A Study On Unsupervised IDS Techniques

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Abstract

Intrusion detection systems are gaining more and more territory in the field of secure networks and new ideas and concepts regarding the intrusion detection process keep surfacing. This paper presents an overview of different intrusions in cloud, various detection techniques used by IDS and the types IDS. Then, we study some pertinent existing tools and intrusion detection systems with respect to their various types, applications and data source. With the continuous evolution of the types of attacks against computer networks, traditional intrusion detection systems, based on pattern matching and static signatures, are increasingly limited by their need of an up-to-date and comprehensive knowledge base. Applying data mining techniques on raw network data, a number of researches have been carried out to develop an unsupervised IDS to fortify systems over the network from the increasing types of attacks.

Keywords: *cloud computing; Intrusion detection; signature; anomaly; BRO; SNORT*

1. Introduction

Information security is an issue of very serious global concern of the present time. The growth of attacks has roughly paralleled the growth of Internet . Malicious usage, attacks have been on the rise as more and more computers are put into use. There are several security measures available to protect the computer resources of a company but even if all expert recommendations are followed, our systems will never be safe against the attacks. It is very difficult to get an invulnerable system, probably impossible and one may need to spend a lot of money designing and developing it.

In companies, a very isolated system could drastically reduce productivity and for a not very experienced home user it may become a hating technology disease. For all these reasons the user or the security department should know what their values are, if they need to be protected and how much it costs, doing Risk Analysis [1]The impact of attacks can lead to delaying delivering services in some organizations causing financial damages. A survey made by Statistia (2015) provides information on the distribution of costs for external consequences of targeted cyber-attacks on companies in global markets in 2014. Figure 1.1 shows the results obtained in that survey, it was found that 38 percent of participants pointed to business disruption as the most expensive consequence of a cyber-attack on their business.

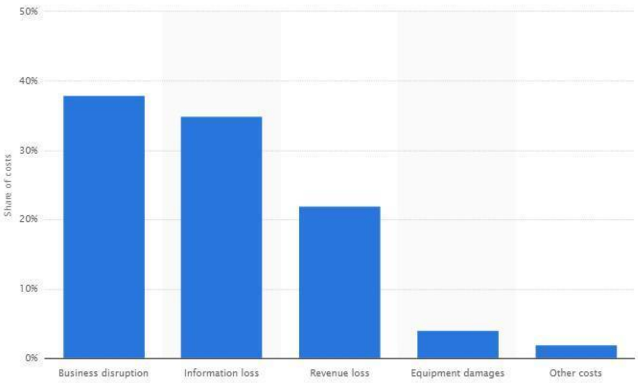


Figure 1.1: Distribution of costs for external consequences of targeted cyber-attacks reported by Statistia (2015)

2. Motivation

Cloud computing environment with its distributed and open structure nature is rapidly gaining popularity, which makes it an attractive target for attackers to exploit vulnerabilities. Cloud services are as cheap and convenient for hackers as are for service customers.

A cloud computing system can be exposed to several threats including threats to the integrity, confidentiality and availability of its resources[2], data and the virtualized infrastructure which can be used as a launching pad for new attacks.

One issue that has hampered the uptake of cloud computing by businesses is the issue of security. This covers the security concerns of all stakeholders from end users, to clients and to the CSPs themselves. The relationships between clients and CSPs are underlined by service agreements, which define the service that clients should receive. These agreements define the responsibilities of all parties with regards to accessibility, data integrity, confidentiality and security.[3]

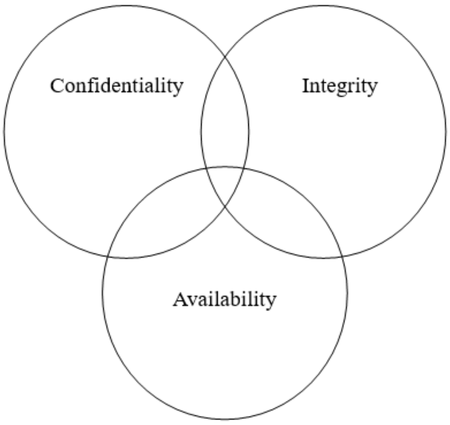
In 2011, a hacker used Amazon's Elastic Computer Cloud service to attack Sony's online entertainment systems by registering and opening an Amazon account and using it anonymously [4]. This malicious attack on Sony compromised more than 100 million customer accounts, causing the largest data breach in the U.S.

