CLARKE CONFECTIONARY PENETRATION TEST

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Ethical Hacking
Comp 3011

Introduction

This report documents a comprehensive Blackbox penetration test conducted on Clarke Confectionary, a prominent confectionary manufacturer in the UK. The initiative for this assessment arose from the Managing Director's concerns regarding the organisation's reliance on fully digitised records, and the potential security vulnerabilities associated with remote work capabilities. This effectively acts as the threat modelling phase of a penetration test, identifying the organisation's assets and their value.

Penetration testing is a strategic imperative for organisations, serving as a proactive measure to assess and strengthen existing digital defence mechanisms within an environment. In an era marked by increasingly sophisticated cyber-attacks, organisations must adopt pre-emptive strategies to safeguard their sensitive data and critical assets (Shebli & Beheshti, 2018; Rahalkar & Jaswal, 2019).

By simulating the offensive tactics employed in real-world attacks against IT infrastructure, including networks, applications, and systems, penetration tests uncover weaknesses and vulnerabilities that may otherwise remain undetected. This process not only identifies potential entry points for unauthorised access, but also provides valuable insight into the strength of existing security protocols. Ultimately, this proactive analysis enhances the resilience of defence mechanisms, enabling organisations to stay ahead of emerging threats (Engebretson & Kennedy, 2013; Rahalkar & Jaswal, 2019).

Furthermore, penetration testing serves as a crucial component of compliance and regulatory frameworks, helping organisations demonstrate adherence to industry standards and best practices. Conducting regular assessments and audits validates organisational compliance with data protection regulations and industry-specific mandates, mitigating the risk of regulatory penalties and reputational damage (Teichmann & Boticiu, 2023; Vimala & Fugkeaw, 2022).

The report is structured to provide an in-depth overview of the penetration test conducted on Clarke Confectionary. It encompasses a detailed methodology outlining the approach adopted for the test, a comprehensive evaluation presenting an analysis of the test, mitigation recommendations providing strategies for addressing identified vulnerabilities, and a conclusion discussing the findings, insights and recommendations resulting from the test.

In essence, the structured format of the report ensures that Clarke Confectionary can effectively navigate the complexities of the security landscape, using the insights gained from the assessment process to address vulnerabilities and mitigate risks, safeguarding assets from emerging cyber threats.

Testing Methodology

Vulnerability Analysis

The vulnerability analysis phase began with a series of network scans using Nmap to assess the target network. A TCP connection scan was executed in verbose mode using ***"nmap -sT -v 192.168.20.0/24"*** identifying hosts, open ports and running services in detail followed by the additional scan, ***"sudo nmap -sT -v 192.168.20.0/24"***, using ***"sudo"*** to grant elevated privileges. These scans identified 3 hosts 192.168.20.9, 192.168.20.12 and 192.168.20.44. Next an aggressive operating system (OS) scan was executed using ***"nmap -A -v 192.168.20.0/24"*** revealing target OS information followed by the additional scan, ***"sudo nmap -A -v 192.168.20.0/24,"***. These scans uncovered OS details on hosts 192.168.20.9, 192.168.20.12 and 192.168.20.44.

Using OpenVAS Greenbone a vulnerability scan was executed on the target network identifying multiple vulnerabilities, notably the server messaging block (SMB) vulnerability CVE-2017-0143 on hosts 192.168.20.12 and 192.168.20.44 and the anonymous FTP login vulnerability CVE-1990-0497 on host 192.168.20.9.

To assess the SMB vulnerability Metasploit was employed and an SMB version detection scan was loaded using ***"use auxiliary/scanner/smb/smb_version"***, the configuration was reviewed using the ***"show options"***, the target was specified using ***"set RHOST 192.168.20.0/24"***, the configurations were confirmed using ***"show options"*** and the scan was executed using ***"run"*** identifying SMB vulnerabilities on hosts 192.168.20.12 and 192.168.20.13.

To assess the FTP login vulnerability an anonymous FTP detection scanner was loaded using ***"use auxiliary/scanner/ftp/anonymous "*** the configuration was reviewed using ***"show options"***, the target was specified using ***"set RHOST 192.168.20.0/9"***, the configurations were confirmed using ***"show options"*** and the scan was executed using ***"run"*** identifying an anonymous FTP login vulnerability on host 192.168.20.9.

Exploitation---Host---192.168.20.12

Host 192.192.20.12 exploitation began by using Metasploit and loading the EternalBlue attack module using ***"use exploit/windows/smb/ms17_010_eternalblue."***, the available payloads were examined using ***"show payloads"***, the configuration was reviewed using the ***"show options"***, the target was specified using ***"set RHOST 192.168.20.12"***, the port was specified using ***"set RPORT 445"***, the target was specified using ***"set TARGET 0"***, the configurations were confirmed using ***"show options"*** and the EternalBlue attack module was executed using ***"run"***. This resulted in the creation of a meterpreter session, granting access to host 192.168.20.12 through a meterpreter shell. This access was confirmed using the ***"sysinfo"*** command, returning information on the target system.

Post-exploitation---Host---192.168.20.12

Following this using ***"getsystem"*** privileges were escalated to the highest level granting significant control over the compromised system. Using ***"getuid"***, which returned ***"NT AUTHORITY\SYSTEM,"*** confirmed the escalated level of privilege. Next using ***"hashdump"*** user account details were extracted from the SAM file and saved in the file ***"nano.save"***, followed by using ***"load kiwi"*** to load the Kiwi post-exploitation module. Using ***"lsa_dump_secrets"*** sensitive data stored on SECAMWINSERVER2 was extracted, and using ***"lsa_dump_sam"*** user account details including tokens were extracted from the SAM file with additional information being added to the ***"nano.save"*** file. Finally, the gathered hashed passwords underwent hash cracking first in HASHCAT using ***"hashcat -m 1000 -a 0 nano.save passwords.txt"*** and John the Ripper using ***"John --format=NT nano.save"***, successfully cracking 6 out of 7 passwords, providing persistent access to the compromised system.

Exploitation---Host---192.168.20.9

Host 192.192.20.9 exploitation began by using Windows PowerShell to execute an FTP login using ***"ftp 192.168.20.9"***, once prompted for login details ***"anonymous"*** was entered and accepted for both username and password granting access to host 192.168.20.9.

Post-exploitation---Host---192.168.20.9

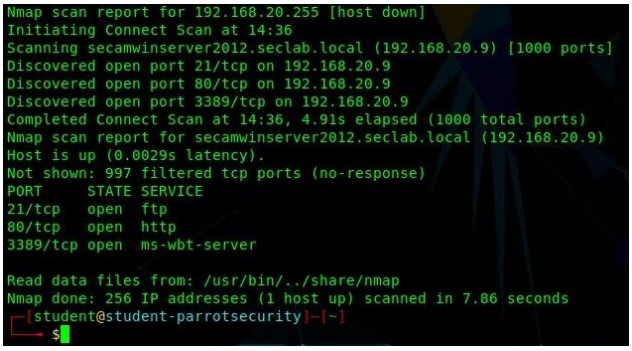
Following this using ***"mkdir"*** a new directory was created on the server followed by using ***"rmdir"*** to delete the new directory demonstrating remote Read/Write abilities.

Evaluation

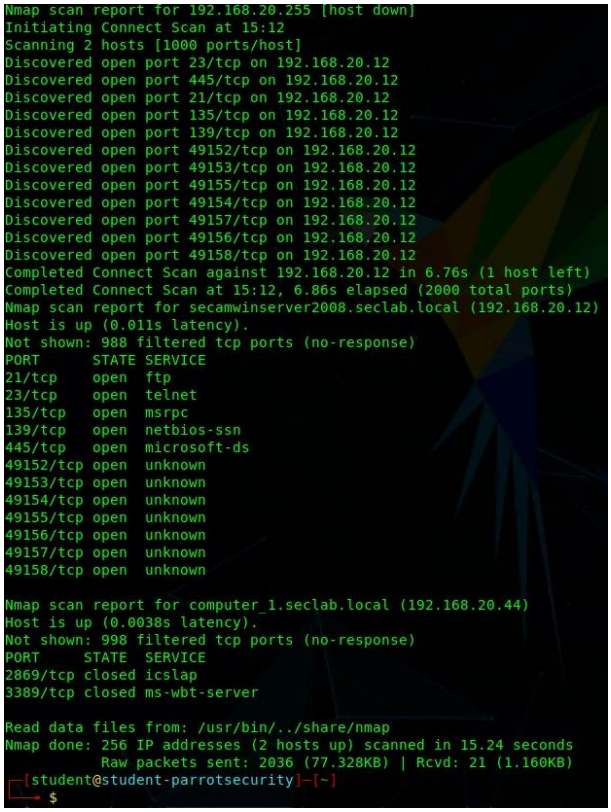
Vulnerability Analysis

Nmap

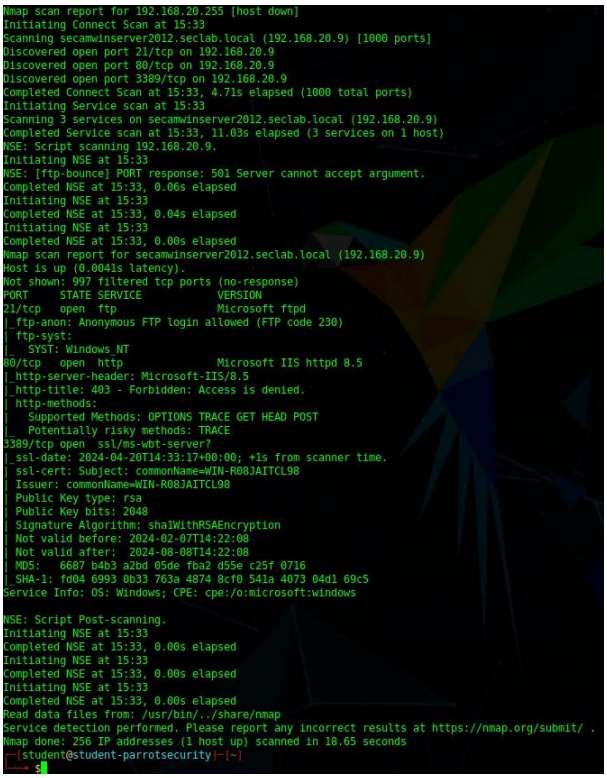
Nmap, is a robust open-source utility used for network reconnaissance tasks (Orebaugh & Pinkard, 2008). Employed during the vulnerability analysis phase, Nmap conducted two distinct scan types: TCP connection scans and aggressive operating system scans. The TCP connection scans probed the network identifying active hosts at IP addresses 192.168.20.9, 192.168.20.12, and 192.168.20.44 (Fig. 1 and Fig. 2). **T**he aggressive OS scan**s** revealed sensitive information on the hosts such as the OS, running software versions and routing information (Fig. 3).



(Fig.1)



(Fig.2)



(Fig. 3)

This initial reconnaissance using Nmap was pivotal in unravelling the network's architecture, providing critical insights into the infrastructure of the target network. Understanding the network topology, service configurations, operating systems and potential points of entry serves as the foundation of a penetration test, identifying potential vulnerabilities within the network to devise targeted attack strategies for maximum effectiveness. The results of the Nmap scans findings can be found in the tables below.

