

Cloud middleware usually provides these features, so we propose an IDS service offered at the middleware layer (as opposed to the infrastructure or software layers). An attack against a cloud computing system can be silent for a network-based IDS deployed in its environment, because node communication is usually encrypted. Attacks can also be invisible to host-based IDS, because cloud-specific attacks don't necessarily leave traces in a node's operating system, where the host-based IDS reside. In this way, traditional IDS can't appropriately identify suspicious activities in a grid and cloud environment [7]. The client system is the system which wants to get service or response from a server by forwarding request to the server.

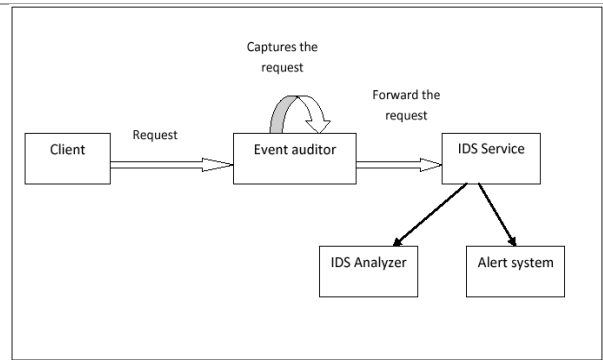


Figure 2: Client request with IDS Service

An anonymous proxy serves as a middleman between your web browser and an end server. Instead of contacting the end server directly to get a Web page, the browser contacts the proxy, which forwards the request on to the end server. When the end server replies to the proxy, the proxy sends the reply on to the browser. No direct communication occurs between the client and the destination server; therefore it appears as if the HTTP request originated from the intermediate proxy server.

2.1 Intrusion Detection System Methods

The Intrusion Detection Service (IDS) service increases a cloud's security level by providing two methods of intrusion detection.

First approach is performance approach which orders how to compare recent user actions to the usual behavior.

The second approach is information approach that notices known trails left by attacks or certain sequences of actions from a user who might represent an attack.

The audited data is sent to the IDS service core, which analyzes the behavior using artificial intelligence to detect deviations. This has two subsystems namely analyzer system and alert system.

The analyzer uses a profile history database to determine the distance between a typical user behavior and the suspect behavior and communicates this to the IDS service. The rules analyzer receives audit packages and determines whether a rule in the database is being broken. It returns the result to the IDS service core. With these responses, the IDS calculate the probability that the action represents an attack and alerts the other nodes if the probability is sufficiently high. This subsystem will work when intrusion is detected. If any node among the cloud system is affected by intrusion then this alert system will alert the remaining nodes about the intrusion.

The storage service is a database system which contains two types of services namely information based service and performance based service. Whenever a node gets requests or responses, the analyzer system compares the node information in the storage service.

This paper used audit data from both a log system and the communication system to evaluate the information based system. The created a series of rules to illustrate security policies that the IDS should monitor. The information service is nothing but set of rules which is formed from previous attacks.

Following things comes under this category:

- Password cracking and access violation,
- Trojan horses,
- Interceptions most frequently associated with TCP/IP stealing and interceptions that often employ additional mechanisms to compromise operation of attacked systems (for example by flooding) man in the middle attacks.
- If any packets come with .exe extension
- Packets containing worms

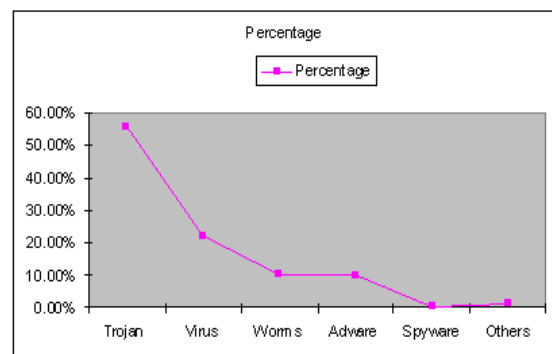


Figure 3: Recent Breakdown of the types of malware programs

In our solution, each node identifies local events that could represent security violations and alerts the other nodes. Each individual intrusion detection system mutually participates in intrusion detection.

The *node* contains the resources, which are accessed homogeneously through the middleware. The middleware sets the access-control policies and supports a service-oriented environment. The *service* provides its functionality in the environment through the middleware, which facilitates

communication. The *event auditor* is the key piece in the system. It captures data from various sources, such as the log system, service, and node messages.

The IDS service analyzes this data and applies detection techniques based on user behavior and knowledge of previous attacks. If it detects an intrusion, it uses the middleware's communication mechanisms to send alerts to the other nodes. The middleware synchronizes the known-attacks and user-behavior databases.

The *storage service* holds the data that the IDS service must analyze. It's important for all nodes to have access to the same data, so the middleware must transparently create a virtualization of the homogeneous environment.

2.2 Intrusion detection system services

The IDS service increases a cloud's security level by applying two methods of intrusion detection. The *performance approach* orders how to compare recent user actions to the usual performance. The *information approach* notices known trails left by attacks or certain sequences of actions from a user who might represent an attack.

