Please enter correct user name or password	Fail
Ok	Username	Please input correct password	Fail
Ok	User name and password	Login accept	Pass

7.1.2 Test Case 2- Snmp Explorer Screen

The following test case is for testing Snmp Explorer Screen. The input parameters are displayed as the static manners. The resulting output is discover SNMP enable agent on the network

Table 4 SNMP Explorer Screen Test

Fields	Input	Expected Result	Remarks
Discover Agent	Click discover agent	Discover SNMP enabled Devices	Pass
Refresh	Click refresh	Discover new hardware changes	Pass
Add Machine	Click add machine and give Accurate Ip address	Add to the list of Snmp Enable devices	Pass
Add machine	Click add machine and give 123 rather than IP address	No such hardware found	Fail

7.1.3 Test Case3-SNMP Manager Screen

The following test case is for testing Snmp Manager Screen. The input parameters are displayed as the static manners. The output is discovering Snmp enable agent on the network as well as its description, sysLocation etc.

Table 5 SNMP Manager Screen Test

Fields	Input	Expected Result	Remarks
Start manager	Port already use	Close port first and then start manager	Fail
Start manager	Port closed	Start manager open port 162	Pass
Refresh List	Click Refresh some field still null	Refresh Above list and finding other Snmp Enabled Device	Pass
Add	Click add	Add to the list of Snmp	Pass

		Enable devices	
Add	Click add and type incorrect IP address	Cannot find Ip Address	Fail
Get Table	Click Get Table if log created	Display log file to see set Request Table	Pass
Get Table	Click Get Table if log not created	Debugging request	Fail
View trap log	Click trap log trap received enabled	Display trap log file	Pass
sysLocation	Double click to change sysLocation	New SysLocation field appear to set field	Pass
sysName	Double click to change sysName	New SysName field appear to set field	Pass
sysDescription	Double click to Change sysDescription	New SysDescription field appear to set field	Pass

7.1.4 Test Case4-Searching Screen

The following test case is for testing Searching Screen. The user would be given different condition for searching such as IP address, SysLocation, SysName etc. the desired fields are verified in database and display records in list View.

Table 6 Searching Screen Test

Fields	Input	Expected Result	Remarks
Select Searching Condition	Field is empty	Retrieve all field from database	Pass
Select searching condition (Ip address) range is	IP Address	The Ip Address you specified doest not match please try again	Fail

not correctly entered			
Select Searching condition(Hard Disk)	Hard Disk	Retrieve data related to Hard Disk	Pass
Select Searching Condition(Ip Address)	IP Address	Retrieve all field Against the IP address from the database	Pass
Select Searching Condition(Hard Disk)	Hard Disk	Retrieve all field Against the Hard Disk from the database	Pass
Select Condition	None	Please Specified Search Condition	Fail

7.1.5 Test Case4-Agent Screen

The following test case is for testing Snmp Agent Screen. The input parameters are displayed as the static manners. The output is showing new SysLocation, sysName, SysContact etc. and maintains a set request table as well as send trap to the Snmp Manager Screen.

Table 7: Agent Screen Test

Fields	Input	Expected Result	Remarks
Start agent	Click Agent start	Port 161 open	Pass
Start agent	Click Agent start already open for trap	Port 161 in use	Fail
Send	Click Send	Trap Sent to the Snmp Manager	Pass

7.2 Results

The test cases were designed in order to test the system's working. Test cases are designed for every user interface separately to check for the expected responses from the system. This resulted in a system, if not 100% bug free but to a major extent, bugs were removed. Retesting is a good practice and helps in identifying defects and their removal from the system.

8 Conclusions

Development of Network Assets Monitoring and security using SNMP, gave us a chance to follow software engineering completely and thoroughly. It started from analysis phase and then projects planning, its management, implementation in a language we had never used before, then thorough testing of the system by performing all the various tests in order to achieve quality.

Network Assets Monitoring and Security is useful in two major areas, one is network assets monitoring and other is inventory management. A lot can still be done in terms of functionality and can be extended to heavy and light machinery management.

This software would provide a base for those who want to implement it in some other area / field such as for some other industry. We believe that, who ever puts hands on this report would like to enhance this project and develop more efficient algorithm for implementing such solutions

It is hoped that such systems would help in automating our industry to the level that it is able to come at par with the competitors in the field. At the same time would help in generating quality and accurate products.

9 Future Works

We can do lot more things in the field of network assets security. The major enhancement we can do is screen capturing of client's workstation, if client have any problem he only have to raise query the administrator will handle problem from server. The second enhancement could be that we can set a camera at our work place if any workstation is not responding than suddenly that camera take snap of infected region, and from that snap we can easily find the prosecute. This application can also be applied in various heavy or light machinery of industry. This software will get information of all hardware, which have IP address and have SNMP service enabled. for e.g. if you are designing industrialist and you have to know how much design have been made from last two days then you don't have to go at your plant for counter reading you may just sit on server and see the counter reading there, one more aspect is that we can facilitate the manager by most of the things online manager will have to logon from anywhere and see the desired data and made certain steps to overcome the problems. This software has various applications in similar fields.

10 References

1) www.oreilly.com/catalog/esnmp/chapter

2) www.SNMP4tPC.com (SNMP for the Public Community)

3) www.Simple-Times.org- is an openly-available publication devoted to the promotion of the SNMP.

4) www.SimpleWeb.org, University of Twente - provides links and information on network management.