An intrusion detection system (IDS) can offer additional security measures for the cloud environment. An IDS can monitor the cloud environment by investigating audit information about network traffic, application, software service, or virtual machine activities. It can also leverage the detection of malicious attempts, whether from external parties or legitimate users aiming at exploiting security vulnerabilities or violating security policies. An IDS can be applied across different layers of the cloud environment including the application, infrastructure, virtualization, and physical layers. In this sense, security monitoring and analysis via IDSs in the cloud layers is an effective way to increase consumers' trust by verifying the cloud security.[5]

A. NEED FOR IDS

In the struggle to secure our stored data and the systems, IDS can prove to be an invaluable tool, where its goal is to perform early detection of malicious activity. Thus By using IDS, one can identify an attack and notify appropriate user immediately.
An intrusion in the system will try to compromise one of the three main aspects in computer security:

• Confidentiality: the intruder has access to confidential
information.
• Integrity: information can be modified or altered by the attacker.
• Availability: the system gets blocked so it can not be used normally.



An IDS typically operates behind the firewall as shown in Figure 1.2, IDSs are used as the second and the final level of defense in any secure network against attacks that breach other defenses. The need for this second layer of protection is many times questioned like "Do we need an IDS once we have a firewall?". To answer this question, it is necessary to understand what a firewall and IDS does and does not do. This will help in understanding the need for both IDS and firewall to help in securing a network. The existing network security solutions, including firewalls, were not designed to handle network and application layer attacks.

Also along with the drastic growth of the Internet, the high threats over the Internet has been the reason to think of IDSs. As a result, IDSs, as originally introduced by Anderson [15] in 1980 and later formalized by Denning [16] in 1987, have received increasing attention in the recent years. The IDSs along with the firewall form the fundamental technologies for network security.

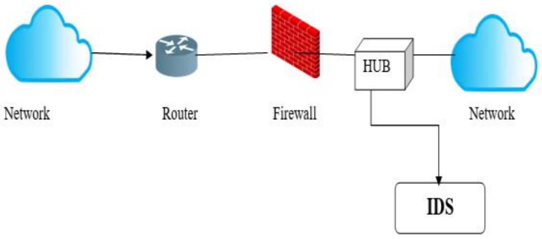


Figure 1.2: Position of IDS in an secure network

3. Ids Overview

An intrusion is define either as an attempt to gain entry directed against a system or network by unauthorized parties or an attempt to disrupt the normal operation of the system.

Intrusion detection system is the unrelenting active attempts in discovering or detecting the presence of intrusive activities.

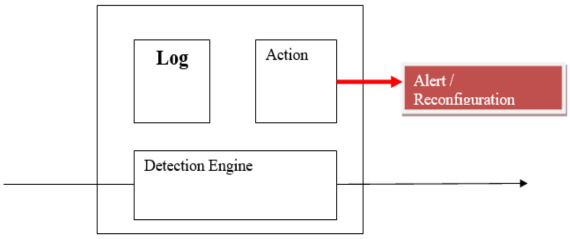


Fig 2. Intrusion Detection system

1.1 Types of Intrusions:

1) Denial of service (DOS) attack

This attack is also known as flooding attack. Attacker tries to flood victim by sending huge number of packets from innocent host (zombie) in network. Packets can be of type TCP, UDP, ICMP or a mix of them. This kind of attack may be possible due to illegitimate network connections.

In case of Cloud, the requests for VMs are accessible by anyone through Internet, which may cause DoS (or DDoS) attack via zombies. Flooding attack affects the service's availability to authorized user. By attacking a single server providing a certain service, attacker can cause a loss of availability of the intended service. Such an attack is called direct DoS attack.

If the server's hardware resources are completely exhausted by processing the flood requests, the other service instances on the same hardware machine are no longer able to perform their intended tasks. Such type of attack is called indirect DoS attack. [8] Flooding attack may raise the usage bills drastically as the Cloud would not be able to distinguish between the normal usage and fake usage.

