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Defend against Anomaly Intrusion Detection using SWT Mechanism

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***Abstract*— In the fast growing internet commercial transaction base, attacks on Internet infrastructure, anomaly intrusion traffic attacks combined with traditional network intruders, have become one of the most serious threats to the network security. The proposed system of the traffic anomaly detection method is carried out on the principle traces of non intrusive packet header data (statistical wavelet transform) obtained from the internet server traffic basement. Traffic is monitored at regular intervals to obtain a signal that can be analyzed through statistical techniques and compared to historical norms to detect anomalies. The proposed methodology of anomaly intrusion traffic detection envisions statistical non intrusive wavelet transform mechanisms for real-time data source extracted from NetCon server (Internet Service Provider popularly running at Erode Region) over a period of three months at various time intervals.**

The experimental results suggest that address spoofing by attackers, which imply that such attacks will be invisible to indirect backscatter measurement techniques. Further, at the detailed packet-level characterization (e.g., attack destination ports), there are significant differences between anomaly and traditional intrusion attack measurements. Thus, there is tremendous value in moving towards direct observations to better understand recent intrusion attacks. Traffic Anomaly intrusion measurements additionally provide information inaccessible to traditional network intrusion measurements, enabling us to better understand how to defend against attacks.

***Index Terms*—Traffic Anomaly, Intrusion Detection, Server Intruders, Traffic Attack and NetCon**

I. Introduction

Many approaches have been studied to detect, prevent and mitigate malicious network traffic. For example, rule-based approaches, such as IDS (intrusion detection system), try to apply previously established rules against incoming traffic to detect and identify potential Intrusion attacks close to the victim's network. To cope with novel attacks, however, IDS tools such as Snort require to be updated with the latest rules. This project looks at the problem of designing generalized measurement based real-time detection mechanisms.

Measurement-based studies have considered traffic volume [3], number of flows as potential signals that can be analyzed in order to detect anomalies in network traffic, while the system further treat the traffic headers such as addresses and port numbers. Input data from multiple sources (i.e., all links in a network), while the work focuses on a single link at a time. Some approaches proactively seek methods to suppress the overflow of traffic at the source [5].

Controls based on rate limits have been adopted for reducing the monopolistic consumption of available bandwidth, to diminish the effects of attacks, either at the source or at the destination [5], [7], [12]. The apparent symptoms of bandwidth attack may be sensed through monitoring bit rates [10] and/or packet counts of the traffic flow. Bandwidth accounting mechanisms have been suggested to identify and contain attacks [8, 9, and 11]. Packeteer [2] and others offer commercial products that can account traffic volume along multiple dimensions and allow policy-based rate control of bandwidth.

Pushback mechanisms have been proposed to contain the detected attacks closer to the source [11, 12]. Trace back has been proposed to trace the source of Intrusion attacks even when the source addresses may be spoofed by the attacker. However, sophisticated low-rate attacks do not give rise to noticeable variance in traffic volume, could go undetected when only traffic volume is considered. Recently statistical analysis of aggregate traffic data has been studied. In general, the generated signal can be analyzed by employing techniques such as FFT (Fast Fourier Transform) and wavelet transforms. FFT of traffic arrivals may reveal inherent flow level information through frequency analysis. Fourier transforms and wavelets have been applied to network traffic to study its periodicity.

The previous work in [1] and the work in [3] studied traffic volume as a signal for wavelet analysis and these earlier studies have considerably motivated the current study. The study builds on this earlier work and extends the statistical analysis of traffic data further in analyzing other packet header data, such as addresses and port numbers in real-time. Various forms of signatures have been traditionally utilized for representing the contents or identities of documents.

This earlier work motivated the representation of aggregate network traffic data in a compact data structure. A similar data structure was employed in [4], with significant differences in processing of collected data, detection mechanisms and the resulting traffic anomaly detectors. The structure of addresses at various points in the network was observed to be multi-fractal in [6].