5) www.SNMPBOY.msft.net (Microsoft Corporation) - Monitoring with MRTG on NT systems

6) www.SNMPInfo.com - is a consulting and software development company founded in 1997 by David T. Perkins.

7) www.mibDepot.com (Previously known as MibCentral.com) - mibDepot offers a new way to view and search through a very large number of SNMP MIBs.

8) www.SLAC.stanford.edu/xorg/nmtf - Network Monitoring Tools - This is a list of tools used for Network (both LAN and WAN) Monitoring tools and where to find out more about them. The audience is mainly network administrators.

9) www.netmon.com Network Monitoring Tools and Tutorials - A detailed listing of tools to help any sized network monitor their network. The focus is on low cost tools for Windows.

10) www.arnoc.com - NetManage Links Directory

11) www.chapo.co.il/articles/snmp Network Management Protocols - Written by Oren Chapo * August 1999

APPENDIX A

ASN: (Abstract Syntax Notation) The OSI Language for describing abstract syntax.

Authentication: The process whereby a message is associated with a particular originating entity

AE: Authentication Entity (SNMPv1) that portion of an SNMP agent responsible for verifying that an SNMP Entity is a member of the community to which it claims to belong. This portion of the agent is also responsible for encoding / decoding SNMP Messages according to the authentication algorithm of a given community.

Authorization: The process whereby an access policy determines whether an entity is allowed to perform an operation

BER: (Basic Encoding Rules) The OSI language for describing transfer syntax.

CCITT: International Telegraph and Telephone Consultative Committee

CMIP: Common Management Information Protocol the OSI protocol for network Management

Community: (SNMPv1) and administrative relationship between SNMP entities.

Community Name: (SNMPv1) an opaque string of octets identifying a community.

Connection: Logical binding between two or more users of a service.

Datagram: A self-contained unit of data transmitted independently of other datagram.

Device: A network element of some kind.

DNS: Domain name system the application protocol offering naming service in the internet suite of protocols.

Enterprise MIB: A MIB module defined in the enterprise-specific portion of the internet management space.

Flow Control: the mechanism whereby a receiver informs a sender how much data it is willing to accept.

IANA: Internet assigned Numbers Authority.

Host: an End System.

Internet Protocol: the network protocol offering a connectionless-mode network service in the Internet suite of protocols.

IP Address: A 32-bit quantity used to represent a point of attachment in an Internet.

LAN: Local Area Network any one of a number of technologies providing high speed, low-latency transfer and being limited in geographic size.

Managed Node: A device containing a network management agent implementation.

MIB: (Management Information Base) a collection of object that can be accessed via a network management protocol.

MIB view: a collection of managed objects realized by an agent, which is visible to a management application.

Manager: an application residing on a network management station.

NMS: (Network Management Station) an end-system responsible for managing (a portion of) the network.

Network identifier: that portion of an IP Address corresponding to a network and an internet.

Object Instance: a particular instance of an object type.

Object Type: an abstract definition of a managed object.

Physical layer: that portion of an OSI-system responsible for the electromechanical interface to the communications media.

Port number: identifies an application-entity to a transport service in the internet suite of protocols.

PDU: a data object exchanged by protocol machines, usually containing both protocol control information and user-data.

Prototype: (management usage) the object type corresponding to an instance.

RFC: (request for Comments) the document series describing the internet suite of protocols and related experiments.

SNMP: the application protocol offering network management service in the internet suite of protocols.

SMI: (Structure of Management Information) the rules used to define the objects that can be accessed via network management protocol.

Subnet: a physical network within an IP network.

Subnet mask: a 32-bit quantity indicating which bits in an IP address identifies the physical network.

Subnet number: that portion of an IP host identifier, which identifies a particular physical network within an IP network.

Subnetting: the process of using IP Subnetting procedures.

UDP: User Datagram Protocol the transport protocol offering a connection less mode transport service in the internet suite of protocols.

APPENDIX B

Introduction:

Network Assets Monitoring and Security using SNMP targets big organizations where number of workstation is very large and network assets security is major issue. This software will monitor the hardware whenever the configuration of hardware changes it will give alert to administrator. The software is divided into two major modules

1) **Monitoring**

   If configuration of any hardware changes than this system will detect these changes automatically, question arises how? The answer is whenever the hardware is plugged first time this system collects all hardware related information from that machine and stored it in database. Whenever the hardware information changes this software scans that hardware in normal routine and collect the desired data then it compares that data with data that is stored in database if conflict arises than this is the indication of problem in hardware configuration and if this changes is in the knowledge of administrator then he may proceed for updating.

2) **Inventory management**

   If new hardware comes in organization then it should registered in inventory. Nowadays inventory management is also very big issue we also solve this problem by introducing the feature of auto registry in our software, now you only have to plugged the network cable then this system will automatically registered the hardware in database.

   If the location or contact person of workstation changed then administrator can update its description or contact person from server.

APPENDIX B

Once the user accesses the system the main screen below would be displayed.

