

Algorithm based network intrusion detection system

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Abstract

As hostile network traffic activities have become more prevalent, the significance of reliable intrusion detection is increasing dramatically. Intrusion Detection Systems offer automatic detection for security violations such as denial of service, malware, port scanning, buffer overflow, CGI attacks, and flooding. Additionally, a thorough analysis of benchmark cybersecurity datasets is provided. This article aims to give readers a roadmap for understanding the approach for intrusion detection system and cyber security. The integration of information and communication technology allow the smart meters to participate in power systems operation in the real-time.^[1] However, cyber threats can affect advanced metering infrastructure. cyber intrusions could affect electricity users as well as utilities.

I. INTRODUCTION

The network intrusion detection system is a vital piece of information management equipment that aids in detecting and preventing security breaches including illegal access, system alteration, duplicating, or any other kind of information system damage. Based on network audit data, the network-based IDS determines if a certain behavior is legitimate or invasive. The majority of web IDS are compatible with security solutions like firewalls and antivirus software.

Incoming traffic signals can be monitored by the NIDS, which can then analyze them to find malicious activities and probes.^[2] We can stop the destruction by dropping the malicious packets or taking appropriate action on them if you can identify them in advance. Only systems with high levels of scalability and little human involvement can perform prevention and detection. Based on rule fingerprint and anomaly testing procedures, Snort happens to be a powerful non-proprietary system for preventing intrusion and system that can detect and analyze that can analyze network data in real time.

It has been developed to encrypt and decode AMI network signals with the least amount of processing and communication latency possible. For smart meters, an IDS with two sensor processes can be used to spot malicious human-initiated behavior.^[3] The development of a thorough anomaly-based detection algorithm minimizes false warning signal and due to unbalanced incidents.

These algorithms can be based on three major drives,

1. Rule-based algorithms
2. Statistics based algorithms
3. Machine learning algorithms.

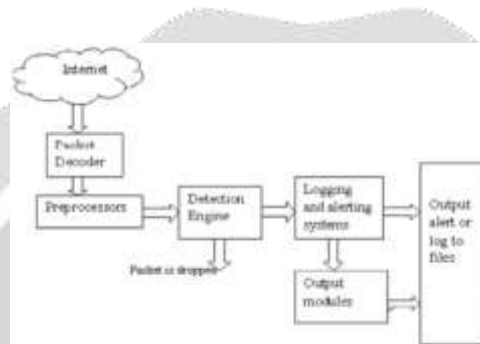
These algorithms are discussed below which are proven valuable for the NIDS.

II. RELATED WORK

The 2 paradimse of the Intrusion detection system are Signature based or misuse intrusion detection, and anomaly detection. Signature based IDS represents attack in the form of pattern matching or signature. signature is one of the best method approaches for identifying the known threats. It operates by using a pre-

programmed list of known threats and their indicators of compromise (IOCs). It monitors the packets traversing the network and it compares the packets to the database of known IOCs and flags any suspicious behavior. It triggers the non-intrusive activities which should be avoided. Anomaly based detection can alert from the malicious behavior that is not known. Anomaly based IDS instead of searching fro the known threats it searches unknown threats it uses machine learning algorithm to train the IDS to recognize the normalized baseline.^[4] So this baseline represents the systems normal behavior and all network activity is compared to the baseline. Pattern matching works with the signature IDS and audit the data. It is used to maintain the reliability of the network security for the signatures. This group of signatures are in interrelation with the signature elements.

Intrusion detection system should be technically, financially or administratively easier to implement than other open-source tools. It decodes the network packets and compares them with the predefined rules and enable the inspects and detect many different types of attacks.^[5] The packet filtering for the traffic can be depicted by block diagram



Block diagram of packet filtering

Data Collection

The collection of data can be done in 2 ways. The first one is based on the processing the system calls and the other is packet headers and payloads extracted from network traffic packages and from protocols such as TCP/IP communication stack. The approaches used to collect the network traffic is packet capture(PCAP) and the NetFlow protocol. PCAP enables collection of more detailed data from the network and it involves the collection of all packet headers for information to be transmitted.^[6] NetFlow enables the collection of summary information and related to the flow of packets in a network. These are the programs to capture the network traffic.

Method	Step	Program
PCAP	Capture	libPCAP winPCAP SNORT
	Preprocessing	Wireshark tshark tcpdump networkminer rapidminer scapy
NetFlow	Capture/Preprocessing	Cisco NetFlow nfdump

Features of IDS:

Network based data are obtained by collecting network traffic data. Basic features are extracted from TCP/IP connections and it can be classified as header-based, connection based and flow based. Flow-based testing attributes computed through analysis of the flow. Header based feature is related to packet header and it includes source and destination port numbers, IP protocols, IP header length. Traffic-based features

are associated with either a specific time intervals. This features can be extracted by considering the same host or service. Content-based features are extracted from data embedded in different data portions of packets and include the request numbers, request type and the number of failed logins.^[7]

Attack types:

This section deals with the various types of attacks in IDSs.