The audited data is sent to the IDS service core, which analyzes the performance using artificial intelligence to detect deviations. The analyzer uses a profile history database to determine the distance between a typical user performance and the suspect performance and communicates this to the IDS service.

The rules analyzer receives audit packages and determines whether a rule in the database is being broken. It returns the result to the IDS service core. With these responses, the IDS calculate the probability that the action represents an attack and alerts the other nodes if the probability is sufficiently high.

To detect an intrusion, need audit data describing the environment's state and the messages being exchanged. The event auditor can monitor the data that the analyzers are accessing.

The first component monitors message exchange between nodes. Although audit information about the communication between nodes is being captured, no network data is taken into account only node information.

The second component monitors the middleware logging system. For each action occurring in a node, a log entry is created containing the action's type (such as error, alert, or warning), the event that generated it, and the message. With this kind of data, it's possible to identify an ongoing intrusion.

2.2.1 Performance Approach

Performance approach is normal or expected performance extracted from reference information is compared with the current activity, any deviation observed, is detected as an intrusion [8].

The advantages of using performance approach are: detect attempts to exploit new and unforeseen vulnerabilities and contribute to the automatic discovery of new attacks; do not face the generalization issue; they help detect abuse of privileges types of attacks that do not actually involve exploiting any technological vulnerability.

The disadvantages of using performance approach are: high false alarm rate; periodic online retraining of the performance profile is required which results in the either unavailability of the intrusion detection system or the additional false alarms.

Numerous methods exist for performance based intrusion detection, such as data mining, artificial neural networks, and artificial immunological systems. This paper use a feed-forward artificial neural network, because—in contrast to traditional methods—this type of network can quickly process information, has self-learning capabilities, and can tolerate small performance deviations. These features help overcome some IDS limitations [9] Using this method, need to recognize expected performance (legitimate use) or a severe performance deviation. Training plays a key role in the pattern recognition that feed-forward networks perform. The network must be correctly trained to efficiently detect intrusions. For a given intrusion sample set, the network learns to identify the intrusions using its retro propagation algorithm.

However, focus on identifying user performance patterns and deviations from such patterns. With this strategy, cover a wider range of unknown attacks.

2.2.2 Information Approach

Information approach contains information about specific attacks and vulnerabilities and looks for attempts to exploit these vulnerabilities. When such an attempt is detected, an alarm is triggered. Accuracy depends on the regular update of information about attacks [8].

The advantages of using information approach are: the potential for very low false alarm rates; contextual analysis proposed by the intrusion detection system is detailed, making it easier to take preventive or corrective action.

The disadvantages of using information approach are: maintenance of the information base of the intrusion detection system and maintaining it up to date; information about attacks is much focused causing it to be closely tied to an environment; detection of insider attacks is difficult.

Information based intrusion detection is the most often applied technique in the field because it results in a low false-alarm rate and high positive rates, although it cannot detect unknown attack patterns. It uses rules (also called signatures) and monitors a stream of events to find malicious characteristics. Using an expert system, describe a malicious behavior with a rule. One advantage of using this kind of intrusion detection is that add new rules without modifying existing ones.

In contrast, performance approach is performed on learned performance that can't be modified without losing the

previous learning. Generating rules is the key element in this technique it helps the expert system recognize newly discovered attacks. Creating a rule consists of defining the set of conditions that represent the attack.

2.2.3 Increasing Attack Exposure

The two intrusion detection techniques are distinct. The performance approach intrusion detection is characterized by a high hit rate of known attacks, but it's deficient in detecting new attacks. Therefore, the complemented it with the performance technique, which can discover deviations from acceptable use and thus help identify privilege abuse.

Rapid increase in the number of vulnerabilities has resulted in an exponential rise in the number of attacks. According to the Computer Emergency Response Team (CERT), the number of vulnerabilities in software has been increasing and many of them exist in highly deployed software [10], [11]. Considering that it is near to impossible to build 'perfect' software, it becomes critical to build effective intrusion detection systems which can detect attacks reliably. The prospect of obtaining valuable information, as a result of a successful attack, subside the threat of legal convictions. The inability to prevent attacks furthers the need for intrusion detection. The problem becomes more profound since authorized users can misuse their privileges and attackers can masquerade as authentic users by exploiting vulnerable applications.

The volume of data in a cloud computing environment can be high, so administrators do not observe each user's actions they observe only alerts from the IDS.

2.2.4 Experimental Analysis

In testing our prototype, it has a low processing cost while still providing a satisfactory performance for real-time implementation. Sending data to other nodes for processing didn't seem necessary. The individual study performed in each node reduces the complexity and the volume of data in comparison to previous solutions, where the audit data is concentrated in single points. In the future, implement our IDS, helping to improve green (energy-efficient), white (using wireless networks), and cognitive (using cognitive networks) cloud computing environments. And also intend to research and improve cloud computing security.

Created data tables to perform the experiments with audit elements coming from both the log system and from data captured during node communications.

- Created data representing legitimate action by executing a set of known services simulating a regular behavior.
- Created data representing behavior anomalies. To represent anomalous sequences of actions, we altered the services and their usage frequency.
- Finally created data representing policy violation. This was prepared with a set of audit packages containing a series of elements violating base rules.

