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SHATRUANJAY

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4. Honeypot
5. DDoS
6. Anomaly
7. Shell
8. NID
9. HID

1.5 Problem Statement

We propose to build and demonstrate a novel system for rapid development and deployment of effective and cost-sensitive HIDSs. We consider intrusion detection as a classification problem, that is, we wish to classify each audit record or log records into one of a discrete set of possible categories, normal or a particular kind of intrusion. However, before we can apply classification algorithms, we need to first select and construct the right set of system features that may contain evidence (indicators) of normal or intrusions. We will develop an automatic feature selection and construction system to systematically discover and construct predictive features that can be used to build effective misuse and anomaly detection models.

1.6 Abstract

After the great revolution in the field of Information Technology, many applications made necessity to run computer systems (either servers or client machines) all the time. Along with improvements and new inventions in technology, the threat of attacks through computer networks becomes a large issue. Host Based Intrusion Detection is a part of security system that protects hosts from various kinds of attacks. It also provides a great degree of visibility (of system activities). It is quite widest that HIDS are vulnerable to attacks. An adversary, if successfully enters in a system can disable HIDS or modify HIDS rules to hide its existence. One can easily evade HIDS.We propose a new architecture that protects HIDS from such attacks. In this paper, we have proposed a new mechanism to check integrity of log files. We have discussed its affects on performance of system.

1.7 Goal And Objective

The purpose of host intrusion detection's systems (HIDSs) is to monitor host systems with the express purpose of identifying and responding to suspicious activity.

1.8 Names of conferences / journals where papers can be published

- IEEE/ACM Conference/Journal 1
- Conferences/workshops in IITs
- Central Universities or SPPU Conferences
- IEEE/ACM Conference/Journal 2

Chapter 2

Technical Keywords

2.1 Technical Keywords

1. IDS
2. IPS
3. Honeypot
4. DDoS
5. Anomaly
6. Network based Intrusion Detection
7. Host based Intrusion Detection
8. Port Scanning
9. TCP
10. Attacks
11. Snort
12. Trojans
13. Logs
14. Client and Server
15. IP Address
16. Port and socket
17. HTTP , SYN , UDP
18. Ping

Chapter 3

Introduction

3.1 Project Idea

Our project is about making a host based intrusion detection system which is compatible with any traditional security system. We just need to set up a system and then we can easily work on the host and the network. We want our project to be based on open source tools and no proprietary software.

3.2 Motivation Of The Project

We referred several IEEE papers during the initial stages of our project. 'An Effective Log Mining Approach for Database Intrusion Detection' published with IEEE paper standards describes that due to sudden proliferation of networked applications, database centered applications are facing a rapidly growing number of threats. Malicious outsiders launch attacks to access or corrupt data by stealing access control credentials or exploiting application vulnerabilities. On the Server side, server admin may sabotage databases by abusing privileges. Although various intrusion prevention and detection mechanisms are employed to protect against outsider and insider attacks, they are not very effective in detecting attacks targeted on the database at the server-side. The above mentioned paper exhibits a novel scheme for identifying malicious transaction patterns to detect attacks launched either by outsiders or insiders on server database.

The IEEE paper titled 'Development of Host Based Intrusion Detection System for Log Files' published with IEEE paper standards describes host based intrusion describes host based intrusion detection by using pattern matching technique on log files. The system will recognize two types of attack and its pattern. If an attack is unknown pattern, the system needs to keep that pattern in the database for the future assessment. Then, if an attack knows pattern, the system will match that pattern in their database and alert the host user about the attack or intrusion.

- Most Common Attacks (source CSI/FBI) In year 2014 most common attacks were:
    - Virus (approx. 78%)
    - Insider Abuse of Net Access (approx. 78%)
    - Laptop theft (55%)
    - Denial of Service and System Penetration (approx. 40%)
    - Unauthorized Access by Insiders (approx. 38%)
- Developing absolutely secure systems is not possible
    - Most existing systems have security flaws
    - Abuses by privileged insiders are possible
    - Not all kinds of intrusions are known
- Quick detection of intrusions can help to identify intruders and limit damage
- IDS serves as a deterrent

3.3 Literature Survey

The aim of [1] is to address the issues of information security and describes the security needs of an organization to protect their critical information from attacks. A well trained staff and analysts are required to continuously monitor the system. But still a huge effort is required to construct new security strategies in this system which are discussed in [2], [9]. [2] Provides a multi-layer approach in IDPS to monitor a single host. Multi-layer approach consists of three layers. File Analyzer, System Resource Analyzer and Connection Analyzer. The advantage of this technique [2] is that it provides both signatures based and anomaly based detection and prevention. The drawback in Multi-layer approach is that the IDPS require a large amount of memory to store the data of the system and network traffic. Proventil desktop is software based solution [3] which detects and protects the system from network layer up to application layer by known and unknown attacks. This software has great flexibility to set different type of filtering rules. The major drawback of HIPS is its high rate of false-positives. A lot of time and trained staff is required to monitor the IDPS [3]. The idea discussed in [4] helps an organization to take an informal decision in order to select the IDPS. The proposed model divides the IDPS into two types,in-source and out-source. Provide a security to an organization against attacks is a key business of Managed Security Services Provider (MSSP) [4]. MSSP spend most of the time to examine new technology to secure the information better than before. A risk is possible if MSSP do not exactly know the customer requirements of IDPS. According to [5], Snort and source fire are best IPSs for a multinational company. Snort [5] product provides high flexibility that allow to the user to self-configure and modify its source code by using source fire. The major drawback of Snort is that it uses only signature based technique to detect the intrusion but if anomaly behavior occur then it will not be possible for SNORT to detect that anomaly attack [5]. Harley [8] defines the difference between host based and network based intrusion detection and prevention system. This paper describes two types of network intrusion detection system: Promiscuous-mode and Network-node. The main disadvantage observed is that this IDS only responds to the signature based detected attacks but not to the anomaly based detected attacks. So still there is a need of human interaction who took real time action to resolve issue [8]. Novel string matching technique [9] is an optimization of other matching algorithms. Novel string matching algorithm breaks the string into small sets of state machines. Each state machine recognizes the subset of string. If any suspicious behavior occurs then the system broadcasts the information about intruder to every module (state machine) which holds the data base in order to define rules and compares the signatures of intruder with predefined detected signatures. This algorithm is most efficient and ten times faster than the other existing systems and it consumes less resources. The major issue is its practical implementation and it requires a large amount of memory. This algorithm is not capable to detect the anomaly behavior of the intrusion as in [7]. According to S. Mrdovi and E. Zajko [10], Distributed IDS is used to analyze the system in which multiple sensors are placed in selected network segments that observe the network traffic behavior. SNORT is used as an analysis engine. MySQL is used to log the events with the help of SNORT. Distributed IDS is managed by management console which monitors and configures the IDS. This IDS provides a greater protection against attacks because multiple computers are continuously monitoring and preventing the network from malicious attacks [7]. Large memory and well trained security analysts are required to implement and continuous management of the system [7]. This paper [11] describes the security of IDS. It highlights the two different techniques of IDS. Misuse detection and anomaly detection. Three different approaches data mining, data fusion and immunological based approach used in IDS. This paper provides brief information about existing intrusion detection technology. It evaluates the challenges and future directions of intrusion detection technology. The approaches that are discussed in [4], [9] are much sufficient for IDPS to detect and respond to anomalies in real time. This paper [10] proposed intrusion detection techniques by combining multiple hosts in order to detect multiple intrusions and to reduce false-positive rate. Hidden Markov Model (HMM) is a speech recognition technique that is used for modeling the system call events. Statistical technique gives the percentage of resource usages and system call events. Decision tree is used to model or classify the type intrusion to examine the future challenges. This technique [10] has advantage of less false-positive rate that increases performance of detection.