1. DDOS attacks are based on the large flooding on the server and make it unavailable to respond by overloading it many service requests.
2. UTR attacks involve behaving as normal user with the aim of detecting systems vulnerabilities and gaining the root access.^[8]
3. R2L attacks attempt to use the remote system to gain unauthorized access to damage the target system.
4. Probe attacks are based on the searching for vulnerable throughout the whole network by sending scanpackets and gaining information about system.
5. Injection attacks use the scripts that inject queries for purpose of gaining. unauthorized access and stealing information.

Attack name	Examples	Description
Denial of Service(DOS)	Botnet,Slowloris,Smurf	Temporarily block the normal use of network
User-to-root(U2R)	Buffer overflow,rootkit,perl	Behaves as a normal user with the aim of detecting system vulnerability
Probe	Satan,IP sweep,port sweep	Search for vulnerability throughout the whole network
Injection	SQL injection,cross-site scripting (XSS)	Uses a script to inject queries to gain unauthorized access

DATA MINING MODEL/ALGORITHM

1. KNN algo

The easiest and most basic method of clustering by splitting, known as K-means, divides the objects into k parts (k n). K-means is a centroid-based methodology. Because the mean value of the cluster is higher when a value is distant from the median of the given data, particularly, the k-means is useful for locating outliers.

It is expected in this outlier identification model that normal behavioral patterns occur far more frequently than outliers or aberrant behaviors.^[9]

2. AES(Advanced Standard Encryption) algo

This algorithm uses cryptography. The AES Encryption method is a symmetric block cypher with a chunk capacity of 128 bits. The keys used to convert these different blocks are 128, 192, and 256 bits strong. After separately encrypting each of these blocks, it then joins them together to produce the ciphertext. The foundation of it is an SP network, also known as a substitution-permutation network.^[10] It consists of several related operations, some of which require bit shuffles while others which involve replacing inputs with specific results (substitutions) (permutations).

3. DES(Data Encryption Standard) algo

DES is unsafe to very eminent attacks. It consists where block size is 64-bit each. Plain text is the input to DES and cipher text of size 64-bits. A single algorithm and key with minor changes can be used incased of both Encryption and Decryption. Exactly the size of key is 56-bits. The bit position 8,16,24,32,40,48,56&64 are abandoned.^[11] Encryption and Decryption are formed in a sequence of

permutations.

4. Data Aggregation algo

The decrease in node energy usage and improvement of network lifetime are qualities of a successful data aggregation algorithm. Despite these advantages, data aggregation also results in a rise in the network's packet transmission time.^[12]

Data aggregation contributes to energy conservation and traffic load reduction. It helps the network become more resilient. With the aid of data aggregation algorithms like MEAN MIN,MAX,MEDIAN and others, the primary goal of data aggregation is to decrease redundant data by extracting the pertinent information from the obtained data and sending it to the end nodes.

5. ANN (Artificial Neural Network)

ANN algorithm is based on a large number of basic neural units (artificial neurons), which are roughly equivalent to the observed behavior of the axons in a real brain. Biological neurons and their behaviors have inspired for the basis of ANN algorithms. They include one or more hidden -layers, their weight is processed for the output to decide the concurrent layers.^[13] ANN algorithms capture distinctly complex and relationships that are non-linear joining both controllable and exposure variables. These systems thrive in areas where the solution or feature identification is challenging to describe in a conventional computer programme because they are self-learning and taught rather than explicitly coded.

6. Blow Fish Algorithm

Blow Fish algorithm, a 64-bit block cipher which is symmetric and is of variable length. It is a general-purpose algorithm providing quick and unpaid alternative for DES and IDEA Encryption algorithms. Blow Fish is remarkably quicker than DES and IDEA. All the, its small block size and this being insecure is one of the major issue. This algorithm includes two vital parts; 1. Data Encryption: It includes key dependent permutation and data dependent substitution. It uses logic gates.^[14] 2.Key Expansion and Sub Keys: Bit keys are transformed into sub key arrays. Sub keys are pre contradicted well before encryption are decryption.

Tabel 1:

SI.NO	Algorithm	Key Size(Bits)	Block Size(Bits)
1	DES	56	64
2	3DES	112-168	64
3	BLOWFISH	32-448(128 By Default)	64

Tabel 2:

SI.NO	Reference No.	Techniques /Methods used	Accuracy(%)
1	9	KNN	85.53
2	10	AES	96.5
3	11	DES	99.2

4	12	DATA AGGREGATION	86.6
5	13	ANN	93
6	14	BLOW FISH	80.35

Conclusion:

In this study, we put the techniques for enhancing intrusion detection systems performance into practice. In a signature-based IDS, the IDS sensor typically checks each packet against all signatures. This strategy is effective in reducing false positives greatly but ineffective in raising detection rates.^[15] Due to the primary pattern's role in minimizing the need to compare rule signatures and improving detection, our research demonstrates that our strategy performs better in terms of detection rate and lowering false positives. Use benchmark datasets for intrusion detections to provide as a point of comparison for modern cybersecurity techniques. We have taken into account the data collection methods, the distribution of feature and attack kinds, and the dataset reliability standards. This paper intends to give academic and industrial researchers working on ML and DL for cybersecurity applications a useful road map.

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