II. Related Works

Tools for analyzing network traffic allow the detection of anomalies in the environment, including attacks and unusual events in the network, and enable fast execution of actions to avoid that the detected threats can propagate through the network. The network traffic should be monitored in regular

intervals to obtain data that will be analyzed by statistical or intelligent techniques in search of anomalies. The idea is storing data from normal traffic (historical data) for future comparison with real traffic (current data) to detect eventual anomalies. By observing the traffic and correlating it to its previous states, it may be possible to see whether the current traffic is behaving in a similar / correlated manner [12]. This approach is named anomaly detection.

Anomalies on the network traffic are defined as previously unseen (yet legitimate) traffic behaviors. A wide range of unusual events some of which, but not all, may be malicious known as traffic anomalies are commonplace in today's computer networks. Identifying, diagnosing and treating anomalies such as failures and attacks in a timely fashion are a fundamental part of day to day network operations. Operators need to detect these anomalies as they occur and then classify them in order to choose the appropriate response. The principal challenge in automatically detecting and classifying anomalies is that anomalies can span a vast range of events: from network abuse (e.g., Intrusion attacks, scans, worms) to equipment failures (e.g., outages) to unusual customer behavior (e.g., sudden changes in demand, flash crowds, high volume flows), and even to new, previously unknown events. A general anomaly diagnosis system should therefore be able to detect a range of anomalies with diverse structure, distinguish between different types of anomalies and group similar anomalies.

Regardless of whether the anomalies in question are malicious or unintentional, it is important to analyze them for two reasons i.e., one, anomalies can create congestion in the network and stress resource utilization in a router, which makes them crucial to detect from an operational standpoint, and second one is that some anomalies may not necessarily impact the network, but they can have a dramatic impact on a customer or the end user. Existing postmortem analysis [4] of traffic volume (in bytes) can reveal changes in traffic patterns. Flow Scan and Auto Focus [5] are used as off-line traffic analyzing tools. Rigorous real-time analysis is required for detecting and identifying the anomalies so that mitigation action can be taken as promptly as possible. Analyze the effectiveness in real-time analysis of traffic data. Real-time analysis provides means of online detection of anomalies while they are in progress. Real-time analysis employs smaller amounts of data in order to keep such analysis simple and efficient. Real-time analysis also requires that any indications of attacks or anomalies be provided with short latencies. This trade-off between robustness and latency makes real-time analysis more challenging.

The proposed approach look at aggregate packet header data to improve scalability and to effectively deal with anomalies in cases where individual attack flows may not look anomalous. Use discrete wavelet transform model to correlate destination IP address. With discrete wavelet outcome, use statistical analysis for effective detection of anomalies. Provide a multidimensional indicator using the correlation of port numbers and the number of flows as a means of detecting anomalies. Results from trace-driven evaluation suggest that proposed approach could provide an effective means of detecting anomalies close to the source.

III. System Model

A. Traffic Sources

The proposed system model's traffic source workable data are obtained from the routers deployed in the network domain considered for evaluation. A traffic monitoring at a source network enables a detector to detect attacks early and is able to control hijacking of admin domain machines. Outbound filtering has been advocated for limiting the possibility of address spoofing i.e., to make sure that source addresses correspond to the designated addresses for the campus. With such filtering in place, we can focus on destination addresses and port numbers of the outgoing traffic for analysis purposes.

B. Anomaly Detection mode

The anomaly detection mode is based on the functions of network traffic splitter, and statistical data transformation. The traffic splitter generates network traffic signal from packet header traces or data flow records. The statistical data transformation analysis is carried out with wavelet transforms of IP address and port number correlation over several timescales. Then the detection of attacks and anomalies are checked using thresholds. The analyzed information will be compared with historical thresholds to see whether the traffic's characteristics are out of regular norms. This comparison will lead to some form of a detection signal that could be used to alert the network administrator of the potential anomalies in the network traffic.