192.168.20.9

Port	*Protocol*	*State*	*Service*	**Version**	**OS**
21	TCP	Open	ftp	Microsoft ftpd	Windows_NT
88	TCP	Open	http	Microsoft IIS httpd 8.5	Unknown
3389	TCP	Open	ms-wbt-server	Unknown	Windows CPE

192.168.20.12

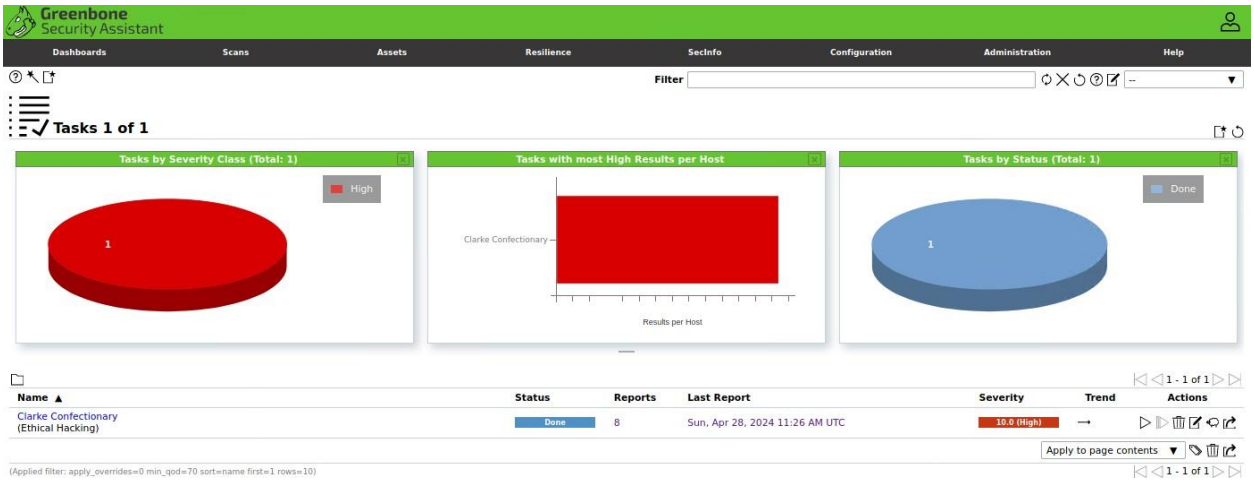
Port	*Protocol*	*State*	*Service*	**Version**	**OS**
21	TCP	Open	ftp	Microsoft ftpd	Windows_NT
23	TCP	Open	telnet	Microsoft windows XP telnetd	Windows XP
135	TCP	Open	msrpc	Microsoft windows RPC	Windows
139	TCP	Open	netbios-ssn	Microsoft windows netbios-ssn	Windows
445	TCP	Open	microsoft-ds	Windows Server 2008 R2 Enterprise 7601 Service Pack 1 microsoft-ds	Windows server 2008 R2 - 2012
49152	TCP	Open	unknown	Microsoft windows RPC	Windows
49153	TCP	Open	unknown	Microsoft windows RPC	Windows
49154	TCP	Open	unknown	Microsoft windows RPC	Windows
49155	TCP	Open	unknown	Microsoft windows RPC	Windows
49156	TCP	Open	unknown	Microsoft windows RPC	Windows
49157	TCP	Open	unknown	Microsoft windows RPC	Windows
49158	TCP	Open	unknown	Microsoft windows RPC	Windows

192.168.20.44

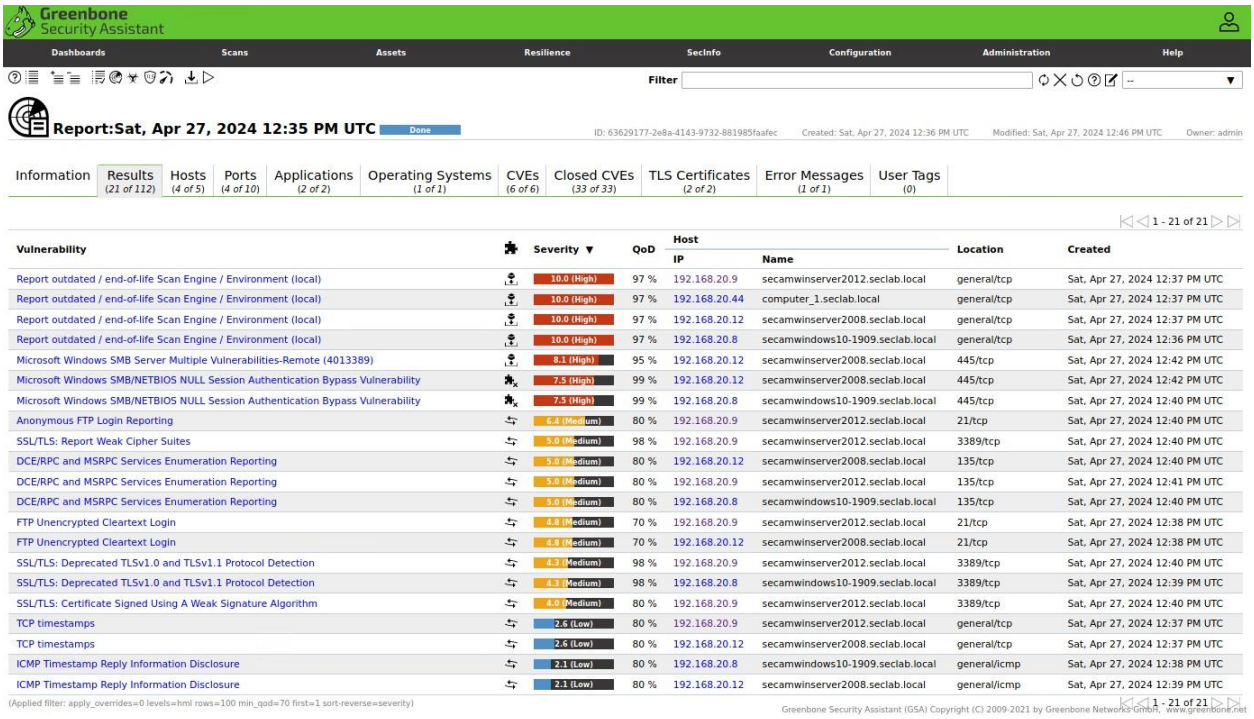
Port	*Protocol*	*State*	*Service*	**Version**	**OS**
2869	TCP	Closed	icslap	Unknown	Windows CPE
3389	TCP	Closed	ms-wbt-server	Unknown	Windows CPE

OpenVAS Greenbone

After completing the Nmap network reconnaissance, OpenVAS Greenbone a powerful vulnerability assessment tool (Kim et al., 2016) was employed to conduct a series of vulnerability scans (see Fig. 4) on the target network to identify security weaknesses. The scans conducted revealed several critical vulnerabilities within the target system. Notably, among these vulnerabilities was the server messaging block (SMB) vulnerability CVE-2017-0143 on hosts 192.168.20.12 and 192.168.20.44 and the anonymous FTP login vulnerability CVE-1990-0497 on host 192.168.20.9 (see Fig. 5).



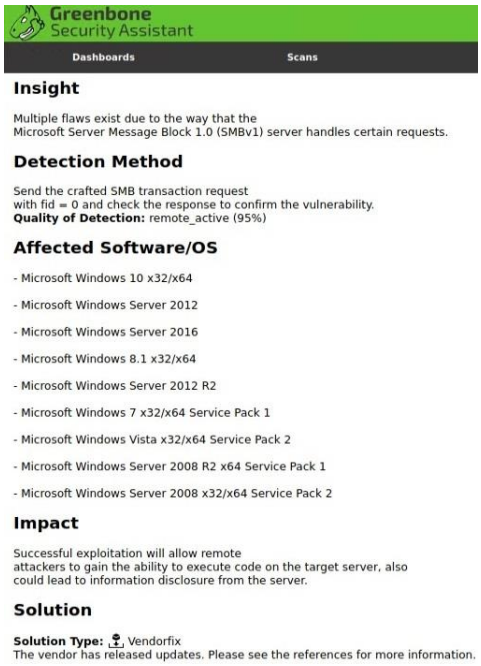
(Fig. 4)



(Fig. 5)

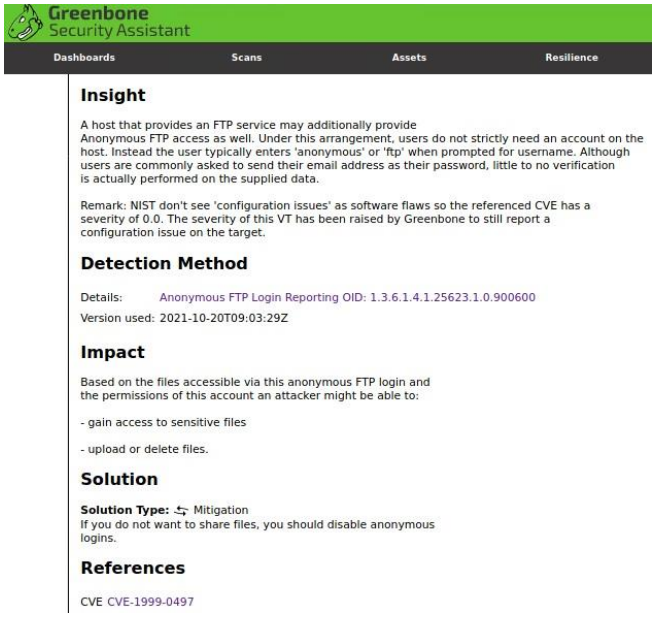
Vulnerability	Severity	Host IP	Location	CVE
Windows SMB server multiple vulnerabilities-remote (4013389)	8.1 (High)	192.168.20.12 / secamwinserver2008.seclab.local	445/TCP	CVE-2017-0143 to CVE-2017-0148
Anonymous FTP Login Reporting	6.4 (Medium)	192.168.20.9 / secamwinserver2012.seclab.local	21/TCP	CVE-1990-0497

The SMB (Server Message Block) protocol is commonly used for network file sharing in Windows operating systems (IU, 2018). However, the identified vulnerability CVE-2017-0143 poses significant risks to systems and networks. This vulnerability is associated with the EternalBlue exploit, which gained notoriety following its use in the WannaCry ransomware attack in 2017. EternalBlue exploits a flaw in SMBv1, allowing remote code execution on vulnerable systems without authentication granting full control over the compromised system (see Fig. 6).



(Fig. 6)

Anonymous FTP is a file transfer protocol that allows users to access files on a remote server without needing a registered username or password (UOO, 2024). The CVE-1999-0497 vulnerability is not a software flaw but a configuration issue, it doesn't fit into the traditional list of software vulnerabilities. Despite this, it's is considered an unsecured protocol for internet-facing systems enabling potential Read/Write access (see Fig. 7).

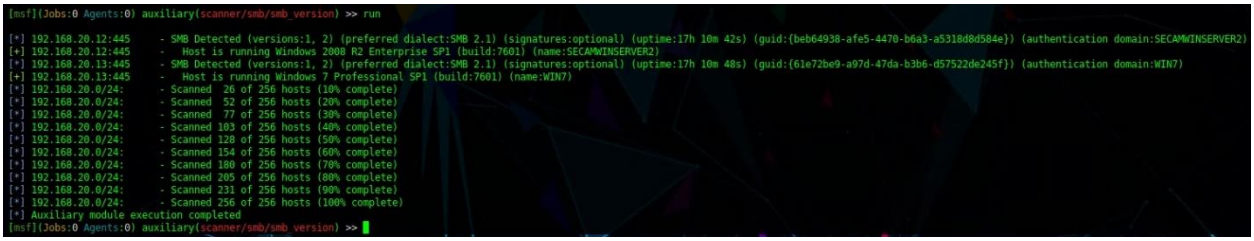


(Fig. 7)

Metasploit SMB Version Scanner

Metasploit is a powerful penetration testing framework renowned for its comprehensive suite of tools designed for security assessments, vulnerability exploitation, and post-exploitation activities (Rahalkar & Jaswal, 2019).

Metasploit's SMB Version Scanner played a crucial role in confirming the SMB weakness initially identified by OpenVAS. The SMB scan results from Metasploit pinpointed vulnerabilities within the target system, specifically highlighting two IP addresses, 192.168.20.12 and 192.168.20.13, as susceptible to SMB exploit CVE-2017-0143 on port 445 potentially granting full remote shell access through EternalBlue, with SMB versions 1 or 2 detected (see Fig. 8).