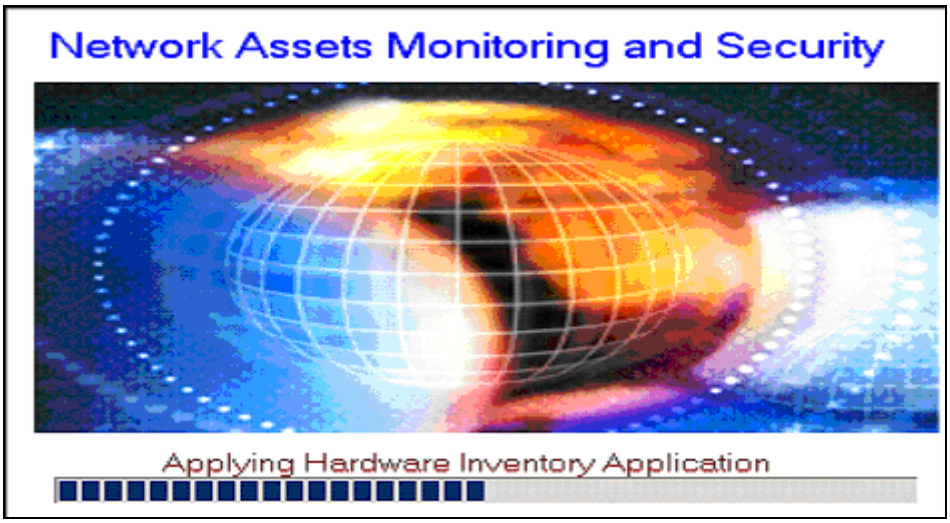


Figure B-1 Splash Screen

A&A Manager:

This module will run on server and do main scanning of all SNMP enabled devices attached on network. This is an stand alone module of project and don't have any dependencies this module can scan and edit information all SNMP enable devices attached on network with out any help of client side application.

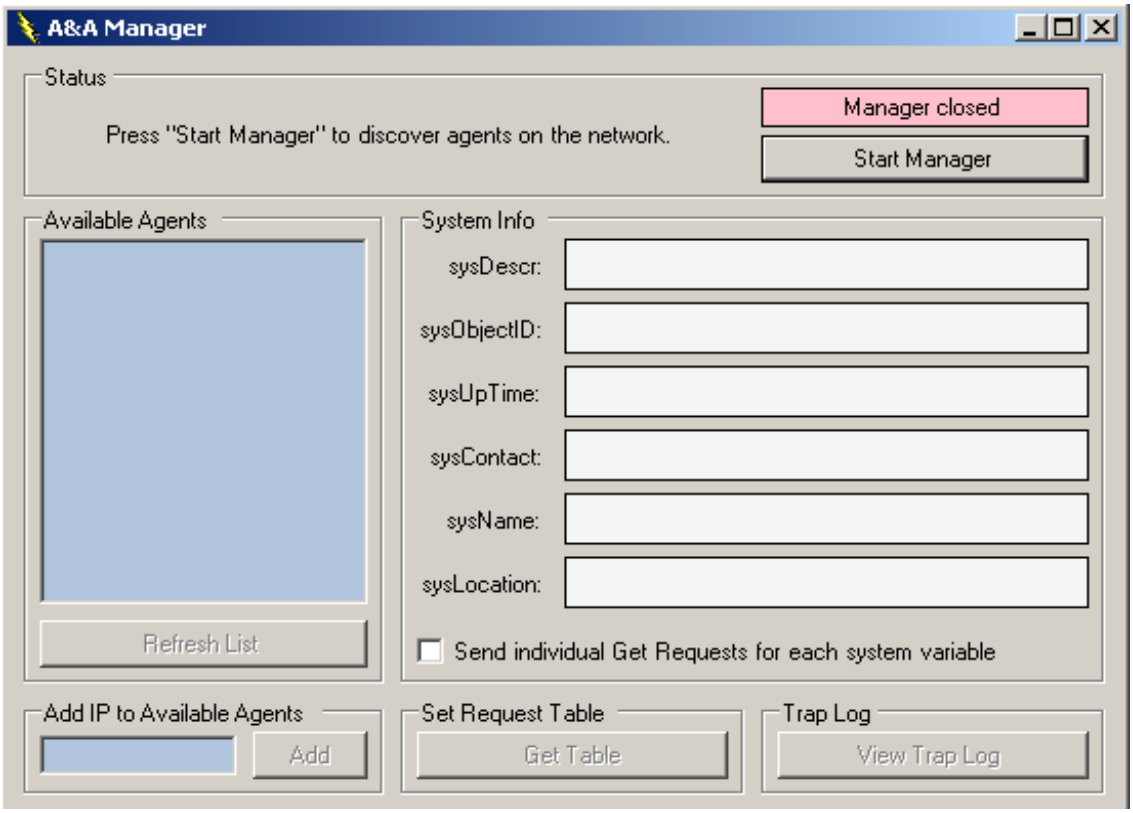


Figure B-2 SNMP Manager Screen

Click **Start Manager** for connection establishment as shown in (Figure B-1)

Once connection is established, it will gather all the SNMP enabled workstation on the network and display it in **available Agent** list. Then by clicking the desire agent, we can find its system information as shown in (Figure B-2).

