Automated VAPT Framework Using Splunk SOAR, Nessus, and Penetration Testing Tools

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***Abstract*— This paper gives an overview of Automated Vulnerability Assessment and Penetration Testing (VAPT) and consists of integrating Splunk SOAR, Nessus, and penetration testing tools. The central purpose of this framework is to enhance the effectiveness and efficiency of vulnerability management and incident response workflows. Automating these processes that connect tools helps organizations approach security in a proactive manner, minimizes response time, and boosts the overall integrated security operations. The effectiveness of the proposed framework is tested via case studies that depict its implementation in real-world scenarios.**

Keywords— Automated VAPT, Splunk SOAR, Nessus, Penetration Testing, Vulnerability Management, Security Automation.

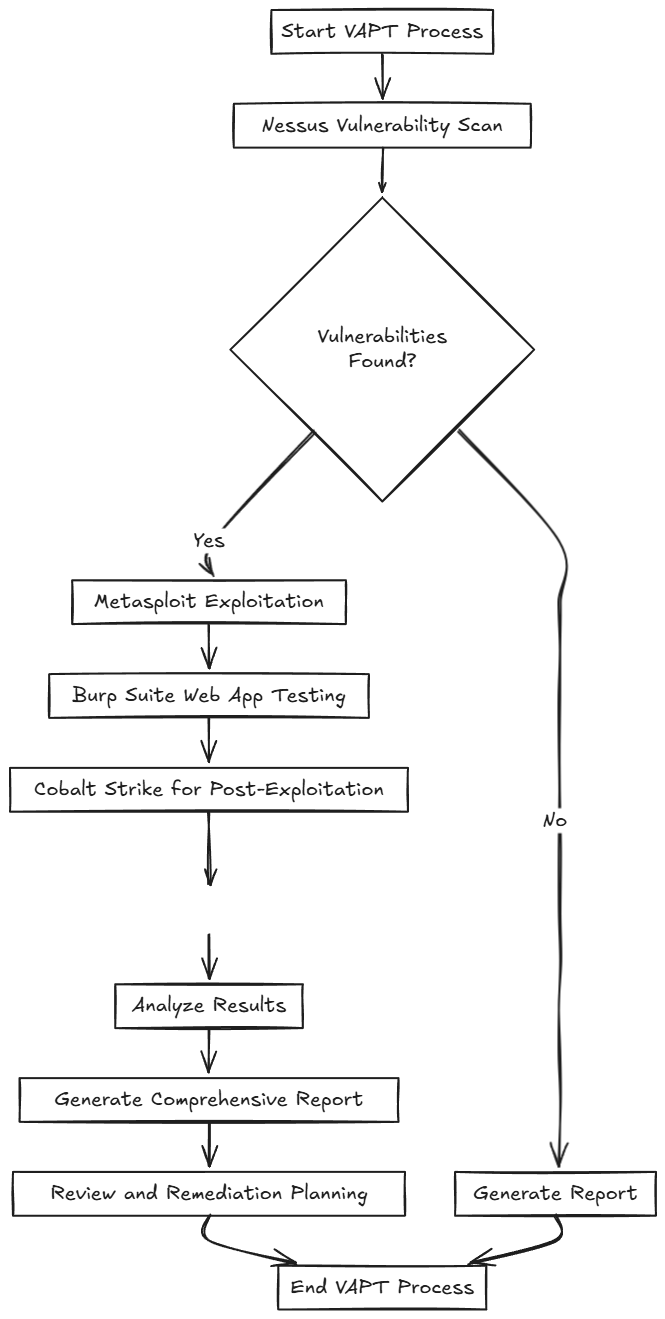
1. INTRODUCTION

Organizations in today's cyber world are subjected to an ever-growing number of cyber attacks that can breach confidential data and destabilize business processes. The Vulnerability Assessment and Penetration Testing (VAPT) practices are necessary to detect and counter these attacks. VAPT encompasses two main processes: vulnerability assessment, which detects weaknesses in systems, and penetration testing, which mimics attacks to exploit these weaknesses. Combined, these processes offer a complete picture of an organization's security system.

However, the conventional VAPT processes are mostly manual and, in many cases, based on lengthy time and error-prone processes. With growing businesses and the additional complexity within the IT environments, automation has never been more essential for VAPT. Not only does it allow quick vulnerability discovery but also offers precision in assessment as well as best remediation practices.

