

Network Forensics – Assignment 2

INCIDENT RESPONSE & ANALYSIS OF MS08-67

BSc's in (Computer Forensics & Security)

Course SE602

A PROJECT REPORT BY

& Support Of

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1. Introduction

Report Briefing:

Report By: Jabez Jacob Dickson

Reviewed By: South East Technological University (SETU)

In the field of computer forensics, maintaining the integrity and admissibility of evidence is paramount. The Association of Chief Police Officers (ACPO) guidelines provide a framework to ensure that digital evidence is collected, handled, and analyzed in a forensically sound manner. These principles are critical in preserving the chain of custody and maintaining the evidential value of data in legal or investigative scenarios.

This project focuses on investigating a simulated network attack and performing a detailed forensic analysis of the recovered data. The investigation adheres to key forensic principles, such as minimizing interaction with the affected system, capturing volatile and non-volatile data securely, and preserving evidence integrity through hashing and proper documentation. The chain of custody is meticulously maintained to ensure the admissibility of findings.



The report follows a structured process, beginning with a live response to capture volatile data from the affected system, followed by network packet analysis to identify traces of malicious activity. Statistical, session, alert, and full content data are analyzed to piece together a comprehensive timeline of the attack. This methodical approach ensures that all findings are both reliable and actionable.

By adhering to established guidelines and best practices, this investigation aims to demonstrate a professional and forensically sound approach to network-based incident response and evidence analysis.

1.1 Objectives of the Investigation

The primary objective of this investigation is to conduct a comprehensive forensic analysis of a simulated network attack, following industry standards and forensic best practices. The investigation is designed to meet the following specific objectives.



The primary objective of this investigation is to recover, analyse, and document traceable data from an attack on a Windows XP machine. The investigation aims to follow a structured approach to ensure the integrity and reliability of the evidence collected. The specific objectives include:

Key Phases of a Forensic Analysis

1. **Evidence Recovery:** Capture volatile and non-volatile data from the Windows XP machine, including processes, network connections, system logs, and memory dumps, while ensuring evidence integrity.
2. **Network Analysis:** Collect and analyze network-based evidence to identify attack traces, including packet captures, session reconstruction, and patterns of malicious activity.
3. **Traceability and Correlation:** Identify and correlate traces of the attack across different data types (statistical, session, alert, and full content) to reconstruct the timeline and progression of the attack.
4. **Forensic Documentation:** Document all findings, and methodologies comprehensively to ensure forensic soundness and provide actionable insights for mitigating future incidents.

1.2 Overview of the MS08-67 Vulnerability

The MS08-067 vulnerability is a critical security flaw in the Windows Server service that allows remote code execution. This vulnerability was first disclosed in 2008 and affects multiple versions of Windows, including Windows XP.

It occurs due to improper handling of specially crafted Remote Procedure Call (RPC) requests, enabling an attacker to execute arbitrary code on the target system without authentication.

This vulnerability gained notoriety as it was exploited by the Conficker worm, one of the most widespread and disruptive malware outbreaks. Exploiting MS08-067 allows attackers to:

- **Gain Unauthorized Access:** Execute malicious payloads to gain control of the target machine.
- **Propagate Across Networks:** Spread to other vulnerable machines within the network.
- **Establish Persistence:** Install backdoors or maintain ongoing access to the compromised system.

In this investigation, **MS08-067** serves as the attack vector simulated in a controlled environment. Analyzing the traces left by this exploit will provide insights into its exploitation process, network behavior, and potential impact on the affected system.

Exploiting Windows XP (MS08-067)



use of exploit & payload



The MS08-067 vulnerability stands as one of the most notable security flaws in Microsoft's history, not only for its technical characteristics but also for its real-world implications.

Introduced in 2008, this vulnerability targeted the Windows Server service and allowed attackers to execute arbitrary code remotely without authentication.

At its core, the flaw was caused by improper handling of specially crafted Remote Procedure Call (RPC) requests. It affected a wide range of Microsoft operating systems, including **Windows XP, 2000, and Server 2003**, where it was deemed critical, and **Vista and Server 2008**, where it was classified as important.

What sets MS08-067 apart is the urgency with which it was addressed. Normally, Microsoft releases patches on a regular, predictable schedule known as "Patch Tuesday," which began in November 2003. However, the MS08-067 patch was one of only 10 out-of-band patches released between 2003 and 2008.

Its release was expedited due to active exploitation by the Conficker worm, a rapidly spreading malware that took advantage of the vulnerability to compromise systems across the globe. The critical nature of this flaw and its exploitation in the wild necessitated an immediate response to mitigate further damage.

History Of the Attack & Critical Rating

The exploitation of MS08-067 became particularly infamous because of its accessibility. At the time, searching for "exploit MS08-067" online yielded thousands of results, including detailed write-ups, tutorials, and even ready-to-use tools.

Metasploit, a popular penetration testing framework, provided comprehensive support for exploiting the vulnerability, allowing even novice users to gain administrative access to unpatched systems with minimal effort.



The ease of use and global applicability made it a common tool for both penetration testers and malicious actors, demonstrating the importance of timely patch management.

Despite its age, MS08-067 remains relevant in network forensics and penetration testing. It exemplifies the dangers of unpatched vulnerabilities and highlights the critical need for organizations to maintain robust patching practices. Even today, outdated systems that have fallen through the cracks of patch management can still be found vulnerable to MS08-067, serving as entry points for attackers.

EXPLOIT
DATABASE

Microsoft Windows Server - Code Execution (MS08-067)

EDB-ID: 7104	CVE: 2008-4250	Author: POLYMORPHOURS	Type: REMOTE	Platform: WINDOWS	Date: 2008-11-12
EDB Verified: ✓		Exploit: 📄 / {}		Vulnerable App:	

Exploit DB Record

The accessibility of MS08-067 exploit scripts on platforms like Exploit-DB demonstrates the widespread understanding and utility of this vulnerability, further emphasizing the importance of patch management and proactive security measures.

Severity Classification

CVE-2008-4250 is classified as Critical under both Microsoft’s Security Bulletin system and the Common Vulnerability Scoring System (CVSS).

Its CVSS base score often ranks between 9.3 and 10 (out of 10), reflecting its high severity. The critical nature of this vulnerability stems from its potential to cause widespread damage

CVE-2008-4250 Detail

MODIFIED

This vulnerability has been modified since it was last analyzed by the NVD. It is awaiting reanalysis which may result in further changes to the information provided.

Description

The Server service in Microsoft Windows 2000 SP4, XP SP2 and SP3, Server 2003 SP1 and SP2, Vista Gold and SP1, Server 2008, and 7 Pre-Beta allows remote attackers to execute arbitrary code via a crafted RPC request that triggers the overflow during path canonicalization, as exploited in the wild by Gimmiv.A in October 2008, aka "Server Service Vulnerability."

Despite being over a decade old, CVE-2008-4250 remains relevant due to poor patch management practices in some organizations. Unpatched systems can still be exploited today, particularly in legacy environments where Windows XP or Windows Server 2003 are in use. The wide availability of exploit tools, such as Metasploit modules, exacerbates this risk.

CVSS Breakdown: Common Vulnerability Scoring System

Metric	Value	Impact
Attack Vector	Network	Exploitable over a network, allowing attackers to target machines without physical access.
Attack Complexity	Low	Requires no advanced techniques or conditions to exploit.
Privileges Required	None	Exploitation does not rely on existing permissions, making all vulnerable systems targets.
User Interaction	None	No action from the victim is required to trigger the exploit.
Confidentiality Impact	Complete	Attackers can gain full access to data on the compromised system.
Integrity Impact	Complete	Attackers can modify data, potentially introducing backdoors or ransomware.
Availability Impact	Complete	The exploit can disrupt system availability, including full system shutdowns or crashes.

1.3 Overview of the MS17-010 Vulnerability

The MS17-010 vulnerability, also known as EternalBlue, is a critical security flaw in Microsoft's Server Message Block (SMB) protocol. Disclosed in March 2017, it became infamous due to its role in large-scale ransomware attacks like WannaCry and NotPetya. The vulnerability exists in how SMBv1 handles specially crafted packets, allowing attackers to execute arbitrary code on vulnerable systems.

The vulnerability was exploited using EternalBlue, a tool allegedly developed by the NSA and later leaked by the hacking group Shadow Brokers. MS17-010 affects multiple versions of Windows, including Windows XP, making it an essential case study for network forensics.