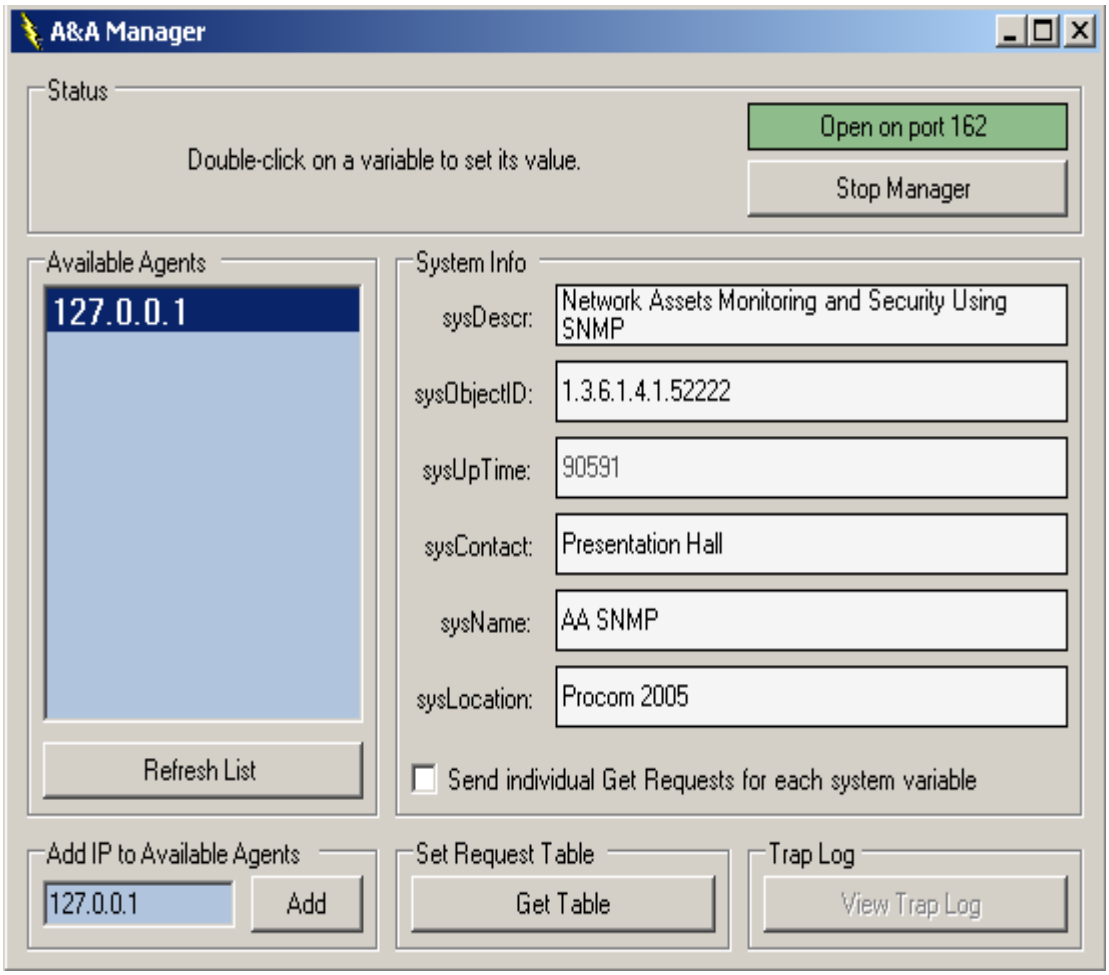


Figure B-2 A SNMP Manager Screen

If you want to change the desire Agent Information related to System Information just double click the desired text field against the System Information and changed it as shown in (Figure B-3)

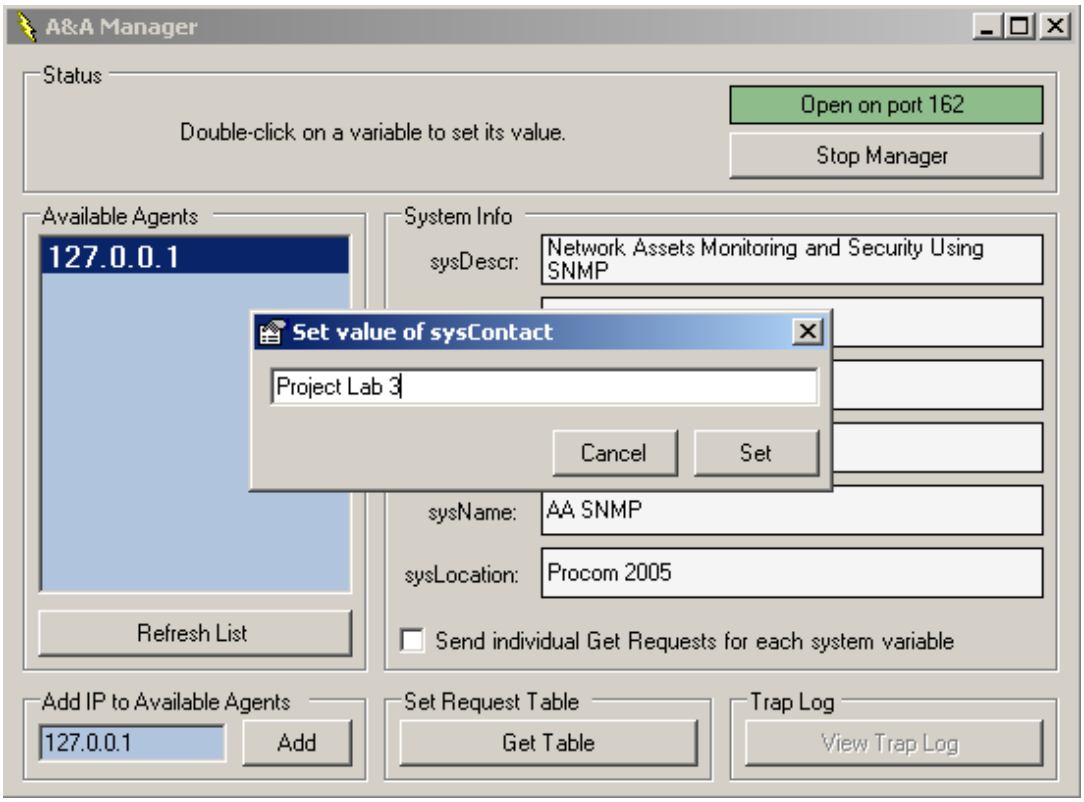


Figure B-2 B Set Value Screen

If you want to know what changes, you have made so far in which agent then you should click **Get Table** as shown in (Figure B-3)