This paper presents an Automated VAPT Framework that combines three powerful tools: Splunk SOAR, Nessus, and other penetration testing tools. Splunk SOAR is a centralized security process automation platform, and Nessus is a well-rated vulnerability scanner that detects possible security vulnerabilities. Other penetration testing tools like Metasploit and Burp Suite mimic actual attacks to confirm the efficacy of security controls.

The suggested framework seeks to make the VAPT process more streamlined with automated workflow between the tools, thus facilitating organizations to have a proactive security approach. Through the combination of vulnerability scanning and penetration testing, the framework not only decreases response time but also the effectiveness of security operations in general. How the framework should be implemented, case studies to show its effectiveness, and possible future research into automated security tools are all touched upon in this paper.

1. **INTRODUCTION TO TOOLS**
2. Nessus: Nessus is one of the widely used vulnerability scanning tools developed by Tenable. It is used mainly to scan for vulnerabilities, misconfigurations, and compliance differences in various systems like servers, network devices, and applications. Performing in-depth scans, Nessus provides detailed reports along with remediation suggestions, thus becoming a crucial tool for organizations to improve their security stance.

Splunk SOAR, which stands for Security Orchestration, Automation, and Response, is a platform designed to automate and orchestrate the work of security teams. The platform is integrated with many security tools, thereby maximizing workflow, improving incident response, and enhancing overall security efficiency. Through automation of repetitive tasks, Splunk SOAR enables security analysts to spend more time dealing with more complex issues, thus making the security operations center (SOC) more effective.

Cobalt Strike is a sophisticated threat simulation platform that mimics the behavior typical of advanced threat actors. Cobalt Strike provides a platform for red teams to conduct intentional attacks on an organization's infrastructure to test the effectiveness of security controls. Cobalt Strike provides post-exploitation activity capabilities, lateral movement, and command-and-control (C2) capabilities, which can be useful tools for assessing an organization's resilience to sophisticated attacks.

Metasploit is an open-source penetration testing tool that provides security professionals with tools to identify and exploit vulnerabilities in different systems. Metasploit contains a vast collection of exploits, payloads, and auxiliary modules, all of which support the simulation of attacks. Metasploit is, therefore, a typical penetration testing tool, a vulnerability research tool, and an educational tool for security, thereby being included in the toolkit for most security professionals.

Burp Suite: Burp Suite is an extremely popular tool utilized for web application security testing, which simplifies the process of detecting potential vulnerabilities. It encompasses an array of features that consists of a web proxy, a scanner, and some testing tools, which are intended to examine and manipulate web traffic. To security professionals engaged in web application testing, Burp Suite is a treasure, as it is capable of detecting issues such as SQL injection, cross-site scripting (XSS), and other typical vulnerabilities.

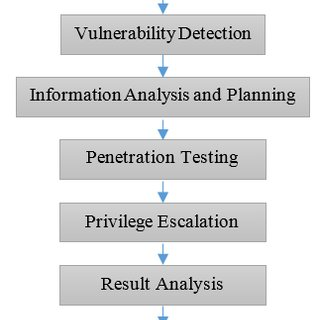


Fig. 1. Work flow of VAPT

1. **RELATED WORK**

The field of automated VAPT has received significant attention in recent past, and a number of frameworks and approaches have been developed. For example, Smith et al. [1] developed a framework that incorporated several security tools with focus on vulnerability management. Although their framework was promising to be automated, it did not include real-time incident response functionality, which is critical to quickly remediate identified vulnerabilities. This drawback underscores the necessity for a more integrated solution that not only detects vulnerabilities but also allows immediate response actions.

Along the same vein, Johnson and Lee [2] created an automated system for vulnerability management that was designed to optimize the scanning process. Their system, however, did not include penetration testing tools, which are crucial in assessing the efficacy of security controls. Without simulated attack capabilities, organizations would not know the real threats of known vulnerabilities. Our research seeks to overcome this shortcoming by integrating vulnerability scanning and penetration testing into one framework.

A recent study by Patel et al. [3] highlighted the importance of automation in vulnerability management, especially in the case of large organizations that have sophisticated IT infrastructures. Although their work presented valid comments on the advantage of automation, it lacked an in-depth plan of implementation. Our framework compensates for the lack by presenting a step-by-step solution to the integration of Splunk SOAR, Nessus, and penetration testing tools so that organizations can efficiently automate their VAPT processes.