Exploiting MS17-010 enables attackers to:

- **Gain Unauthorized Access:** Exploit SMBv1 to execute malicious payloads without authentication.
- **Propagate Automatically:** Spread across networks by exploiting other unpatched machines.
- **Establish Persistence:** Deploy backdoors or maintain ongoing access.

History of EternalBlue

The attack gained notoriety with the WannaCry ransomware outbreak in May 2017, which leveraged EternalBlue to compromise over 200,000 systems in 150 countries. The vulnerability enabled WannaCry to propagate quickly, causing widespread disruption in critical sectors such as healthcare and logistics.

Like MS08-067, the MS17-010 exploit's accessibility made it a popular tool for both malicious actors and penetration testers. Frameworks like Metasploit added support for EternalBlue, allowing even novice users to exploit unpatched systems with minimal effort.

Despite the availability of patches, many systems remain vulnerable due to poor patch management practices. Legacy systems running Windows XP or Server 2003 often provide entry points for attackers leveraging this exploit.

Severity and Classification

CVE-2017-0144, the identifier for MS17-010, is classified as Critical by Microsoft and holds a CVSS score of 9.3, indicating its severe impact. The vulnerability allows attackers to:

Gain full control over compromised systems.

Spread ransomware or other malware rapidly across networks.

The widespread exploitation of MS17-010 underscores the importance of timely patching and the dangers of using outdated protocols like SMBv1.


CVE-2017-0144 Detail

MODIFIED

This vulnerability has been modified since it was last analyzed by the NVD. It is awaiting reanalysis which may result in further changes to the information provided.

Description

The SMBv1 server in Microsoft Windows Vista SP2; Windows Server 2008 SP2 and R2 SP1; Windows 7 SP1; Windows 8.1; Windows Server 2012 Gold and R2; Windows RT 8.1; and Windows 10 Gold, 1511, and 1607; and Windows Server 2016 allows remote attackers to execute arbitrary code via crafted packets, aka "Windows SMB Remote Code Execution Vulnerability." This vulnerability is different from those described in CVE-2017-0143, CVE-2017-0145, CVE-2017-0146, and CVE-2017-0148.



The screenshot shows the Exploit Database entry for CVE-2017-0144. The title is "Microsoft Windows 7/8.1/2008 R2/2012 R2/2016 R2 - 'EternalBlue' SMB Remote Code Execution (MS17-010)". The entry includes the following details:

EDB-ID:	CVE:	Author:	Type:	Platform:	Date:
42315	2017-0144	SLEEPYA	REMOTE	WINDOWS	2017-07-11
EDB Verified: ✓		Exploit: 📄 / {}		Vulnerable App:	

Exploit Demonstration

In this investigation, the MS17-010 vulnerability was used instead of MS08-067 because the attack was unsuccessful and did not work in the demonstration environment. EternalBlue was deployed in a controlled lab setup to simulate an attack.

The forensic analysis in subsequent sections will provide insights into the traces left by this exploit, including network traffic patterns and system artifacts.

1.4 Overview of Tools & Methodology

Importance of Incident Response

Incident response is critical for minimizing damage, recovering quickly, and preserving evidence for further analysis.

The primary objectives include:

- Containing the attack.
- Eradicating the threat.
- Recovering affected systems.
- Identifying the root cause to prevent recurrence.

(i) Stages of Incident Response

Preparation:

Establishing policies, procedures, and tools for responding to incidents.
Ensuring availability of digital forensic tools and a secure environment for analysis.
Training personnel on live response and evidence collection techniques.

Detection and Analysis:

Identifying the attack through indicators such as unusual traffic, system anomalies, or alerts from intrusion detection systems. Collecting volatile and non-volatile data for analysis, including memory dumps, network traces, and logs. Employing tools like **netstat, fport, and packet capture utilities for detailed analysis.**

Containment, Eradication, and Recovery:

Isolating the compromised system to prevent further damage or propagation.
Removing the threat and ensuring all backdoors or persistent threats are eradicated.
Restoring the system to its operational state while applying patches and updates to close the exploited vulnerability.

Post-Incident Activities:

Conducting a lessons-learned meeting to review the effectiveness of the response.
Updating policies and procedures to address gaps identified during the investigation.
Preserving collected evidence for possible legal or organizational use.

Adherence to ACPO Guidelines

Principle 1: No Action That Alters Evidence

"No action taken by law enforcement agencies or their agents should change data held on a computer or storage media which may subsequently be relied upon in court."

(ACPO Good Practice Guide for Digital Evidence, Version 5, 2012)

Principle 2: Documentation of Processes

"In circumstances where a person finds it necessary to access original data held on a computer or storage media, that person must be competent to do so and be able to give evidence explaining the relevance and the implications of their actions."

(ACPO Good Practice Guide for Digital Evidence, Version 5, 2012)

Principle 3: Forensic Soundness

"An audit trail or other record of all processes applied to computer-based electronic evidence should be created and preserved. An independent third party should be able to examine those processes and achieve the same result."

(ACPO Good Practice Guide for Digital Evidence, Version 5, 2012)

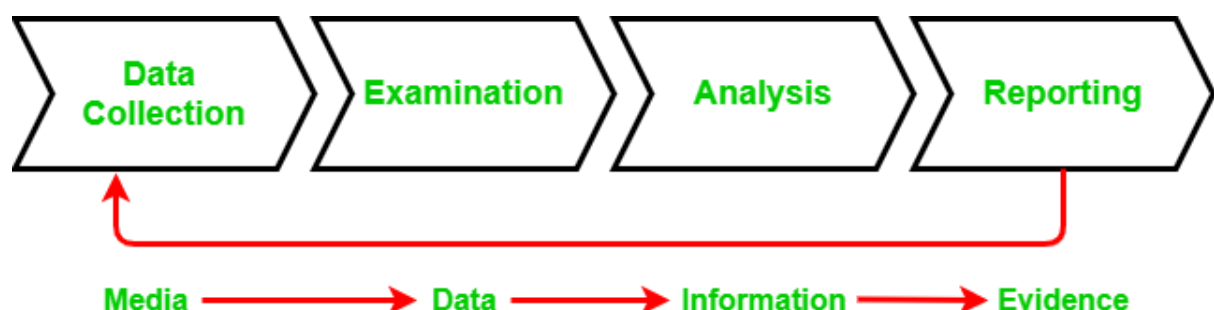
Principle 4: Accountability

"The person in charge of the investigation has overall responsibility for ensuring that the law and these principles are adhered to."

(ACPO Good Practice Guide for Digital Evidence, Version 5, 2012)

The diagram below emphasizes the transformation of raw media into actionable evidence by progressively refining it from data to information and finally into evidence, suitable for legal or investigative purposes.

The feedback loop indicates the importance of iterative processes to ensure the integrity and comprehensiveness of the analysis.



Tools Utilized for Analysis

These tools are used to capture data that exists only in the system's memory and will be lost upon shutdown or restart.

1. Volatile Data Collection

PsList (Sysinternals Suite): Captures a list of currently running processes, providing details like process ID, memory usage, and execution times.

PsLoggedOn (Sysinternals Suite): Identifies users currently logged into the system locally or remotely, aiding in tracking active sessions.

netstat: Displays active network connections and listening ports, revealing suspicious external connections.

fport: Maps open ports to the processes using them, helping identify malicious or unauthorized activities.

nbstat: Dumps the NetBIOS name cache, showing recent network connections and resolving machine names to IP addresses.

Volatility: Analyzes memory dumps to extract details about processes, network connections, and potentially malicious activity

2. Non-Volatile Data Collection

FTK Imager: Creates forensic images of drives while maintaining data integrity, ensuring no changes are made during acquisition.

RegRipper: Extracts and analyzes registry data, including evidence of malicious persistence mechanisms or startup entries.

PsFile (Sysinternals Suite): Lists files that are currently open on the system, identifying potential signs of active malware.

auditpol: Examines the system's auditing policy to determine if logging was enabled or manipulated by an attacker.

tcpdump: Captures network packets, providing insights into ongoing network communications. Used to analyze anomalies or suspicious connections.

Wireshark: Decodes captured packets into human-readable formats, making it easier to spot malicious communication.

Netcat (nc): Transfers captured volatile data securely from the infected machine to a forensic workstation for analysis.