(Fig. 8)

Anonymous FTP Scanner

Metasploit's FTP detection scanner was pivotal in confirming the FTP login configuration weakness identified by OpenVAS. The FTP scan results from Metasploit confirmed the presence of the vulnerability within the target system, highlighting the IP address 192.168.20.9 as susceptible to the FTP exploit CVE-1999-0497 on port 21 potentially granting anonymous Read and Write access through an anonymous remote FTP connection (see Fig. 9).

(Fig. 9)

The findings obtained from the combined execution of Nmap, OpenVAS, Metasploit's SMB Version Scanner and Metasploit's FTP Detection Scanner provided invaluable insights into the network topology, service configurations, operating systems and potential entry points. This comprehensive approach successfully identified and confirmed vulnerabilities on three host IPs within the target network. Using the insights gained from these tools enabled the meticulous development of a targeted attack strategy to exploit the identified weaknesses.

Exploitation

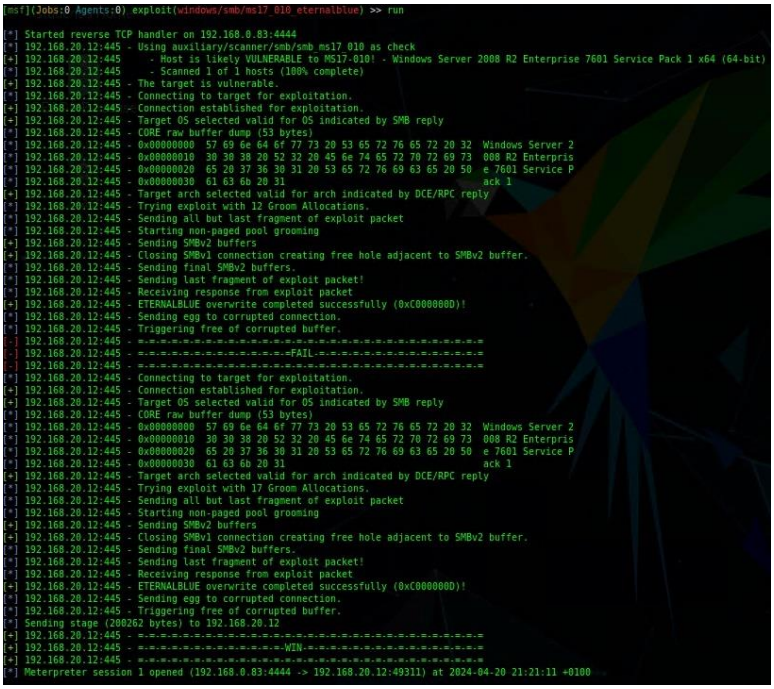
Host---192.168.20.12

Metasploit EternalBlue Attack Module

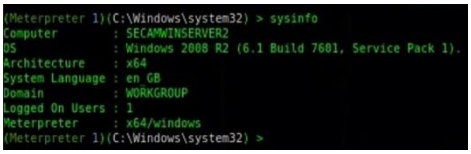
Having successfully identified and confirmed the presence of vulnerability CVE-2017-0143 on SECAMWINSERVER2008, Metasploit's EternalBlue attack module was executed on the target host enabling the execution of a Meterpreter active shell attack payload. This payload granted access to explore the target system, leveraging Meterpreter's extensive capabilities to read, write, and execute code, enhancing control over the compromised system.

To circumvent potential firewall restrictions, the reverse TCP connection method was used. Unlike conventional communication methods where the attacker initiates the connection, reverse TCP listens on a port and prompts the target machine to establish a connection with the port. By evading firewall restrictions that may block inbound connections, this method ensured the successful delivery of the payload, granting access to the system (Heath, 2023).

The successful execution of the EternalBlue attack module (see Fig. 10) resulted in the creation of a Meterpreter session, establishing access to IP 192.168.20.12 through a Meterpreter shell. Subsequent confirmation of the exploit's success and the system access it provided was obtained using the ***"sysinfo"*** command. This command returned information about the target system, including its name and operating system, offering valuable insight into the target environment (see Fig. 11).



(Fig. 10)

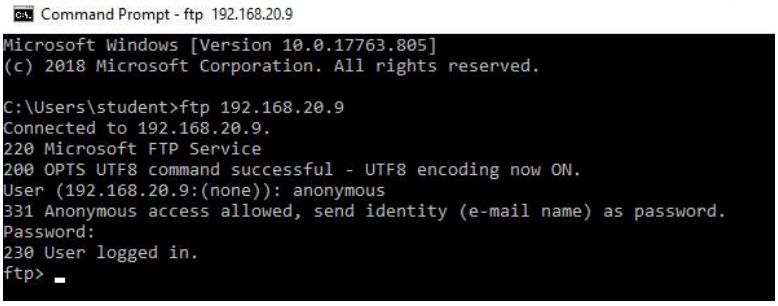


(Fig. 11)

Host---192.168.20.9

Anonymous FTP Connection

Having successfully identified and confirmed the presence of the vulnerability CVE-1990-0497 on SECAMWINSERVER2012 a Windows PowerShell module was loaded. Subsequently a remote FTP connection was established using **"ftp 192.168.20.9"** followed by a successful anonymous login using ***"anonymous"*** for both the username and password (see Fig. 12). This granted access to the target system, with read and write capabilities providing a degree of control over the compromised system.



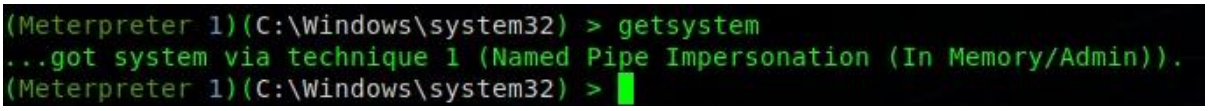
(Fig. 12)

<u>Post-exploitation</u>

Host---192.168.20.12

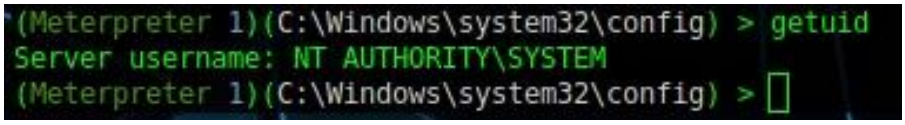
Privilege Escalation

Following successful access to the system at IP 192.168.20.12 via port 445 privilege escalation was achieved using ***"getsystem"*** to leveraging pipe impersonation (see Fig. 13), a technique used in Windows to emulate a named pipe to circumvent security measures and attain access to critical system functionalities (Cerrudo, 2024).



(Fig. 13)

Subsequently, the effectiveness of the privilege escalation was confirmed using ***"getuid"*** which returned **"NT AUTHORITY\SYSTEM"** (see Fig. 14) validating the successful elevation of privileges providing enhanced control over the compromised system.



(Fig. 14)

HashDump

With privilege escalation achieved using ***"hashdump"*** sensitive user account information was extracted from the Security Accounts Manager (SAM) file displaying user names, IDs, and hashed password values on screen (see Fig. 15). To enable preservation and further examination, the data was saved as a nano text file marking an initial step towards establishing persistence by establishing a permanent foothold within the system after password cracking.

(Fig. 15)

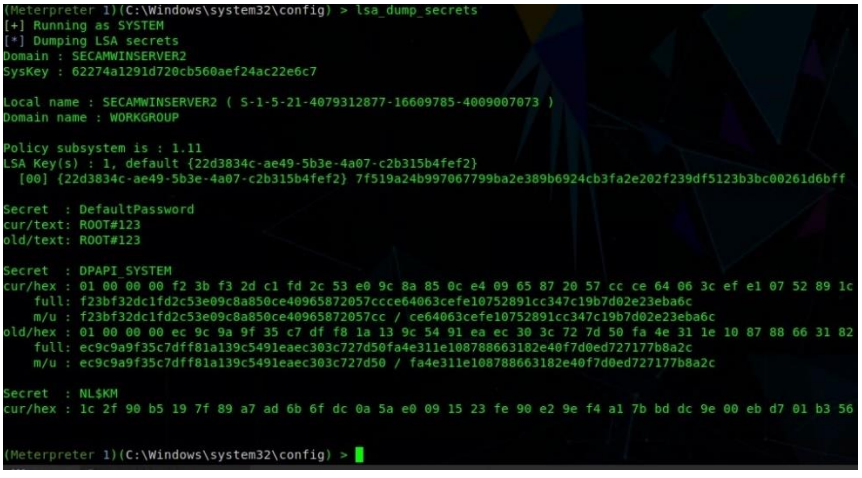
Kiwi Module

The Kiwi Meterpreter extension was initiated using ***"load kiwi"*** (see Fig. 16) providing a post-exploitation toolkit for extracting sensitive information, manipulating system configurations, and executing additional attacks to comprehensively assess the networks security (Tóth, 2021).

(Fig. 16)

LSA Secrets Dump

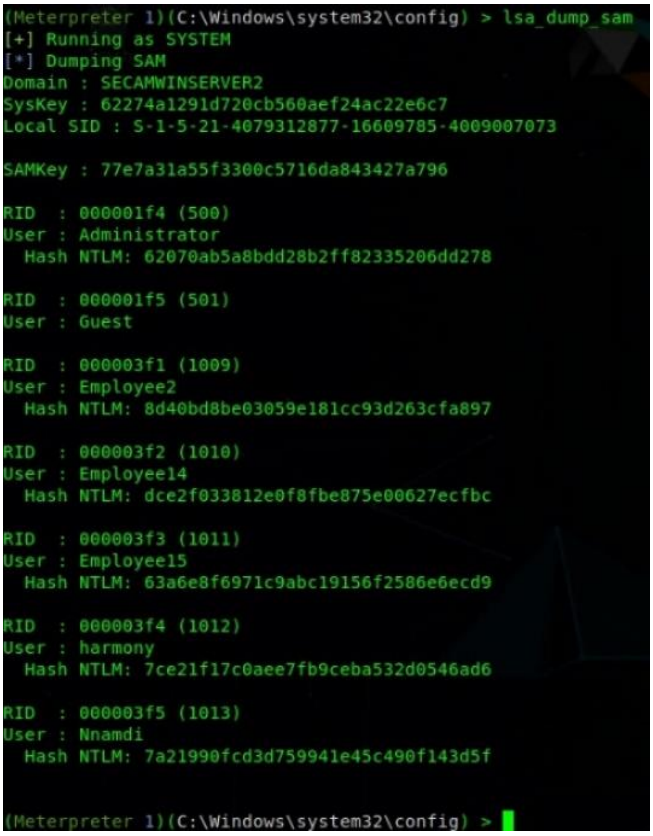
Using Kiwi's ***"lsa_dump_secrets"*** sensitive data was extracted from the Local Security Authority (LSA) subsystem of the SECAMWINSERVER2 displaying server passwords, hashes, and other secure data on screen. This discovered critical information about SECAMWINSERVER2 revealing the password to be ROOT#123 enabling further exploitation (see Fig. 17).



(Fig. 17)

LSA SAM Dump

Using Kiwi's ***"lsa_dump_sam"*** sensitive user account information was again extracted from the SAM file displaying user names, IDs, and hashed password values along with the SYSTEM key and SAM key on screen (see Fig. 18).