2) User to root attacks

Here, an attacker gets an access to legitimate user's account by sniffing password. This makes him/her able to exploit vulnerabilities for gaining root level access to system. In case of Cloud, attacker acquires access to valid user's instances which enables him/her for gaining root level access
to VMs or host. [8]

3) Remote to User Attack

A remote to user attack is a class of attacks in which an attacker sends packets to a machine over a network but who does not have an account on that machine and thus, exploits some vulnerability to gain local access as a user of that machine.
Examples are Dictionary, Ftp-write, Guest, Imap, Named, Phf, Sendmail, Xlock, Xsnoop.[17]

4) Probe

It is used to gather information about a targeted network or host and, more formally, for reconnaissance purposes. Probing is a class of attacks in which an attacker scans a network of computers to gather information or find known vulnerabilities. Examples [17] are Ipsweep , Mscan, Nmap, Saint, Satan.

A Probe attack[18] is considered the first step in an actual attack to compromise a host or network. Although no specific damage is caused by these attacks, they are considered serious threats to corporations because they might obtain useful information for launching another dreadful attack.

Also the uninterrupted service of cloud technology attracts the intruders to gain access and misuse services and resources provided by Cloud service provider. The attacks that may affect cloud computing system are:

5) Insider Attack

The attackers may attempt to gain and misuse the privileges that are either assigned or not assigned to them officially. Consequently, they may commit frauds, modify information intentionally or reveal secrets to opponents. This poses a serious trust issue.[6] For example, Amazon Elastic Compute Cloud (EC2) suffered from an internal DoS attack [7].

6) Port scanning

Port scanning provides list of open ports, closed ports and filtered ports. Through port scanning, attackers can find open ports and attack on services running on these ports. Network related details such as IP address, MAC address, router, gateway filtering, firewall rules, etc.[8] In cloud system, port scanning attack may cause loss of confidentiality and integrity on cloud.[6]

7) Attacks on virtual machine (VM) or hypervisor

An attacker may successfully control the virtual machines by compromising the lower layer hypervisor. For e.g. SubVir[10] , BLUEPILL [11], and

DKSM[12] are well-known attacks on virtual layer.

8) Backdoor channel attacks

It is a passive attack, which allows hackers to gain remote access to the infected node in order to compromise user confidentiality. Using backdoor channels, hackers can be able to control victim's resources and can make it a zombie for attempting a DDoS attack. It can also be used to disclose the confidential data of the victim [6]

3.2 Types of IDS

IDS can be divided into two main types:

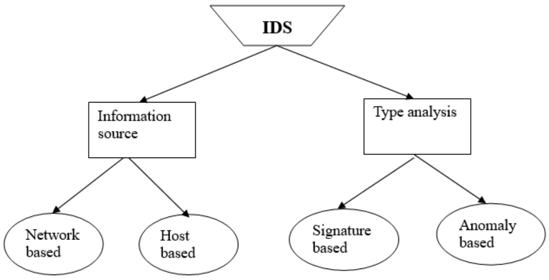


Fig 3. Intrusion Detection system types

1) Network based IDS (NIDS)

Most of the intrusion detection systems are Network-based. These IDSs detect attacks by capturing and analysing network packets. It usually performs intrusion detection by inspecting the IP and transport layer headers of each packet. NIDS utilizes the anomaly and signature based detection approach to identify intrusions. It is unable to perform analysis if traffic is encrypted [19], and it cannot detect intrusions inside a virtual network contained by hypervisor.

Advantages :

- A well-located IDS can monitor a large network.
- The NIDSs have a small impact on the network, usually not interfering with normal operations of the network.
- NIDSs can be configured to be invisible to the network in order to increase the security against attacks.

Disadvantages :

- The network-based IDSs do not analyse the encrypted. Information.
- The network-based IDSs do not know whether the attack was successful or not, the only thing known is that it was launched.
- NIDSs may have a high false acceptance or false positive rate.

2) Host based IDS (HIDS)

HIDS were the first type of IDSs developed and implemented. They run on the information acquired from inside a computer . This allows the IDS to analyse actual activities with precision and thus, determining exactly which processes and users are involved in a particular attack within the operating system.

Advantages

- The host-based IDSs, having the ability to monitor local events of a host, can detect attacks that cannot be seen by a NIDS.
- The host-based IDSs do can analyse the encrypted information.