3. Network Forensics

tcpdump: Captures network packets, providing insights into ongoing network communications. Used to analyze anomalies or suspicious connections.

Wireshark: Decodes captured packets into human-readable formats, making it easier to spot malicious communication.

Netcat (nc): Transfers captured volatile data securely from the infected machine to a forensic workstation for analysis.



4. Intrusion Detection and Alert Data

Snort: An intrusion detection system (IDS) that scans network packet captures (.pcap files) for patterns of known attacks using pre-defined signatures.



Argus: Generates session data summaries from packet captures, providing high-level insights into the traffic.

tcpflow: Reconstructs data flows from captured packets, allowing investigators to see the actual content transmitted between attacker and victim.

5. Disk Forensics and System Metadata

dir /q: Lists files and directories along with ownership information, highlighting changes to file permissions or additions by malware.

find (Cygwin): Searches for file metadata changes, such as creation, modification, or access times, to track suspicious activity.

pwdump: Extracts hashed passwords from the Windows SAM database, aiding in identifying potential credential compromise.



6. Timeline Analysis

Psloglist (Sysinternals Suite): Extracts Windows event logs, including security, system, and application logs, to detect login attempts, privilege escalations, or errors.

NtLlast (Foundstone): Reviews historical login events to identify unauthorized access or suspicious activity.

LogParser: Analyzes and queries logs for patterns indicating exploitation or backdoor installation

Redline (FireEye): Performs memory and file analysis to detect malware and other artifacts.



2. Live Response

In this section, the live response process is documented to collect volatile data from the compromised system.

The response was conducted in a forensically sound manner to ensure the integrity of the data and allow for comprehensive analysis of the MS17-010 exploit. The evidence collected serves as the foundation for further analysis in the following sections.

Live forensics refers to the process of collecting volatile data from a computing device in real-time to preserve evidence before it is lost or altered, crucial in ongoing cybersecurity investigations.

The goal of data collection was to capture all relevant volatile data that could indicate traces of the MS17-010 exploitation, including:

(i) Network Connections

Network connections refer to the active and open connections between the system and external or internal networks at the time of the live response. These connections are critical for identifying:

- Unusual traffic patterns, such as communication with malicious IP addresses.
- Active exploits, like connections to an attacker's Command and Control (C2) server.
- Compromised ports, such as SMB traffic over port 445 (used in MS17-010).

Tools like **netstat** are used to list all active connections, including:

Local and remote IP addresses.

Ports being used (e.g., 445 for SMB, 80 for HTTP).

Connection state (e.g., LISTENING, ESTABLISHED).



(ii). Running Processes

Running processes represent the active programs and services on the system. These are crucial for identifying:

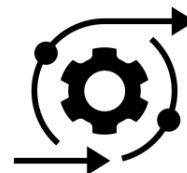
- Malicious processes that could be injected by the exploit payload.
- Unauthorized or unusual programs running with elevated privileges.
- Hidden or renamed processes designed to evade detection.

Tools like **pslist** or Task Manager are used to capture:

Process IDs (PIDs).

Parent processes (to track how the process started).

CPU and memory usage.



(iii). Logged-In Users

Logged-in users indicate the accounts currently authenticated and active on the machine. This helps identify:

- Unauthorized access, such as an attacker logging in remotely.
- Privilege escalation attempts, where a lower-privileged user account is exploited to gain administrative access.



Tools like **psloggedon** are used to collect:

Currently logged-in accounts.
Session types (local or remote).
Login times to establish a timeline of access.

(iv). Open Files

Open files refer to files currently being accessed by processes or users. This can provide evidence of:

- Malicious payloads or backdoors being executed.
- Stolen data being accessed or exfiltrated.
- Executable files related to the exploit.

Tools like **psfile** or system commands list open files and their associated processes, which can reveal:

File paths (e.g., a temporary directory for payloads).
Associated users or processes accessing the file.

(v). Internal Routing Tables

Internal routing tables define the network routes known to the system, specifying how data packets are forwarded. Analyzing routing tables helps identify:

- Malicious routes added by attackers to redirect traffic.
- Network misconfigurations that could facilitate an attack.
- Suspicious network activity from unusual routes.



Commands like **netstat -rn** display:

Destination addresses.
Gateway addresses.
Network interfaces and metrics.

(vi). Scheduled Jobs

Scheduled jobs are tasks configured to run automatically at specified times. Attackers often use scheduled tasks to:

- Maintain persistence, ensuring their payload runs after a reboot.
- Execute malicious scripts or programs periodically.
- Exfiltrate data during low-traffic periods.

Tools like **schtasks** list all scheduled jobs, including:

Job names and execution times.
Associated programs or scripts.
User accounts used to create the jobs.



(vii). Memory Contents

Memory contents include the data currently stored in the system's RAM. This is highly volatile but provides the most detailed insights into an attack. Analyzing memory can reveal:



Injected exploit payloads directly in memory.

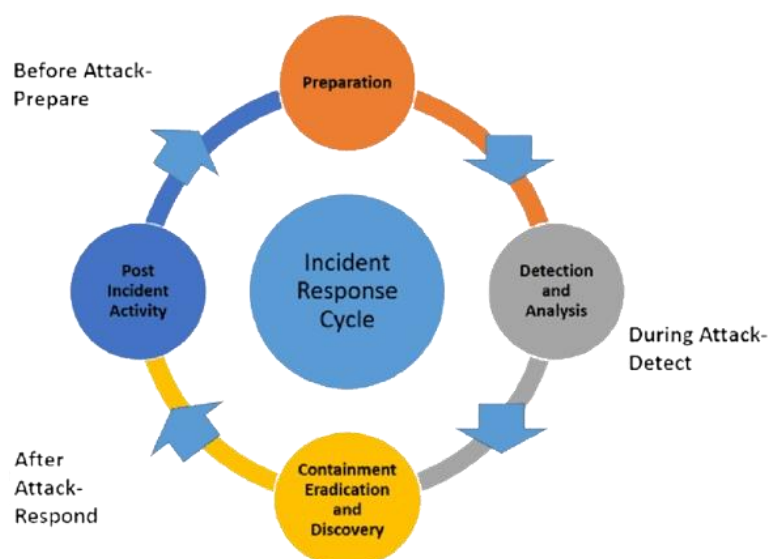
Credential harvesting attempts, such as cached passwords.

Network activity not logged on disk.

Malware attempting to hide itself by only residing in memory.

Tools like **dumpit** capture a memory image for offline analysis using tools like Volatility to extract:

Running processes and modules.
Network artifacts (e.g., IPs and connections).
Cryptographic keys or sensitive data used during the attack.



2.1 Data Collection & Analysis

Objective – An Analysis of an attack on Windows XP (Service Pack 2)

The primary objective was to collect volatile data from the Windows XP machine, focusing on:

- **Traces of the MS17-010 exploitation.**
- **Network behaviours and system processes triggered by EternalBlue.**
- **Evidence of post-exploitation activity, such as unauthorized user sessions or open files.**



During this forensic investigation, several challenges were encountered due to the legacy nature of the target system (Windows XP) and compatibility issues with modern tools.

The Challenges of using modern tools:

Evidence gathering in conjunction with the MS17-010 exploit we can see according to the logs for evidence of the Metasploit attack and these are the following tests that were initiated:

PS Commands Not Triggering Activity

During the forensic analysis, attempts were made to utilize Sysinternals "ps" commands (e.g., psfile, pslist, and psloggedon) to monitor file activity, logged-on users, and running processes. These commands were used to detect interactions with a test file (bankdetails.txt) during the attack. However, the following challenges were encountered:

1. Tools Not Available on Win32:

- The modern versions of Sysinternals tools are incompatible with Windows XP due to legacy system limitations.
- As a result, the tools had to be retrieved from an archived internet link: Internet Archive - Sysinternals Suite.