(Fig. 18)

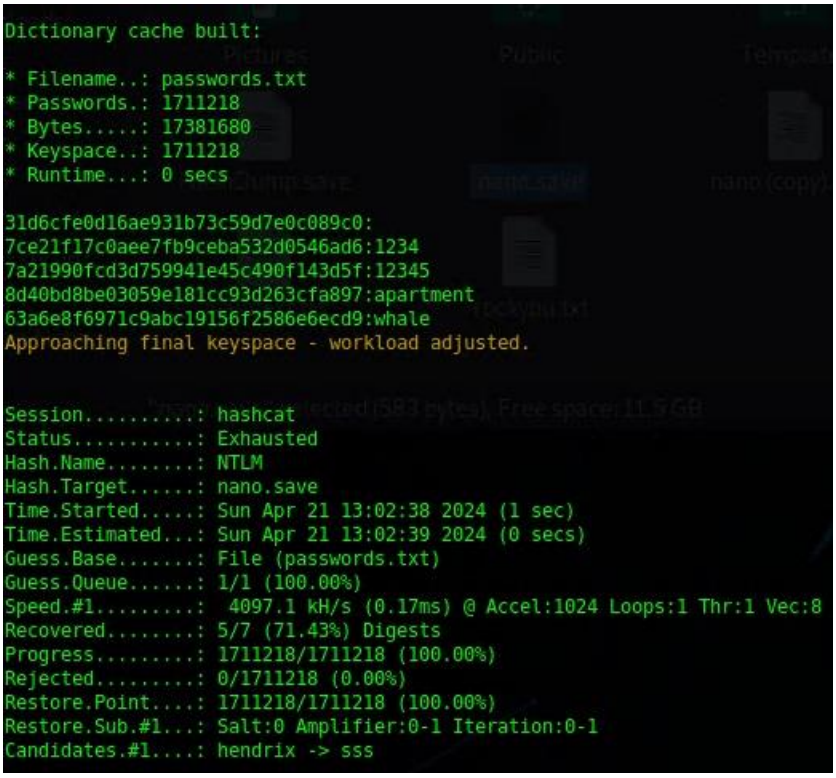
The ***"hashdump"***, ***"lsa_dump_secrets"*** and ***"lsa_dump_sam"*** results enable the strength of password security measures to be analysed and potential vulnerabilities in user authentication mechanisms to be identified. Additionally, similarly to ***"hashdump", "lsa_dump_sam"*** obtaining more detailed user account information serves as a step towards establishing persistence to maintain a permanent foothold within the system after successfully cracking passwords.

Password Hash Cracking

Password hash cracking involves performing dictionary, rainbow-table or brute-force attacks to reverse the cryptographic hashing technique used to convert the password into a fixed-length string of characters, to recover the original plain-text password (Tatli, 2015). The hashed password values extracted from the SAM file underwent password hash cracking using HASHCAT, and John the Ripper.

HASHCAT

HASHCAT is a multithreaded CPU password recovery tool that uses dictionary, brute-force and hybrid attacks to crack hashed passwords. Known for its speed and versatility its capable of cracking a wide range of password hashes efficiently (Binnie, 2016). Using ***"hashcat -m 1000 -a 0 nano.save passwords.txt"*** the file containing the hashed passwords was loaded into HASHCAT'S CLI where 5 of the 7 password hashes were cracked (see Fig. 19).

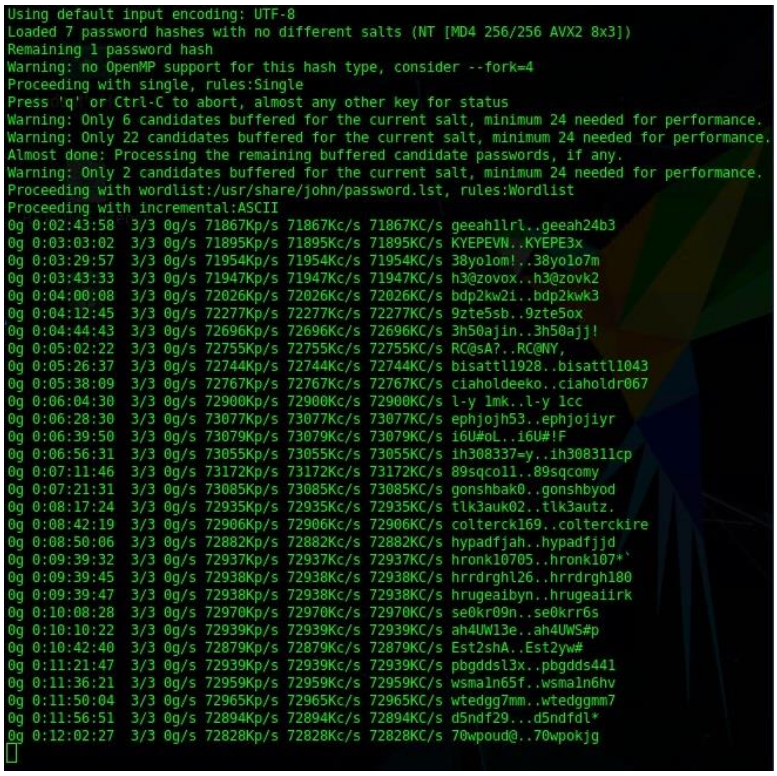


(Fig. 19)

John the Ripper

John the Ripper is a versatile and widely used password cracking tool that uses dictionary, brute-force and hybrid attacks to crack hashed passwords (Marchetti & Bodily, 2022). Using ***"John --format=NT nano.save" t***he file containing the hashed passwords was loaded into John the Ripper's CLI where 6 of the 7 password hashes were successfully cracked and stored in the **john.pot** file (see Fig. 20). Additionally, the remaining Admin password underwent a John the Ripper brute force attack for a period of 12 hours, with John failing to crack the password hash due to the strength and complexity of the Admin password (see Fig. 21).

(Fig. 20)



(Fig. 21)

Extracted Server Data

Name	System Key	Password
SECAMWINSERVER2	62274a1291d720cb560aef24ac22e6c7	ROOT#123

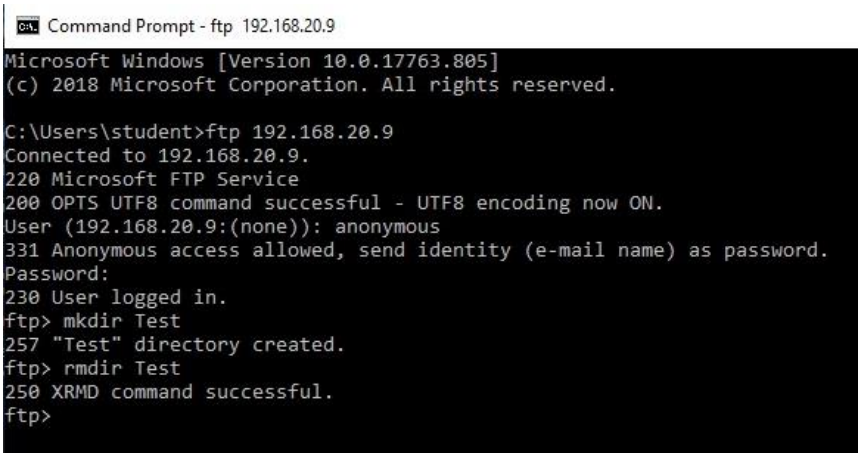
Extracted User Data

Name	Hash	Cracked Password
Administrator	62070ab5a8bdd28b2ff82335206dd278	Unknown
Guest		
Employee2	8d40bd8be03059e181cc93d263cfa897	apartment
Employee14	dce2f033812e0f8fbe875e00627ecfbc	Elle6
Empoyee15	63a6e8f6971c9abc19156f2586e6ecd9	whale
Harmony	7ce21f17c0aee7fb9ceba532d0546ad6	1234
Nnamdi	7a21990fcd3d759941e45c490f143d5f	12345

Host---192.168.20.9

Anonymous FTP Privileges

Following successful access to the system at IP 192.168.20.9 via port 21 remote privileges were confirmed using ***"mkdir Test"*** to create the directory Test. Subsequently using ***"rmdir Test"*** the directory was deleted (see Fig. 22). This confirms the anonymous, remote Read and Write privileges gained from the FTP exploit providing a degree of control over the system.



(Fig. 22)

Mitigation Recommendations

Vulnerability Mitigation Table

Vulnerability	Host IP	Mitigation
Report outdated / end-of-life Scan Engine / Environment (local)	192.168.20.8 192.168.20.9 192.168.20.12 192.168.20.44	Update the scanning software to the latest stable release provided by the vendor. Prioritise regularly checking for updates and patches released by the vendor ensuring the scan engine remains current and effective against evolving threats. Keeping the scanning software up-to-date, can address known vulnerabilities, improve detection capabilities, and enhance security overall, reducing the risk of unauthorised access, data breaches, and other security incidents.
Microsoft Windows SMB Server Multiple Vulnerabilities-Remote (4013389)	192.168.20.12	Update the SMB version to the Microsoft released secure version that patches the SMB vulnerabilities CVE-2017-0143 to CVE-2017-0148. Additionally, implementing network segmentation, enforcing strong access controls, and monitoring network traffic would mitigate the impact of these or any similar future vulnerabilities. Regularly updating and maintaining security measures is crucial to protecting systems from exploitation and ensuring overall cybersecurity resilience.
Microsoft Windows SMB/NETBIOS NULL Session Authentication Bypass Vulnerability	192.168.20.8 192.168.20.12	Update both the SMB version and the NETBIOS version to Microsoft released secure versions that patched the CVE-1999-0519 vulnerability. Additionally, disabling NULL session access, applying access controls, and monitoring network traffic to prevent unauthorised access to vulnerable systems. Regularly updating and securing Windows systems is essential to protect against exploitation and maintain a secure computing environment.
Anonymous FTP Login Reporting	192.168.20.9	Reconfigure FTP servers to disable anonymous access altogether or implementing access controls, such as restricting the directories that anonymous users can access and monitoring FTP server logs for suspicious activity to minimise security risks. Implement regular auditing and reporting on FTP server configurations to maintain a secure network environment and

		protecting against unauthorised access or data breaches.
SSL/TLS: Report Weak Cipher Suites	192.168.20.9	Update SSL/TLS configurations to disable insecure or outdated vulnerable cipher suites prioritising the use of strong, secure cipher suites and explicitly disabling weak algorithms. Implement strong encryption standards, such as AES and RSA, additionally, conduct regular security audits, and provide education and training on SSL/TLS security best practices to strengthen the security of the SSL/TLS implementations, safeguard sensitive data, and mitigate the risk of unauthorised access and data breaches.
DCE/RPC and MSRPC Services Enumeration Reporting	192.168.20.8 192.168.20.9 192.168.20.12	Update and apply patches addressing DCE/RPC and MSRPC vulnerabilities, isolate critical systems and services from potentially vulnerable or untrusted networks. Configure firewalls and intrusion prevention systems (IPS) to restrict access to DCE/RPC and MSRPC services to only authorised users and systems and implementing strong access controls and authentication mechanisms, such as multifactor authentication (MFA) and least privilege principles, to prevent unauthorised access to these services. Additionally, conduct regular security audits and vulnerability assessments to identify and remedy any weaknesses or misconfigurations in DCE/RPC and MSRPC implementations.
FTP Unencrypted Cleartext Login	192.168.20.9 192.168.20.12	Enable FTPS (FTP over SSL/TLS) or SFTP (SSH File Transfer Protocol), to encrypt data transmission preventing eavesdropping and unauthorised interception of sensitive information. Additionally, enforce strong password policies requiring users to create complex passwords to reduce the likelihood of password-based attacks and implementing account lockout mechanisms to mitigate brute-force attacks by temporarily locking users out after a certain number of failed login attempts.