Disadvantages

- Host-based IDSs are more costly in time as well as in money.
- They are not adequate for detecting attacks on an entire network Example, port scans.
- They can be disabled by certain Denial of Service attacks.

3.3 Detection Techniques used by IDS

Mainly there are two types of detection techniques used by IDS; anomaly detection (based on behavior of users) and signature detection (based on signatures of known attacks). To improve the performance of IDS, it is better to use a combination of these techniques, which called Hybrid detection. As Shown in Figure 4. below[6]

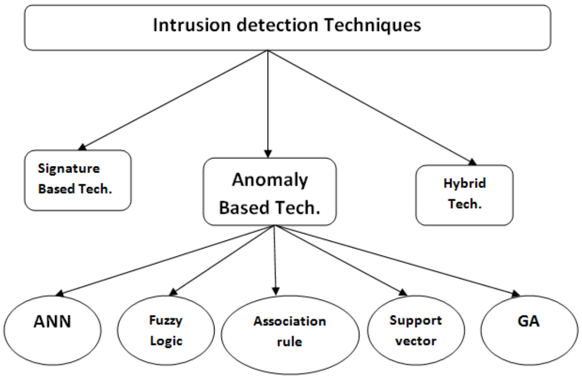


Fig 4 .Detection techniques used by IDS

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A. Signature detection (based on signatures of known attacks)

Signature based detection is performed by comparing the information collected from a network or system against a database of signatures. A signature is a predefined set of patterns or rules that correspond to a known attack. This technique is also recognized as misuse detection.

To decide whether or not the network traffic corresponds to a known signature, the IDS uses pattern recognition techniques. Some IDS that use this approach are Snort, Network Flight Recorder, Network Security Monitor and Network Intrusion Detection, etc. Signature based method helps network managers with average security expertise to identify intrusions accurately.

It is a flexible approach since new signatures can be added to database without modifying existing ones. However, it is unable to detect unknown attacks.[14]

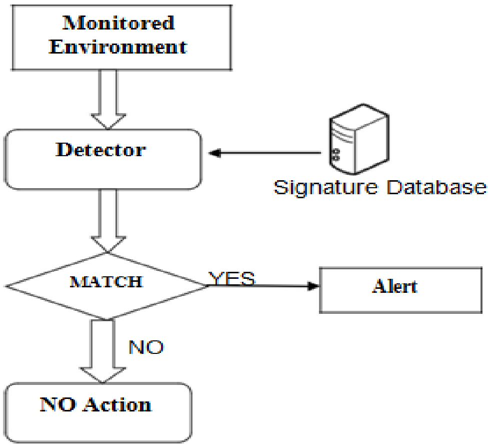

Fig 5. Signature based Ids [13]

B. *Anomaly detection (based on behavior of users)*

The anomaly detection focuses on identifying unusual behavior in a network. They operate assuming that the attacks are different from the normal activity. Anomaly detectors construct profiles representing the normal behavior of users, hosts or network connections. These profiles are constructed from data collected during normal operation. The detectors collect data from the events and use a variety of measures to determine when the monitored activity deviates from normal activity.

Anomaly based detection is efficient against unknown attacks. Also, Anomaly detectors produce information that is very useful to define new patterns for signature detection. One of the drawback of anomaly based detection is that it produces a high number of false alarms due to the unpredictable behavior of users and networks. as well as they require very hard training to characterize patterns of normal behavior.

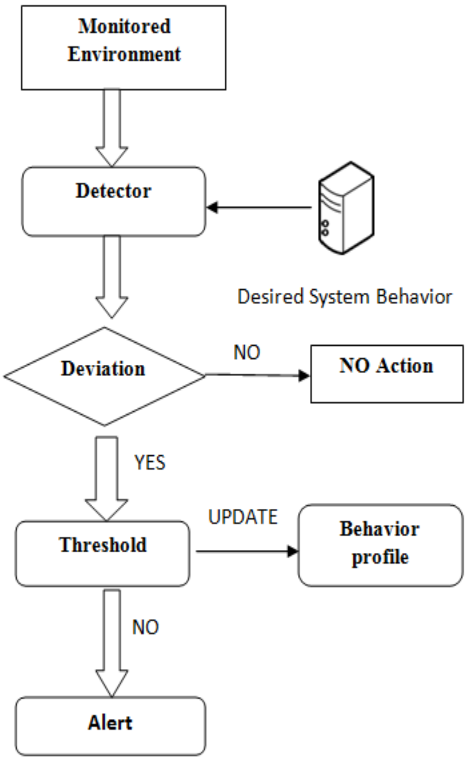

Fig 6. Anomaly Based Ids [13]

a) *Artificial Neural Network based IDS*

A neural network consists of a collection of processing units called neurons that are highly interconnected according to a given topology. ANN have the ability to learning by example and generalize from limited, noisy, and incomplete data. They have been successfully employed in a broad spectrum of data-intensive applications.[20]

