

A Project Report on
Multi-Service Honeypot: Comprehensive Network Security

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the
academic requirements for the award of the degree.

Bachelor of Technology
in
Computer Science and Engineering
(Cyber Security)

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CERTIFICATE

This is to certify that the Major Project Phase I report entitled "**Multi-Service Honeypot: Comprehensive Network Security**" being submitted by Bathula Chandana (20H51A6251), Shrutika Shrikhande (20H51A6267), Tadicherla Deva Kumar (20H51A6268) in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering (Cybersecurity)** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodied in this project report have not been submitted to any other university or Institute for the award of any Degree.

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DECLARATION

We hereby declare that the results embodied in this Report of Project on “**Multi-Service Honeypot: Comprehensive Network Security**” are from work carried out by using partial fulfillment of the requirements for the award of a B. Tech degree. We have not submitted this report to any other university/institute for the award of any other degree.

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TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	LIST OF FIGURES	iii
	ABSTRACT	iv
1	INTRODUCTION	1
	1.1 Problem Statement	6
	1.2 Research Objective	6
	1.3 Project Scope and Limitations	7
2	BACKGROUND WORK	8
	2.1. PentBox	9
	2.1.1. Introduction	9
	2.1.2. Merits, Demerits and Challenges	10
	2.1.3. Implementation of PentBox	12
	2.2. KF Sensor	13
	2.2.1. Introduction	13
	2.2.2. Merits, Demerits and Challenges	14
	2.2.3. Implementation of KF Sensor	16
	2.3. Snare	18
	2.3.1. Introduction	18
	2.3.2. Merits, Demerits and Challenges	20
	2.3.3. Implementation of Snare	22
3	PROPOSED SYSTEM	24
	3.1. Objective of Proposed Model	25
	3.2. Designing	26
	3.2.1. Flow Chart	26
4	IMPLEMENTATION	27
5	SYSTEM REQUIREMENTS	30
6	RESULTS AND DISCUSSION	32
7	CONCLUSION	36
	7.1 Conclusion and Future Enhancement	37
	REFERENCES	39

List of Figures**FIGURE**

NO.	TITLE	PAGE NO.
1	Interface of PentBox Console	10
2	GUI of KF Sensor	14
3	Snare Console	19
4	Flow Chart of ErsBox Honeypot	26
5	Multi-Service Honeypot Interface	34
6	Specific Configurations	34
7	HTTP Emulation from Honeypot Site	35
8	HTTP Emulation from Attacker Side	35

ABSTRACT

The field of cybersecurity faces a never-ending barrage of new attacks. Defenders usually concentrate on strengthening their perimeter defenses and don't pay attention to the attackers' evolving strategies. Examining current approaches for using honeynets to detect and prevent cyberattacks is the primary objective of this field's research. There are two that are especially fascinating techniques that focus on demonstrating empirically that honeypots—more precisely, Multi-service Honeypots—offer a proactive defense. The idea behind honeypots and their variations, such as Multi-service Honeypot, is to mimic a controlled environment to be able to entice an attacker and provide important details regarding any security holes in the system.

Security experts can strengthen the defenses defending their company's IT systems by keeping an eye on the tactics, tools, and procedures (TTPs) that attackers utilize in the regulated honeypot configuration and networks from possible online dangers. Under the pretense of purposeful deceit, honeypot's function. They give the impression of being trustworthy systems, complete with information or weaknesses that draw in bad actors. But in reality, they have a secret goal: to learn more about threat actors that interact with the honeypot. When threat actors use the honeypot in this way, they unintentionally give the defenders recorded interactions that provide crucial details regarding the attack tactics, tools, and procedures they employ.

Cybersecurity is a critical concern, with web applications being prime targets for various attacks due to their network accessibility and inherent vulnerabilities. Intrusion detection systems play a pivotal role in safeguarding web applications by monitoring and alerting against potential attack attempts. Traditional intrusion detection systems often rely on manually selected features extracted from network packets or input string characteristics, demanding considerable time and domain expertise.

This paper explores advancements in autonomic intrusion detection systems through the implementation of an Ersbox Honeypot. Unlike conventional methods, this approach utilizes an unsupervised/semi-supervised model based on the principles of the Ersbox Honeypot architecture. The Ersbox Honeypot autonomously monitors and captures the runtime behavior of web applications, providing a comprehensive understanding without the need for exhaustive feature selection.

The creation of the Honeypot is carried out within Ersbox, which provides a set of integrated computer security tools in one package. One of the features of ErsBox is Honeypot. By using Honeypot, one can learn the methods and techniques used by attackers. Ersbox's Honeypot feature allows users to deploy a simulated system that attracts and traps attackers.

By monitoring the activities of the attackers on the Honeypot, network administrators and security experts can gain valuable insights into the types of attacks being used, the attacker's tactics, and potential vulnerabilities in their network defenses. This knowledge can be instrumental in improving overall network security and developing better countermeasures to protect against real-world attacks.

CHAPTER 1

INTRODUCTION

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Data security and network system security have recently drawn increased attention. Network systems must be secured against hackers since they house crucial data and resources. Honeypots and honeynets are commonly used by security professionals to safeguard network infrastructures. Honeypots are another tool used by security professionals to pick up new hacking skills from fresh attackers and intruders. A honeypot: what is it? The Honeynet Project is credited to Spitzner, who described a honeypot as "A protection asset whose worth depends on being examined, assaulted, or destroyed" in 2002. "A data system resource that is valuable only when used illegally or uninvited source," was the more expansive definition provided by Spitzner a year later. To put it practically, a device known as a honeypot is meticulously laid out to feast on a connection to draw in an uninvited attacker.

The world of parked automobiles and trench coats has given way to a network and program playground where competing countries and companies scour the landscape in search of that fleeting opening. Too often marketed as "security solutions." The objective is straightforward and admirable: to cease operations and, most importantly, to get rid of the requirements for deception stratagem appellations. One, cunning is cunning, a term that originates from a project carried out in the early 1990s by a collection of astute researchers who were eager to put an opponent in an artificially confined and constrained space, with their opening countered by force, regardless of the ultimate result, which they refused to acknowledge in the air quotes: decoy, act, bait; whatever it took to create evidentiary fact, in the form of a certification of the enemy's strategy and execution.

This study looks at the honeypot space. The fundamental ideas of the subject are examined, in addition to the characteristics that set it apart and several security-related study topics that could be used as models for honeypot studies. The dirty system finds many appealing targets in complex systems. Security analysts benefit much from the examination of attacker interactions with honeypots. They can gather intelligence on emerging threats, zero-day vulnerabilities, and the greatest recent attacker Tactics, Techniques, and Procedures (TTPs) by closely analyzing attacker activity.

The landscape of honeypots varies greatly in complexity. Low-interaction honeypots provide a targeted view of attacker activity restricted to a single service. They are expertly designed to mimic specific services (like a web server or secure shell login). High-interaction honeypots, conversely, offer a wider perspective.

They entice the attacker in by seeming like whole operating systems, which reveals their entire toolkit of techniques and goals. This article will go over the benefits and drawbacks of each type of honeypot in detail to assist security professionals in choosing the best instrument for their unique security objectives. The setup and planning of a honeypot deployment must be just as thorough.

Organizations and individuals are paying more and more attention to cyber defense as cyber threats and attacks have been on the rise. According to a recent data breach investigation report, denial of service and system intrusions are among the major attacks targeting enterprise networks. Meanwhile, cyber-attack methods are becoming more sophisticated. For example, traditional denial of service attacks have become more distributed and are launched from massive botnets, and system intrusions involve increasing leverage of malware and deployment of ransomware. Unfortunately, we often do not know the attacks until after they happen and the damage is done.