SSL/TLS: Deprecated TLSv1.0 and TLSv1.1 Protocol Detection	192.168.20.8 192.168.20.9	Update and configure server-side SSL/TLS protocols to support only the latest and most secure versions, such as TLSv1.2 onwards, mitigating the vulnerabilities associated with outdated protocols. Implement strong cipher suites and cryptographic algorithms compliant with current security standards enhancing the security of SSL/TLS connections. Disable weak cipher suites and prioritise the use of modern, secure encryption algorithms to prevent exploitation of cryptographic weaknesses.
SSL/TLS: Certificate Signed Using a Weak Signature Algorithm	192.168.20.9	Ensure that SSL/TLS certificates are issued and signed using strong cryptographic algorithms such as RSA with a minimum key length of 2048 bits or ECC (Elliptic Curve Cryptography) with appropriate curve parameters. Replace certificates signed using weak signature algorithms like MD5 or SHA-1 with certificates using SHA-256 or SHA-3. Regularly update and patch SSL/TLS implementations and certificate authorities ensuring compatibility with modern cryptographic standards to address security vulnerabilities.
TCP timestamps	192.168.20.9 192.168.20.12	Disable TCP timestamps where possible and regularly update systems to address known vulnerabilities.
ICMP Timestamp Reply Information Disclosure	192.168.20.8 192.168.20.12	Filtering ICMP timestamp replies at the network perimeter preventing unauthorised access to sensitive information. Additionally, implement network intrusion detection and prevention systems to detect and block malicious ICMP traffic.

Mitigations

A comprehensive vulnerability mitigation strategy for Clarke Confectionary's network encompasses a multi-tiered approach aimed at addressing the multiple security weaknesses identified in the vulnerability mitigation table.

A critical aspect of this strategy involves updating and patching systems across the network to mitigate known vulnerabilities. This includes updating scanning software, Microsoft Windows SMB Server, NETBIOS versions, and SSL/TLS configurations. For instance, vulnerable systems identified by IP addresses 192.168.20.8, 192.168.20.9, 192.168.20.12, and 192.168.20.44 require immediate attention to update scanning software and apply patches to mitigate potential risks associated with outdated or end-of-life software versions. Additionally, systems at IP addresses 192.168.20.12 and 192.168.20.13 require SMB version updates to prevent exploitation via the EternalBlue vulnerability. Systems at IP addresses 192.168.20.8 and 192.168.20.12 require immediate attention to update both SMB and NETBIOS versions, ensuring comprehensive protection against external threats.

Furthermore, common themes such as weak cipher suites, deprecated protocols, and cleartext login vulnerabilities require comprehensive measures to strengthen network security. Updating SSL/TLS configurations to disable weak cipher suites on IP address 192.168.20.9 and configuring servers to support only the latest and most secure versions of TLS on IP addresses 192.168.20.8 and 192.168.20.9 are crucial steps in mitigating these vulnerabilities. Additionally, enabling encryption protocols like FTPS or SFTP to prevent cleartext login vulnerabilities on IP addresses 192.168.20.9 and 192.168.20.12 is essential for safeguarding sensitive information during data transmission.

Moreover, addressing vulnerabilities related to network services such as DCE/RPC and MSRPC Services Enumeration requires a combination of updating and patching vulnerable systems on IP addresses 192.168.20.8, 192.168.20.9 and 192.168.20.12 enforcing strong access controls. Additionally, mitigating risks associated with FTP anonymous logins on IP address 192.168.20.9 involves reconfiguring the FTP server to disable anonymous access and implement access control measures to further minimise security risks.

Combined with these specific vulnerability mitigations, company-wide security strategies including regular audits, vulnerability assessments, and employee training on cybersecurity best practices are essential to ensure continuous monitoring and improvement of the network's security.

Conclusion

In conclusion, the penetration test conducted on Clarke Confectionary's network revealed several critical vulnerabilities that demand immediate attention to provide network security.

By employing the Nmap, OpenVAS, and Metasploit combination of network scanning tools, various vulnerabilities, ranging from outdated software versions to protocol weaknesses were identified across the network. These vulnerabilities pose serious threats to the integrity, confidentiality, and availability of the network and its assets. Notably, Metasploit's EternalBlue successfully breached 192.168.20.12's system, while a simple PowerShell anonymous FTP connection successfully breached 192.168.20.9's system.

Addressing these vulnerabilities requires a multi-tiered approach, including updating software, implementing security patches, employing access controls, strengthening encryption protocols and configuring systems to adhere to best practices. Moving forward, it's imperative for Clarke Confectionary to establishing strong vulnerability management processes including regular security audits, vulnerability assessments, software updates and employee training on security best practices with ongoing monitoring to maintain a strong security network.

Furthermore, in the result of a data breach to mitigate password hash cracking, Clarke Confectionary should enforce a strong, unique password policy for each user with added security measures like salting and hashing algorithms with higher computational complexity. Additionally, implementing multi-factor authentication can add an extra layer of security, in the event hashed passwords are compromised.

By adopting a proactive approach to network security and implementing the recommended mitigation strategies, Clarke Confectionary can significantly reduce the risk of potential security breaches and safeguard its sensitive data and infrastructure from malicious threats. However, the continuous monitoring and improvement of security protocols will be essential in maintaining a resilient and secure network environment in the face of evolving cybersecurity threats. Ultimately, investing in robust cybersecurity measures is not only essential for protecting sensitive information and preserving business continuity, but also critical for maintaining the trust and confidence of customers and stakeholders in an increasingly digital world.

By embracing this proactive and comprehensive approach to security assessment, Clarke Confectionary can fortify their digital defences, safeguard sensitive information, and mitigate cyber risks.

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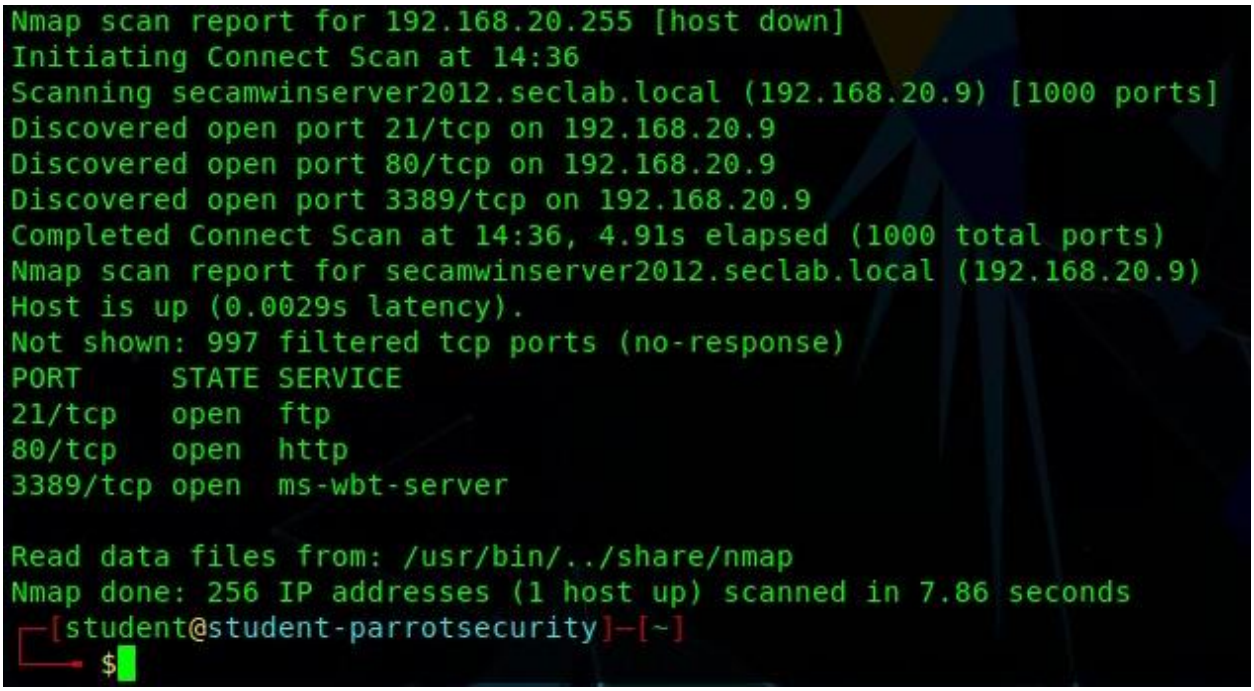
Image List

Appendix A – Nmap

Nmap TCP Connection Scan



Nmap Sudo TCP Connection Scan

```
┌─[student@student-parrotsecurity]─[~]
└──╼ $sudo nmap -sT -v 192.168.20.0/24
Starting Nmap 7.92 ( https://nmap.org ) at 2024-04-20 15:12 BST
Initiating Ping Scan at 15:12
Scanning 256 hosts [4 ports/host]
Completed Ping Scan at 15:12, 8.29s elapsed (256 total hosts)
Initiating Parallel DNS resolution of 2 hosts. at 15:12
Completed Parallel DNS resolution of 2 hosts. at 15:12, 0.00s elapsed
Nmap scan report for 192.168.20.0 [host down]
```

```
Nmap scan report for 192.168.20.255 [host down]
Initiating Connect Scan at 15:12
Scanning 2 hosts [1000 ports/host]
Discovered open port 23/tcp on 192.168.20.12
Discovered open port 445/tcp on 192.168.20.12
Discovered open port 21/tcp on 192.168.20.12
Discovered open port 135/tcp on 192.168.20.12
Discovered open port 139/tcp on 192.168.20.12
Discovered open port 49152/tcp on 192.168.20.12
Discovered open port 49153/tcp on 192.168.20.12
Discovered open port 49155/tcp on 192.168.20.12
Discovered open port 49154/tcp on 192.168.20.12
Discovered open port 49157/tcp on 192.168.20.12
Discovered open port 49156/tcp on 192.168.20.12
Discovered open port 49158/tcp on 192.168.20.12
Completed Connect Scan against 192.168.20.12 in 6.76s (1 host left)
Completed Connect Scan at 15:12, 6.86s elapsed (2000 total ports)
Nmap scan report for secamwinserver2008.seclab.local (192.168.20.12)
Host is up (0.011s latency).
Not shown: 988 filtered tcp ports (no-response)
PORT      STATE SERVICE
21/tcp    open  ftp
23/tcp    open  telnet
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
49152/tcp open  unknown
49153/tcp open  unknown
49154/tcp open  unknown
49155/tcp open  unknown
49156/tcp open  unknown
49157/tcp open  unknown
49158/tcp open  unknown

Nmap scan report for computer_1.seclab.local (192.168.20.44)
Host is up (0.0038s latency).
Not shown: 998 filtered tcp ports (no-response)
PORT     STATE  SERVICE
2869/tcp closed icslap
3389/tcp closed ms-wbt-server

Read data files from: /usr/bin/../share/nmap
Nmap done: 256 IP addresses (2 hosts up) scanned in 15.24 seconds
           Raw packets sent: 2036 (77.328KB) | Rcvd: 21 (1.160KB)
┌─[student@student-parrotsecurity]─[~]
└──╼ $
```