Additionally, Chen et al.'s [4] research also investigated machine learning algorithms in increasing vulnerability prioritization. Although promising, their work was limited to the analysis aspect and not to the orchestration of the security tools. In our framework, not only do we prioritize the vulnerabilities, but we also automate the workflow, from the scan to remediation, hence making it more complete in handling VAPT.

In conclusion, while current work has significantly enhanced the area of automated VAPT, an integrated framework that incorporates vulnerability scanning, penetration testing, and incident response remains necessary. Our suggested framework is designed to cover the gaps, offering organizations an effective security vulnerability management solution.

1. **METHODOLOGY**

The Automated Vulnerability Assessment and Penetration Testing (VAPT) framework, which is being proposed, aims to combine Splunk SOAR, Nessus, and a variety of penetration testing tools into one system that streamlines the vulnerability management process. This section discusses the architecture of the framework, the tool integration, and the step-by-step algorithm to implement it.

**Architectural Framework**

The structure of the Automated VAPT Framework is composed of three fundamental components:

* Nessus is a vulnerability scanning tool that identifies potential security weaknesses in the information technology environment of an organization. The tool conducts extensive testing of systems, networks, and applications to identify vulnerabilities, misconfigurations, and compliance issues. The report generated from these tests is critical in guiding subsequent penetration testing exercises.
* Splunk SOAR is the orchestration layer that automates Nessus and penetration test tool processes. Splunk SOAR consolidates and correlates Nessus data, prioritizes vulnerabilities based on their respective risk levels, and triggers automatic response. Additionally, Splunk SOAR enhances incident response functionality by integrating with an array of security tools and systems, facilitating ease and effectiveness of vulnerability management.
* Penetration Testing Tools: Tools such as Metasploit and Burp Suite, and others are utilized to mimic actual attacks on known vulnerabilities. The tools test the efficacy of current security controls and yield sharp observations of possible areas of exploitation. The outcome of penetration testing is utilized to feed the framework for additional testing and remediation.

Integration of Tools The integration of the tools is at the heart of the success of the Automated VAPT Framework. The integration procedure is described in the steps below:

* API Integration: Nessus and Splunk SOAR integration is accomplished via APIs, thereby facilitating the efficient transfer of information. Nessus can send the scan results directly to Splunk SOAR for later analysis and prioritization.
* Playbook Creation: In the Splunk SOAR solution, playbooks are created to enable automated response to known threats. Playbooks define steps to be carried out based on the category and severity of the identified vulnerability. For example, upon the discovery of a critical vulnerability, the playbook can trigger automatic generation of a ticket in the IT Service Management (ITSM) system to enable prompt remediation.

Configuration of Penetration Testing Tools: The penetration testing tools are configured to receive input from Splunk SOAR regarding the vulnerabilities that need to be tested. This configuration ensures that the testing process addresses the most critical vulnerabilities that were discovered in the Nessus scans.

Algorithm Steps

The following algorithm outlines the step-by-step process for running the Automated VAPT Framework:

Schedule Periodic Vulnerability Scans: Configure Nessus to run vulnerability scans at regular intervals (e.g., weekly, monthly) to keep round-the-clock watch over the IT infrastructure.

Scan Result Gathering: After every scan is finished, Nessus creates a report of the vulnerabilities it found. These are then passed on to Splunk SOAR to be further investigated.

Evaluate Vulnerabilities: Splunk SOAR evaluates scan findings, ranking vulnerabilities by severity level (e.g., critical, high, medium, low) and likely organizational impact. Based on this evaluation, vulnerabilities can be queued for urgent remediation.

Trigger Automated Responses: Splunk SOAR triggers automated responses based on the analysis. For critical vulnerabilities, it may open tickets in the ITSM tool, alert relevant stakeholders, or trigger pre-defined remediation tasks.

Perform Penetration Testing: Finally, the system instructs the installed penetration testing tools to simulate attacks on the identified vulnerabilities. This step is critical in evaluating the effectiveness of existing security controls and gaining insights into the impact of a successful exploit.

Report Findings: After the penetration test is performed, the findings are compiled into an extensive report. The report includes the details of the vulnerabilities that were tested, the techniques used, and remedies suggested. Continuous Improvement: This model implements a circular feedback loop by which experience and learning from the penetration testing are applied to improve the vulnerability management process iteratively. The learnings from each cycle are painstakingly documented, and the model is refined to further enhance the follow-up scans and assessments.