Methods such as firewalls and Demilitarized Zone (DMZ) have been used differently, but for today's network protection, it is not effective. The limitations of the current network would then be resolved by intrusion detection systems. The intrusion detection system quietly monitors the traffic of the network and provides warnings about any form of intruders based on the current intrusion signature database. The Honeypots will be introduced in the network to run the unused IPs of the network and the actions of the attacker on these honeypots will be analyzed.

The Ersbox honeypot is a powerful tool used in cybersecurity to detect and analyze cyber threats. It acts as a trap, enticing potential attackers and gathering valuable information about their methods and behaviors. By mimicking vulnerable systems or services, the honeypot lures attackers into its virtual environment, allowing security professionals to study their techniques and develop effective countermeasures.

This honeypot is equipped with various features and functionalities that make it a robust tool in the cybersecurity arsenal. It can simulate vulnerable services like FTP, HTTP, and SSH, attracting attackers who attempt to exploit these services. The Ersbox honeypot also provides monitoring capabilities, allowing security teams to track and analyze incoming attacks in real-time.

One of the key advantages of the Ersbox honeypot is its ability to gather valuable intelligence. It captures critical data such as attack vectors, IP addresses, and attack payloads, providing security professionals with insights into the latest hacking techniques and trends. This information can be used to enhance existing security measures and develop proactive defense strategies.

Furthermore, the Ersbox honeypot offers a safe and controlled environment for studying attacks. By isolating the attackers within the honeypot, security teams can analyze their behavior without risking the security of the actual production systems. This enables them to gather valuable forensic evidence and improve incident response capabilities.

In addition to its detection and analysis capabilities, the Ersbox honeypot also plays a crucial role in threat intelligence sharing. By collaborating with other security teams and sharing attack data, organizations can collectively improve their defenses and stay ahead of emerging threats. This collaborative approach fosters a strong cybersecurity community and enhances the overall security posture of organizations.

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1.1 Problem Statement

A project “**Multi Service Honeypot: Comprehensive Network Security Monitoring and Deception Framework**” aimed at creating a website honeypot could be to design and develop a realistic web platform that lures and captures malicious actors, providing valuable insights into their attack techniques. The honeypot should have robust security measures in place to ensure the safety of the system and data being collected. It will use various techniques such as honey tokens, honey files, honey words, honey links, honey scripts, honey traps, and honey networks to detect malicious activities. The system will also monitor user activity and detect any malicious activity. The system will also provide alerts to the administrator when malicious activity is detected.

1.2 Research Objective

1.Evaluate the Effectiveness of Website Honeypots:

Assess the ability of website honeypots to detect and deter web-based threats and attacks.

2.Analyze Attack Patterns and Tactics:

Investigate the attack patterns, tactics, and techniques observed in honeypot data to gain insights into the methods used by malicious actors.

3.Study the Impact of Honeypots on Attackers:

Examine the behavior of attackers when interacting with website honeypots, including their persistence and motivations.

4.Assess the False Positive Rate:

Determine the rate of false positives generated by website honeypots and explore methods for reducing them.

1.3 Project Scope and Limitations

The scope of the project on “Multi Service Honeypot: Comprehensive Network Security Monitoring and Deception Framework” is primarily centered around the enhancement of web security through the deployment of website honeypots. If applicable, the project seeks to integrate threat intelligence sources to provide context for identified threats, thereby enhancing the effectiveness of security measures.

Building secure infrastructure and implementing robust security measures to protect the honeypot and its data. Collecting and analyzing data on the tactics and techniques used by attackers. Conducting regular threat analysis and staying updated on emerging cyber threats. Contributing to the broader understanding of cybersecurity risks and enhancing defensive strategies.

Limitations:

1.False Positives: Honeypots may generate false positives, where legitimate traffic are misidentified as malicious. This can lead to unnecessary alerts and may require time-consuming investigation.

2.Complex Deployment: Setting up and configuring honeypots can be a complex task, especially for those with limited cybersecurity expertise.

3.Lack of Real Traffic: Honeypots mainly attract malicious traffic. They don't replicate the normal, legitimate traffic patterns of a production environment, making them less suitable for understanding real user behaviors.

CHAPTER 2

BACKGROUND WORK

CHAPTER 2

BACKGROUND WORK

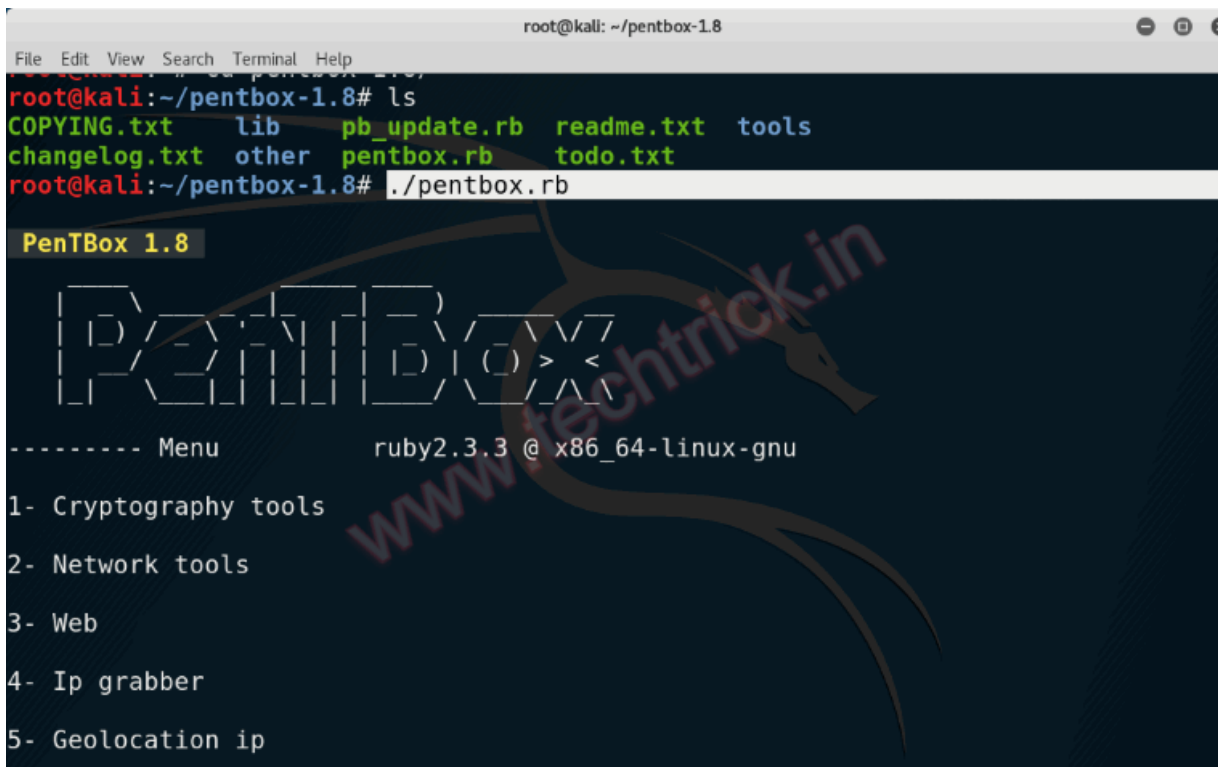
2.1 PentBox

2.1.1 Introduction

PentBox is an open-source penetration testing toolkit that provides various tools for security professionals and ethical hackers. It is designed to assist in network security assessments, vulnerability scanning, and penetration testing tasks. PentBox includes a range of tools such as packet sniffers, port scanners, password crackers, and more, all within a user-friendly interface.