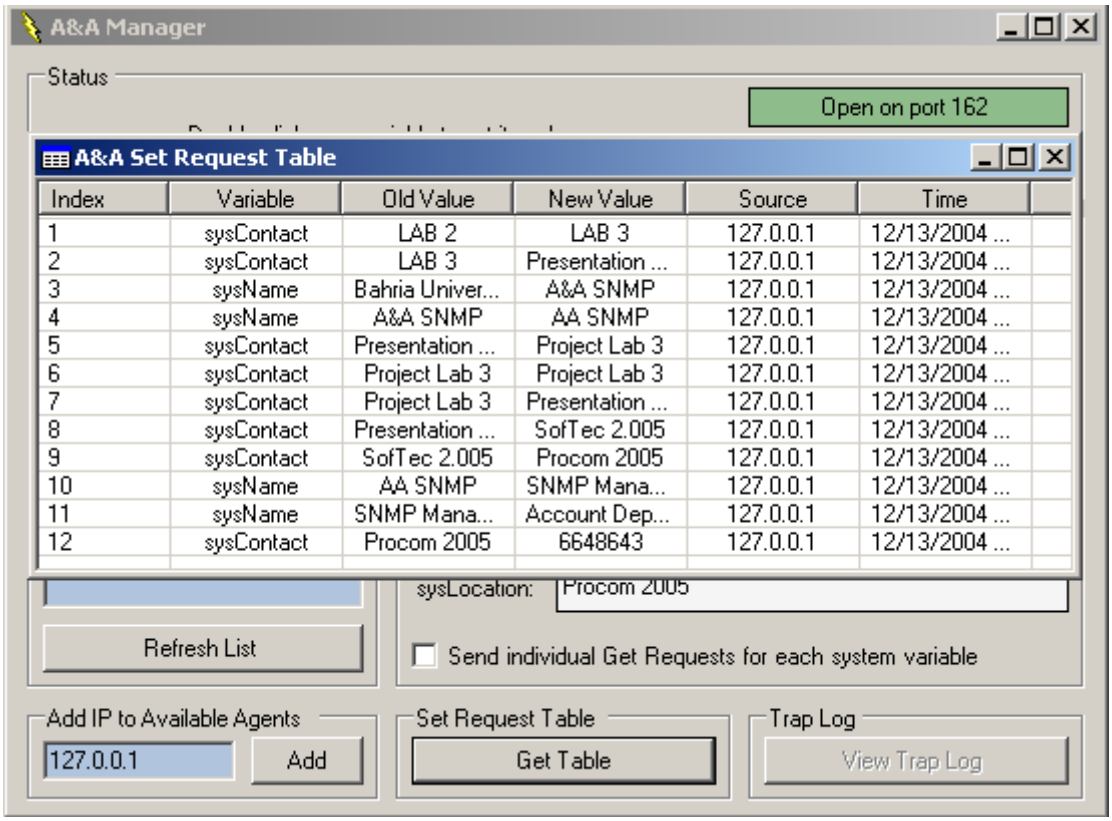


Figure B-3 Get Table

If you want detail of all Traps received so far at this manager then you should click **View Trap Log** as shown in (figure B-5)