Chapter 4

Problem Definition And Scope

4.1 Problem Statement

We propose to build and demonstrate a novel system for rapid development and deployment of effective and cost-sensitive HIDSs. We consider intrusion detection as a classification problem, that is, we wish to classify each audit record or log records into one of a discrete set of possible categories, normal or a particular kind of intrusion. However, before we can apply classification algorithms, we need to first select and construct the right set of system features that may contain evidence (indicators) of normal or intrusions. We will develop an automatic feature selection and construction system to systematically discover and construct predictive features that can be used to build effective misuse and anomaly detection models.

4.2 Goals And Objectives

The purpose of host intrusion detection's systems (HIDSs) is to monitor host systems with the express purpose of identifying and responding to suspicious activity.

4.3 Software Context

There are various factors and benchmarks which are to be kept in mind while we design and develop a HIDS . This phase of the HIDS project development process decides the actual outcome of the HIDS . The environment and the HIDS objects in the system must support the story line and should be rendered in such way that they are a treat to the eyes of the hackers. At the same time we'll have to make sure that the HIDS is light weight so as to run at an optimal pace with minimum system requirements. Hence it is important to know the problems in hand and also to grade them in the best possible so that it would help us in deciding up on the factors that is to be given a higher priority while designing and developing the HIDS.

4.4 Major Constraints

- Noise can severely limit an intrusion detection system's effectiveness. Bad packets generated from software bugs, corrupt DNS data, and local packets that escaped can create a significantly high false-alarm rate.

- It is not uncommon for the number of real attacks to be far below the number of false-alarms. Number of real attacks is often so far below the number of false-alarms that the real attacks are often missed and ignored.

- Many attacks are geared for specific versions of software that are usually outdated. A constantly changing library of signatures is needed to mitigate threats. Outdated signature databases can leave the HIDS vulnerable to newer strategies.

- For signature-based HIDS there will be lag between a new threat discovery and its signature being applied to the IDS. During this lag time the HIDS will be unable to identify the threat.

- It cannot compensate for a weak identification and authentication mechanisms or for weaknesses in network protocols. When an attacker gains access due to weak authentication mechanism then IDS cannot prevent the adversary from any malpractice.

- Encrypted packets are not processed by most intrusion detection devices. Therefore, the encrypted packet can allow an intrusion to the network that is undiscovered until more significant network intrusions have occurred.

- Intrusion detection software provides information based on the network address that is associated with the IP packet that is sent into the network. This is beneficial if the network address contained in the IP packet is accurate. However, the address that is contained in the IP packet could be faked or scrambled.

4.5 Methodologies Of Problem Solving And Efficiency Issues

- Feasibility Analysis It is an analysis of our idea related to the system and give a validity and make our idea important. It takes an effort and necessity of thinking ability about the system feasibility of a problem occurred. Feasibility is the study of a significant or strong influence, what occurs at the time of system development. The influence can be either positive or negative. The system is considered feasible when positivity entitles negativity. Feasibility study can be performed in various ways related to various fields, we are describing four important way of performing feasibility study which are described following:-
  - Technical Feasibility: Technical feasibility of a system defines the compatibility, comfort, ability to achieve using current existing technology. It takes into attention weather the required technology is available or not and it also check for available resources like equipment's and software tools for development of the system. We can say that our developed system is technically feasible because we are not getting any difficulty related to resource of development and maintenance of this project. Whatever software tools related to the development of system are commonly available and easy to get from internet and any other way like shop, friends etc.
  - Economical Feasibility: This system is highly economic feasible because it is not taking any extra tools other than our required tools for development which are easily available and free to download and use for development of projects. We need not to spend more money for the development of the system. It is making an environment for the development with an effective manner. If we do as it than we can see the maximum usability of the related resources of system. After development of this system, we need not to be attentive for this system. Therefore we can say that, this system is economically feasible.
  - Schedule Feasibility: It is defined as the state of being probable and completed within scheduled time. Our Project can be fail when it takes too long to be completed before it is used. It means estimating the project with respect of time that how long this system will take to develop. Schedule feasibility

is a measurement of is timetable for project is reasonable. We discuss with our team and decide is the project deadline reasonable? Our project is initiated with specific deadline. We have determined whether the deadlines are mandatory or desirable.

- Operational Feasibility: It is related to the measurement of performance of system for which purpose it is developed. It relates to all the functions and features related to the system and look for speed of execution of requests came from users and effectiveness of response in well manner. It provides an advantage of the opportunities introduced at time of scope definition and its satisfaction of requirement identified. It also provide satisfaction for phase of system development. It ensures desired operational outputs which is the part of design and development. It includes design parameters like reliability, maintainability, supportability, usability of system for users. There all parameters are required for consideration of stages of design. A design and development of system requires appropriate and timely application software for development and provide efforts to meet the mentioned parameters which are defined previously. A system performs its planned purpose most effectively when its technical and operational characteristics are identifies into the design. So, we can say that operational feasibility is a critical aspect of systems engineering that needs to be an integral part of the early design phases.

4.6 Outcome

Monitors a network or systems for malicious activity or policy violations and after detection of these activities pop up alert messages to administrator for required actions.

