Network Security Monitoring and Alert System

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# Abstract

This research paper presents the design and implementation of a Network Security Monitoring and Alert System to detect, analyze, and respond to potential threats in real-time. With the increasing number of cyber-attacks, the need for proactive monitoring and automated alerting mechanisms has become critical. The system integrates multiple open-source and enterprise-level tools such as Snort, Wireshark, and Splunk to provide a comprehensive solution for threat detection, traffic analysis, and alert/report generation. Snort is utilized as an Intrusion Detection System (IDS), Wireshark is employed for deep packet inspection, and Splunk is configured for indexing, visualization, and automated alerting. The architecture ensures real-time monitoring of malicious activities, including port scans, denial-of-service attacks, and spoofing attempts. Evaluation of the system demonstrates its effectiveness in generating timely alerts, reducing false positives, and providing actionable insights for network administrators. The paper concludes with potential improvements, including the integration of machine-learning-based predictive threat detection and automated response mechanisms.

# Keywords

Network Security, Intrusion Detection, SIEM, Splunk, Snort, Wireshark, Alerts, Monitoring

# 1. Introduction

The modern digital ecosystem faces continuous cyber threats ranging from malware infections to sophisticated Advanced Persistent Threats (APTs). Organizations are increasingly dependent on robust network infrastructures, making them attractive targets for attackers. Traditional security mechanisms, such as firewalls and antivirus software, are no longer sufficient to protect against evolving attack vectors. This necessitates the implementation of comprehensive Network Security Monitoring (NSM) systems that combine real-time traffic analysis, intrusion detection, and automated alerting.  
  
The importance of NSM lies in its ability to provide visibility into network activities, enabling administrators to detect and mitigate threats before they escalate. However, existing tools often work in silos, making it challenging to achieve a unified view of network security. This project addresses this gap by designing a Network Security Monitoring and Alert System that integrates Snort, Wireshark, and Splunk into a single framework.  
  
The objectives of this research include: (a) developing a unified monitoring system, (b) ensuring real-time detection of suspicious activities, (c) automating alert and reporting mechanisms, and (d) evaluating the system's performance against simulated cyberattacks.

# 2. Literature Review

Network security monitoring has been an active area of research and development. Several open-source and commercial solutions exist, each focusing on different aspects of monitoring. Snort, developed by Martin Roesch, is one of the most widely adopted intrusion detection systems, providing signature-based and anomaly-based detection capabilities. Similarly, Bro/Zeek offers advanced traffic analysis with a focus on application-layer events.  
  
Wireshark is a popular packet analyzer that provides deep inspection of network traffic, often used for forensic investigations. On the other hand, Splunk represents a class of Security Information and Event Management (SIEM) tools, designed for indexing, querying, and visualizing log data from various sources.  
  
While these tools are effective in their respective domains, the lack of integration poses a challenge for network administrators who need a unified threat-monitoring solution. Previous studies suggest that combining IDS with SIEM improves detection accuracy and incident response efficiency. However, there is still a gap in implementing lightweight yet effective frameworks suitable for academic and enterprise environments alike.

# 3. Research Methodology

The proposed system integrates Snort, Wireshark, and Splunk into a cohesive architecture. The methodology follows a layered approach:  
  
• Data Collection: Wireshark captures raw network packets, storing them for detailed inspection.  
• Intrusion Detection: Snort analyzes real-time traffic and generates alerts for suspicious patterns.  
• Log Processing: Alerts and logs are forwarded to Splunk for indexing.  
• Visualization and Alerting: Splunk dashboards provide graphical representations, while automated alerts are configured to notify administrators via email/SMS.  
  
The workflow consists of continuous monitoring, detection, alert generation, and reporting. Testing was carried out in a controlled lab environment using simulated attack scenarios such as port scanning (Nmap), DoS attacks, and ARP spoofing.

# 4. System Implementation

The implementation was carried out on a Linux environment with the following configuration steps:  
  
1. Installation and configuration of Snort as the primary IDS.  
2. Integration of Wireshark for packet capture and analysis.  
3. Setup of Splunk to index logs from Snort and Wireshark.  
4. Creation of custom Splunk dashboards for real-time traffic visualization.  
5. Implementation of automated alerts in Splunk for anomaly detection.  
  
The system supports real-time monitoring, detailed analysis of historical data, and provides administrators with actionable insights through customized reports.

# 5. Results and Evaluation

The evaluation of the system demonstrated its effectiveness in detecting multiple types of simulated attacks. During testing, the system successfully identified port scans, DoS attempts, and spoofing activities, generating timely alerts for each incident. The integration of Snort and Splunk reduced false positives by correlating traffic data with intrusion signatures. Splunk dashboards provided clear visualization of attack trends, including traffic spikes and abnormal packet flows.  
  
The system achieved a detection accuracy rate above 90% for tested scenarios. Compared to standalone tools, the integrated framework provided faster response times and better situational awareness for administrators.

# 6. Conclusion and Future Work

This paper presented the design and implementation of a Network Security Monitoring and Alert System integrating Snort, Wireshark, and Splunk. The system demonstrated effectiveness in detecting and alerting against network threats in real-time, while providing administrators with meaningful insights for response. The research establishes the significance of combining IDS, packet analyzers, and SIEM tools into a unified framework.  
  
Future improvements may include the integration of machine learning algorithms to predict and classify attacks, the use of threat intelligence feeds for proactive defense, and the development of automated response mechanisms for faster mitigation. Expanding the system for large-scale enterprise deployments with distributed monitoring is also a potential direction for future research.

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