The goal of using ANNs [22] for intrusion detection is to be able to generalize data (from incomplete data) and to be able to classify data as being normal or intrusive [21].

Types of ANN used in IDS are as [21]:

- Multi-Layer Feed-Forward (MLFF) neural nets
- Multi-Layer Perceptron (MLP)
- Back Propagation (BP).

ANN based IDS is an efficient solution for unstructured network data. The intrusion detection accuracy of this approach is based on number of hidden layers and training phase of ANN.

b) *Fuzzy based IDS*

Fuzzy logic is a method to computing based on degrees of truth rather than the usual true or false Boolean logic on which the modern computers are based.This makes fuzzy logic a great choice for intrusion detection because the security itself includes fuzziness and the boundary between the normal and anomaly is not well defined.[20] An behavior that deviates only slightly from a model may not be detected or may cause a false positive. With fuzzy logic, it is possible to model this small deviations to keep the false positive/negative rates small.

Also, To reduce training time of ANN [23], fuzzy logic with ANN can be used for fast detection of unknown attacks in Cloud.

c) *Genetic Algorithm based IDS*

Genetic algorithms are aimed at finding optimal solutions to problems. Each potential solution to a problem is represented as a sequence of bits called a genome or chromosome. A genetic algorithm begins with a set of genomes and an evaluation function called fitness function that measures the goodness of each genome. The algorithm uses two reproduction operators called crossover and mutation to create new descendants (solutions), which are then evaluated.[20]

Genetic algorithm based intrusion detection system is used to detect intrusion based on past behavior.A profile is created for the normal behavior based on that genetic algorithm learns and takes the decision for the unseen patterns. Genetic algorithms also used to develop rules for
network intrusion detection.[24]

In Cloud environment, selection of net work features for intrusion detection will increase the accuracy of IDS. For that, Genetic algorithm based IDS can be used in Cloud.

d) *Bayesian network based IDS*

A Bayesian network is a model that encodes probabilistic relationships among the variables of interest. This technique is generally used for intrusion detection in combination with statistical schemes. The naïve Bayesian (NB) algorithm is used for learning task, where a training set with target class is provided.[24]

e) *Support vector machine based IDS*

SVM [22] is used to detect intrusions based on limited sample data, where dimensions of data will not affect the accuracy.

The results regarding false positive rate in SVM are better than of ANN as ANN requires large amount of training samples whereas SVM has to set fewer parameters.

C. *Hybrid Detection*

By combining signature based and anomaly based techniques called as Hybrid detection technique efficiency of IDS can be improved .The idea behind this is to detect both known and unknown attacks based on signature and anomaly detection techniques.

4. Challenges Faced By Different Intrusion Detection Techniques

a. *Signature based detection*

- Misuse detection is showing its severe limitation in unknown attacks detection (called zero-days) as new attacks are constantly evolving. Their inability is not only limited to unknown attacks, they have difficulty for even intrusions which are already known as attacks but have unknown signatures
- The probability of erroneously misclassification of normal events as attacks is high.
- Matching the signatures are well done for single connection attacks only, while most of the attacks involve multiple connections
- High false alarm rate for unknown attacks

b. *Anomaly detection*

- Detection accuracy is based on amount of collected behavior or features. Anomaly detectors have higher false positive alarms, because deviating from normal behavior does not always mean that an attack is occurring.
- More time is required to identify the attack
- Another difficulty exists in adapting to continuously changing normal behavior, particularly for dynamic anomaly. Attacker can change the behavior patterns so that it will accept attack behavior as normal

c. *Neural Networks*

- Has lesser flexibility.
- Slow training process so not suitable for real-time detection. Over-fitting may happen

during neural network training

d. *Bayesian Network*

- Harder to handle continuous features. May not contain any good classifiers if prior knowledge is wrong.

e. *Support Vector Machine*

- Training takes a long time. Mostly used binary classifier which cannot give additional information about detected type of attack.