4.7 Applications

- Monitor a mail server and other services
- monitors a network or systems for malicious activity or policy violations
- Digital Forensics
- Terminus Shock Detection Systems

4.8 Software Resources Required

Sr. No.	TOOLS	USE
1	Perl	Programming Language
2	Wireshark	Packet Sniffing Tool
3	Tshark	Command Line Packet Sniffing Tool
4	TCP DUMP	TCP Traffic Intercepting Tool
5	Apache Server	HTTPD Server to host Websites
6	Airmon-ng	To Put wireless network card at monitor mode
7	Airodump-ng	To Dump All Wireless connection detail
8	Airplay-ng	To do ARP Poisoning Attack on Base Stations
9	Airbase-ng	To Create a New Base Station
10	DHCP Server	To configure Networking such as IP-Address Ranges
11	BrupSute	To Intercept Session Of Users
12	Driftnet	To Sniff Images form captured packets
13	Hamster & Ferret	To Sniff Documents from captured packets

Chapter 5

Project Plan

5.1 Project Estimates

- Reconciled Estimates
  - Cost Estimates
    All the software used are open source software's.
    Cost of router
  - Time Estimates
    Estimated time of research is 8 months.
  - Project Resources
    1. System Requirements
       (a) Linux OS
          i. Backtrack OS
          ii. Kali OS
       (b) Linux Distribution
          i. Fedora
          ii. Ubuntu
          iii. Redhat
       (c) Software Installation Required
          i. Perl Programming
          ii. Wireshark
          iii. Apache Server
          iv. Tcp-dump
          v. Tshark
    2. System Architecture
       (a) System Hardware Requirements
          i. Linux compatible PC with OS architecture x86 or x64
          ii. CPU
             A. Core 2 Duo
             B. RAM: 4 GB
             C. HDD : 320 GB
             D. Virtual Memory : 12,215 MB
             E. NIC
       (b) System Software Architecture
          ∗ Install Perl In UNIX Systems By Default Perl Package is installed test using " perl -v " Command.
          ∗ Install PerlX-Assert-0.900 _01
          ∗ Install TCP Dump Program
          ∗ Install Wireshark Program
          ∗ Install Tshark Program
          ∗ Install Apache Server
          ∗ Install airmon-ng Program

- ∗ Install airodump-ng Program
- ∗ Install airplay-ng Program
- ∗ Install airbase-ng Program
- ∗ Configure DHCP Server
- ∗ Install BrupSute Program
- ∗ Install Driftnet Program
- ∗ Install hamster & Ferret Program

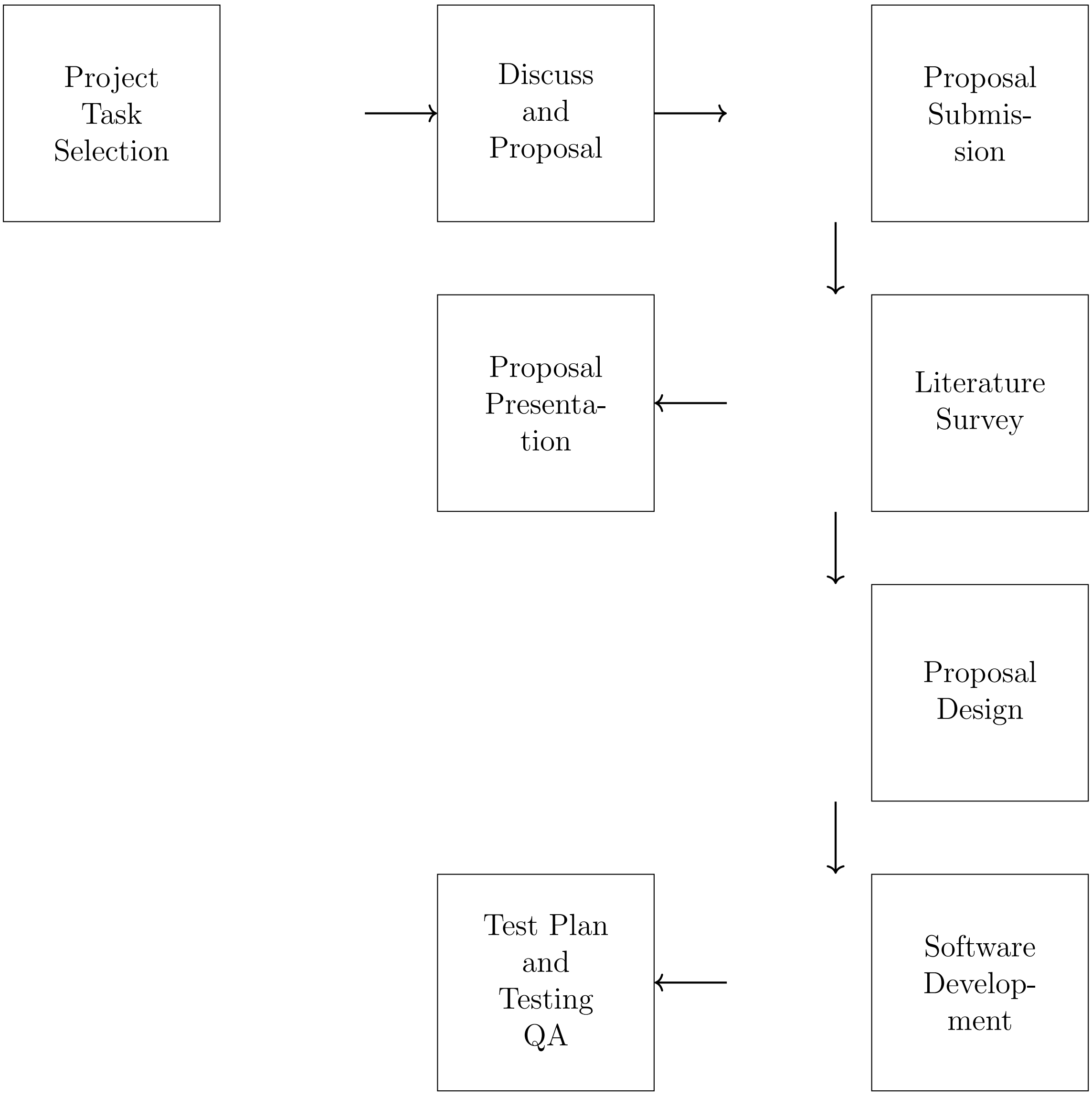
5.2 Project Schedule

5.2.1 Project Task Set

Major Tasks in the Project stages are:

- Project Title Selection
- Discussion & Proposal
- Proposal submission
- Literature Survey
- Proposal Presentation
- Proposal Design
- Software Development
- Test Plan
- Testing and QA

5.2.2 Task Network



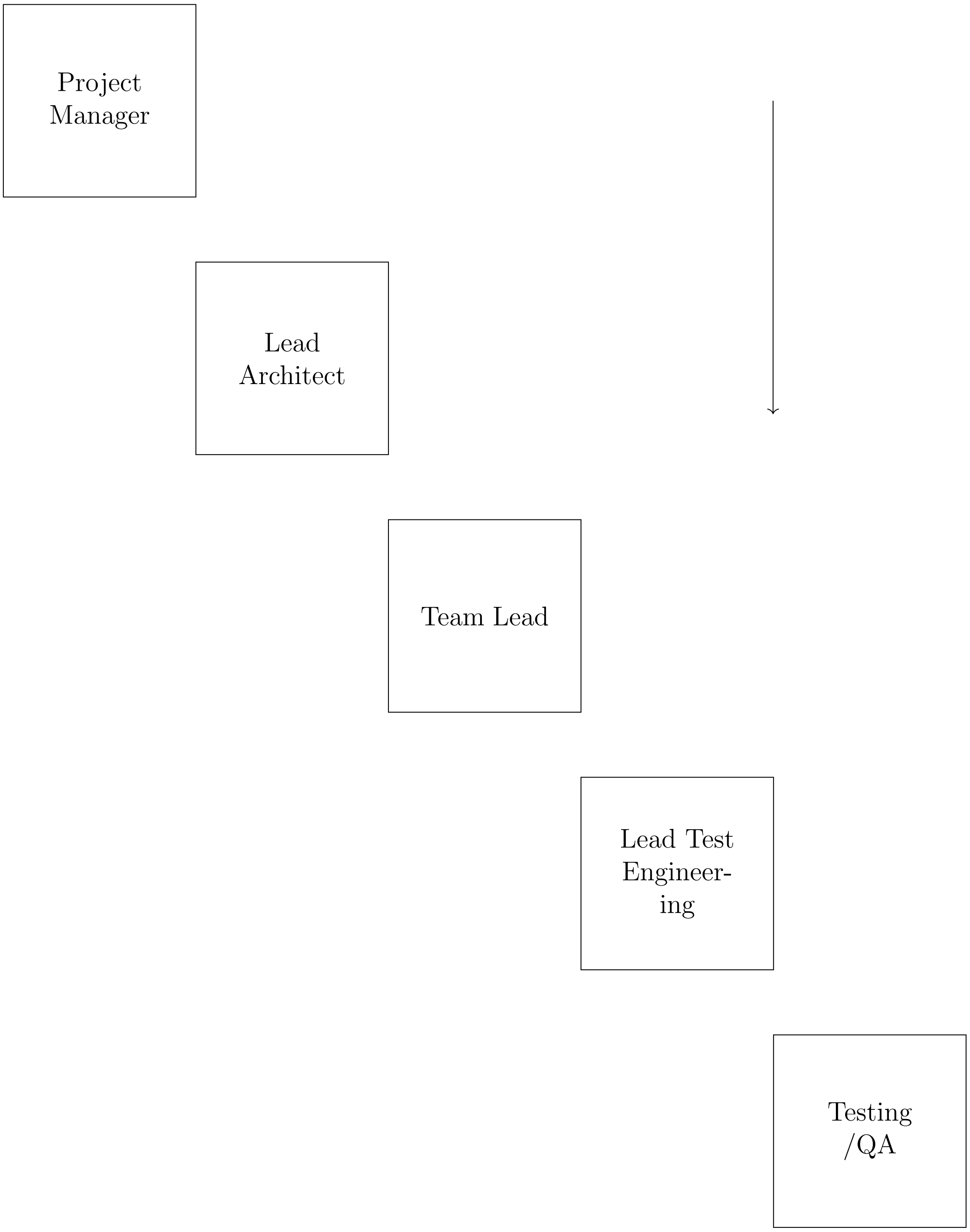
5.3 Team Organisation

The team had three members under guidance of associated professors as follows:

- Project Guide: Prof. Sushma S Shirke
- Team Lead: Surjit Singh
- Lead Architecture: Shatruanjay Kumar
- Lead Test Engineer: Yogesh Faguna
- Lead Designer: Sachin Yadav and Vikas

5.3.1 Team Structure

The team structure for the project is identified. Roles are defined



Chapter 6

Project Implementation

6.1 Introduction

A host-based intrusion detection system (HIDS) is a system that monitors a computer system on which it is installed to detect an intrusion and/or misuse, and responds by logging the activity and notifying the designated authority. A HIDS can be thought of as an agent that monitors and analyzes whether anything or anyone, whether internal or external, has circumvented the system's security policy.

6.2 Types of host-based intrusion detection system (HIDS)

There are two types of HIDS:-

- Anomaly Based Detection
- Signature Based Detection

6.2.1 Anomaly Based Detection

An anomaly-based intrusion detection system, is an intrusion detection system for detecting both network and computer intrusions and misuse by monitoring system activity and classifying it as either normal or anomalous. The classification is based on heuristics or rules, rather than patterns or signatures, and attempts to detect any type of misuse that falls out of normal system operation. This is as opposed to signature-based systems, which can only detect attacks for which a signature has previously been created. In order to positively identify attack traffic, the system must be taught to recognize normal system activity. The two phases of a majority of anomaly detection systems consist of the training phase (where a profile of normal behaviors is built) and testing phase (where current traffic is compared with the profile created in the training phase). Systems using artificial neural networks have been used to great effect. Another method is to define what normal usage of the system comprises using a strict mathematical model, and flag any deviation from this as an attack. This is known as strict anomaly detection.

Advantages

The major benefit of anomaly-based detection methods is that they can be very effective at detecting previously unknown threats. For example, suppose a computer becomes infected with a new type of malware. The malware can consume the computer's processing resources, send large numbers of e-mails, initiate large numbers of network connections, and perform other tasks that may be significantly different from the established profiles for the computer. However, anomaly detection has an advantage over signature-based engines in that a new attack for which a signature does not exist can be detected if it falls out of the normal traffic patterns. The best example of this is how such systems detect new automated worms. When a new system is infected with a worm it usually starts scanning for other vulnerable systems at an accelerated or abnormal rate flooding the network with malicious traffic, thus triggering a TCP connection or bandwidth abnormality rule.