Some of the tools and features offered by PentBox include:

- 1. Packet Sniffing:** Allows users to capture and analyze network traffic, which can be useful for identifying security vulnerabilities or monitoring network activity.
- 2. Port Scanning:** Helps identify open ports on target systems, which can be crucial for understanding the attack surface of a network.
- 3. Password Cracking:** Provides tools for attempting to crack passwords, including dictionary-based attacks and brute-force methods.
- 4. Denial of Service (DoS) Attacks:** PentBox includes tools for launching various types of denial of service attacks against target systems, which can be used to test their resilience to such attacks.
- 5. Exploitation Tools:** Offers tools for identifying and exploiting vulnerabilities in target systems, which can help security professionals assess the security posture of a network.



```
root@kali: ~/pentbox-1.8
File Edit View Search Terminal Help
root@kali:~/pentbox-1.8# ls
COPYING.txt  lib  pb_update.rb  readme.txt  tools
changelog.txt  other  pentbox.rb  todo.txt
root@kali:~/pentbox-1.8# ./pentbox.rb

PentBox 1.8

----- Menu          ruby2.3.3 @ x86_64-linux-gnu
1- Cryptography tools
2- Network tools
3- Web
4- Ip grabber
5- Geolocation ip
```

FIG. 1 – Interface of PentBox Console

2.1.2 Merits, Demerits and Challenges

Here are some merits, demerits, and challenges associated with using PentBox or similar penetration testing toolkits:

I.Merits:

- 1. Versatility:** PentBox offers a wide range of tools and features for conducting penetration testing and security assessments, making it suitable for various scenarios and requirements.
- 2. User-Friendly Interface:** PentBox is designed with a user-friendly interface, which can make it easier for security professionals, even those with limited technical expertise, to utilize its capabilities effectively.
- 3. Open Source:** Being open-source software, PentBox allows users to inspect its source code, customize it to suit their needs, and contribute improvements back to the community.

4. Educational Purposes: PentBox can be a valuable tool for learning about network security, ethical hacking techniques, and vulnerabilities. It provides hands-on experience in a controlled environment.

II. Demerits:

1. Potential for Misuse: Like any other penetration testing tool, PentBox can be misused for malicious purposes if it falls into the wrong hands. Unauthorized use of such tools can lead to legal consequences and ethical concerns.

2. False Positives: PentBox tools may sometimes generate false positives or inaccurate results, which can lead to wasted time and resources chasing non-existent vulnerabilities.

3. Complexity: While PentBox aims to provide a user-friendly interface, some of its features and capabilities may still be complex for users who are new to penetration testing or network security.

III. Challenges:

1. Legal and Ethical Considerations: One of the biggest challenges when using PentBox or similar tools is ensuring that their use complies with legal and ethical guidelines. Penetration testing should only be conducted with proper authorization and consent from relevant stakeholders.

2. Keeping Up with Evolving Threats: Network security threats are constantly evolving, and maintaining an up-to-date understanding of the latest vulnerabilities and attack techniques is essential for effective penetration testing. This requires ongoing education and awareness.

3. Resource Limitations: PentBox and other penetration testing tools may require significant computational resources to run effectively, especially when conducting tests on large-scale networks or complex systems. Ensuring access to adequate hardware resources can be a challenge, particularly for individuals or organizations with limited budgets.

2.1.3 Implementation of PentBox

Implementing PentBox involves several steps, including installation, familiarization with its features, and responsible usage. Here's a general guide to implementing PentBox:

1. System Requirements:

- Ensure that your system meets the hardware and software requirements for running PentBox. This typically includes having a Linux-based operating system installed, as PentBox is primarily designed for Linux environments.

2. Installation:

- Download the PentBox package from a trusted source, such as the official GitHub repository or the developer's website.
- Follow the installation instructions provided in the documentation or README file accompanying the PentBox package.
- Depending on the distribution, you may need to install additional dependencies or libraries to ensure PentBox functions correctly.

3. Familiarization:

- Take the time to familiarize yourself with PentBox's features, tools, and capabilities. Explore the documentation and user guides to understand how each tool works and how they can be used for penetration testing and security assessments.

4. Practice Environment:

- Set up a practice environment where you can safely conduct penetration testing exercises using PentBox. This could be a virtualized network or isolated lab environment where you have control over the systems and network infrastructure.

5. Responsible Usage:

- Ensure that you use PentBox responsibly and ethically. Only conduct penetration testing activities on systems and networks for which you have explicit authorization from the owner or administrator.
- Avoid using PentBox for any malicious or unauthorized purposes, as this can lead to legal consequences and ethical concerns.
- Keep accurate records of your penetration testing activities, including any findings, vulnerabilities discovered, and actions taken.

6. Regular Updates:

- Keep PentBox and its dependencies up to date by installing updates and patches as they become available. This helps ensure that you have access to the latest features and security fixes.

7. Training and Education:

- Consider undergoing training or certification in ethical hacking and penetration testing to enhance your skills and knowledge. There are many online courses, tutorials, and resources available for learning about penetration testing methodologies and best practices.

8. Community Engagement:

- Engage with the PentBox community by participating in forums, discussion groups, and online communities where you can ask questions, share experiences, and learn from other users' insights and expertise.

2.2 KF Sensor**2.2.1 Introduction**

KF Sensor is a term that may encompass various meanings or interpretations, depending on the context in which it's used. Without specific information, it's challenging to provide a detailed description. However, in the realm of technology and sensor applications, it could potentially refer to a type of sensor technology used for various purposes such as monitoring environmental conditions, detecting specific substances or materials, or measuring physical parameters like temperature, pressure, or motion. Sensor technologies have become increasingly integral in numerous industries, including healthcare, manufacturing, agriculture, and environmental monitoring, among others. They enable real-time data collection, analysis, and decision-making, contributing to enhanced efficiency, productivity, and safety across various domains. If "KF Sensor" pertains to a particular product, project, or concept, additional context would be necessary to provide a more precise explanation of its functionality and applications.