2. Limitations of Sysinternals Tools:

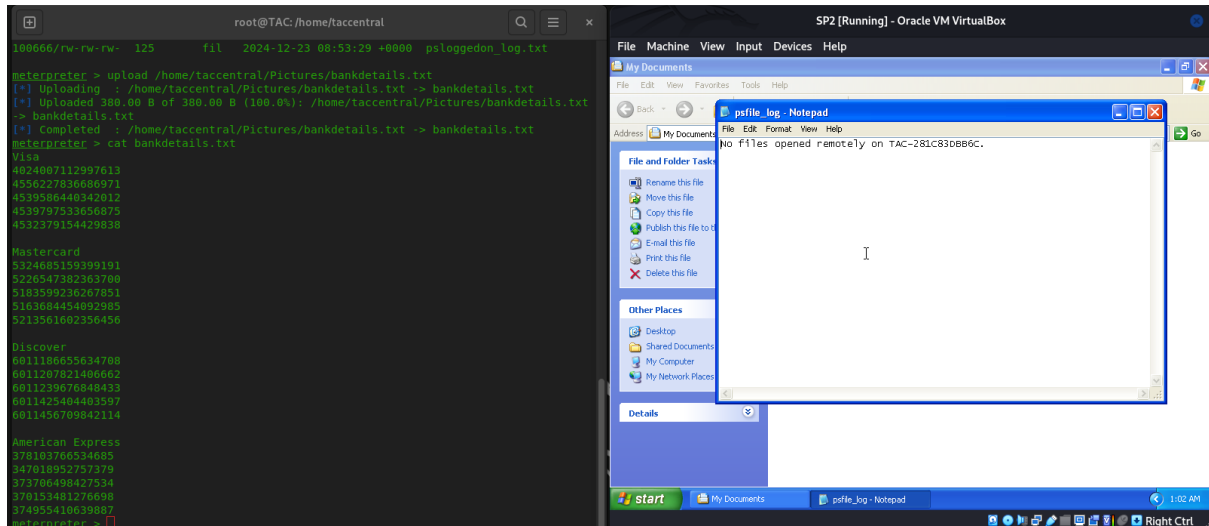
The inability of the tools to detect the attack can be attributed to:

- **Compatibility limitations** of Sysinternals tools with the outdated Windows XP environment.
- **Stealth mechanisms** of the modern exploitation framework (e.g., Meterpreter), which operates in-memory and bypasses standard Windows APIs and file-sharing mechanisms, rendering it invisible to legacy monitoring tools.

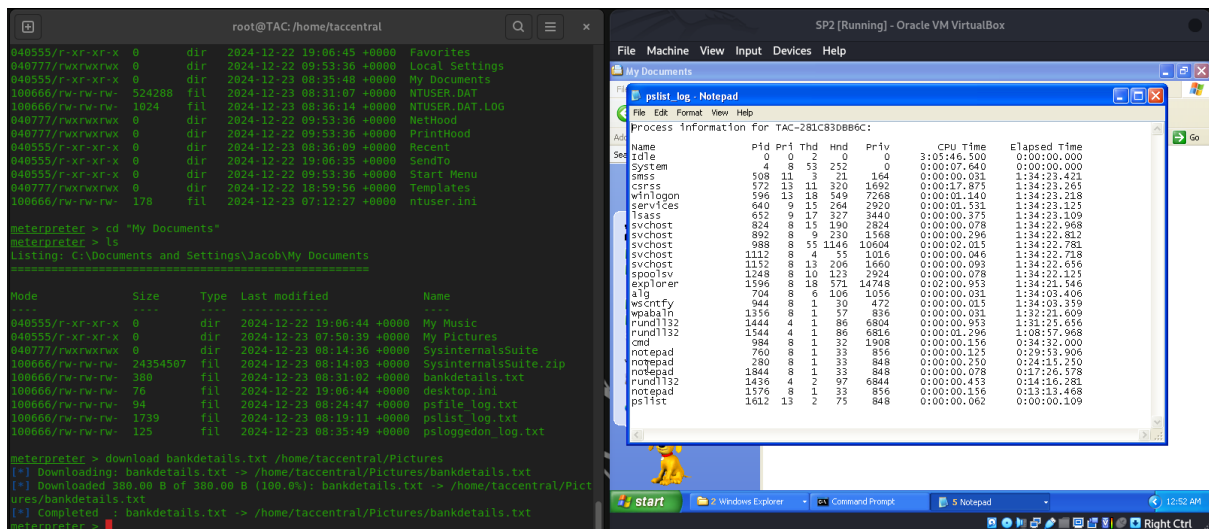
3. Sysinternals Tools Did Not Detect the Attack:

While the archived tools were functional, they failed to capture any evidence of the attack or file access operations involving bankdetails.txt. This included:

File activity monitoring using psfile



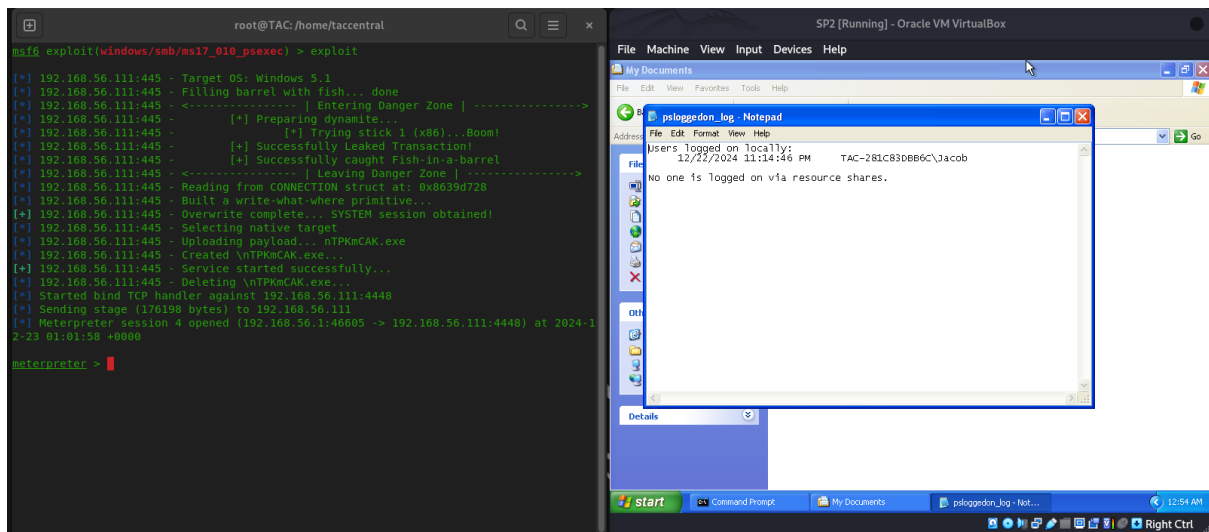
Process monitoring using pslist



Instructions to run Sysinternals on command line

1. Download the Sysinternals Suite from the Internet Archive if using Windows XP.
2. Extract the tools to a directory (e.g., C:\SysinternalsSuite).
3. Open a Command Prompt and navigate to the directory:
cd C:\SysinternalsSuite
4. Run the desired commands.

User session monitoring using psloggedon

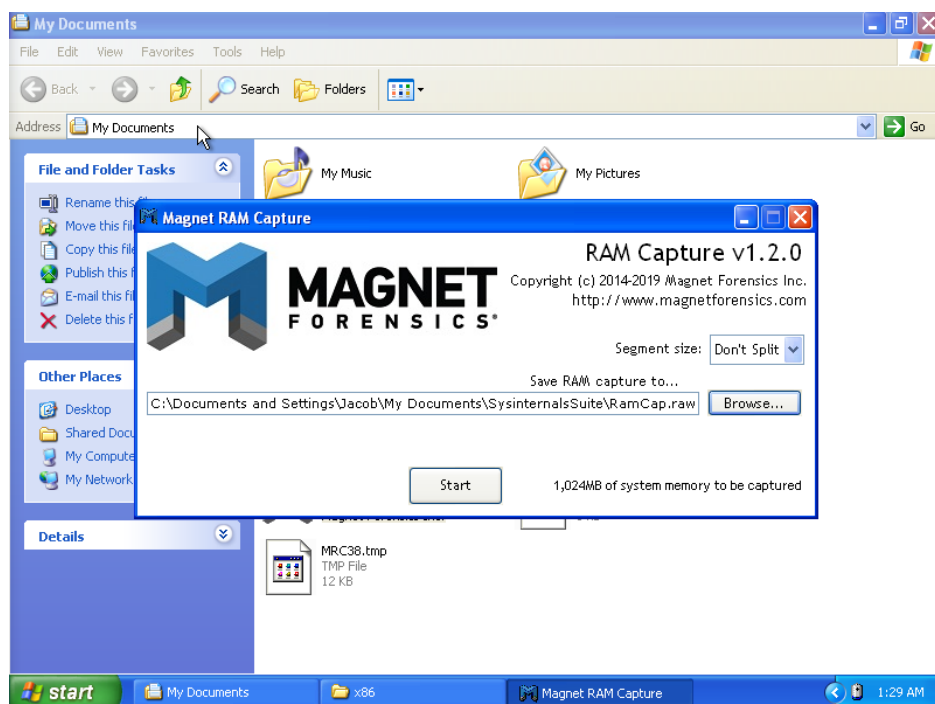


Despite the file being read, downloaded, and uploaded during the demonstration, no traces of these operations were detected.