- It can classify only discrete features. So, preprocessing of those features is required.

f. *Genetic Algorithm*

- Genetic algorithm cannot assure constant optimization response times. It is complex method.

- Used in specific manner rather than general.

g. *Fuzzy Logic*

- High resource consumption Involved. Reduced, relevant rule subset identification and dynamic rule updation at runtime is a difficult task.
- Detection accuracy is lower than ANN.

h. *Decision Tree*

- building decision tree is computationally intensive task.

i. *Association rules based IDS*

- It cannot detect totally unknown attacks.
- It requires more number of database scans to generate rules.

- Used only for misuse detection.

5. Ids Tools

A. SNORT

Snort is a tool for small, lightly utilized networks. Snort is useful when it is not cost efficient to deploy commercial NIDS sensors. Modern commercial intrusion detection systems cost thousands of dollars at minimum, tens or even hundreds of thousands in extreme cases. Snort is free for use in any environment, making the employment of Snort as a network security system more of a network management and coordination issue than one of affordability.

It features rules based logging to perform content pattern matching and detect a variety of attacks and probes, such as buffer overflows, stealth port scans, CGI attacks, SMB probes, and much more. Snort has real-time alerting capability, with alerts being sent to system log, Server Message Block.[25]

Snort has its own processing language used to define rules. Recently, with the release of the v2 series of Snort, regular expression processing has been added to make good rule-writing easier.

It’s not enough to have Snort in use on the network and leave it at that when the installation is done. Like with any system, the administrator needs to make sure that the NIDS and its rules are relevant and up to date. Otherwise snort system will not be able to detect new intrusion which are recently discovered.[26]

Advantages of using Snort, in a network are properly configured, it gives a good overview of what’s going on in the network, and provides a way of automatically logging packets from potential attacks for future reference. With some careful thinking, it can even be used for reacting directly to attacks as they occur.

B. BRO

Bro is an open-source, Unix-based Network Intrusion Detection System (NIDS) that passively monitors network traffic and looks for suspicious activity. Bro detects intrusions by first parsing network traffic to extract its application-level semantics and then executing event-oriented analyzers that compare the activity with patterns deemed troublesome. Its analysis includes detection of specific attacks including those defined by signatures, but also those defined in terms of events and unusual activities.

If Bro detects something of interest, it can be instructed to either generate a log entry, alert the operator in real-time, execute an operating system command.

Important feature of bro that differentiates it from other IDS system is that bro scripts could be written to understand the application semantics and could be trained to look for anomalies which can effectively eliminate attacks as compared to pattern oriented rules found in systems such as SNORT.

A bro script could be written to keep track of user attempts against the application and trigger an alert if it exceeds a threshold value. Bro can detect a large number of protocols, and the notice policy tells which of them the user wants to be acted upon in some manner. In particular, the notice policy can customize the specific actions that needs to be taken, such as sending an alert to the Security Incident and Event Management (SIEM) framework or adding firewall rules to block the offending IP's. Bro ships with a large number of policy scripts which perform a wide variety of analyses (Bro Documentation, 2012). Both network and application attacks can be detected using Bro scripts.