Disadvantages

A disadvantage of anomaly-detection engines is the difficultly of defining rules. Each protocol being analyzed must be defined, implemented and tested for accuracy. The rule development process is also compounded by differences in vendor implementations of the various protocols. Custom protocols traversing the network cannot be analyzed without great effort. Moreover, detailed knowledge of normal network behavior must be constructed and transferred into the engine memory for detection to occur correctly. On the other hand, once a protocol has been built and a behavior defined, the engine can scale more quickly and easily than the signature-based model because a new signature does not have to be created for every attack and potential variant. Another pitfall of anomaly detection is that malicious activity that falls within normal usage patterns is not detected. An activity such as directory traversal on a targeted vulnerable server, which complies with network protocol, easily goes unnoticed since it does not trigger any out-of-protocol, payload or bandwidth limitation flags.

6.2.2 Signature Based Detection

Signature detection, also known as misuse detection, builds patterns of well-known attacks or weak spots of the system and uses these patterns for identifying intrusions [9]. Signature detection, thus, gives accurate results for the attacks whose signature is known and has a very low false alarm rate as compared to anomaly detection. It also gives high performance as compared to anomaly detection because of explicit knowledge about the attack. Signature detection, however, suffers from the following drawbacks:

- Signature detection fails when any new type of attack occurs.

- Signature detection is also not able to detect attack which has slight variation with the available signatures of attacks.

- Signature detection needs explicit knowledge about the attack scenario. Moreover, this knowledge building requires analysis by the humans which is time consuming and error prone.

6.3 Log Files

In computing, a log file is a file that records either events that occur in an operating system or other software runs, or messages between different users of a communication software. Logging is the act of keeping a log. In the simplest case, messages are written to a single log file.

6.3.1 Types of Log files

Server side log files

A web server log file is a text file that consists of activities performed on the web server. These log files collect and store following types of data: Date, Time, Client IP Address, Referrer, User Agent, Service Name, Server Name, Server IP, etc.. Hence, these files are useful for analyzing server performance and search engine optimization.

Client side log files

Client side log files contain data collected from client side by the execution of a script on the client side machine. This script is send by the server along with the web document. Page tagging is one of the most widely used methods for client side data collection.

Proxy side log files

Proxy server is present between the client machine and server machine. It reduces burden of web server by serving the request for the pages which are available with it. It eliminates the drawback of web server's log files which allows analyzing only the behavior of user for one particular site only .

Firewall side log files

Firewall logs only those events which are denied by the system. As such, examination of firewall log files is vital for intrusion detection. It is also necessary to measure the strength of security measures implemented at firewall using Firewall auditing .

Network side log files

Network side log files can be obtained from network components such as from network firewall, routers and packet filters for analysis. It has an edge over other log files because it does not involve legal issues about violation of privacy of user's data .

System side log files

System side log files manage the information generated by the kernel and the system utilities. Detailed information about the activities of operating system is captured in system log files.

6.3.2 Extracting User Commands from Log Files

User signatures are created from the log files generated by the Basic Security Module (BSM) of the Solaris operating system. The BSM is a kernel module that logs all events that occur on a given machine. Each of these events is actually a system call, and for each system call a record is generated, consisting of tokens corresponding to the type of event. In order to extract commands a given user typed, first all system calls generated by the user are extracted from the log file. This is done through the use of the Unix utility commands, auditreduce and praudit. The auditreduce command is used for audit management and record selection, while praudit is used to convert binary log files in to ascii format. At the command prompt, this is done as follows:

```
auditreduce -u [username] [log file in binary form] — praudit – l
```

The auditreduce command takes the log file specified and extracts all system calls generated from the given username. The output of this is piped to the praudit command, which will then write each record (system call) to stdoutput one record per line. To save the output in a file, a script is started and ended before and after the auditreduce command. Below is an example of what one system call returned from praudit looks like:

```
header,86,2,login – telnet,,Tue 07 Mar 2000 10:14:08 AM EST, + 356353537 msec, subject,2051,2051,rjm,2051,rjm,2746,2746,24 0 172.16.113.105,text,successful login, return, success,0,trailer,88
```

Once all the system calls are extracted for a given user, the next step is to identify only the system calls that correspond to actual commands the user entered. To do this, a filter is used to identify execve system calls, because each execve system call corresponds to an actual command the user entered at a prompt. The filter also extracts a small set of system calls that are not execve, namely login and chdir. During the process of extracting the user commands, the filter also extracts the timestamp, and writes both the user command and timestamp to another file. This process is repeated for each of the log files we wish to train on. It is essential that the log files we build our signatures on are attack-free, so that each user's signature is valid, thus invalid behavior will never match the signature. Given the listing of user commands and the timestamp of each command we are ready to build our probabilistic finite automata.

6.3.3 XML converter

XML converter converts each new event traced in log file into XML format because of following advantages of XML over text files:

- XML files follow a structured format.
- XML format is more readable by machine.
- XML gives better performance.

Feature Extractor

Feature Extractor performs feature extraction from the XML format of log event. Feature extraction process is necessary to identify fields from the log event which have high information gain value and collect them for further processing.

Knowledge base of normal behavior

It consists of patterns of normal behavior that can occur in the log files.

Comparator

It is responsible for comparison of information extracted by Feature Extractor with the knowledge base of normal behavior. If comparator found match for the event, it should wait until a new event is logged in log file. If no match is found for the event, the comparator should then, hand over the logged event to the Central Comparator Unit after converting it to association rule format with the help of association rule converter.

6.4 String Matching Algorithms

6.4.1 Introduction

String matching is an important subject in the wider domain of text processing. These algorithms are basic components used in implementations of practical softwares existing under most operating systems. Moreover, they emphasize programming methods that serve as paradigms in other fields of computer science (system or software design). Finally, they also play an important role in theoretical computer science by providing challenging problems. String matching generally consists of finding a substring (called a pattern) within another string (called the text). The pattern is generally denoted as,
X = X[0......M-1]
whose length is M and the text is generally denoted as
Y = Y[0......N-1]
While searching the pattern within the text, at one time, we consider a subset of the text generally with the help of a window whose size is equal to M . Then the window is aligned with the pattern and they are matched for equality- either from the right or from the left- this specific work is known as an attempt. If they completely match, then either the algorithm ends or it continues to find any more occurrences of pattern in text. If they do not match, then the window is shifted to a new position. This is known as sliding window mechanism.

6.4.2 Types of String Matching Algorithm

Single-Keyword Pattern Matching

Pattern matching algorithms solve the general keyword pattern matching problem. That is, given a fixed and finite non-empty set of keywords and an input string, they find all occurrences of any of the keywords in the input string .