C. Data Transform

The generated signal can be, in general, analyzed by employing techniques such as FFT (Fast Fourier Transform) and wavelet transforms. The analysis carried out on the signal may exploit the statistical properties of the signal such as correlation over several timescales and its distribution properties. Since wavelet analysis can reveal scaling properties of the temporal and frequency dynamics simultaneously unlike Fourier Transform, proposal compute a wavelet transform of the generated address correlation signal over several sampling points. Through signal can be detected in certain timescales that imply frequency components, and in certain positions of the timescales that mean temporal information, can induce the frequency and temporal components respectively. Discrete Wavelet Transform (DWT) consists of decomposition and reconstruction. The proposed model iterates a multilevel one-dimensional wavelet analysis up to 8 levels in case of the postmortem analysis, so our final analysis coefficients. The filtered signal is down sampled by 2 at each level of the analysis procedure. The signal of each level has an effect that sampling interval extends 2 times. Consequently it means that the wavelet transform identifies the changes in the signal over several timescales. When use t minutes as sampling interval j, the time range at a level spans t*2j minutes. This time range can independently sample and restore frequency components

D. Statistical Method Interaction

Individual fields in the packet header are analyzed to

observe anomalies in the traffic. Individual fields in the traffic header data take discrete values and show discontinuities in the sample space. For example, IP address space can span 232 possible addresses and addresses in a sample are likely to exhibit many discontinuities over this space making it harder to analyze the data over the address space. In order to overcome such discontinuities over a discrete space, we convert packet header data into a continuous signal through correlation of samples over successive samples. To investigate the sequence of a random process, we employ a simplified correlation of time series for computational efficiency without compromising performance.

For each address in the traffic count the number of packets sent in the sampling instant. For computing address correlation signal, consider two adjacent sampling instants. The detection model define address correlation signal in sampling point. If an address spans the two sampling points i.e., n-1 and n, the user obtain a positive contribution. In order to minimize storage and processing complexity, employ a linked data structure. A location count is used to record the packet count for the address *j* in *ith* field of the IP address through scaling. This provides a concise description of the address instead of 232 locations that would be required to store the address occurrence uniquely.

The detection model filters this signal by computing a correlation of the address in two success samples. Consequently four correlation signals are calculated. The employment of this approximate representation of addresses allows us to reduce the computational and storage demands by an appreciable factor. In order to generate the address correlation signal at the end of sampling point, multiply each segment correlation with scaling factors. From a statistical view, they have an approximately same mean and dispersion standard deviation as cross-correlation coefficient.

IV. Experimental Evaluation

The experimental evaluation of anomaly traffic detection was conducted based on the monitored traces of network traffic generated synthetically as shown in Figure.1 and real time samples obtained from NetCon server of an Internet Service Provider at our Erode Region. The real trace samples of the NetCon server was carried for a period of one month connecting with 10Mbps broad band link. Additionally employ the packet traces from the monitored trace data and super-imposed with simulated virtual attacks. The scenario in which the samples taken from the NetCon server having nearly 23000 connections at the rate of 1MBPs 600 packets / second. These traces were anonym, but preserved IP prefix relationships. The deployment of the anomaly traffic detection applied in the network is shown in Fig 1. In this mode of the experiment, packets with different sizes flow from ISP to network.