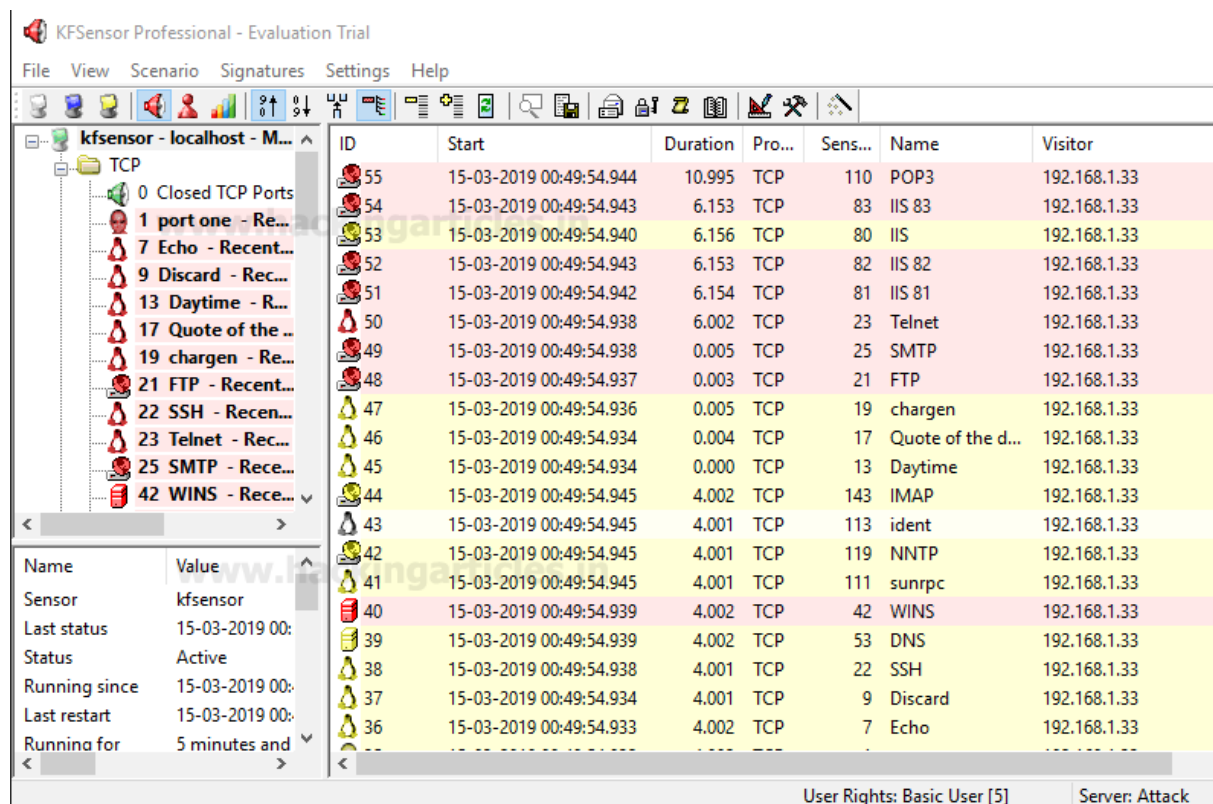


FIG. 2 – GUI of KF Sensor

2.2.2 Merits, Demerits and Challenges

I.Merits:

1. Data Collection: Sensors such as KF Sensor can efficiently collect vast amounts of data from the environment or target system, providing valuable insights into various parameters such as temperature, pressure, humidity, and more.

2.Real-Time Monitoring: These sensors enable real-time monitoring of critical parameters, allowing for prompt responses to changes or anomalies in the monitored environment or system.

3.Automation: Sensor data can be integrated into automated systems, facilitating process optimization, predictive maintenance, and improved efficiency in various industries.

4.Enhanced Decision-Making: The data provided by sensors can support informed decision-making processes, enabling businesses and organizations to respond proactively to changing conditions or requirements.

5.Remote Monitoring: Sensor technology often allows for remote monitoring capabilities, enabling users to monitor and manage systems or environments from a distance, which can be particularly beneficial in inaccessible or hazardous locations.

II. Demerits:

1.Cost: Implementing sensor technology, including KF Sensor, can entail significant initial costs, including the purchase of sensors, infrastructure setup, and integration with existing systems.

2.Data Security: Sensor data may contain sensitive information, and ensuring its security and integrity can be a challenge, particularly in interconnected systems or IoT (Internet of Things) environments.

3.Data Overload: With the proliferation of sensors and the volume of data they generate, organizations may face challenges in effectively managing and analyzing the vast amounts of data collected.

4.Accuracy and Reliability: Sensor data may be subject to inaccuracies or errors due to various factors such as sensor drift, environmental conditions, or calibration issues, which can impact the reliability of the insights derived from the data.

5.Maintenance: Sensors require periodic calibration, maintenance, and sometimes replacement, which can add to the overall cost of ownership and complexity of managing sensor networks.

III. Challenges:

1.Interoperability: Ensuring compatibility and interoperability between different sensor technologies, communication protocols, and data formats can be a challenge, particularly in heterogeneous or legacy systems.

2. Standardization: The lack of standardized protocols and formats for sensor data can hinder interoperability, data exchange, and integration with other systems or platforms.

3. Privacy Concerns: Collecting and analyzing sensor data may raise privacy concerns, particularly in contexts where personal or sensitive information is involved, necessitating appropriate data protection measures and compliance with regulations such as GDPR (General Data Protection Regulation).

4. Energy Efficiency: Some sensor applications, particularly those deployed in remote or resource-constrained environments, may face challenges related to energy efficiency and power consumption, requiring optimization strategies to prolong battery life or reduce energy usage.

2.2.3 Implementation of KF Sensor

1. Define Objectives: Clearly define the objectives and requirements of implementing KF Sensor. Determine what parameters you need to measure, the accuracy required, environmental conditions, and any specific constraints or considerations.

2. Select Sensors: Choose the appropriate sensors based on the defined objectives. Consider factors such as sensor type (e.g., temperature, pressure, humidity), accuracy, range, size, power requirements, and compatibility with the intended application.

3. Hardware Setup: Install and configure the sensor hardware according to the manufacturer's guidelines. This may involve connecting sensors to microcontrollers, data acquisition systems, or IoT devices, depending on the application.

4. Calibration: Calibrate the sensors to ensure accurate and reliable measurements. Follow the calibration procedures provided by the sensor manufacturer or use calibration standards and equipment as necessary.

5. Data Acquisition: Set up data acquisition systems or software to collect data from the sensors. This may involve programming microcontrollers, configuring data logging devices, or implementing IoT platforms for real-time monitoring and data analysis.

6. Data Processing and Analysis: Process and analyze the sensor data to derive meaningful insights. Depending on the application, this may involve filtering, smoothing, averaging, or performing more complex data analysis techniques to extract useful information.

7. Integration: Integrate sensor data with existing systems or applications as required. This could involve developing APIs, protocols, or interfaces to communicate with other software or hardware components in the ecosystem.

8. Power Management: Implement power management strategies to optimize energy usage and prolong battery life for battery-operated sensor devices. This may include sleep modes, duty cycling, or energy harvesting techniques, depending on the application.

9. Testing and Validation: Test the implemented sensor system under various conditions to ensure functionality, accuracy, and reliability. Validate the sensor measurements against known standards or reference measurements to verify their accuracy.

10. Deployment: Deploy the sensor system in the target environment or application. Ensure proper installation, protection against environmental factors, and compliance with relevant safety regulations or standards.

11. Maintenance and Monitoring: Establish procedures for ongoing maintenance, calibration, and monitoring of the sensor system. Regularly check sensor performance, replace faulty sensors or components as needed, and update software or firmware to address any issues or improvements.

12. Data Security and Privacy: Implement measures to ensure the security and privacy of sensor data. This may include encryption, access controls, data anonymization, and compliance with data protection regulations such as GDPR.

By following these steps, you can effectively implement KF Sensor or similar sensor technologies in various applications, ranging from industrial monitoring and automation to environmental sensing and IoT systems. Adapt the implementation process to suit the specific requirements and constraints of your project or application.

2.3 Snare

2.3.1 Introduction

Snare is a family of software products designed for log management and security information and event management (SIEM). Originally developed by InterSect Alliance International Pty Ltd, Snare is widely used in IT environments for collecting, analyzing, and monitoring event log data from various sources such as servers, workstations, applications, and network devices. It provides organizations with the ability to centralize and correlate log data, enabling them to detect security incidents, troubleshoot issues, and meet compliance requirements effectively.