Memory Analysis Using Magnet RAM Capture

Since the Sysinternals tools and PS commands were ineffective in detecting the attack, memory forensics was employed:

Magnet Forensics RAM Capture was used to create a memory dump (RamCap.raw) from the target system. This tool was selected as it supports legacy systems like Windows XP and offers forensic integrity.



2.2 RAM Capture Analysis

For the ram analysis setup, a tool called Redline made by FireEye will be used to analyze any altered data, actions and established connections. The following instructions will be a guide in exploring the **RamCap.raw** file:

Download and Install:

- Install Redline from FireEye.

Load the RAM Dump:

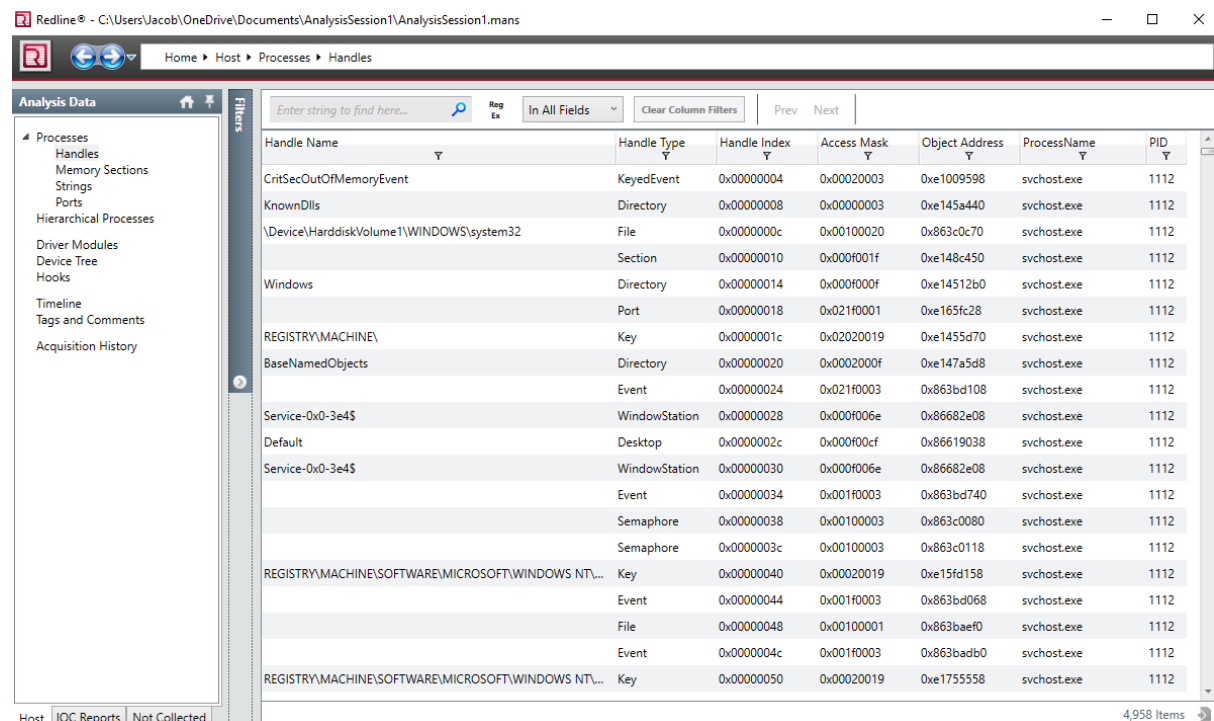
- Open Redline and create a new analysis session.
- Select Memory Dump and point to RamCap.raw.

Analyze:

The Interface was used to view the following:

- Running processes.
- Network connections.
- Potential malware or injected processes.

The following should show us a detailed analysis of the ram process once analysis is complete



Handle Name	Handle Type	Handle Index	Access Mask	Object Address	ProcessName	PID
CritSecOutOfMemoryEvent	KeyedEvent	0x00000004	0x00020003	0xe1009598	svchost.exe	1112
KnownDlls	Directory	0x00000008	0x00000003	0xe145a440	svchost.exe	1112
\Device\HarddiskVolume1\WINDOWS\system32	File	0x0000000c	0x00100020	0x863c0c70	svchost.exe	1112
Windows	Section	0x00000010	0x000f001f	0xe148c450	svchost.exe	1112
Windows	Directory	0x00000014	0x000f000f	0xe14512b0	svchost.exe	1112
Windows	Port	0x00000018	0x021f0001	0xe165fc28	svchost.exe	1112
REGISTRY\MACHINE\	Key	0x0000001c	0x02020019	0xe1455d70	svchost.exe	1112
BaseNamedObjects	Directory	0x00000020	0x0002000f	0xe147a5d8	svchost.exe	1112
BaseNamedObjects	Event	0x00000024	0x021f0003	0x863bd108	svchost.exe	1112
Service-0x0-3e4\$	WindowStation	0x00000028	0x000f006e	0x86682e08	svchost.exe	1112
Default	Desktop	0x0000002c	0x000f00cf	0x86619038	svchost.exe	1112
Service-0x0-3e4\$	WindowStation	0x00000030	0x000f006e	0x86682e08	svchost.exe	1112
Service-0x0-3e4\$	Event	0x00000034	0x001f0003	0x863bd740	svchost.exe	1112
Service-0x0-3e4\$	Semaphore	0x00000038	0x00100003	0x863c0080	svchost.exe	1112
Service-0x0-3e4\$	Semaphore	0x0000003c	0x00100003	0x863c0118	svchost.exe	1112
REGISTRY\MACHINE\SOFTWARE\MICROSOFT\WINDOWS NT\...	Key	0x00000040	0x00020019	0xe15fd158	svchost.exe	1112
REGISTRY\MACHINE\SOFTWARE\MICROSOFT\WINDOWS NT\...	Event	0x00000044	0x001f0003	0x863bd068	svchost.exe	1112
REGISTRY\MACHINE\SOFTWARE\MICROSOFT\WINDOWS NT\...	File	0x00000048	0x00100001	0x863baef0	svchost.exe	1112
REGISTRY\MACHINE\SOFTWARE\MICROSOFT\WINDOWS NT\...	Event	0x0000004c	0x001f0003	0x863badb0	svchost.exe	1112
REGISTRY\MACHINE\SOFTWARE\MICROSOFT\WINDOWS NT\...	Key	0x00000050	0x00020019	0xe1755558	svchost.exe	1112

Evidence of Attack on XP Ram Analysis using Redline

Redline - C:\Users\Jacob\OneDrive\Documents\AnalysisSession1\AnalysisSession1.mame

Home Host Processes Ports

Analysis Data

445

In All Fields

Clear Column Filters

Prev Next

1 match found

Process Name	PID	Path	State	Created	Local IP Address	Local Port	Remote IP Address	Remote Port	Protocol
svchost.exe	1152	C:\WINDOWS\system32	UNKNOWN	2024-12-23 07:15:04Z	1900	*	*	0	UDP
svchost.exe	988	C:\WINDOWS\system32	UNKNOWN	2024-12-23 07:15:03Z	123	*	*	0	UDP
svchost.exe	988	C:\WINDOWS\system32	UNKNOWN	2024-12-23 07:15:00Z	1025	*	*	0	UDP
lsass.exe	652	C:\WINDOWS\system32	UNKNOWN	2024-12-23 07:15:00Z	500	*	*	0	UDP
lsass.exe	652	C:\WINDOWS\system32	UNKNOWN	2024-12-23 07:15:00Z	4500	*	*	0	UDP
rundll32.exe	1064	C:\WINDOWS\system32	ESTABLISHED	2024-12-23 07:14:44Z	192.168.56.111	4448	192.168.56.1	4448	TCP
System	4		UNKNOWN	2024-12-23 07:14:54Z			*	0	UDP
System	4		UNKNOWN	2024-12-23 07:14:54Z			*	0	UDP
System	4		UNKNOWN	2024-12-23 07:14:54Z			*	0	UDP

Indicators of Compromise

Established Connections:
Port 4448 is not commonly used for legitimate Windows processes. A connection on this port, especially in combination with suspicious processes, suggests possible Command and Control (C2) activity.