In this problem the input string is finite as well, but often a set of (multiple) input strings is used as input when searching for the keywords. In our case in particular, the input strings will be packets in the detection engine of the NIDS, and therefore, there will be many of them to process rapidly. This implies an alphabet size of 256 (quite large), and the size of the set of keywords on the other hand will be extremely small in comparison to the number of input strings. Furthermore, the set of keywords is known before the algorithm begins processing the input. Should this not be the case, if efficient modifications to the keyword set are needed, the searching process is known as dynamic string matching . Herein, we refer to computation performed on the set of keywords before processing the input as offline computation, pre-computation, or preprocessing. Types of single keyword matching algorithm:

1. Knuth Morris Pratt
2. Boyer Moore

Multiple-Keyword Pattern Matching

The pattern matching algorithms pertaining to the general keyword pattern matching problem are the ones of particular interest in this thesis. In this chapter we examine some of the proposed algorithms to solve this problem. Cleophas et al. have presented a comprehensive taxonomy and toolkit of pattern matching algorithms that updates and collects the past works of Watson and Zwaan. That taxonomy will give the reader a much more complete idea of what is available in terms pattern matching algorithms, and how the different basic types and variations of algorithms have arisen. This section will only go over explanations and pseudocode of certain representative algorithms to match multiple keywords. Of course the set of algorithms that solve this problem is growing all the time and slight variations of the algorithms do exist; however, we try to present the algorithms herein as generally as possible and without any attunement to a programming language. Types of multiple keyword matching algorithm

1. Aho Corasick
2. Fan Su
3. Wu Manber
4. Myer

6.4.3 Myer Algorithm

The Myers algorithm is an approximate string matching algorithm. An approximate matching algorithm matches a large text of length n with a short pattern p of length m allowing up to k differences, where k is a chosen threshold error . The Myers algorithm relies on a simple dynamic programming (DP) concept . It uses recursive formulas and simple bit operations to compute the edit distance between the text and patterns to find the equalities or differences . The edit distance between two strings is expressed as the minimum edit operations required to transform a text t1 to another text t2 or vice versa. Commonly, there are three typical variations of edit distance. The first form is called the Hamming distance . It computes the number of positions in the text that has different characters, i.e., how many characters are needed to convert a text t1 to another text t2. The compared texts or strings must be of the same length. The second formis called the Levenshtein distance, which does not have any restriction over the text size .

The edit distance is the minimum number of edit operations: insertion, deletion, and substitution, which are needed to convert two strings into each other. The third one is the Damerau edit distance. It allows the transposition of two adjacent characters to complete the conversion between the two strings . The Myers algorithm uses the

Levenshtein distance to compute the matches. It considers two strings similar if the edit distance (ed) between the two strings (A, B) is less than or equal to a predefined threshold (k) (ed(A, B) ¡= k). The formal approach to solve the problem of approximate string matching and to find the minimum edit distance is to use dynamic programming. Dynamic programming is an approach which uses a recursive formula to compute new values based on a prior knowledge of previous values. The patterns are arranged vertically and the packet is arranged horizontally.

6.4.4 Parallel programming

Parallel programming is a technique in which many computations are performed concurrently. Parallel computation divides a big task into smaller sub-tasks to be executed simultaneously. Parallelism can utilize multicore processors in a single machine or multiprocessors in a cluster of machines. The parallel execution on a multi-core or a cluster can take many forms. It can be categorized into bit-parallelism, data parallelism, or task/function parallelism. The focus of bit-parallelism is to minimize the count of instructions to execute an operation. This can be done by increasing the processor word size. In data parallelism, the data is split into many pieces and is distributed to multiple cores or processes. All processors run the same code simultaneously but on different data piece. This is also known as single instruction multiple data (SIMD) approach. In contrast to data parallelism, task parallelism is a form of parallelism where multiprocessors run different codes or tasks on the same piece of data simultaneously.

6.4.5 MPI

MPI is a standard interface that contains a set of libraries and routines to write a parallel program and distributes it over a cluster of machines or a multi-core processor. There are two basic components which are implemented in each MPI library. The first one deals with the compilation such as mpicc. It is a wrapper that links the MPI library and provides an easy operation to set the appropriate paths of both the library and the included files. mpicc also passes its argument to the C compiler which is required to run the program. The second tool is an agent which is responsible for executing the code in a distributed environment such as the mpirun or mpiexe.

6.4.6 Open multi-processing (OpenMP)

MPI is just a standard. It has several implementations such as MVAPICH, Intel MPI, and OpenMP. OpenMP is a high-quality open-source implementation of the latest MPI standard with a superior performance compared to other implementations . It provides a set of application programming interfaces (APIs) that is easy to use. OpenMP supports shared memory in a multi-processor environment, which gives more flexibility to programmers to develop their distributed applications. It is comprised of a set of library routines and compiler directives that allow the master processor to distribute the data and tasks among the processing units.

6.4.7 MapReduce

MapReduce is a programming model released by Google to handle the processing of large dataset in parallel . The idea behind this framework is to hide the complexity of parallelism from the programmer. Moreover, the framework provides the programmer with a simple API to present the logical perspective of an application. Recently, MapReduce has been widely used in both academia and industry. MapReduce has become a standard computing platformused by large companies such as Google, Yahoo!, Facebook, and Amazon. Statistics show that Google uses MapReduce framework to process more than 20 petabytes of data per day .

MapReduce basic programming model

MapReduce framework consists of two primitive functions defined by the user: Map and Reduce. Additionally,it has a runtime library to automatically manage the parallel computations without the need for user interventions. The library handles data parallelization, fault tolerance, and load balancing. In MapReduce model, the input and output data take the form of key/value pairs ¡ key, value ¿. Map and Reduce are the main two operations that are applied to the key/value pairs. A large input data is split into chunks of a specified size. For example, Google's implementation partition the data into M pieces each of size 16–64 MB. The Map function takes the input as a series of key/value pairs ¡ k1, v1 ¿ and performs the task assigned by the programmer. The output of the Map function is a series of intermediate key/value pairs ¡ k2, v2 ¿. The framework performs a shuffle phase in order to group the values of the same key. Afterwards, the intermediate data pairs are sent to the appropriate Reduce function. The Reduce phase takes the combined intermediate values as a key and a list of values and then executes the user-defined Reduce function to produce the final Result.