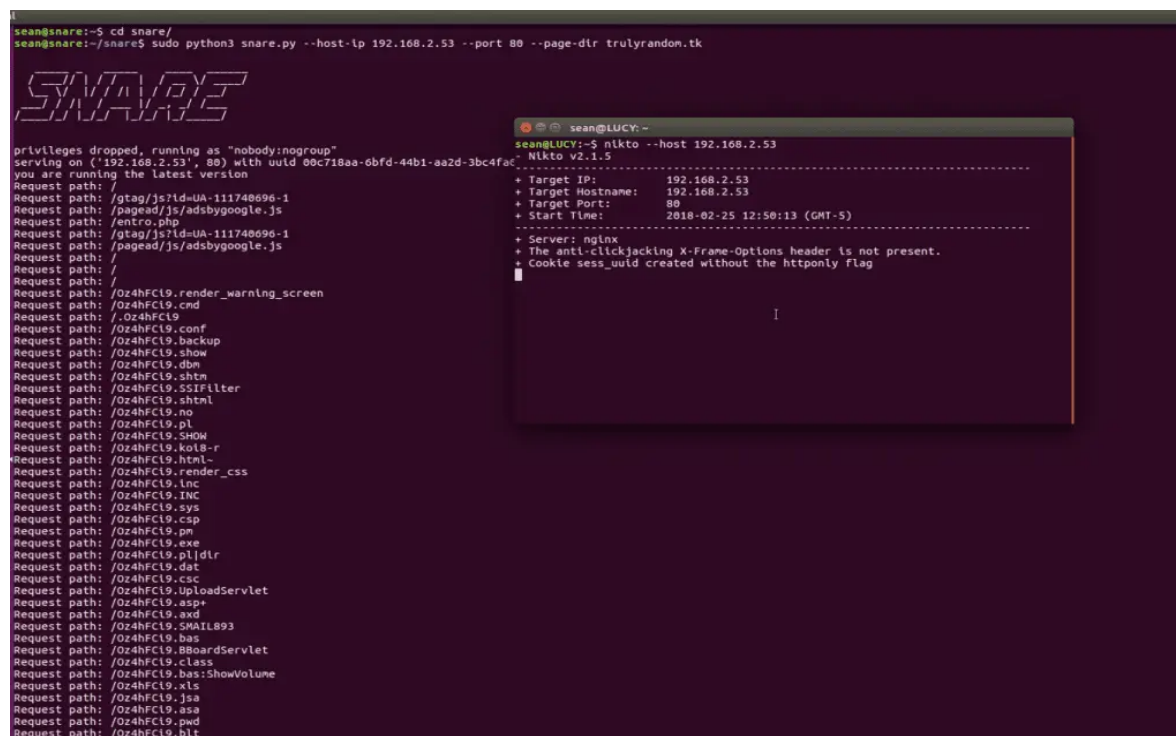
Key components and features of Snare include:

- 1. Log Collection:** Snare agents are deployed on individual systems to collect event log data generated by operating systems, applications, and other sources. These agents can be configured to filter and forward specific log events to a centralized repository for analysis.
- 2. Normalization and Parsing:** Snare processes incoming log data, normalizing it into a standardized format and parsing it into individual fields for easy analysis and correlation. This helps ensure consistency and uniformity across diverse log sources.
- 3. Centralized Storage:** Snare supports various storage options for log data, including local storage, centralized databases, and SIEM platforms. This centralized storage facilitates efficient data retention, archival, and retrieval for compliance and forensic purposes.
- 4. Real-Time Monitoring:** Snare provides real-time monitoring capabilities, allowing organizations to monitor critical events as they occur and respond promptly to security incidents or operational issues.
- 5. Alerting and Notification:** Snare enables organizations to define custom rules and thresholds for detecting specific events or patterns indicative of security threats or policy violations. It can generate alerts and notifications to alert security teams or administrators to potential issues.
- 6. Reporting and Analysis:** Snare offers reporting and analysis features to help organizations gain insights into their log data. It provides predefined reports as well as custom query capabilities for generating ad-hoc reports and performing trend analysis.

7. Integration: Snare integrates with various SIEM platforms, security analytics tools, and ticketing systems, enabling seamless workflow integration and automation of incident response processes.

8. Compliance Support: Snare assists organizations in meeting regulatory compliance requirements by providing the necessary tools and features for log management, audit trail creation, and reporting.

Overall, Snare serves as a robust log management and SIEM solution, empowering organizations to enhance their cybersecurity posture, streamline IT operations, and achieve regulatory compliance objectives effectively. Its versatility, scalability, and ease of integration make it a popular choice among enterprises and SMBs seeking comprehensive log management capabilities.



```

sean@snare:~$ cd snare/
sean@snare:~/snare$ sudo python3 snare.py --host-ip 192.168.2.53 --port 80 --page-dir trulyrandom.tk

  SNARE

privileges dropped, running as "nobody:nogroup"
serving on ('192.168.2.53', 80) with uuid 00c718aa-6bfd-44b1-aa2d-3bc4fa
you are running the latest version
Request path: /
Request path: /gtag/js?id=UA-111740696-1
Request path: /pagead/js/adsbygoogle.js
Request path: /entro.php
Request path: /gtag/js?id=UA-111740696-1
Request path: /pagead/js/adsbygoogle.js
Request path: /
Request path: /
Request path: /
Request path: /Oz4hFCL9.render_warning_screen
Request path: /Oz4hFCL9.cmd
Request path: /Oz4hFCL9
Request path: /Oz4hFCL9.conf
Request path: /Oz4hFCL9.backup
Request path: /Oz4hFCL9.show
Request path: /Oz4hFCL9.dbn
Request path: /Oz4hFCL9.shtm
Request path: /Oz4hFCL9.SSIFilter
Request path: /Oz4hFCL9.shtml
Request path: /Oz4hFCL9.no
Request path: /Oz4hFCL9.pl
Request path: /Oz4hFCL9.SHOW
Request path: /Oz4hFCL9.kol8-r
Request path: /Oz4hFCL9.html-
Request path: /Oz4hFCL9.render_css
Request path: /Oz4hFCL9.lnc
Request path: /Oz4hFCL9.LNC
Request path: /Oz4hFCL9.sys
Request path: /Oz4hFCL9.csp
Request path: /Oz4hFCL9.pm
Request path: /Oz4hFCL9.exe
Request path: /Oz4hFCL9.plldir
Request path: /Oz4hFCL9.dat
Request path: /Oz4hFCL9.csc
Request path: /Oz4hFCL9.UploadServlet
Request path: /Oz4hFCL9.asp+
Request path: /Oz4hFCL9.axd
Request path: /Oz4hFCL9.SMIL893
Request path: /Oz4hFCL9.bas
Request path: /Oz4hFCL9.BBoardServlet
Request path: /Oz4hFCL9.class
Request path: /Oz4hFCL9.bas:ShowVolume
Request path: /Oz4hFCL9.xls
Request path: /Oz4hFCL9.jsa
Request path: /Oz4hFCL9.asa
Request path: /Oz4hFCL9.pwd
Request path: /Oz4hFCL9.bl1
  
```

```

sean@LUCY:~$ ntkto --host 192.168.2.53
Ntkto v2.1.5
-----
+ Target IP:      192.168.2.53
+ Target Hostname: 192.168.2.53
+ Target Port:    80
+ Start Time:     2018-02-25 12:58:13 (GMT-5)
-----
+ Server: nginx
+ The anti-clickjacking X-Frame-Options header is not present.
+ Cookie sess_uuid created without the httponly flag
  
```

FIG. 3 – Snare Console

2.3.2 Merits, Demerits and Challenges

Here's a breakdown of the merits, demerits, and challenges associated with Snare:

I.Merits:

- 1. Comprehensive Log Management:** Snare offers comprehensive log management capabilities, allowing organizations to collect, store, and analyze log data from various sources across their IT infrastructure.
- 2. Enhanced Security Monitoring:** By providing real-time monitoring, alerting, and correlation features, Snare helps organizations detect and respond to security incidents promptly, thereby enhancing their overall cybersecurity posture.
- 3. Compliance Assistance:** Snare assists organizations in meeting regulatory compliance requirements by facilitating the collection, storage, and reporting of log data, which is often necessary for compliance audits and regulatory filings.
- 4. Customization and Flexibility:** Snare offers customization options, allowing organizations to tailor the solution to their specific requirements and integrate it seamlessly into their existing IT environment.
- 5. Scalability:** Snare is scalable and can handle large volumes of log data, making it suitable for organizations of all sizes, from small and medium-sized businesses to large enterprises.

II. Demerits:

- 1. Complexity:** Implementing and managing a comprehensive log management and SIEM solution like Snare can be complex and resource-intensive, requiring specialized knowledge and expertise.
- 2. Cost:** The cost of deploying and maintaining Snare, including licensing fees, infrastructure costs, and ongoing support and maintenance expenses, can be significant, particularly for smaller organizations with limited budgets.