Nmap Aggressive Operating System Scan

```
┌──[student@student-parrotsecurity]─[~]
└─$nmap -A -v 192.168.20.0/24
Starting Nmap 7.92 ( https://nmap.org ) at 2024-04-20 15:32 BST
NSE: Loaded 155 scripts for scanning.
NSE: Script Pre-scanning.
Initiating NSE at 15:32
Completed NSE at 15:32, 0.00s elapsed
Initiating NSE at 15:32
Completed NSE at 15:32, 0.00s elapsed
Initiating NSE at 15:32
Completed NSE at 15:32, 0.00s elapsed
Initiating Ping Scan at 15:32
Scanning 256 hosts [2 ports/host]
Completed Ping Scan at 15:33, 2.51s elapsed (256 total hosts)
Initiating Parallel DNS resolution of 1 host. at 15:33
Completed Parallel DNS resolution of 1 host. at 15:33, 0.00s elapsed
Nmap scan report for 192.168.20.0 [host down]
```

```
Nmap scan report for 192.168.20.255 [host down]
Initiating Connect Scan at 15:33
Scanning secamwinserver2012.seclab.local (192.168.20.9) [1000 ports]
Discovered open port 21/tcp on 192.168.20.9
Discovered open port 80/tcp on 192.168.20.9
Discovered open port 3389/tcp on 192.168.20.9
Completed Connect Scan at 15:33, 4.71s elapsed (1000 total ports)
Initiating Service scan at 15:33
Scanning 3 services on secamwinserver2012.seclab.local (192.168.20.9)
Completed Service scan at 15:33, 11.03s elapsed (3 services on 1 host)
NSE: Script scanning 192.168.20.9.
Initiating NSE at 15:33
NSE: [ftp-bounce] PORT response: 501 Server cannot accept argument.
Completed NSE at 15:33, 0.06s elapsed
Initiating NSE at 15:33
Completed NSE at 15:33, 0.04s elapsed
Initiating NSE at 15:33
Completed NSE at 15:33, 0.00s elapsed
Nmap scan report for secamwinserver2012.seclab.local (192.168.20.9)
Host is up (0.0041s latency).
Not shown: 997 filtered tcp ports (no-response)
PORT     STATE SERVICE            VERSION
21/tcp   open  ftp                Microsoft ftpd
|_ftp-anon: Anonymous FTP login allowed (FTP code 230)
| ftp-syst:
|_  SYST: Windows_NT
80/tcp   open  http               Microsoft IIS httpd 8.5
|_http-server-header: Microsoft-IIS/8.5
|_http-title: 403 - Forbidden: Access is denied.
| http-methods:
|   Supported Methods: OPTIONS TRACE GET HEAD POST
|_  Potentially risky methods: TRACE
3389/tcp open  ssl/ms-wbt-server?
|_ssl-date: 2024-04-20T14:33:17+00:00; +1s from scanner time.
| ssl-cert: Subject: commonName=WIN-R08JAITCL98
| Issuer: commonName=WIN-R08JAITCL98
| Public Key type: rsa
| Public Key bits: 2048
| Signature Algorithm: sha1WithRSAEncryption
| Not valid before: 2024-02-07T14:22:08
| Not valid after:  2024-08-08T14:22:08
| MD5:   6687 b4b3 a2bd 05de fba2 d55e c25f 0716
|_SHA-1: fd04 6993 0b33 763a 4874 8cf0 541a 4073 04d1 69c5
Service Info: OS: Windows; CPE: cpe:/o:microsoft:windows

NSE: Script Post-scanning.
Initiating NSE at 15:33
Completed NSE at 15:33, 0.00s elapsed
Initiating NSE at 15:33
Completed NSE at 15:33, 0.00s elapsed
Initiating NSE at 15:33
Completed NSE at 15:33, 0.00s elapsed
Read data files from: /usr/bin/../share/nmap
Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 256 IP addresses (1 host up) scanned in 18.65 seconds
┌──[student@student-parrotsecurity]─[~]
└─$
```

Nmap Sudo Aggressive Operating System Scan

```
┌──[student@student-parrotsecurity]─[~]
└─$sudo nmap -A -v 192.168.20.0/24
Starting Nmap 7.92 ( https://nmap.org ) at 2024-04-20 15:39 BST
NSE: Loaded 155 scripts for scanning.
NSE: Script Pre-scanning.
Initiating NSE at 15:39
Completed NSE at 15:39, 0.00s elapsed
Initiating NSE at 15:39
Completed NSE at 15:39, 0.00s elapsed
Initiating NSE at 15:39
Completed NSE at 15:39, 0.00s elapsed
Initiating Ping Scan at 15:39
Scanning 256 hosts [4 ports/host]
Completed Ping Scan at 15:39, 8.27s elapsed (256 total hosts)
Initiating Parallel DNS resolution of 2 hosts. at 15:39
Completed Parallel DNS resolution of 2 hosts. at 15:39, 0.00s elapsed
Nmap scan report for 192.168.20.0 [host down]
```

```
Nmap scan report for secamwinserver2008.seclab.local (192.168.20.12)
Host is up (0.0093s latency).
Not shown: 988 filtered tcp ports (no-response)
PORT      STATE SERVICE      VERSION
21/tcp    open  ftp          Microsoft ftpd
| ftp-syst:
|_  SYST: Windows_NT
23/tcp    open  telnet       Microsoft Windows XP telnetd
| telnet-ntlm-info:
|   Target_Name: SECAMWINSERVER2
|   NetBIOS_Domain_Name: SECAMWINSERVER2
|   NetBIOS_Computer_Name: SECAMWINSERVER2
|   DNS_Domain_Name: SECAMwinserver2008
|   DNS_Computer_Name: SECAMwinserver2008
|_  Product_Version: 6.1.7601
135/tcp   open  msrpc        Microsoft Windows RPC
139/tcp   open  netbios-ssn  Microsoft Windows netbios-ssn
445/tcp   open  microsoft-ds Windows Server 2008 R2 Enterprise 7601 Service Pack 1 microsoft-ds
49152/tcp open  msrpc        Microsoft Windows RPC
49153/tcp open  msrpc        Microsoft Windows RPC
49154/tcp open  msrpc        Microsoft Windows RPC
49155/tcp open  msrpc        Microsoft Windows RPC
49156/tcp open  msrpc        Microsoft Windows RPC
49157/tcp open  msrpc        Microsoft Windows RPC
49158/tcp open  msrpc        Microsoft Windows RPC
Warning: OSScan results may be unreliable because we could not find at least 1 open and 1 closed port
Device type: general purpose|specialized|phone
Running: Microsoft Windows 2008|8.1|7|Phone|Vista
OS CPE: cpe:/o:microsoft:windows_server_2008:r2 cpe:/o:microsoft:windows_8.1 cpe:/o:microsoft:windows_
ft:windows_8 cpe:/o:microsoft:windows_7 cpe:/o:microsoft:windows cpe:/o:microsoft:windows_vista::- cpe
OS details: Microsoft Windows Server 2008 R2 or Windows 8.1, Microsoft Windows 7 Professional or Windo
 Standard 7, Microsoft Windows Phone 7.5 or 8.0, Microsoft Windows Vista SP0 or SP1, Windows Server 20
Windows Vista SP2, Windows 7 SP1, or Windows Server 2008
Uptime guess: 0.566 days (since Sat Apr 20 02:06:39 2024)
Network Distance: 2 hops
TCP Sequence Prediction: Difficulty=260 (Good luck!)
IP ID Sequence Generation: Incremental
Service Info: OSs: Windows, Windows XP, Windows Server 2008 R2 - 2012; CPE: cpe:/o:microsoft:windows,
```

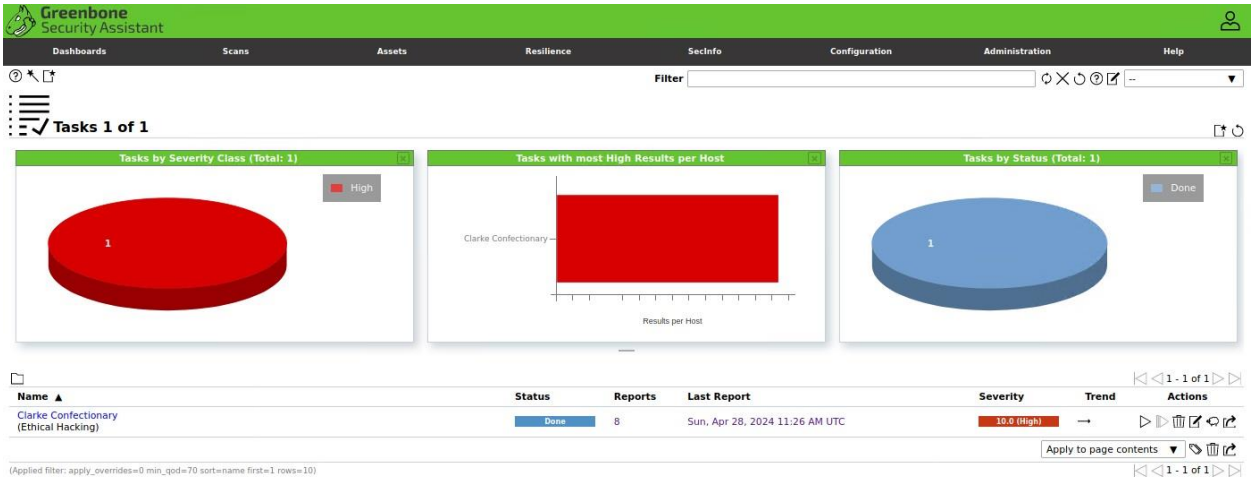
Nmap Sudo Aggressive Operating System Scan Continued…

```
Host script results:
| nbstat: NetBIOS name: SECAMWINSERVER2, NetBIOS user: <unknown>, NetBIOS MAC: 00:0c:29:64:17:52 (VMware)
| Names:
|   SECAMWINSERVER2<20>  Flags: <unique><active>
|   SECAMWINSERVER2<00>  Flags: <unique><active>
|_  WORKGROUP<00>        Flags: <group><active>
| smb2-security-mode:
|   2.1:
|     Message signing enabled but not required
| smb-os-discovery:
|   OS: Windows Server 2008 R2 Enterprise 7601 Service Pack 1 (Windows Server 2008 R2 Enterprise 6.1)
|   OS CPE: cpe:/o:microsoft:windows_server_2008::sp1
|   Computer name: SECAMwinserver2008
|   NetBIOS computer name: SECAMWINSERVER2\x00
|   Workgroup: WORKGROUP\x00
|_  System time: 2024-04-20T15:40:55+01:00
| smb-security-mode:
|   account_used: guest
|   authentication_level: user
|   challenge_response: supported
|_  message_signing: disabled (dangerous, but default)
| smb2-time:
|   date: 2024-04-20T14:40:55
|_  start_date: 2024-04-20T02:06:49
|_clock-skew: mean: -14m59s, deviation: 30m00s, median: 0s

TRACEROUTE (using port 139/tcp)
HOP RTT      ADDRESS
1   13.21 ms firewall.seclab.local (192.168.0.1)
2   10.48 ms secamwinserver2008.seclab.local (192.168.20.12)
```

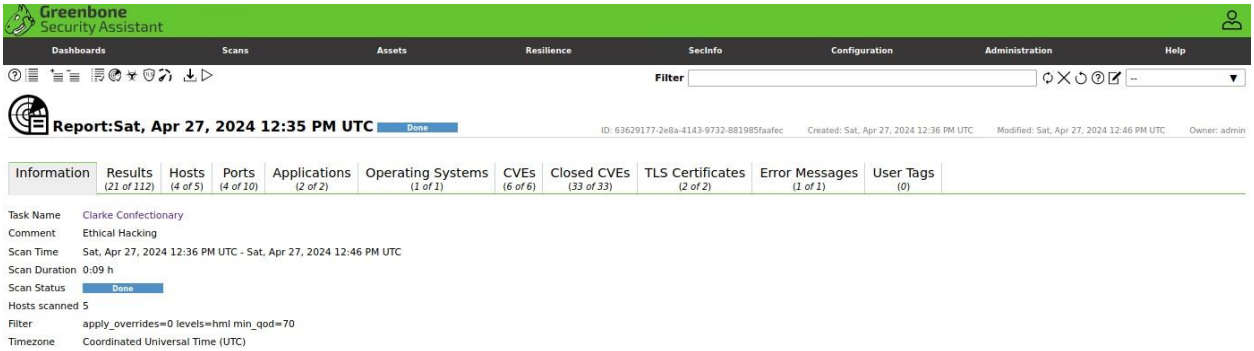
```
Nmap scan report for computer_1.seclab.local (192.168.20.44)
Host is up (0.0092s latency).
Not shown: 998 filtered tcp ports (no-response)
PORT     STATE  SERVICE       VERSION
2869/tcp closed icslap
3389/tcp closed ms-wbt-server
Device type: media device|specialized|power-device|general purpose
Running: Beat embedded, Belkin embedded, SMA embedded, Microsoft embedded, Microsoft Windows 2000|XP|2003|7|PocketPC/CE, Motorola embedded
OS CPE: cpe:/o:microsoft:windows_2000::sp4:server cpe:/o:microsoft:windows_xp::sp3:professional cpe:/o:microsoft:windows_server_2003 cpe:/
o:microsoft:windows_7 cpe:/o:microsoft:windows_ce:5.0 cpe:/h:motorola:vip1216 cpe:/o:microsoft:windows_ce:6.0
Too many fingerprints match this host to give specific OS details
Network Distance: 2 hops

TRACEROUTE (using port 3389/tcp)
HOP RTT      ADDRESS
-   Hop 1 is the same as for 192.168.20.12
2   12.01 ms computer_1.seclab.local (192.168.20.44)

NSE: Script Post-scanning.
Initiating NSE at 15:41
Completed NSE at 15:41, 0.00s elapsed
Initiating NSE at 15:41
Completed NSE at 15:41, 0.00s elapsed
Initiating NSE at 15:41
Completed NSE at 15:41, 0.00s elapsed
Read data files from: /usr/bin/../share/nmap
OS and Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 256 IP addresses (2 hosts up) scanned in 115.64 seconds
           Raw packets sent: 6098 (259.428KB) | Rcvd: 78 (4.356KB)
┌─[student@student-parrotsecurity]─[~]
└──╼ $
```