The event auditor captures all requests received by a node and the corresponding responses, which is fundamental for performance approach. For each action a node performs, a

log entry is generated to register the methods and parameters invoked during the action.

In the experiments with the performance based IDS, considered using audit data from both a log and a communication system. Unfortunately, data from a log system with the exception of the message element has a limited set of values with little variation. This made it difficult to find attack patterns, so opted to explore communication elements to evaluate this technique.

In the Evaluated performance technique using artificial intelligence enabled by a feed forward neural network [12]. Increasing the sample period for the learning phase improved the results.

2.2.5 Evaluating the performance approach

To measure IDS efficiency [13] considered accuracy in terms of the system's ability to detect attacks and avoid false alarms. A system is imperfect if it accuses a legitimate action of being malicious. So, measured accuracy using the number of false positives (legitimate actions marked as attacks) and false negatives (the absence of an alert when an attack has occurred).

Anomaly detection models operate by building a model of system performance based upon the standard operation of the network or component under observation. After this model of normal system performance has been created, current activity is compared to it. When the deviation grows greater than a threshold level, an alert is triggered [14]. Such a system has the advantage of being able to detect attacks that are not currently known. The drawback of such systems is that they often have a high false positive rate, which can lead to a lack of trust in the software.

The training was sporadic to plan updates to the performance profile database according to a routine in the execution environment (since a user's behavior tends to change with time). This helped us identify a convenient period of days for determining the profile of a legitimate user. Artificial neural networks aren't deterministic, so the number of false positives and false negatives didn't represent a linear decreasing progression. The neural network tended to avoid identifying legitimate actions as attacks there were always more false negatives than false positives when using the same quantity of input data.

No false alarms occurred during the training with simulation periods, although the uncertainty level was still high, with several outputs near zero. The algorithm showed a low number of false positives, but after several repetitions, the quantity of false positives varied, again representing the nondeterministic nature of neural networks.

2.2.6 Evaluating the Information Approach

In contrast to the performance approach, used audit data from both a log system and the communication system to evaluate the information based system. The created a series of rules to illustrate security policies that the IDS should monitor. Collected audit data referring to a route discovery service, service discovery and service request and response. The series of policies created tested the system's performance,

although our scope didn't include discovering new kinds of attacks or creating an attack database.

Our goal was to evaluate our solution's functionality and the prototype's performance. The rule below characterizes an attack in any message related to the storage service. The functions of the rule are as follows:

- At start-up, the rules stored in an XML file are loaded into a data structure.
- The auditor starts to capture data from the log and communication systems.
- The data is preprocessed to create a data structure dividing log data from communication data to provide easy access to each element.
- The corresponding policy for the audit package is verified.
- An alert is generated if an attack or violation occurred.

In testing our prototype learned that it has a low processing cost while still providing a satisfactory performance for real-time implementation. Sending data to other nodes for processing didn't seem necessary [9]. The individual analysis performed in each node reduces the complexity and the volume of data in comparison to previous solutions, where the audit data is concentrated in single points. When an intrusion-detection system is deployed, it becomes the natural primary target of hostile attacks, with the aim of disabling the detection feature and allowing an attacker to operate without being detected. Disabling the intrusion-detection system can happen in the following ways:

Denial-of-service attacks are a powerful and relatively easy way of temporarily disabling the intrusion-detection system. The attack can take place against the detector, by forcing it to process more information than it can handle (for example by saturating a network link). This usually has the effect of delaying detection of the attack or, in the worst case, of confusing the detector enough so that it misses some critical element of the attack. A second possibility is to saturate the reaction capability of the operator handling the intrusion-detection system. When the operator is presented with too many alarms, the person can easily miss the important one indicating penetration, even if it is present on the screen.

Several techniques have been developed to evade detection of an attack by intrusion-detection systems.

Intrusion-detection systems are beginning to protect themselves from these attacks, but little information is released by vendors as to the effectiveness of these protection measures. It is often difficult to assert the configuration of an intrusion-detection system, as in most cases there is no easy way to check the configuration and the proper detection of the attacks.

In the future, implement our IDS, helping to improve green (energy-efficient), white (using wireless networks), and cognitive (using cognitive networks) cloud computing environments. And also intend to research and improve cloud computing security.

3. Conclusion

Intrusion detection currently attracts considerable interest from both the research community and commercial companies. This paper is providing a satisfactory performance for real-time implementation. In this system implement a best remedial technique to overcome the drawbacks in the existing cloud and grid system. The individual analysis performed in each node reduces the complexity and the volume of data in comparison to previous solutions, where the audit data is concentrated in single points.

This approach increases the detection speed which meets the requirements of network communication. It improves the interactive performance of intrusion detection system for enhancing the security of the whole system. It is relatively low cost.

4. Future Enhancement

In the future, implement our intrusion detection system, helping to improve energy-efficient, using wireless networks, and using cognitive networks cloud computing environments. We also intend to research and improve cloud computing security.

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