3. Integration Challenges: Integrating Snare with existing IT systems, security tools, and processes may pose challenges, especially in heterogeneous environments with diverse technologies and platforms.

4. Performance Impact: Deploying agents and centralizing log data with Snare may impose performance overhead on systems and networks, potentially affecting overall system performance and responsiveness.

III. Challenges:

1. Data Volume and Complexity: Managing and analyzing large volumes of log data generated by numerous sources can be challenging, requiring efficient data processing, storage, and analysis capabilities.

2. Security and Privacy Concerns: Safeguarding sensitive log data against unauthorized access, tampering, or breaches is critical. Organizations must implement robust security measures and adhere to privacy regulations to protect their log data effectively.

3. Skills Gap: There is often a shortage of skilled personnel with expertise in log management, SIEM technologies, and cybersecurity, which can pose challenges for organizations looking to implement and operate Snare effectively.

4. Adapting to Evolving Threat Landscape: The cybersecurity threat landscape is constantly evolving, with new threats and attack vectors emerging regularly. Organizations must continually update and adapt their log management and security monitoring strategies to mitigate evolving threats effectively.

By addressing these demerits and challenges while leveraging the merits of Snare, organizations can maximize the benefits of log management and SIEM solutions to enhance their cybersecurity posture and operational efficiency.

2.3.3 Implementation of Snare

Implementing Snare involves several steps to effectively collect, manage, and analyze log data from various sources within an organization's IT environment. Here's a generalized outline of the implementation process:

1. Assessment and Planning:

- Assess your organization's log management requirements, including the types of logs you need to collect, the volume of log data, compliance requirements, and security objectives.
- Develop a detailed implementation plan that outlines the scope of the project, goals, timelines, resource requirements, and budget considerations.

2. Installation and Configuration:

- Install Snare agents on the systems and devices from which you want to collect log data. These may include servers, workstations, network devices, and applications.
- Configure the Snare agents to specify which log sources to monitor, how to format the log data, and where to send it for centralized storage and analysis.

3. Centralized Log Collection:

- Set up a centralized log collection infrastructure to receive and store log data from the Snare agents. This could involve deploying a log management server or SIEM platform capable of handling large volumes of log data.
- Configure the centralized log collection system to receive and process log data from the Snare agents, ensuring compatibility and interoperability between different components.

4. Normalization and Parsing:

- Normalize and parse the incoming log data to ensure consistency and standardization across different log sources. This may involve mapping log fields to a common schema, extracting relevant information, and enriching the data with additional context.

5. Alerting and Monitoring:

- Configure alerting rules and thresholds to detect security incidents, anomalies, or other events of interest within the log data.
- Set up real-time monitoring dashboards or consoles to visualize log data and receive alerts and notifications when predefined conditions are met.

6. Integration with SIEM and Other Tools:

- Integrate Snare with your existing SIEM platform, security analytics tools, or other monitoring and management systems to leverage their capabilities and streamline workflow processes.
- Implement APIs, protocols, or custom connectors to facilitate data exchange and interoperability between Snare and other tools within your IT ecosystem.

7. Testing and Validation:

- Test the implementation thoroughly to ensure that Snare agents are collecting and forwarding log data correctly, the centralized log collection infrastructure is functioning as expected, and alerting and monitoring mechanisms are working effectively.
- Validate the accuracy, completeness, and reliability of the log data collected by Snare through comparison with known sources or manual verification.

8. Training and Documentation:

- Provide training to IT staff responsible for managing and operating the Snare deployment, including how to configure agents, interpret log data, and respond to security incidents.
- Document the implementation process, configuration settings, operational procedures, and troubleshooting guidelines to facilitate ongoing maintenance and support.

9. Deployment and Rollout:

- Deploy the Snare implementation into production environments gradually, starting with a pilot phase or limited rollout to validate functionality and performance before expanding to broader deployment.
- Monitor the deployment closely during the rollout phase, addressing any issues or challenges that arise promptly to ensure a smooth transition to full production.

10. Ongoing Maintenance and Optimization:

- Establish procedures for ongoing maintenance, monitoring, and optimization of the Snare deployment, including regular updates, performance tuning, and capacity planning.
- Continuously evaluate the effectiveness of the Snare implementation against organizational objectives and evolving security requirements, making adjustments as needed to enhance its value and efficacy over time.

CHAPTER 3

PROPOSED SYSTEM

CHAPTER 3

PROPOSED SYSTEM

3.1 Objective of Proposed Model

ErsBox is a comprehensive penetration testing toolkit that includes a variety of tools for ethical hacking and security testing. Implementing a honeypot within the Ersbox environment adds an extra layer of defense, acting as a decoy to attract and detect potential attackers. In this proposed solution, we'll outline the steps to set up an Ersbox honeypot, enhancing your network security.

1.Virtual Machine Setup:

Install VMware on your host machine and create a new virtual machine. Install the selected Linux distribution using the downloaded ISO image. Configure network settings to ensure proper connectivity.

2.Ersbox Installation:

Ensure Ersbox is properly installed on your system. You can obtain the latest version from the official repository. Once installed, familiarize yourself with the Ersbox toolkit, as it contains various modules for penetration testing.

3.Selecting Honeypot Type:

Ersbox supports different types of honeypots, including low-interaction and high-interaction honeypots. Depending on your security needs, choose an appropriate type. Low-interaction honeypots simulate services and are easier to deploy, while high-interaction honeypots mimic entire operating systems, providing a more realistic environment.

4.Configuring Honeypot Parameters:

Access the Ersbox configuration settings to specify parameters for the honeypot. Define the type of services your honeypot will emulate, set up logging mechanisms, and establish alert thresholds for suspicious activities. Fine-tune these settings to match your network environment and security requirements.

5.Integration with ErsBox Modules:

Integrate the honeypot functionality with other Ersbox modules. This ensures that the honeypot is seamlessly woven into your penetration testing toolkit. Consider utilizing features like network scanning, vulnerability assessment, and exploitation modules in conjunction with the honeypot for a comprehensive security strategy.

6.Monitoring and Logging:

Implement robust monitoring and logging mechanisms within the honeypot. Track incoming connections, analyze patterns, and log potential intrusion attempts. Regularly review logs to identify new tactics employed by attackers and adjust your security measures accordingly.

7.Automated Responses:

Enhance the honeypot's capabilities by incorporating automated response mechanisms. For example, you can configure the honeypot to dynamically adjust its behavior based on detected threats, such as blocking specific IP addresses or modifying simulated vulnerabilities to divert attackers.

3.2 Designing Model

3.2.1 Flow Chart

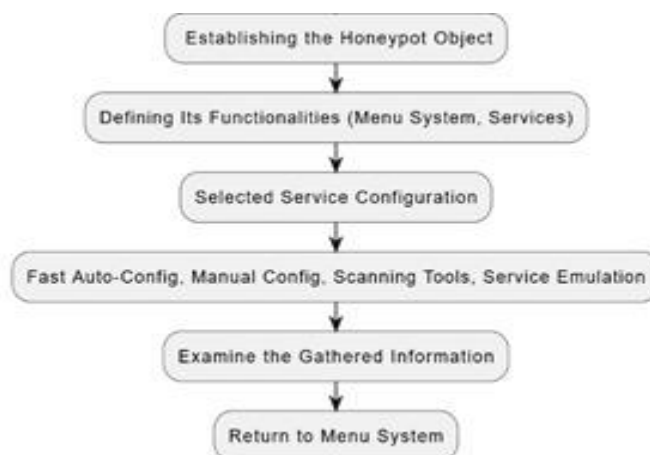


FIG. 4 – Flow Chart of ErsBox Honeypot

CHAPTER 4

IMPLEMENTATION

CHAPTER 4

IMPLEMENTATION

In this Architecture had three main types of options they are geolocation finder, website cloning, and camera phishing. Here the users can opt/select an option for further process. It is a completely web-based project that offers different types and also provides customization for various factors.