Appendix B – OpenVas

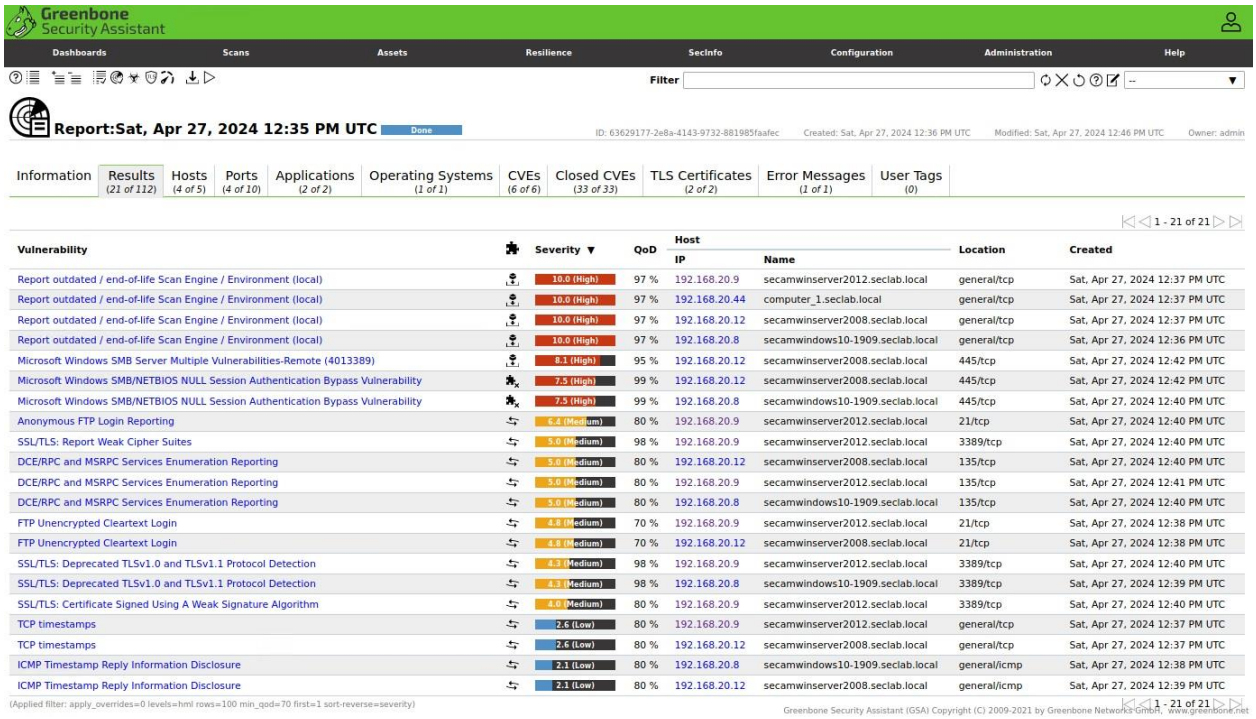
Dashboard



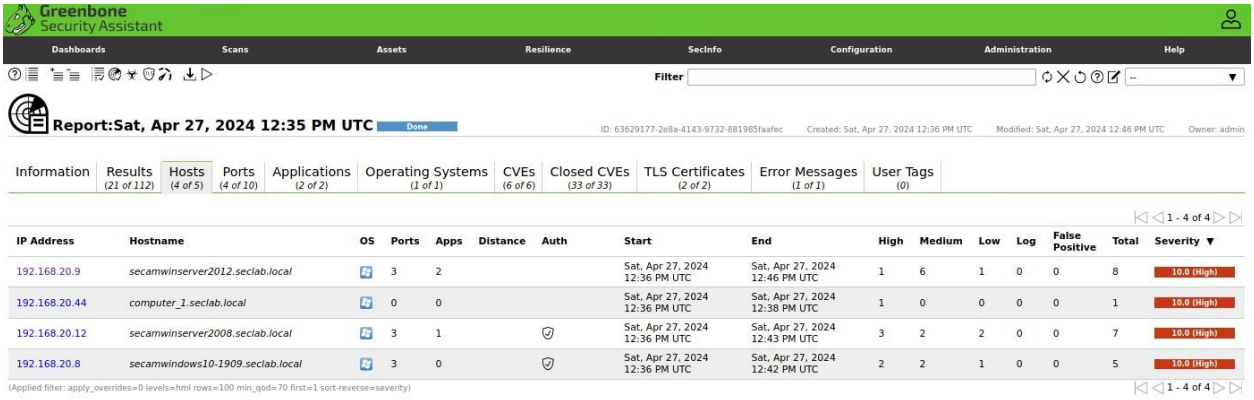
Info



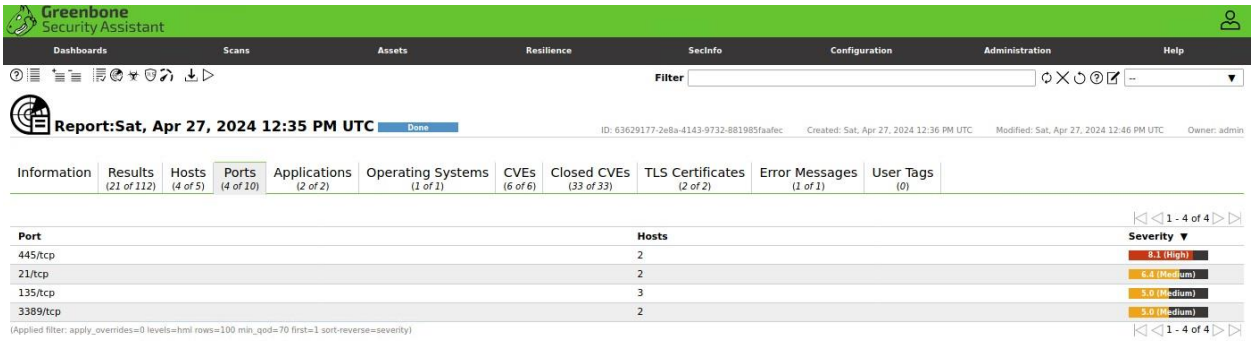
Results



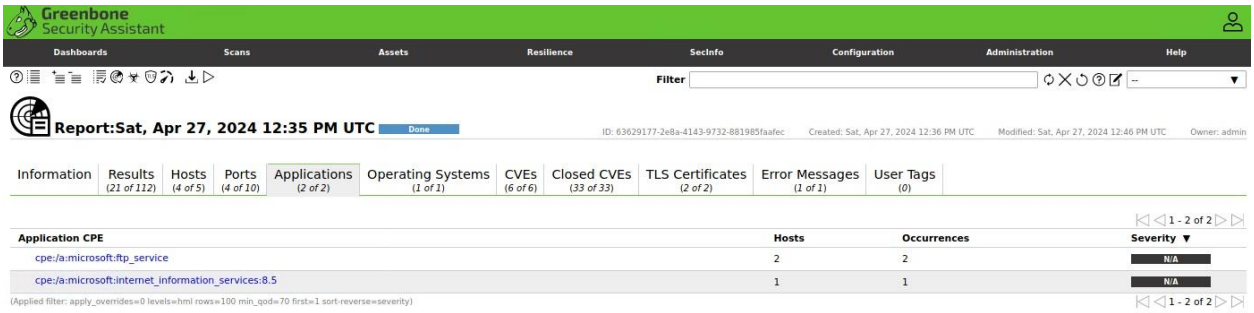
Hosts



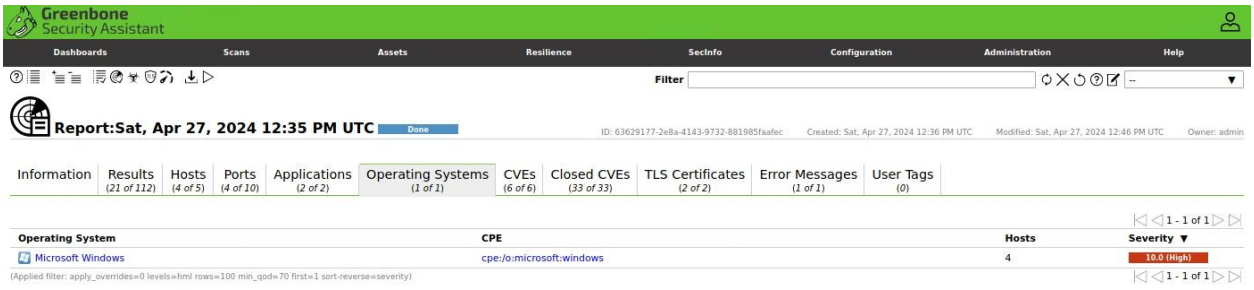
Ports



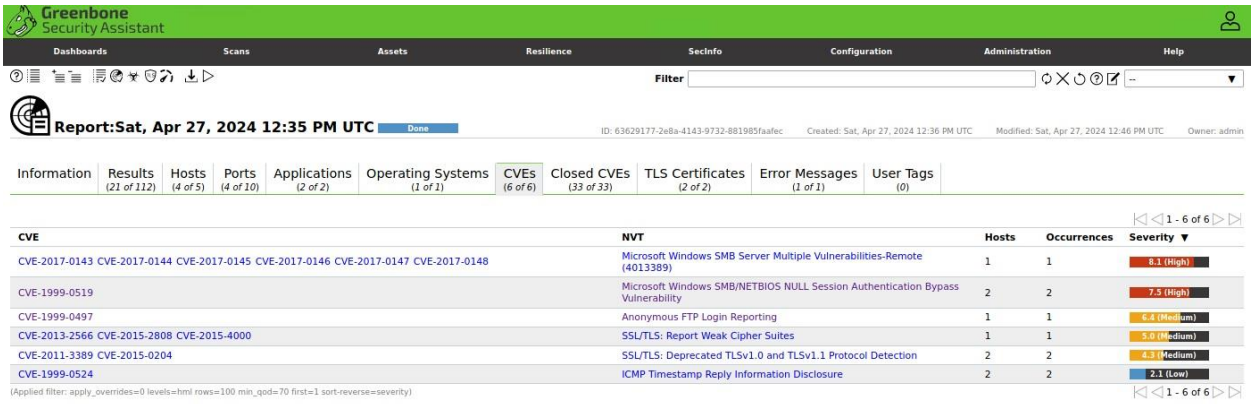
Applications



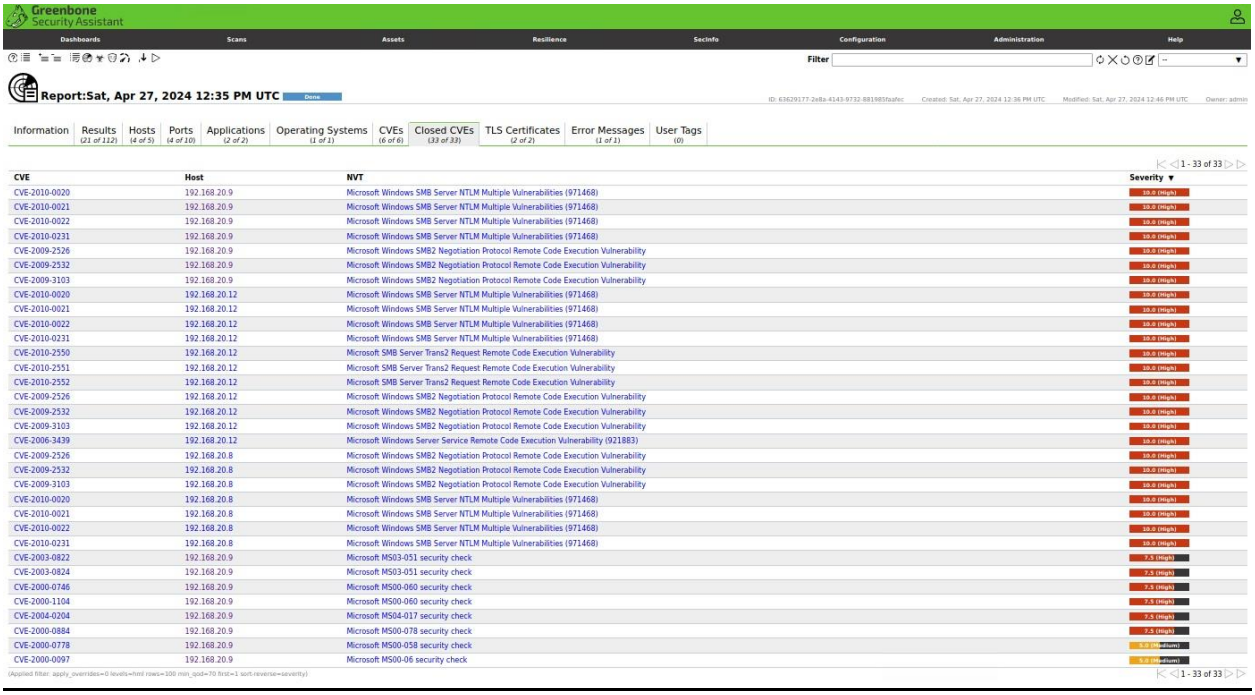
Operating Systems



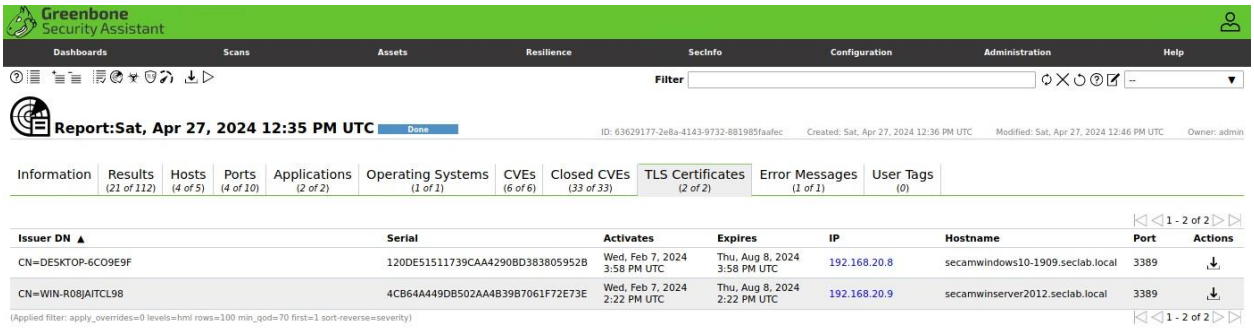
CVE’s



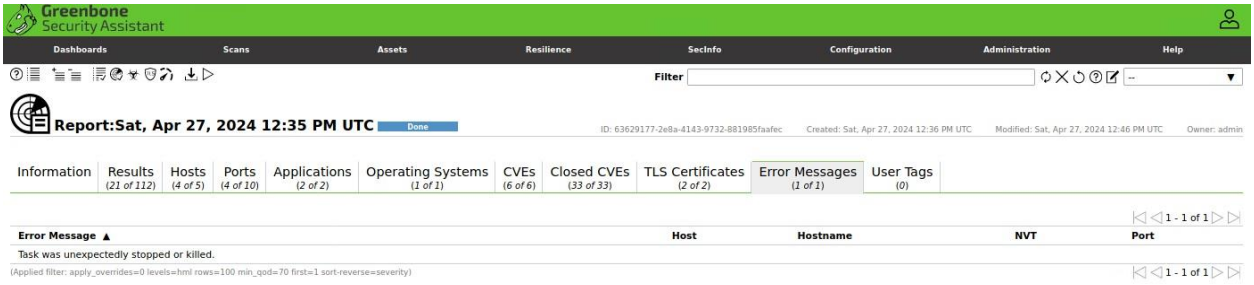
Closed CVE’s



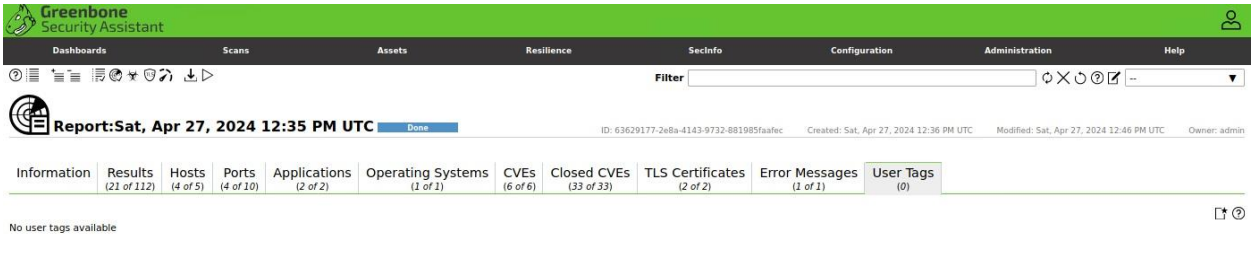
TLS Certificates



Errors

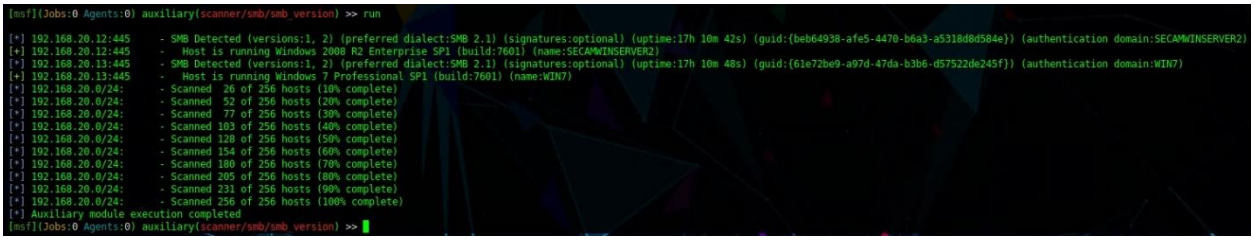


User Tags

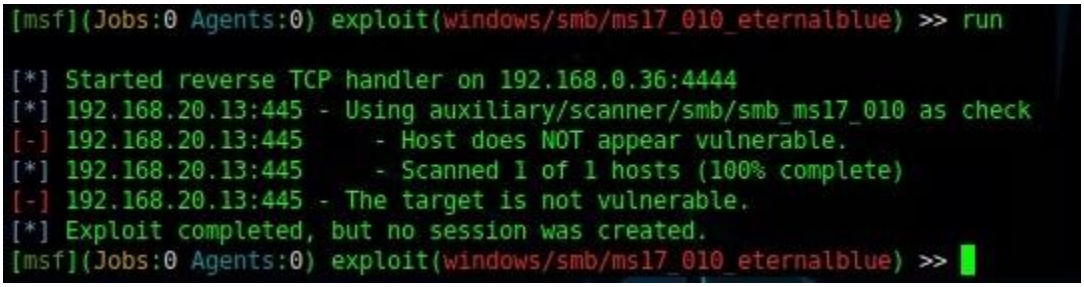


Appendix C – 192.168.20.13 Exploit Failed

192.168.20.13 SMB Version Vulnerability Present



192.168.20.13 Not Vulnerable



Appendix D – 192.168.20.8 Host Disappeared

Host 192.168.20.8 Discovered

```
Nmap scan report for secamwindows10-1909.seclab.local (192.168.20.8)
Host is up (0.024s latency).
Not shown: 996 closed tcp ports (conn-refused)
PORT     STATE SERVICE
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
3389/tcp open  ms-wbt-server

Nmap scan report for secamwinserver2012.seclab.local (192.168.20.9)
Host is up (0.0062s latency).
Not shown: 993 filtered tcp ports (no-response)
PORT      STATE SERVICE
21/tcp    open  ftp
80/tcp    open  http
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
3389/tcp  open  ms-wbt-server
49155/tcp open  unknown

Nmap scan report for secamwinserver2008.seclab.local (192.168.20.12)
Host is up (0.012s latency).
Not shown: 988 filtered tcp ports (no-response)
PORT      STATE SERVICE
21/tcp    open  ftp
23/tcp    open  telnet
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
49152/tcp open  unknown
49153/tcp open  unknown
49154/tcp open  unknown
49155/tcp open  unknown
49156/tcp open  unknown