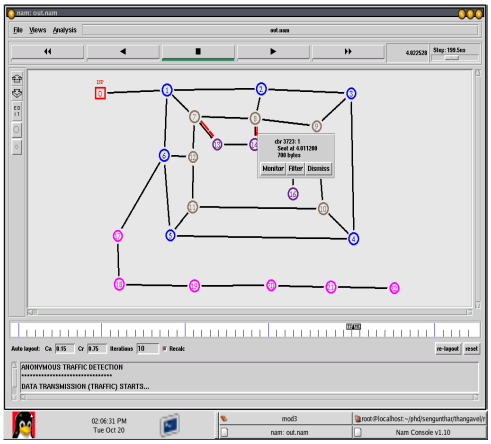


Figure.1 Anomaly traffic detection

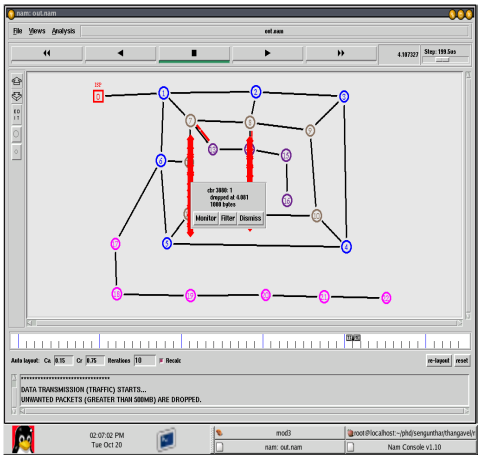


Figure.2 Packets with greater than 500MB are dropped

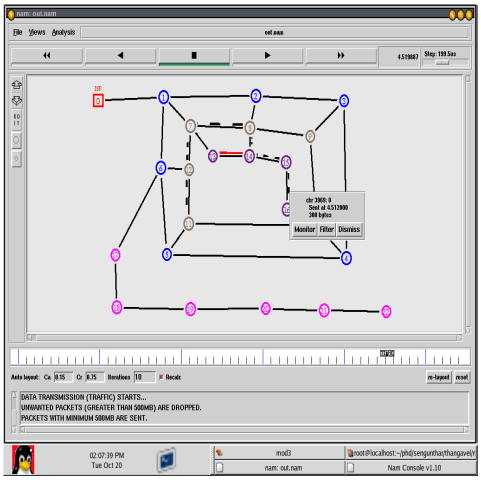


Figure.3 Packets with less than 500MB are sent

Based on bandwidth threshold the admission of anomalous packets will be controlled by dropping the packets. Bandwidth threshold is applied on the packet examination is shown in Figure 2. This made the control scheme of the bandwidth mode to drop some unwanted packets. The dropped packet size is 1000 bytes. As shown in Figure-3 packets with less than 500 MB are allowed to transmit into the destination.

The attacks cover a diversity of behaviors and allow us to deterministically test the efficacy of proposed mechanisms. These are classified by following criteria of persistency, IP address, protocol, port and size. Persistency is the process of remnant attacks persistently assault. IP address attack

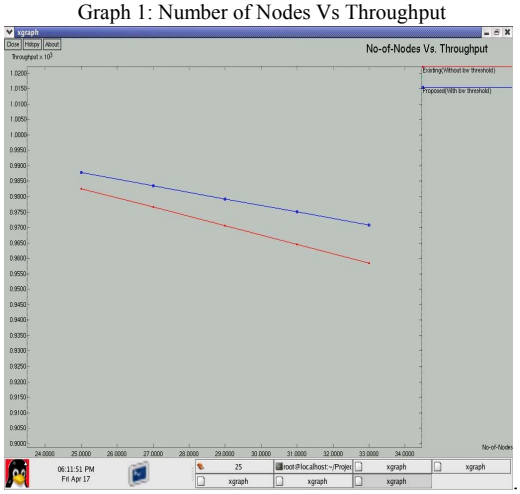
damage a portion of addresses preserve the class-A and a partition of it. Comparison of full-32 bit correlation and data structure addresses preserve class-B for the infiltration efficiency. The other type is randomly generated address. The Protocol ICMP, TCP and UDP, are exploited in turn. The port attacks are a representative #80 that stands for the reserved ports for well-known services. The port targets for randomly generated destination ports that are used to probe port scan. The three size denominations are random ones.