1. Honeypot Installation: The Honeypot object is created at the start of the code and acts as the main hub for controlling various features. It contains instructions for setting up, activating, and monitoring many facets of Honeypot.

2. Menu System: The menu system has been designed to offer an interface that is easy to use allowing the user to select what to do by inputting the corresponding numeric option. It is modular allowing it to seamlessly engage with the various features. This object is used as a central management point and encapsulates methods for configuring, starting, and managing different characteristics of the honeypot.

3. Selection for Specific Configuration: The layout demonstrates how simple it is to use each component individually. It offers "several configurations, e.g., Fast Auto-Config, Manual Configuration. Fast Auto-Configuration allows for real-time setup that applies predefined configurations, specially designed for fast deployment. Any settings that are likely to remain constant, such as port configurations, response messages, and logging (etc.), may be defined to save time at setup. Manual Config lets advanced users customize many settings to taste."

4. Examine service emulation functionalities: Accepted protocols of the framework are (Hypertext Transfer Protocol) HTTP Server, (Transmission Control Protocol) TCP Server, HTTP Emulation, and (Secure Shell) SSH Emulation. Utilizing the WEBrick library and the HTTP Server option, you can build a basic web server that is always open on port 8000. Making efforts to entice possible attackers and monitor their activities, primarily shows how honeypots can be configured to mimic internet services. In addition, using the Transmission Control Protocol (TCP) Server option causes a TCP server to start listening on port 20, accept connections, and reply with a brief message.

However, in contrast, the HTTP Finally, an emulated SSH server is launched via SSH Emulation, listening on port 22 and displaying a 2.8 OpenSSH fake banner. To track unwanted login attempts, offer information about possible intrusion attempts, and identify structures in exploit usage, this was arranged to fake SSH services.

5. Investigate gathered Information: Once the Honeypot system is up and running, the gathered data may be viewed through the menu system. This is all available for further analysis and Some threat intelligence. This is all available for further analysis and Some threat intelligence. By using this extensive framework, you will have access to a variety of features to improve your network security and threat detection skills while customizing and deploying the Honeypot system to your exact requirements.

CHAPTER 5

SYSTEM REQUIREMENTS

CHAPTER 5

SYSTEM REQUIREMENT

A.Hardware Requirements:

- 1.Minimum 8GB RAM
- 2.Hard Disk: 20GB
- 3.Processor: Intel Core i3

B.Software Requirements:

- 1.Operating system: Linux.
- 2.Coding Language: Ruby 3.7v
3. VS Code

C.Libraries:

- 1.Socket
- 2.WEBrick
- 3.Open3
- 4.TCP Server

CHAPTER 6

RESULTS AND DISCUSSIONS

CHAPTER 6

RESULTS AND DISCUSSION

Honeypots are essential tools for improving overall security posture in the field of cybersecurity. Honeypots offer a distinct perspective on attacker behavior by imitating susceptible systems and submerging themselves in the cyber world. Organizations are able to create proactive defensive plans that are adapted to new threats thanks to this priceless knowledge into enemy tactics. Furthermore, honeypots function as an initial line of defense, providing early threat detection capabilities that allow prompt response to any intrusions. Through the timely identification and reporting of suspicious actions, companies may successfully manage risks prior to their escalation into major security crises. Honeypot integration increases overall security resilience and strengthens threat detection capabilities inside current security frameworks. The present study employs a technique that is methodical in order to achieve its goals of efficiently implementing and making use of the Multi-service Honeypot system. Step 1 comprises the initial configuration, in which the Linux terminal environment is merged with the Ruby file that is given. A possible cyber threat can be detected by launching the honeypot system by running the command `"/."` followed by the name of the Ruby file. Step 2 involves selecting the proper attack scenario that will be recreated in the honeypot environment with great care. This choice is important because it establishes the kind of harmful conduct that the honeypot will mimic, which will direct the investigation of attacker behavior that follows. Step 3 is setting up the honeypot system to listen on designated ports that match the attack scenario that has been selected. By doing this step, you can be sure that the honeypot will successfully imitate weak services or systems and draw in prospective attackers. At last, Step 4 involves researchers waiting patiently for bad actors to enter the honeypot setting. During this phase, close observation is necessary since the honeypot system records and captures interactions with the simulated assault, giving important information about the tactics and methods of the attacker.

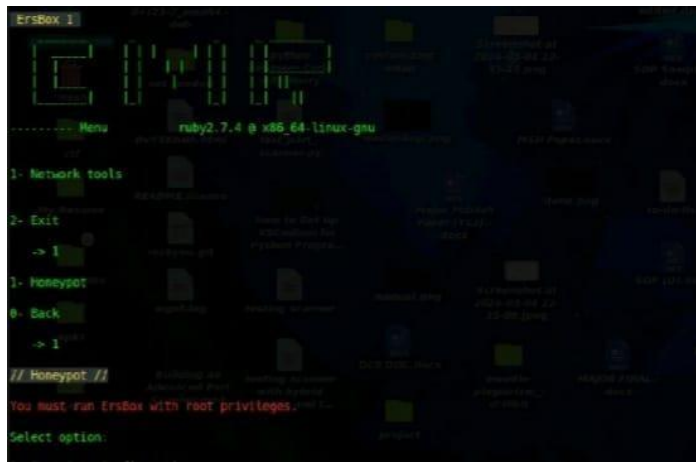


FIG.5 - Multi-Service Honeypot Interface

A Multi-Service Honeypot Interface is a unified platform that hosts multiple honeypot services, each mimicking different types of systems or services, such as web servers, email servers, or database servers. This interface provides a comprehensive environment for attracting and monitoring various types of attacks across different protocols and services.



FIG. 6 - Specific Configurations

A Multi service Honey pot window with all available specifications like Fast Auto Configuration, Manual Configuration, Port Scanner, DNS Lookup, WHOIS Lookup, HTTP Server, TCP Server, HTTP Emulation, SSH Emulation.

```
you must run IrssiBox with root privileges.
select option:
1. Fast Auto Configuration
2. Manual Configuration (Advanced Users, more options)
3. Port Scanner
4. DNS Lookup
5. WHOIS Lookup
6. HTTP Server
7. TCP Server
8. HTTP Emulation
9. SSH Emulation
10. ...

HTTP emulation selected.
Starting HTTP emulation...
Press Ctrl+C to stop the server.
2024-03-28 12:43:21 INFO WEBrick 1.6.3
2024-03-28 12:43:21 INFO ruby 2.7.4 (2021-07-07) [x86_64-linux-gnu]
2024-03-28 12:43:21 INFO WEBrick::HTTPServer#start: pid=3608 port=8080
02.168.226.185 - - [28/Mar/2024:12:43:39 IST] "GET / HTTP/1.1" 200 29
-> /
02.168.226.185 - - [28/Mar/2024:12:43:39 IST] "GET /favicon.ico HTTP/1.1" 200 29
-> /favicon.ico
```

FIG. 7 - HTTP Emulation from Honeypot Site

Set up a virtual server with web server software. Develop enticing yet fake content for the site. Implement logging and monitoring to capture attacker behavior. Apply security measures to prevent harm to the system. Analyze collected data to enhance overall security.