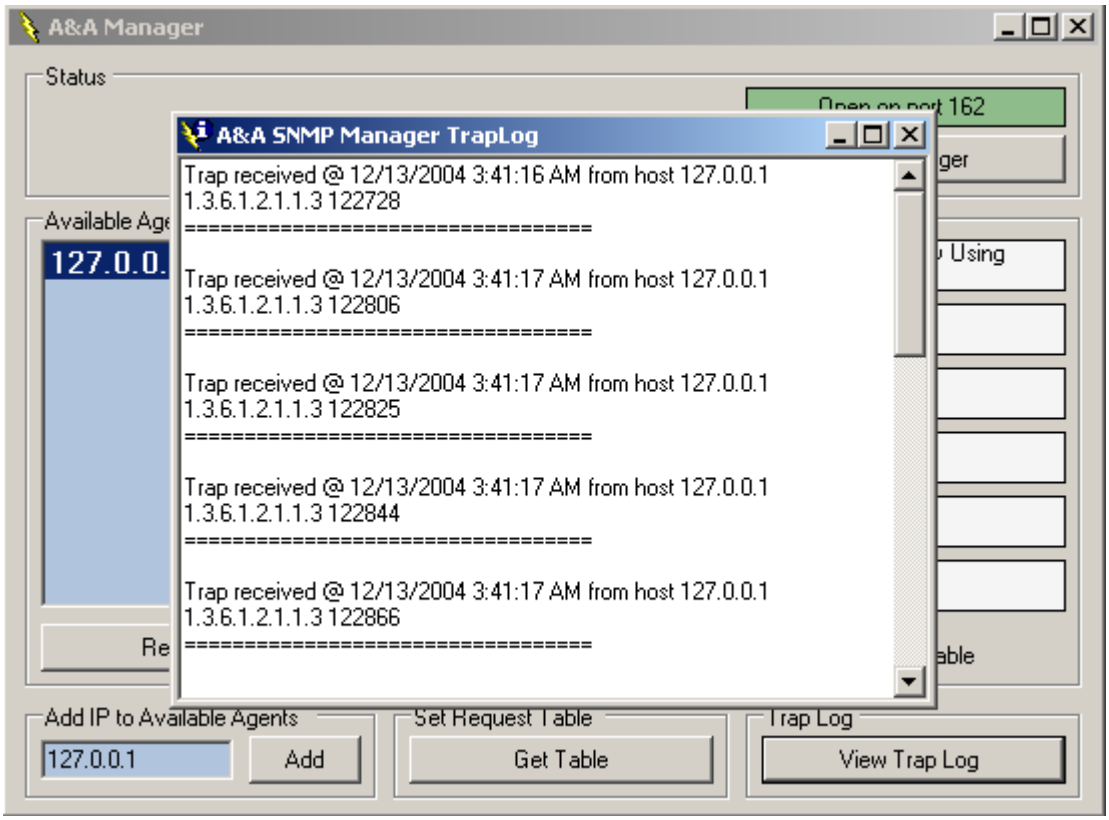


Figure B-4 View Trap

A&A SNMP Agent:

A&A SNMP Agent is use at client side but it is not facilitates SNMP Manager because SNMP manager is its self independent application. Its major function is to maintain the temporary record of set request made by manager and use for firing traps. In the beginning for starting agent press **Start Agent** button as shown in (Figure B-5)

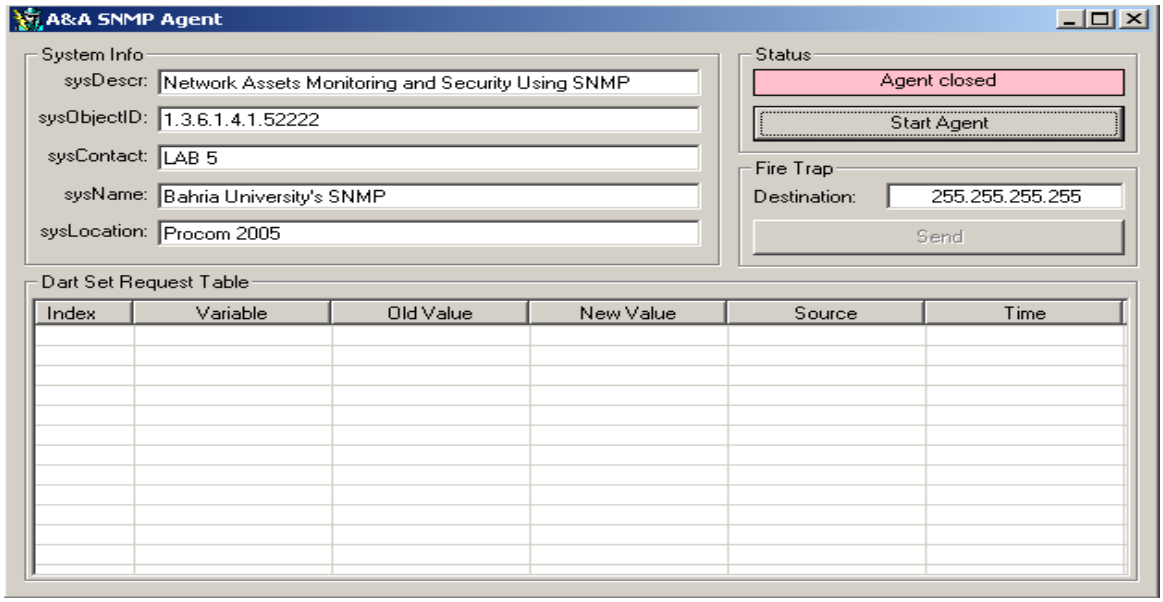


Figure B-5 SNMP Agent Screen

If you want to view Set Request detail you can see in set request table and if you want to fire trap you may press send button as shown in (Figure B-6)