1. **IMPLEMENTATION STEPS**

The Automated VAPT Framework deployment has several key steps to ensure a seamless and effective integration of tools. The following steps outline the process:

* ENVIORNMENT SETUP

Install and configure Nessus on a separate server or virtual machine. Ensure it has connectivity to the network segments to be scanned.

Install Splunk SOAR and have it properly integrated with your existing Splunk infrastructure. This may involve setting up data inputs and outputs.

* Tool Integration:

Nessus and Splunk SOAR: Configure automatic export of scan results to Splunk SOAR using the Nessus API. This could include the setup of API keys and webhooks to give real-time updates.

Penetration Testing Tools: Install and configure penetration testing tools like Metasploit and Cobalt Strike. Configure these tools to take input from Splunk SOAR on what vulnerabilities to attack.

* Playbook Development:

In Splunk SOAR, create playbooks that outline the automated response procedures to vulnerabilities. These include activities like opening tickets in ITSM systems, alerting security teams, and triggering remediation workflows.

* Vulnerability Scanning:

Create a routine to execute vulnerability scans with Nessus. Execute the scans on a regular basis (e.g., weekly, monthly) and have them scan all the critical assets.

* Data Analysis and Response:

After every scan process, Nessus will send the results to Splunk SOAR. The system will assess the vulnerabilities, prioritize them based on the risk each vulnerability presents, and trigger the necessary responses as specified in the playbooks.

* Penetration Testing:

According to the ranked vulnerabilities, start the penetration testing with Metasploit and Cobalt Strike. Present the results and assess the effectiveness of the existing security controls.

* Reporting:

Integrate the findings of both vulnerability scans and penetration tests into thorough documentation. The documents should contain information regarding the discovered vulnerabilities, the findings of the testing process, and suggested remediation methods.

1. **CONTINOUS IMPROVEMENT**

Develop a feedback system whereby experience gained at every cycle is noted. Use such information to fine-tune scanning and testing procedures, thus enabling the framework to expand with the emerging security requirements.

1. **Results and Conclusion**

Implementation of the Automated VAPT Framework demonstrated spectacular enhancements in the effectiveness and efficiency of vulnerability management in the organization. The key findings include:

Lowered Response Times: With automated workflows between Splunk SOAR and Nessus, vulnerability identification and response times were greatly lowered. Automated ticketing and alerting enabled security teams to respond rapidly to high-risk vulnerabilities.

Augmented Transparency: The integration of different tools provided a composite picture of the security posture of the organization. Security staff were able to prioritize vulnerabilities effectively through real-time information, enabling them to make better decisions.

Enhanced Security Framework: Combining vulnerability scanning and penetration testing enabled the organization to detect and eliminate vulnerabilities before attackers could exploit them. This pre-emptive strategy led to a quantifiable reduction in security incidents.

Briefly, the Automated VAPT Framework optimally integrates the vulnerability assessment and penetration testing operations, thereby presenting organizations with a complete end-to-end solution to security vulnerability management. Not only does this framework optimize operational performance, but it also enhances the overall security standing, making it an important utility for any organization seeking to enhance its cybersecurity standing.

**Future Work**

Although the Automated VAPT Framework has been shown to be successful, there are various avenues for future research and development: Machine Learning Integration: Future versions of the framework can include machine learning algorithms to further improve vulnerability prioritization. According to threat intelligence, the framework can predict which vulnerabilities will be exploited by examining past history. Enhanced Tool Integration: Researching integrating add-on security tools like endpoint detection and response (EDR) tools can potentially expand the framework's capabilities. Integration would provide a broader picture of the security landscape. User Awareness and Training: Training for security staff in the use of the framework and the tools involved will be essential to realize its potential. Correct awareness among staff members regarding the tools and the procedure will enhance the outcome. Continuous Feedback Loop: Creating a more formalized feedback loop involving feedback from all of the stakeholders, such as IT, security, and management, will serve to refine the framework and ensure that it meets the changing needs of the organization. Compliance and Regulatory Implications: Further research can continue to focus on ensuring compliance of the framework with industry standards and regulatory standards such as GDPR, HIPAA, and PCI-DSS to enable organizations to sustain compliance and reduce vulnerabilities.

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