TABLE I. ANALYSIS OF CLOUD BASED IDS USING UNSUPERVISED DETECTION TECHNIQUE

Sr. no	YEAR	BASED ON	SUMMARY	FEATURES	FUTURE SCOPE
1	2009 Eighth IEEE International Conference on Dependable, Autonomic and Secure Computing [27]	Intrusion Detection in the Cloud	Facing new application scenarios in Cloud Computing, the IDS approaches yield several problems since the operator of the IDS should be the user, not the administrator of the Cloud infrastructure .Extensibility, efficient management, and compatibility to virtualization-based context need to be introduced into many existing IDS implementations. This paper summarizes several requirements for deploying IDS in the Cloud and propose an extensible IDS architecture for being easily used in a distributed cloud infrastructure.	The proposed architecture meets the requirement of extensibility and reflects the state-of-the-art architecture of general distributed IDS. Due to more supported logical communication channels, the sensors can be located anywhere in the network or even inside virtual machines. Such information as VM status, VM workload, and IDS-VM assignments can be monitored and the involved IDS VMs can be stopped, started, and recovered by the management system	An interesting future topic is the correlation of alerts from the virtual components in the Cloud infrastructure. Additionally, further types of IDS which are useful for the Cloud need to be determined and integrated into the architecture
2	2012 Elsevier [28]	IDPS in Cloud Computing (A Review)	The traditional Intrusion Detection and Prevention Systems (IDPS) are largely inefficient to be deployed in cloud computing environments due to their openness and specific essence. This paper surveys, explores and informs researchers about the latest developed IDPSs and alarm management techniques by providing a comprehensive taxonomy and investigating possible solutions to detect and prevent intrusions in cloud computing systems. Considering the desired characteristics of IDPS and cloud computing systems, a list of germane requirements is identified and four concepts of autonomic computing self-management, ontology, risk management, and fuzzy theory are leveraged to satisfy these requirements.	A specific attention is given to cloud systems characteristics and current challenges banning IDPS development for cloud. A list of requirements for a cloud based intrusion detection and prevention system was provided along with grabbing four applicable concepts in developing a CIDPS from review on latest researches: autonomic computing, ontology, risk management, and fuzzy theory for making an ideal design to meet these requirements.	A fully fledged framework and design of a CIDPS by lever- aging the concepts of autonomic computing, ontology, risk management, and fuzzy theory can be developed in future.
3	2014 11th International Conference on Fuzzy Systems and Knowledge Discovery [29]	Fuzzy c-means clustering; particle swarm optimization; association amendment	In this paper, an improved FCM algorithm based on PSO is used for network intrusion detection classification and the clustering results is further association amended to get the final test results. The test results show that the improved intrusion detection algorithm under unsupervised conditions can get better detection effect. Compared with the	An improved FCM algorithm based on PSO has been proposed. Fuzzy c-means clustering algorithm has been optimized using PSO to avoid falling into local optimal. Using single clustering algorithm may result in deviations, so the clustering	Further study is needed to find the method both good at the accuracy and real-time of the system in order to improve the overall performance of the intrusion detection

			traditional FCM, the method increases the detection rate of intrusion detection effectively, while reducing the false detection rate, but the real time of the system is affected slightly.	result is amended using association mining to get more accurate result. An improved correlation algorithm is proposed that can improve the efficiency, reduce the amount of calculation and conduct correlation correction on the unsupervised clustering results.	
4	International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 4, April 2013 [30]	Artificial Neural Networks	A system is proposed in which there is no need to manually updating the attack pattern in IDS rule sets, the proposed FC-ANN algorithm will automatically capture the patterns of new attack and store it in IDS database which will reduces the human time as well as effort to learn new attacks pattern manually.	The proposed intrusion detection approach, called FCANN is based on ANN and fuzzy clustering. Through fuzzy Clustering technique, the heterogeneous training set is divided to several homogenous subsets. Thus complexity of each sub training set is reduced and consequently the detection performance is increased.	The main drawbacks of ANN-based IDS exist in two aspects: 1) lower detection precision, especially for low-frequent attacks 2) weaker detection stability. Future work can be directed to solve these problems.
5	International Journal of Data Mining & Knowledge Management Process (IJDKP) Vol.4, No.2, March 2014 [31]	Clustering, data mining	Clustering techniques of data mining is an interested area of research for detecting possible intrusions and attacks. This paper presents a new clustering approach for anomaly intrusion detection by using the approach of K-medoids method of clustering and its certain modifications. The proposed algorithm is able to achieve hi gh detection rate and overcomes the disadvantages of K-means algorithm.	The algorithm specified a new way of selection of initial medoid and proved to be better than K-means for anomaly intrusion detection. The algorithm conveys the idea of data mining technologies. Advantages over the existing algorithm: overcomes the disadvantages of dependency on initial centroids, dependency on the number of cluster and irrelevant clusters. High detection rates and less false negative rate.	The detection rate can for probe and user to root attack can be further enhanced by efficient method of clustering which is our future work.
6	2016 Elsevier [32]	Unsupervised IDS	An Immune inspired Unsupervised Intrusion Detection System for Detection of Novel Attacks : It is an immune system based real time intrusion detection system using unsupervised clustering. The model consists of two layers: a probabilistic model based T-cell algorithm which identifies possible attacks, and a decision tree based B-cell model which uses the output from T-cells together with feature information to confirm true attacks.	The algorithm is tested on the KDD 99 data, where it achieves a low false alarm rate while maintaining a good detection rate. This technique also works for novel attacks, which is a significant improvement over other algorithms.	This algorithm has low false alarm rate but it has relative less detection ratio to other algorithms.
7	2012 Elsevier [33]	Anomaly detection	Negative selection algorithm with further training for anomaly detection : Negative selection algorithm is efficient to detect anomaly. But using this	In this algorithm with NSA, further training gives more efficient result than NSA and SDC. This algorithm	Optimization of generated detectors and reducing overlap of Generated detectors.