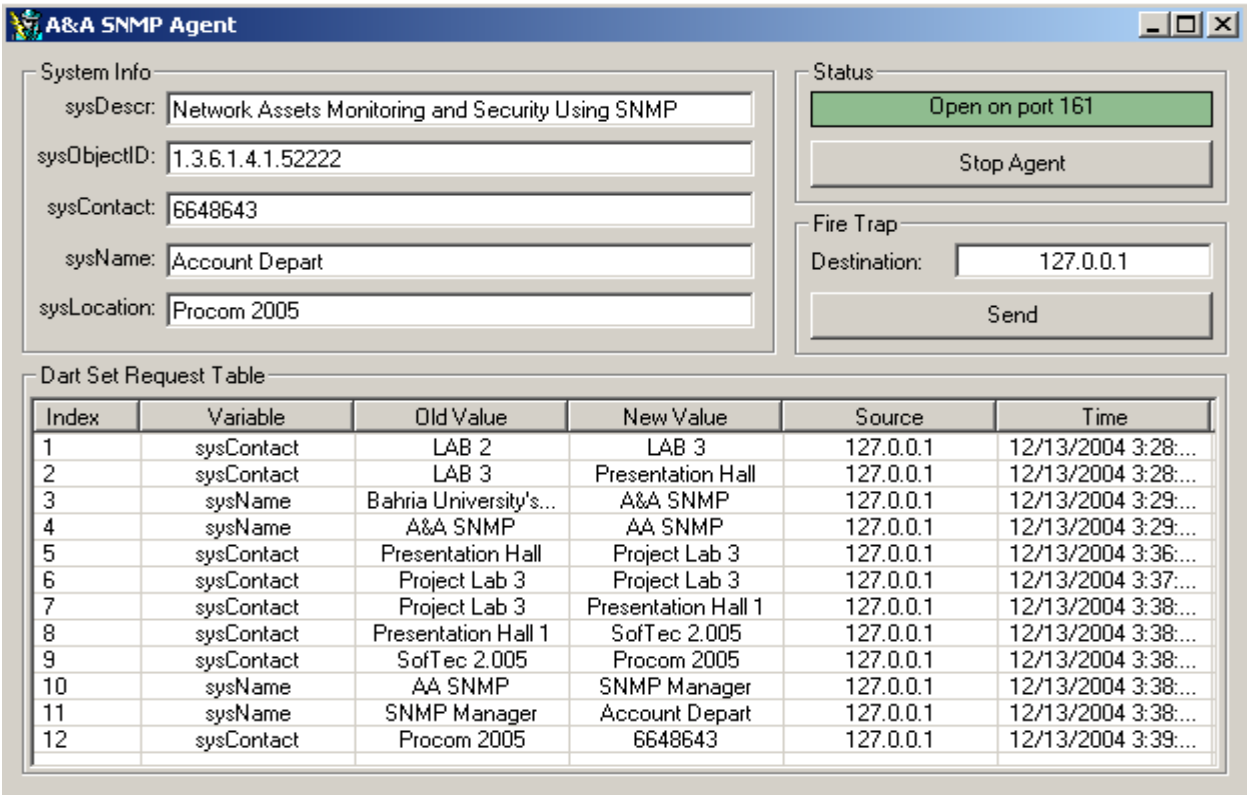


Figure B-6 Overview Agents

Trap Catcher:

It manages all information regarding traps received so far for starting Trap Catcher press **Start** button. It uses UDP Port 162 for receiving the Traps.

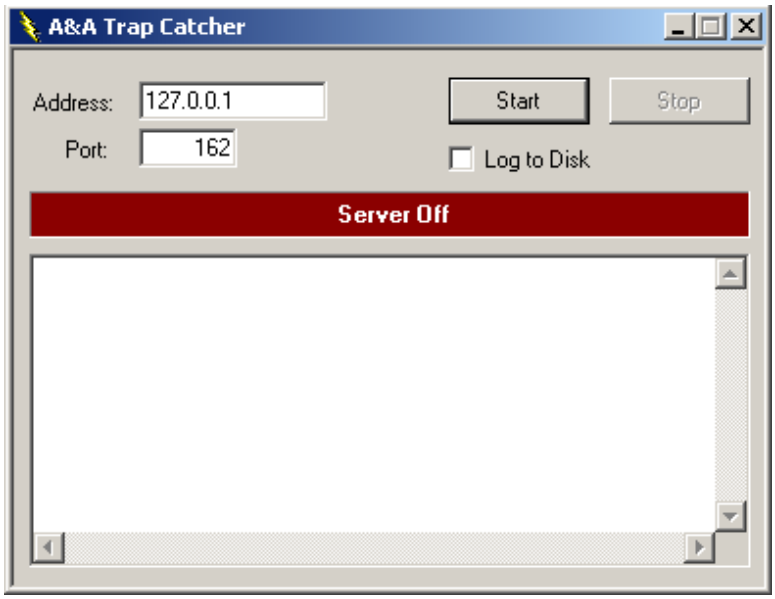


Figure B-7 Trap Catcher

You may see the received traps information in (Figure B-9)

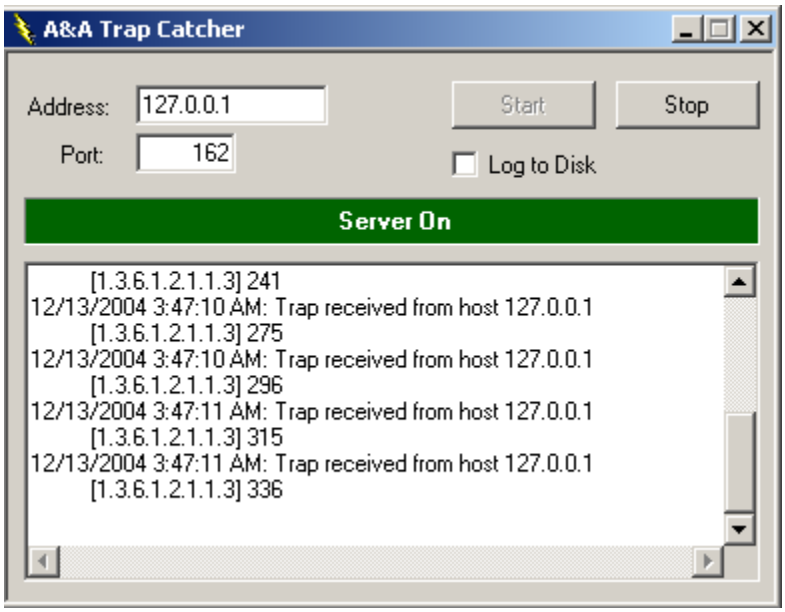


Figure B-8 Trap Start and Catches Trap

SNMP Explorer:

It is use for scanning all SNMP enable devices attached to the network and it also keep reference level information of traps receive on server. All information in SNMP Explorer display is in tree format it uses UDP port 162 for communication.