Injected Memory Sections:

Filters

Review Memory Sections / DLLs

These views show the memory sections that each running process is comprised of. Named memory sections are those that are mapped to files, primarily DLLs.

Named Sections Only

Show only Named Sections.

Injected Memory Sections

Show only Injected Memory Sections.

All Memory Sections

Show all Memory Sections.

Temp

In All Fields

Clear Column Filters

Prev Next

Certificate Issuer	Certificate Subject	Injects	Protection	Region Start	Region Size	Raw Flags	Mapping	ProcessName	PID
		✓	EXECUTE_READWRITE Pri...	0x009b0000	176 Kilobytes	0xc600002c		rundll32.exe	1064
		✓	READWRITE PrivateMem...	0x009e0000	196 Kilobytes	0xc4000031		rundll32.exe	1064
		✓	READWRITE PrivateMem...	0x00cc0000	396 Kilobytes	0xc4000063		rundll32.exe	1064
		✓	READWRITE PrivateMem...	0x00d60000	148 Kilobytes	0xc4000025		rundll32.exe	1064
		✓	EXECUTE_READWRITE Pri...	0x009b0000	176 Kilobytes	0xc600002c		rundll32.exe	1544
		✓	READWRITE PrivateMem...	0x009e0000	196 Kilobytes	0xc4000031		rundll32.exe	1544
		✓	READWRITE PrivateMem...	0x00cc0000	396 Kilobytes	0xc4000063		rundll32.exe	1544
		✓	READWRITE PrivateMem...	0x00d60000	148 Kilobytes	0xc4000025		rundll32.exe	1544
		✓	EXECUTE_READWRITE Pri...	0x009b0000	176 Kilobytes	0xc600002c		rundll32.exe	1444
		✓	READWRITE PrivateMem...	0x009e0000	196 Kilobytes	0xc4000031		rundll32.exe	1444
		✓	READWRITE PrivateMem...	0x00cc0000	396 Kilobytes	0xc4000063		rundll32.exe	1444
		✓	READWRITE PrivateMem...	0x00d60000	148 Kilobytes	0xc4000025		rundll32.exe	1444
		✓	EXECUTE_READWRITE Pri...	0x009b0000	176 Kilobytes	0xc600002c		rundll32.exe	1436
		✓	READWRITE PrivateMem...	0x009e0000	196 Kilobytes	0xc4000031		rundll32.exe	1436
		✓	READWRITE PrivateMem...	0x00cc0000	396 Kilobytes	0xc4000063		rundll32.exe	1436
		✓	READWRITE PrivateMem...	0x00d60000	148 Kilobytes	0xc4000025		rundll32.exe	1436

Hide Whitelisted Items

Show Details

16 Items

rundll32.exe:
Often abused to execute malicious DLLs. If it is tied to a connection on port 4448, it could indicate a payload execution.

lsass.exe:
This process is a target for credential dumping attacks (e.g., via tools like Mimikatz)

svchost.exe:
Attackers commonly inject malicious code into this process because it is critical to Windows and often overlooked by defenders.

All processes being in an "unknown state" strengthen the suspicion of malicious activity.

Why is a Injected Memory Sections Important?

An injected memory section refers to a memory region in a process where malicious code has been injected by an attacker. This technique is commonly used in cyberattacks to execute payloads stealthily.

Injected code allows attackers to run their malicious programs inside the memory space of legitimate processes, making it harder for security tools to detect their activity.

Code Injection:

Malicious code is inserted into the memory of a legitimate process (e.g., svchost.exe, lsass.exe, or explorer.exe).

Attackers use this technique to bypass antivirus and security tools because the injected code appears to belong to a trusted process.

Common in Eternal Blue Attacks:

The code is executed in the context of the target process. Once the EternalBlue vulnerability is exploited, attackers typically inject malicious code into the memory of legitimate processes for stealth and functionality. This is common because:



(i) Stealth and Evasion

Injected code resides in the memory of trusted processes like lsass.exe or svchost.exe. Security tools monitoring disk activity or filesystem changes will not detect the payload because it is never written to disk.

(ii) Persistence

Injected code stays active as long as the target process runs. Key processes like svchost.exe are essential system processes and rarely terminated.

(iii) Privilege Escalation

EternalBlue often targets high-privilege processes like lsass.exe or services.exe, allowing injected code to inherit administrative or SYSTEM-level permissions.

3. Packet Capture

This section will detail the steps taken to capture, analyze, and interpret network traffic related to the attack. In this section an analysis tool called Wireshark and tcpdump will be used to analyze the live traffic between the attacker and the victim's machine.



3.1 Packet Capture Process

Tcpdump is a command-line tool used to capture network traffic in real time. It is lightweight, versatile, and often used on Linux systems. Captured traffic can be saved as a `.pcap` file for further analysis in tools like Wireshark.

Real-Time Capture: tcpdump must be ran during the attack to capture packets, as it cannot analyze past network activity unless logs were saved previously. Once the attack is complete, it can only analyze **existing captures** or monitor ongoing traffic.

Wireshark is a GUI-based tool for network traffic analysis. It provides advanced filtering, deep packet inspection, and visualization of network protocols, making it a go-to tool for forensic investigations.

Feature	TCPDump	Wireshark
Capture Traffic	Command-line tool; lightweight	GUI-based tool; user-friendly
Real-Time Monitoring	Yes, but requires CLI filters	Yes, with visual filtering and analysis
Post-Attack Analysis	Only with pre-existing <code>.pcap</code> files	Excellent for analyzing <code>.pcap</code> files
Advanced Filtering	Requires complex CLI filters	Easy-to-use GUI with protocol decoders
Visualization	None	Graphical representation of traffic

How is traffic captured?

Real-Time Capture: Like tcpdump, Wireshark captures packets in real time.

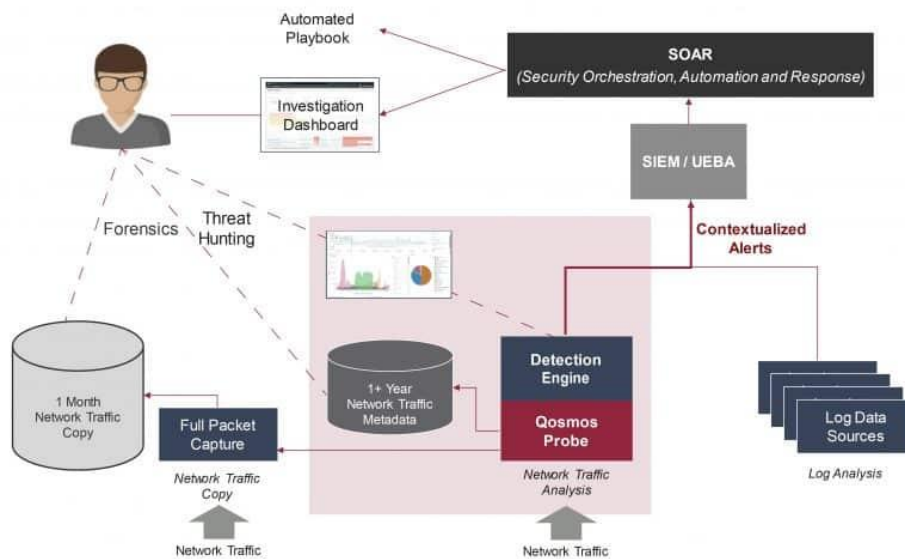
Post-Capture Analysis: Wireshark excels at analyzing previously captured `.pcap` files, making it ideal for detailed forensic investigation.



Wireshark and tcpdump cannot capture past traffic unless it was actively running during the attack. However:

- It can analyze pre-existing `.pcap` files if the attack was captured by another tool.
- You can start it to monitor for ongoing or subsequent malicious activity.