V. PERFORMANCE EVALUATION

Detection of anomalies using the real attack traces are based on composite approach with network traffic measures on the sampled time band. The weighted correlation signal of IP addresses is used for wavelet transform with real attacks. The anomaly detection results of0020the wavelet-transform and reconstructed signal are supposed to be evaluated from the experimentation.

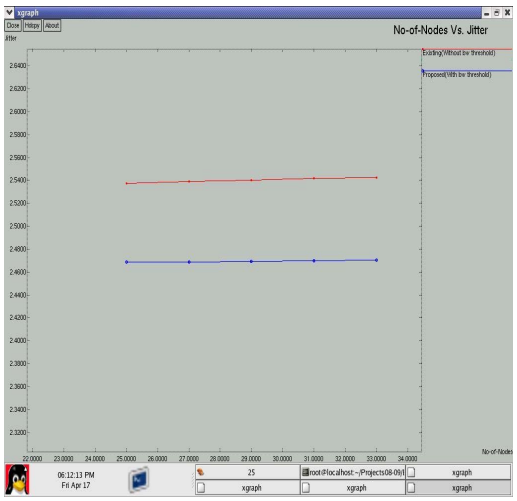
If statistical parameters of network traffic, such as mean and standard deviation, are stationary distributed under given traffic, parameters of specific day could be applied to other days. The experiment is conducted over a given time scale of two months trace and analyze their statistical summary measures. Wide-sense stationary (WSS) regarding these traces are obtained with the average independent on time, and autocorrelation function of time difference regardless of sample path. Based on communication, the analysis of the ambient trace could be considered as WSS Gaussian white noise, on the other hand, the attack and anomaly could be considered as signal of interest. It illustrates the thresholds status over the sampled time scale on anomaly traffic range.

Graph 1: Number of Nodes Vs Throughput



The graph1 depicts the output of the simulation by varying the number of nodes in the network traffic. There is an appreciable change in the throughput of the data communication. As the number of nodes increases, throughput decreases. By comparing it with non bandwidth threshold model, the throughput is high in the anonymous traffic detection with bandwidth threshold model.

Graph 2: Number of Nodes Vs Jitter



The simulation result based on the node variation affecting the jitter is depicted in the graph 2. The jitter value increases as the number of nodes increased in the anonymous traffic network. As for comparison made on existing method (without bandwidth threshold), the jitter is low in the proposed method.

VI. CONCLUSION

The anomaly intrusion traffic detection work carried out in this paper combine multiple independent data sources to study combined traditional intrusion attack and anomaly intrusion and provides the statistical wavelet based detection mechanism. The examined backscatter data from a mostly unused NetCon server network along with flow anomaly based traffic data from a tier-1 ISP network. The attack characterization indicates that most properties such as attack duration, packet count, packet rate, and dominant protocol type match fairly well in the two data sets. In addition load, demand capacity of the server at lean and heavy traffic scenarios are observed to provide better clarity of anomaly intrusion detection across all time zone of the server uptime. Using anomaly intrusion attack measurements, the proposed model performed an analysis of several traffic anomaly properties which is impossible using traditional intrusion measurements.

There is significant predictability in attacks both in terms of their originating server as well as from which interface they enter a large ISP network. Small businesses seem to be the most common targets of attacks. These results have significant implications for attack defense. With respect to anomaly intrusion attack detection and understanding attacks, relying on traditional measurements is clearly not sufficient given current trends in attacks, since very few if any of attacks appear to be using spoofed source addresses. As an alternate, it is found that anomaly traffic intrusive attack measurements can provide significantly more diagnostic capability that can better guide the design and deployment of attack defenses. In fact, there are positive implications for attack defense. From the perspective of service providers, intrusion attacks are really not as distributed as they are made out to be. Since the vast majority of malicious traffic arises from a small set of internet attacking servers and network

ingress points. Service providers can ensure significant protection for their customers with even limited (but intelligently targeted) deployment of intrusion defense mechanisms.

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