6.5 Parallel Implementation of Myer Algorithm

6.5.1 MAPCG implementation

String matching is one of the benchmarks used to evaluate MAPCG framework. It simply compares a single pattern that is passed as an argument by the user with a large text file searching for a possible match. Because we plan to use Myers algorithm to match the Snort signatures against a packet traces, we re-implement the string match to fit our needs. A function is implemented to read the patterns and store them in a vector. Additionally, we use the modified Myers algorithm, the same that was used in Phoenix++, to perform the matching. The Myers algorithm is implemented in the Map function as well. 5 Evaluation and analysis This section summarizes the experiments that were used to evaluate our implementations. We present the experimental results of both memory usage and execution time.

Chapter 7

SOFTWARE REQUIREMENT SPECIFICATION(SRS)

7.1 Introduction

7.1.1 Purpose and Scope of Document

Nowadays the use of internet and computer usage has increased so much, that there is need for check on increased risk of security so that user feels more secure.

7.1.2 Overview of responsibilities of Developer

Responsibilities of a developer include tracking of the current usage of the user and predicting the usage of resources in the future to the user in a graphical manner i.e. through graph ,pie charts etc.

7.2 Usage Scenario

User's needs an optimum limit of the usage of resources .For example: For an allocated limit of ram of 4 GB ,if user's limit is at max 3 GB then extra cost of 1 GB can be reduced and profited by user.

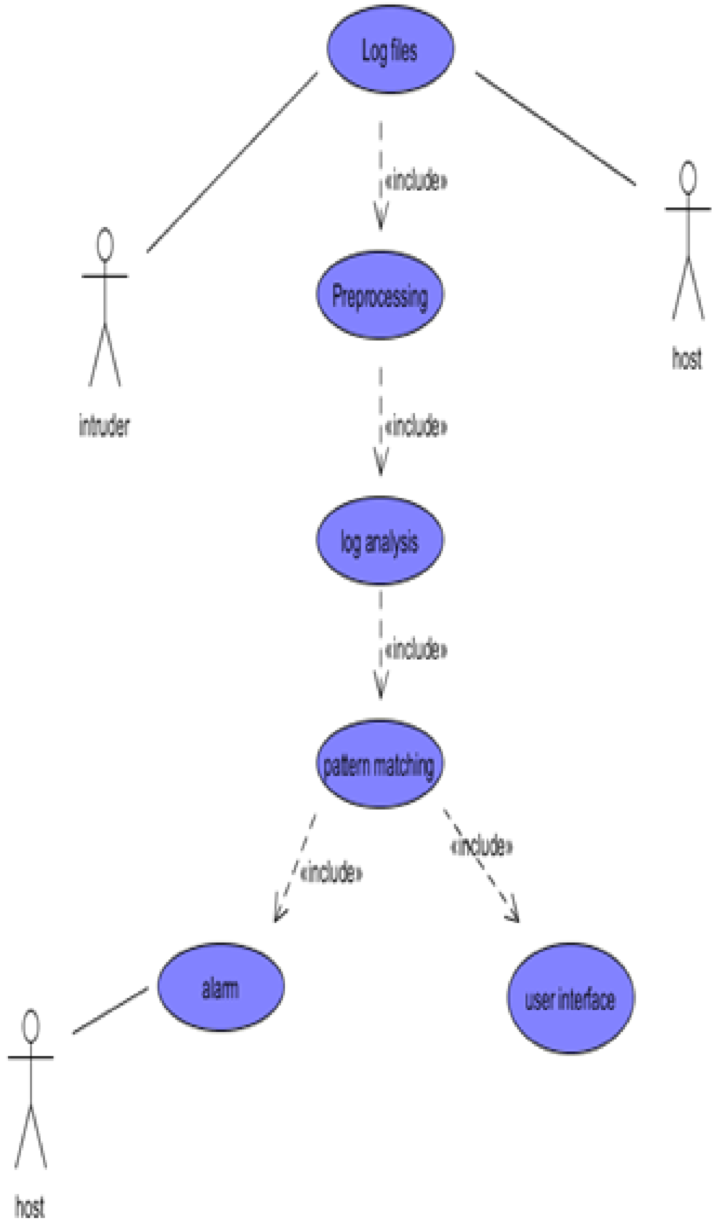
7.2.1 User Profiles

A user profile defines how client applications interact with one or more server components by a network connection. A server user profile defines how resources on the server are affected by parameters you specify.

7.2.2 Use-cases

All use-cases for the software are presented. Description of all main Use cases using use case template is to be provided.

7.2.3 Use Case View


Log files
«include»
intuder
host
Preprocessing
«include»
log analysis
«include»
pattern matching
«include»
«include»
alarm
user interface
host