TCP Dump Commands



Capture traffic on port 445 (SMB):

```
sudo tcpdump -i eth0 port 445
```

Capture HTTP traffic (port 80):

```
sudo tcpdump -i eth0 port 80
```

Capture traffic to/from a specific IP:

```
sudo tcpdump -i eth0 host 192.168.1.10
```

Capture only TCP traffic:

```
sudo tcpdump -i eth0 tcp
```

Capture only UDP traffic:

```
sudo tcpdump -i eth0 udp
```

Capture only ICMP (ping) traffic:

```
sudo tcpdump -i eth0 icmp
```

Capture traffic to a specific host and port:

```
sudo tcpdump -i eth0 host 192.168.1.10 and port 445
```

Capture packets larger than 1000 bytes:

```
sudo tcpdump -i eth0 greater 1000
```

Capture Specific Packet Count:

```
sudo tcpdump -i eth0 -c 100
```

Display Traffic in Readable Format:

```
tcpdump -i eth0 -A
```

Show Timestamp for Packets:

```
tcpdump -i eth0 -tttt
```

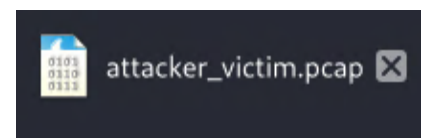

Given that this attack is done through a Host Only Adapter in a controlled environment on VirtualBox, the following interface **vboxnet0** is used for the attack traffic (common in VirtualBox host-only networking), you can adjust the **TCPDump commands** to capture traffic specifically on that interface.

Here's how to proceed:

```
(root@TAC) - [/home/taccentral]
# sudo tcpdump -i vboxnet0 host 192.168.56.1 and host 192.168.56.111 -w attacker_victim.pcap

tcpdump: listening on vboxnet0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
^C339 packets captured
339 packets received by filter
0 packets dropped by kernel
```

In this case the following command was used to monitor all traffic between the attacker and the victim. Once the attack is complete, analyze the resulting .pcap file in Wireshark to identify exploit related traffic and the Meterpreter session establishment.



What to Expect in the Capture

During Exploit Delivery:

- SMB packets (port 445) from the attacker to the victim.
- Malformed packets or unusual SMB requests.

During Payload Execution:

- TCP traffic between the attacker and victim.
- Evidence of the payload being delivered (e.g., Meterpreter).
- During Meterpreter Session Establishment:

No.	Time	Source	Destination	Protocol
245	0.245102	192.168.56.1	192.168.56.111	SMB
246	0.245204	192.168.56.111	192.168.56.1	TCP
247	0.245230	192.168.56.111	192.168.56.1	SMB
248	0.246078	192.168.56.1	192.168.56.111	SMB
249	0.246293	192.168.56.1	192.168.56.111	SMB
250	0.246387	192.168.56.111	192.168.56.1	TCP
251	0.246398	192.168.56.111	192.168.56.1	SMB
252	0.246534	192.168.56.1	192.168.56.111	TCP
253	0.246640	192.168.56.111	192.168.56.1	TCP
254	0.246648	192.168.56.1	192.168.56.111	TCP
255	0.249054	192.168.56.1	192.168.56.111	TCP
256	0.249251	192.168.56.111	192.168.56.1	TCP
257	0.855341	192.168.56.1	192.168.56.111	TCP
258	0.857620	192.168.56.111	192.168.56.1	TCP

Given the fact bind TCP was used:
The attacker connects to the victim's port (e.g., 4448 and other unusual ports).

Protocol	Length	Info
SMB	108	Echo Request
TCP	66	445 → 37397 [ACK] Seq=6732 Ack=26075 Win=64321 Len=0 TSval=103684 TSecr=424105289
SMB	108	Echo Response
SMB	206	NT Trans Secondary Request (secondary request)
SMB	108	Echo Request
TCP	66	445 → 37397 [ACK] Seq=6774 Ack=26257 Win=64139 Len=0 TSval=103684 TSecr=424105291
SMB	108	Echo Response
TCP	66	37397 → 445 [FIN, ACK] Seq=26257 Ack=6816 Win=64128 Len=0 TSval=424105291 TSecr=103684
TCP	66	445 → 37397 [FIN, ACK] Seq=6816 Ack=26258 Win=64139 Len=0 TSval=103684 TSecr=424105291
TCP	66	37397 → 445 [ACK] Seq=26258 Ack=6817 Win=64128 Len=0 TSval=424105291 TSecr=103684
TCP	74	43565 → 4448 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=424105294 TSecr=0 WS=128
TCP	54	4448 → 43565 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
TCP	74	44595 → 4448 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=424105900 TSecr=0 WS=128
TCP	78	4448 → 44595 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=1 TSval=0 TSecr=0 SACK_PERM

4. Statistical Data

Statistical data in network forensics provides insights into traffic patterns, protocol usage, and anomalies within a network.

By analyzing this data, we can identify unusual behavior, such as port scanning or excessive connections, which might indicate malicious activity.

Given the nature of the attack, it's evident and the high SMB traffic aligns with the MS17-010 exploit simulation, as this protocol is commonly targeted. The predominance of HTTP traffic suggests potential web-based communication or data exfiltration.

4.1 Network Protocol Usage

Given the attacker_victim.pcap file, the usage of the network protocols used in the attack is very important as it will give the investigator a better perspective of the attack technique as well as the type of attack.

The following command is used to output the data statistically:

```
(root@TAC) - [ /home/taccentral ]
# tshark -r attacker_victim.pcap -q -z io,phs

Running as user "root" and group "root". This could be dangerous.

=====
Protocol Hierarchy Statistics
Filter:

eth                frames:339 bytes:479843
  ip                frames:339 bytes:479843
    tcp             frames:339 bytes:479843
      nbss           frames:226 bytes:47987
        smb          frames:226 bytes:47987
          data        frames:33 bytes:20770
            ws.malformed frames:4 bytes:564
              dcerpc.cn_deseg_req frames:1 bytes:367
                dcerpc frames:12 bytes:2896
                  svcctl frames:10 bytes:1979
                    data frames:47 bytes:427464
=====
```

Overall Traffic Summary

Total Frames: 339

Total Bytes: 479,843 bytes

Primary Protocol:



TCP, indicating a connection-oriented communication protocol used extensively in this session.

Protocol Breakdown

1. Ethernet and IP Traffic

- **Ethernet (eth):**
 - The base layer for all packets, with 339 frames and a total of 479,843 bytes.
- **IP (Internet Protocol):**
 - Matches the Ethernet layer (339 frames, 479,843 bytes), as all packets carry IP headers.

2. TCP Traffic

- **TCP Protocol:**
 - All 339 frames use TCP, confirming the session is entirely connection oriented. TCP ensures reliable communication, often used for applications such as file sharing, SMB, or HTTP.

3. NetBIOS Session Service (NBSS)

- **Frames:** 226
- **Bytes:** 47,987 bytes
- NBSS is typically used for communication over SMB (Server Message Block). Its high usage indicates that the network traffic involves SMB-related activities.

4. SMB (Server Message Block)

- **Frames:** 226
- **Bytes:** 47,987 bytes
- SMB is a network file-sharing protocol used primarily on Windows systems. This high traffic volume confirms SMB usage in the session, likely related to the MS17-010 exploit, which targets SMB vulnerabilities.

5. Data Traffic within SMB

- **Frames:** 33
- **Bytes:** 20,770 bytes
- Data packets within SMB are used to exchange files or perform operations. The high data volume suggests potential file transfers or actions executed over SMB.

6. Malformed SMB Packets

- **Frames:** 4
- **Bytes:** 564 bytes
- Malformed packets indicate irregular or corrupted SMB communication. This could result from:
 - An intentional exploitation attempt (e.g., MS17-010 sends malformed SMB packets to trigger buffer overflow vulnerabilities).
 - Network anomalies or packet corruption.

This aligns with known exploitation behaviours for vulnerabilities like EternalBlue.

7. DCE/RPC (Distributed Computing Environment / Remote Procedure Calls)

- **Frames:** 12
- **Bytes:** 2,896 bytes
- DCE/RPC is used for remote procedure calls over a network. In this capture, it serves SMB traffic and is an indicator of attempts to interact with services on the target machine.
 - **svcsctl Frames:** 10 frames (1,979 bytes): Likely related to accessing or controlling Windows services remotely.

8. TCP Data

- **Frames:** 47
- **Bytes:** 427,464 bytes
- High data traffic outside SMB is indicative of file or payload exchanges. This is typical during post-exploitation stages where attackers transfer tools or exfiltrate data.