			algorithm further training is introduced in training to improve performance. By using further training self detectors are created to cover self region. It also helps in reducing self samples to reduce computational cost.	reduces the computational cost. The variable parameter alpha makes FtNSA more flexible.	
8	2011 Elsevier [34]	Self adaptive & dynamic clustering	Self-adaptive and dynamic clustering for online anomaly detection : The approach is designed so that an initial model is constructed and then it gradually evolves according to the current state of online data without any human intervention. In this framework, a self-organizing map (SOM) that is seamlessly combined with K-means clustering is transformed into an adaptive and dynamic algorithm suitable for real-time processing.	The proposed approach not achieves high detection performance and also reduces false alarms. This approach allows the earliest possible detection of new types of attacks. So, It can be effectively applied to guard against emerging threats in online environments.	In the future, integration of other data mining techniques such as the one-class support vector machine can be used to achieve better detection performance. Also work is exploring dynamic feature selection in online environments.
9	2013 Elsevier [35]	Probabilistic	In this paper, a novel probabilistic approach is proposed effectively to forecast and detect network intrusions. It uses a Markov chain for probabilistic modeling of abnormal events in network systems. First, to define the network states, approach perform Kmeans clustering, and then it introduce the concept of an outlier factor. Based on the defined states, the degree of abnormality of the incoming data is stochastically measured in real-time.	To detect Internet attacks in advance, the importance of intrusion forecasting in a network intrusion system is growing rapidly. Given approach achieves high detection performance while representing the degree of risk on a probability scale. Also gives robust decisions by outlier factor.	Future work will include combining various probabilistic techniques to improve the accuracy of predictions. Moreover, a new forecasting method using differences between each attack protocol should be developed.
10	2012 Elsevier [36]	SVM and gradually feature removal method.	In this paper, a pipeline of IDS via a series of machine learning strategies is proposed with the following steps: construct a compact data set by clustering redundant data into a compact one; select a proper small training data set with the method of ACO; reduce the feature dimension from 41 to 19 so as to seize the key feature of the network visit; obtain the classifier with SVM and undertake a thorough prediction to the total KDD cup data set.	The accuracy of this IDS pipeline achieves 98.6249%, and MCC value achieves 0.861161. The result show that this IDS pipeline is a reliable one, which performs well in accuracy and efficiency.	how to choose the proper small training data set. Current strategy of small training data setting is not adaptive to complex program in multiple classification problem.

6. Conclusion

The security of cloud computing must be considered primarily to fulfill the promise of the cloud. Chances of intrusion is more in cloud computing because of its distributed nature. To defend the cloud against this intrusions Firewall only may not be sufficient. So, to address this issue, the Intrusion Detection System (IDS) in Cloud Environment may enhance the security by acting as a second line of defense after the firewall. In this paper, we explore number of intrusions that affect the cloud computing environment. We have comprehensively described different types of IDS that are used by cloud environment. We have provided the summary of different intrusion detection techniques which help in detection of intrusions in cloud. Also, we have compare and contrast different IDS tools (SNORT,BRO). The studies has shown that the research effort for intrusion detection solutions to address the security issues in the cloud is still inadequate thus improving intrusion detection methods is an important element in enhancing the security of a system. Finally, in the table we have analyzed some latest research works that have been proposed to enhance the cloud security based on unsupervised IDS technique. The analysis shows that although different IDS techniques help in detections of intrusions but they don't give complete security. So, to have an effective and efficient IDS, the hybrid intrusion detection approach is certainly the best detection technique used by the IDS.

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