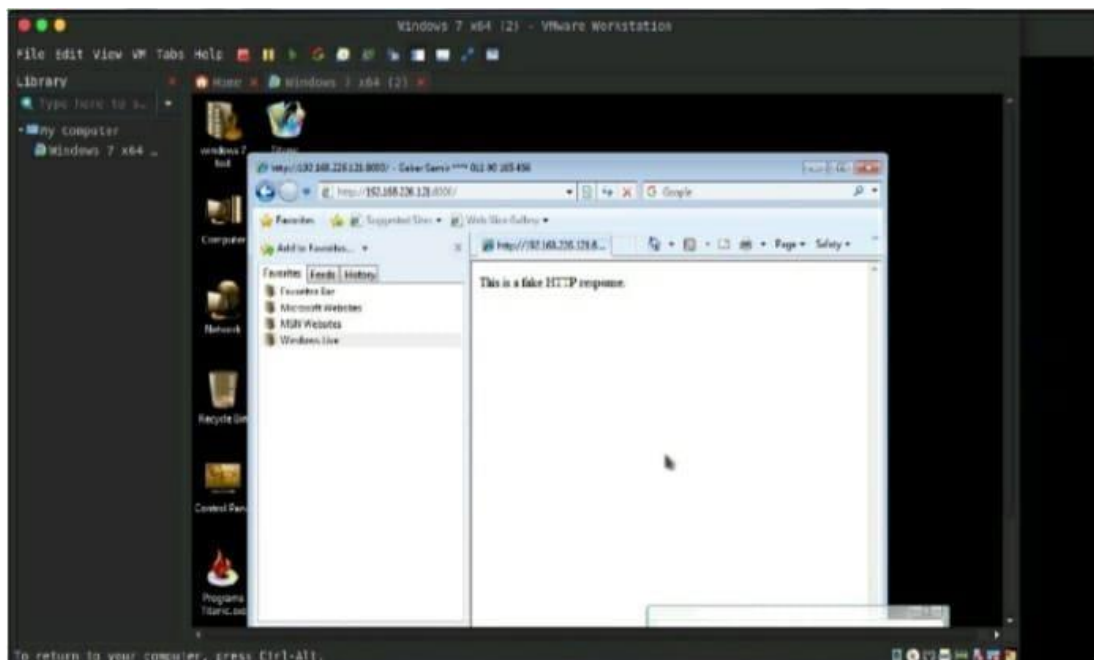


FIG. 8 - HTTP Emulation from Attacker Side

Emulating HTTP from the attacker's side involves crafting requests to exploit vulnerabilities or gain unauthorized access to web servers. Attackers might use tools like Burp Suite or Metasploit to simulate HTTP traffic, sending specially crafted requests to probe for weaknesses in the target system.

CHAPTER 7

CONCLUSION

CHAPTER 7

CONCLUSION

7.1 Conclusion and Future Enhancement

The project “Multi-Service Honeypot: Comprehensive Network Security Monitoring and Deception Framework” involves creating a realistic online platform to attract and gather information about malicious actors. This helps in understanding their attack techniques and enhancing cybersecurity practices. It requires implementing strong security measures, analyzing collected data, and developing centralized management capabilities. The goal is to contribute to the broader understanding of cyber threats and improve defensive strategies. It is an online trap set to detect, deflect, or counteract attempts at unauthorized use of information systems. It can be used to detect malicious traffic, such as malicious bots, and can also be used to detect and prevent malicious activities such as data breaches and denial of service attacks. By providing insights into attacker behavior and offering a mechanism for early threat detection, honeypots can significantly enhance your overall security posture.

The proposed modular honeypot platform represents a significant step forward in the field of deception-based security solutions. It greatly facilitates deployment, builds in analysis tools, and enables security teams to quickly and easily identify attacker patterns. This deeper understanding of attacker behavior is what will finally enable security teams to get one step ahead of cyber threats rather than remain in a reactive mode. Further work may involve integrating the platform with existing security systems, advanced threat intelligence feeds, and machine learning-fed anomaly detection to broaden the system’s overall situational awareness and threat analysis capabilities. This crucial tool will continue to be relevant in the ongoing fight against cybercrime thanks to its ongoing evolution.

Ersbox, which are decoy system designed to lure in potential attackers, has a promising future incybersecurity for several reasons:

- 1. Threat Intelligence:** Ersbox provides valuable insights into the tactics, techniques, and procedures (TTPs) of attackers. Analyzing the interactions with honeypots can help in understanding evolving threats and improving defensive strategies.
- 2. Early Warning System:** Ersbox can serve as an early warning system by detecting and alerting organizations to potential security breaches. They can catch attackers in the reconnaissance phase before they penetrate deeper into the network.
- 3. Deception Tactics:** As cyber threats become more sophisticated, deception tactics like honeypots become increasingly effective. By diverting attackers' attention and resources away from valuable assets, organizations can buy time to respond and mitigate the threat.
- 4. Research and Development:** Honeypots are valuable tools for cybersecurity researchers and developers. They provide a controlled environment for studying attacker behavior, testing new detection techniques, and validating security controls.
- 5. Legal and Ethical Considerations:** With growing concerns about privacy and data protection, there's a need for legal and ethical frameworks governing the use of honeypots. Future developments may focus on ensuring compliance with regulations and ethical guidelines.
- 6. Integration with Threat Hunting Platforms:** Integration of honeypots with threat hunting platforms can enhance their effectiveness by automating the analysis of collected data and correlating it with other security events across the network.
- 7. Cloud-based Honeypots:** As more organizations transition to cloud-based infrastructures, there's a need for honeypot solutions tailored to cloud environments. Cloud-based honeypots can mimic various services and applications hosted in the cloud, providing a more realistic target for attackers.

REFERENCES

REFERENCES

- [1] Mohammadzad M. et al. published a paper titled "Using Rootkits Hiding Techniques to Conceal Honeypot Functionality" in the Network and Computer Applications Journal, 2023.
- [2] Angelo Dell'Aera, 2022 Angelo Dell'Aera M., libemu - x86 emulation and shellcode detection, 2022.
- [3] M. Umer Altaf and M. Shafique, "Honeypots: Concepts, mechanisms, and potential", Computers & Security, vol. 103, pp. 17-34, 2021.
- [4] Mariconti, E., Onaolapo, J., Andriotis, P., Kastania, A., & Stringhini, G. (2017). It's a trap: Emperor Honeypot strikes back. USENIX Security Symposium (pp. 665-682).
- [5] Iuga, C., Nurse, J. R. C., and Erola, A. (2016). Baiting the hook: factors impacting susceptibility to phishing attacks. Hum. Cent. Comput. Inf. Sci. 6, 8. doi:10.1186/s13673-016-0065-2.
- [6] Wilson, T., Maimon, D., Sobesto, B., & Cukier, M. (2015). The effect of a surveillance banner in an attacked computer system: Additional evidence for the relevance of restrictive deterrence in cyberspace. Journal of Research in Crime and Delinquency.
- [7] Virvilis, N., Serrano, O. S., & Vanautgaerden, B. (2014). Modifying the scenario: The skill of tricking crafty assailants. NATO CCD COE Publications.
- [8] Kaur, T., Malhotra, V., & Singh, D. D. (2014). Comparison of various instruments for network security. honeypot and firewall intrusion detection system.
- [9] Stiawan, D., Abdullah, A. H., & Idris, M. Y. (2011). Characterizing network intrusion prevention system. The International Journal of Computer Applications (0975–8887).
- [10] Akkaya & Thalgott, F. (2010). Honeypots in network security.
- [11] L. Spitzner, "Honeypots: Catching the Insider Threat", IEEE Security & Privacy, vol. 1, no. 2, pp. 15-23, 2003.
- [12] N. Provos, "A Virtual Honeypot Framework", The actions of the 1st Workshop on Virtualization in Dependable Systems, VIDS '05, pp. 1-10, 2005.
- [13] Weiler, N. (2002). Honeypots for distributed denial of service attacks. IEEE Computer Society, 109-114.