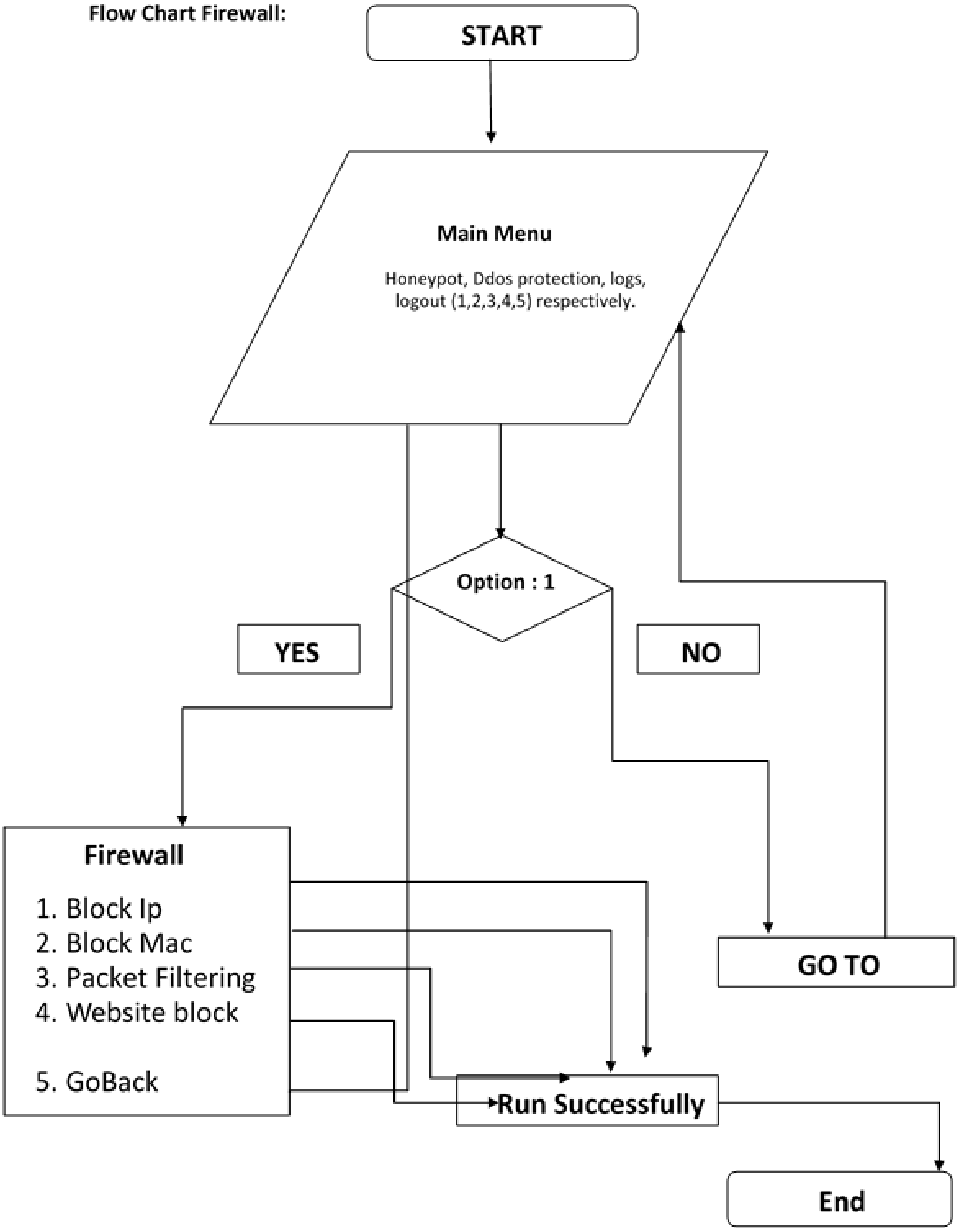
7.3 Functional Model and Description

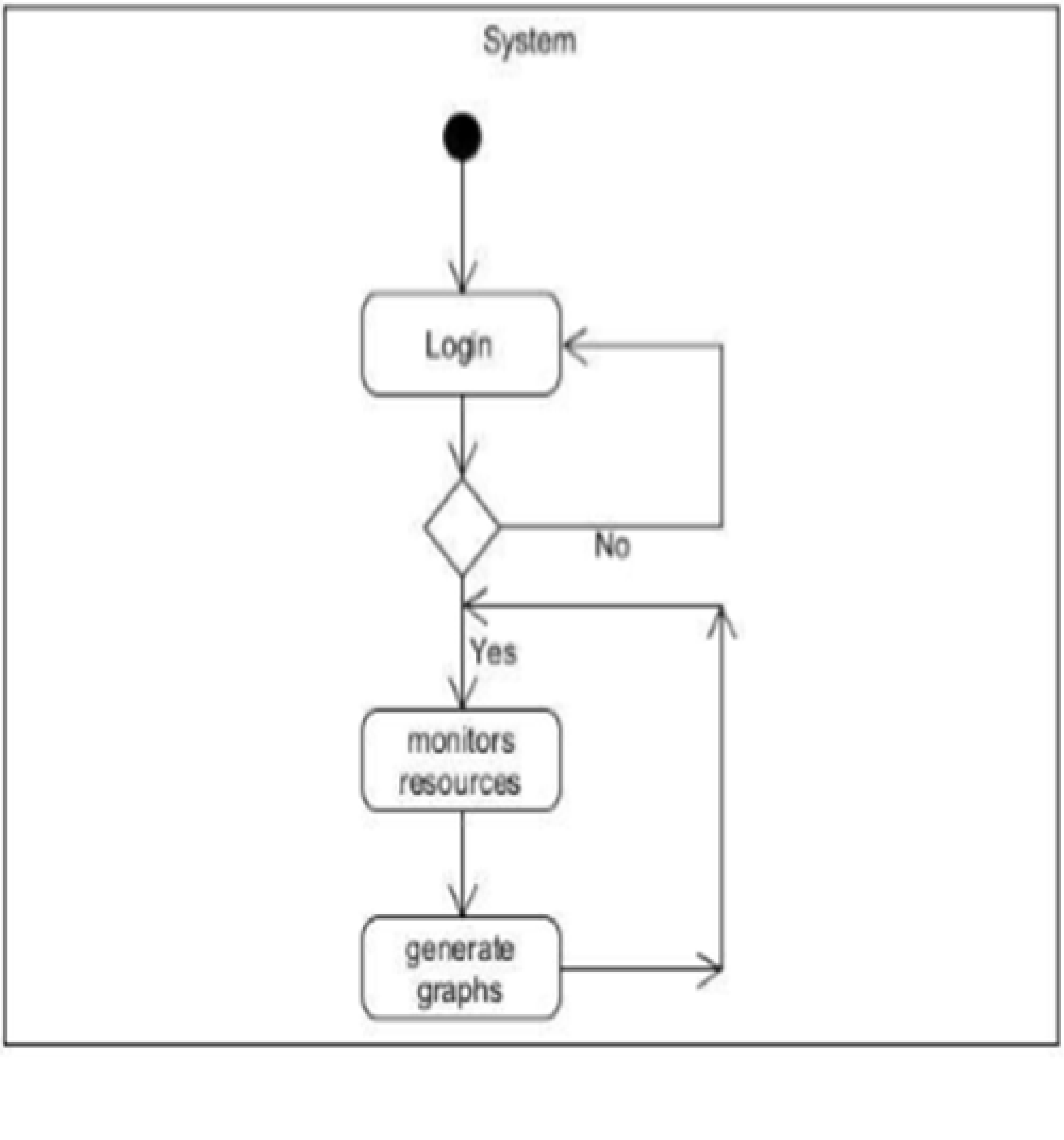
7.3.1 Data Flow Diagram

7.3.2 Activity Diagram

Activity states represent the performance of a step within the work flow. Transitions allow transitions from one activity state to another. This is referred as completion transition. It differs from a transition in that it does not require an explicit trigger event; it is triggered by the completion of the activity that the activity state represents. Decisions for which a set of guard conditions are defined. These guard conditions control which transition of a set of alternative transitions follows once the activity has been completed. You may also use the decision icon to show where the threads merge again. Decisions and guard conditions allow you to show alternative threads in the work flow of a business use. There are actually 2 activity diagrams i.e. for admin and user.

Flow Chart Firewall:




System
Login
No
Yes
monitors resources
generate graphs

Chapter 8

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