You do not have to weary about SNMP Explorer working you just run this module and exploring network as shown in (**Figure B-10).** This module is also stand alone application and don't have any sort of dependencies on client side application.

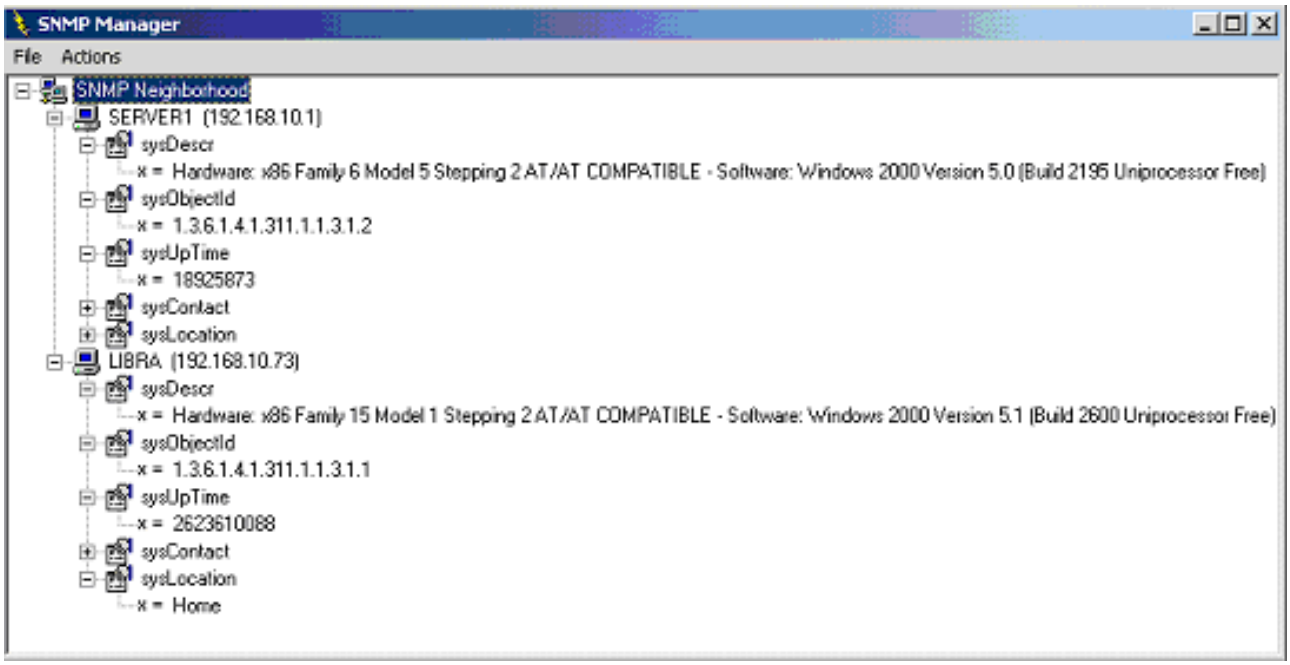


Figure B-9 SNMP Explorer

APPENDIX C

Resource Allocation

Below, is a list of, how resources have been allocated in all phases of the project that is the participation of project members in each phase of system development.

Task	Recourse	Days
ANALYSIS		
Establish list of tasks	A.A	6
Specify scope and feasibility	I.S	6
Understand problem and outline requirements	I.S	4
How to do? /what to do? Analyze problem, limitation, constraints in current systems and definite detail requirement	I.S	4
Plan project		
1. prepare a schedule for design and implementation	I.S	6
2. decide process model	I.S	4
Research technical criteria and options	A.A	4
DESIGN		
Design preliminary report	I.S	3
Design prototype screen	I.S	3
Design feasibility analysis	I.S	3
Decide Hardware/Software requirements	I.S	3
Develop prototype model/Approval	I.S, A.A	5
Design methods and procedures	I.S, A.A	16
Resource allocation	I.S, A.A	2
Algorithms design	I.S, A.A	5
Arrange meeting to finalized algorithms	I.S, A.A	5
Design flow chats	I.S, A.A	4
DFD (Data Flow Diagram)	I.S, A.A	4
ERD (Entity Relationship Diagram)	I.S, A.A	5
Design intermediate report	I.S, A.A	5

IMPLEMENTATION		
Plan For Programming	I.S, A.A	5
Write and computer program test	I.S, A.A	3
Design installation guide & user manual	I.S, A.A	2
Design presentation	I.S	2
Install files and database	I.S	5
TESTING		
Test all features separately.	I.S, A.A	20

Appendix D

NETWORK MONITORING AND SECURITY USING SNMP

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Worked on	VB .Net, SQL Server 2000

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Project Overview

Objective is to develop software that will maintain the database of all component information of workstations. The information like motherboard configuration, number of ports in use and number of ports free, hard disk space, processor speed and so on. The Server side component will be installed on server side and on the client side the client component will be installed which will send the information to the main server. When the software is installed for the first time it will broadcast a signal to all the client side computers to send their respective information mention above. This software will monitor hardware changes of components of the workstation in real time.

Developed Front-end using VB.Net and Back-end using SQL Server 2000

In SNMP architecture server side is referred as SNMP manager and the client side is known as SNMP agent.

The following illustration shows the project architecture.