49157/tcp open  unknown
49158/tcp open  unknown

Nmap scan report for computer_1.seclab.local (192.168.20.44)
Host is up (0.0042s latency).
Not shown: 998 filtered tcp ports (no-response)
PORT     STATE  SERVICE
2869/tcp closed icslap
3389/tcp closed ms-wbt-server
```

Host 192.168.20.8 Vulnerability Identified (CVE-1999-0519)

Microsoft Windows SMB/NETBIOS NULL Session Authentication Bypass Vulnerability		7.5 (High)	99 %	192.168.20.12	secamwinserver2008.seclab.local	445/tcp	Sat, Apr 27, 2024 12:42 PM UTC
Microsoft Windows SMB/NETBIOS NULL Session Authentication Bypass Vulnerability		7.5 (High)	99 %	192.168.20.8	secamwindows10-1909.seclab.local	445/tcp	Sat, Apr 27, 2024 12:40 PM UTC
Anonymous FTP Login Reporting		5.4 (Medium)	80 %	192.168.20.9	secamwinserver2012.seclab.local	21/tcp	Sat, Apr 27, 2024 12:40 PM UTC

Host 192.168.20.8 Disappeared

```
Nmap scan report for secamwinserver2012.seclab.local (192.168.20.9)
Host is up (0.0062s latency).
Not shown: 993 filtered tcp ports (no-response)
PORT      STATE SERVICE
21/tcp    open  ftp
80/tcp    open  http
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
3389/tcp  open  ms-wbt-server
49155/tcp open  unknown

Nmap scan report for secamwinserver2008.seclab.local (192.168.20.12)
Host is up (0.012s latency).
Not shown: 988 filtered tcp ports (no-response)
PORT      STATE SERVICE
21/tcp    open  ftp
23/tcp    open  telnet
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
49152/tcp open  unknown
49153/tcp open  unknown
49154/tcp open  unknown
49155/tcp open  unknown
49156/tcp open  unknown
49157/tcp open  unknown
49158/tcp open  unknown

Nmap scan report for computer_1.seclab.local (192.168.20.44)
Host is up (0.0042s latency).
Not shown: 998 filtered tcp ports (no-response)
PORT     STATE  SERVICE
2869/tcp closed icslap
3389/tcp closed ms-wbt-server
```