Indicators of Scanning and Exploitation

1. **High SMB Traffic:**
 - A significant portion of the traffic is SMB, including both legitimate and malformed packets. This aligns with the MS17-010 attack vector, which specifically targets SMB services.
2. **Malformed Packets:**
 - These indicate potential exploitation attempts, as malformed SMB packets are a hallmark of the EternalBlue exploit used for buffer overflows.
3. **DCE/RPC Activity:**
 - DCE/RPC frames involving svcsctl suggest attempts to interact with or control services on the victim machine. This is consistent with post-exploitation techniques, where attackers escalate privileges or maintain persistence.

4.2 Session Tracking & Data

To detect scanning activity in network traffic, specific types of packets and patterns are key indicators. These often suggest reconnaissance efforts, where an attacker probes the network to identify live hosts, open ports, or services.

What to Look For:

Nmap scans may exhibit specific patterns depending on the scan type:

TCP Connect Scan: SYN followed by ACK.

SYN Scan: SYN packets without a final handshake.

Null Scan: Packets with no flags set.

Xmas Scan: Packets with FIN, PSF, and URG flags set.

These are results of the current capture filter:

255 0.249054	192.168.56.1	192.168.56.111	TCP	74 43565 → 4448 [SYN] Seq=0 Win=64240
257 0.855341	192.168.56.1	192.168.56.111	TCP	74 44595 → 4448 [SYN] Seq=0 Win=64240
258 0.857620	192.168.56.111	192.168.56.1	TCP	78 4448 → 44595 [SYN, ACK] Seq=0 Ack=1

To filter these activities in Wireshark, use the following:

SYN Scan:

```
tcp.flags.syn == 1 && tcp.flags.ack == 0
```

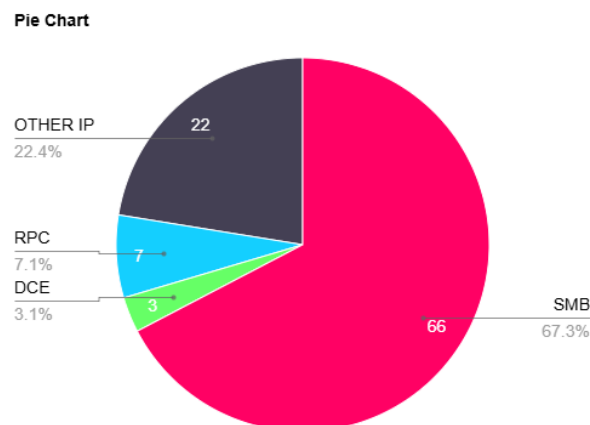
Null Scan:

```
tcp.flags == 0
```

Xmas Scan:

```
tcp.flags.fin == 1 && tcp.flags.psh == 1 && tcp.flags.urg == 1
```

By following these steps, you can effectively identify scanning activities and link them to potential reconnaissance or attack attempts.



5. Alert Data

The Alert Data Section focuses on detecting anomalies or attack-related events flagged by monitoring tools, logs, or forensic analysis. In the context of your MS17-010 exploit investigation, this section will document any alerts or suspicious patterns that point to the presence of the attack.

Purpose of Alert Data

- Identify anomalies or indicators of compromise (IoCs) related to the attack.
- Highlight suspicious activity (e.g., exploitation, payload execution, or file exfiltration).
- Correlate forensic evidence with detected alerts for a comprehensive understanding.

Improved Monitoring:

Enable logging for all SMB traffic on port 445.

Monitor critical processes (svchost.exe, lsass.exe) for injected memory.

Use host-based intrusion detection systems (HIDS) to flag unauthorized logins and file access.

Deploy network-based IDS/IPS tools like Snort or Suricata to detect malformed SMB packets.

Apply patches for known vulnerabilities like MS17-010 to prevent exploitation.

The following IoCs were flagged during the investigation:

1. SMB Exploitation:

- Malformed SMB packets from the attacker's IP

2. Unauthorized Access:

- Remote login as SYSTEM.

3. Payload Execution:

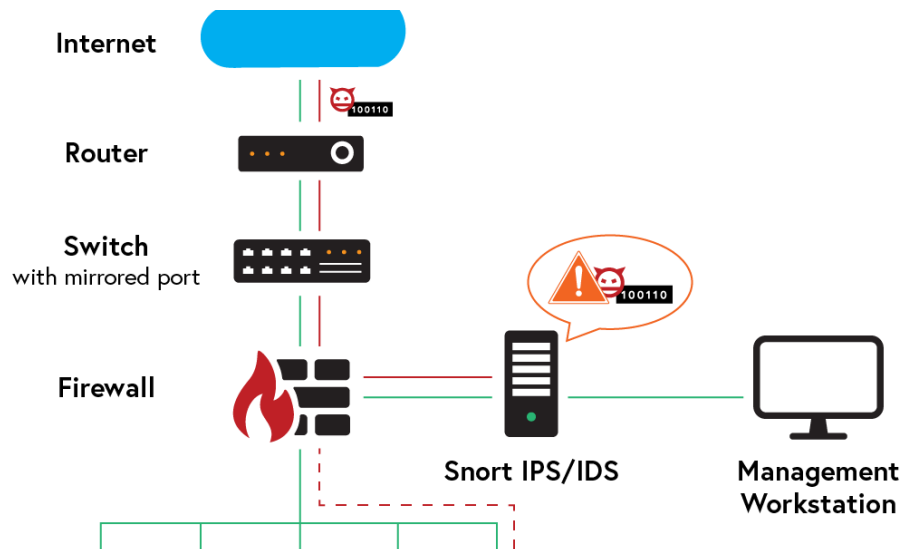
- Suspicious processes (rundll32.exe, svchost.exe) with injected memory.

4. C2 Traffic:

- Outbound connection on **port 4448** to the attacker.

5.1 IDS Setup & Alert Analysis

An Intrusion Detection System (IDS) is a security tool or software designed to monitor network traffic or system activities for malicious activities, policy violations, or suspicious behaviour. If it detects something unusual, it generates alerts for further investigation.



There are two primary types of IDS:

1. Network-Based IDS (NIDS):

Monitors network traffic in real-time.

Placed at strategic points in a network, like behind a firewall or near critical assets.

Inspects data packets for malicious patterns, such as known exploit signatures or unusual traffic behaviour.

Example: Snort, Suricata

2. Host-Based IDS (HIDS):

Monitors a specific host or device for suspicious activity.

Tracks file changes, unauthorized logins, and malicious processes.

Uses logs, memory, and file integrity monitoring for intrusion detection.

Example: OSSEC, Tripwire

Benefits of Using IDS

- Early detection of potential threats.
- Provides visibility into suspicious activity on the network or host.
- Helps in forensic investigations by logging and reporting attack details.



What are the Detection Techniques Used?

Signature-Based Detection:

Matches traffic or activity against known attack signatures (e.g., MS17-010 exploit).
Fast and accurate for known threats but ineffective for new or unknown attacks.

Anomaly-Based Detection:

Detects deviations from normal behaviour (e.g., unusual login times or excessive file access).
Can detect zero-day or unknown attacks but may generate more false positives.

Hybrid Detection:

Combines signature-based and anomaly-based methods to improve detection accuracy.

Detecting SMB Exploits for (MS17-010):

An IDS like [Snort](#) can flag malformed SMB packets or specific attack patterns associated with EternalBlue.

Monitoring File Integrity:

HIDS tools like OSSEC can detect unauthorized file modifications on a victim machine.

Detecting Command and Control (C2) Traffic:

NIDS tools can alert on unusual outbound traffic to attacker-controlled servers.



1. Update System: `sudo apt update && sudo apt upgrade -y`

2. Install Snort: `sudo apt install snort -y`

3. Verify Installation: `snort -V`

For NIDS (Zeek):

Simulate an attack, such as an SMB exploit (MS17-010).

Snort will log:

Malformed SMB packets.

Unauthorized access attempts.

Setting up IDS Using Zeek

```
root@TAC: /home/taccentral x root@TAC: /home/taccentral x root@TAC: /home/taccentral x
GNU nano 8.1 /opt/zeek/share/zeek/site/local.zeek *
# the conn.log file.
# @load policy/protocols/conn/community-id-logging

# Uncomment the following line to enable logging of connection VLANs. Enabling
# this adds two VLAN fields to the conn.log file.
# @load policy/protocols/conn/vlan-logging

# Uncomment the following line to enable logging of link-layer addresses. Enabling
# this adds the link-layer address for each connection endpoint to the conn.log file.
# @load policy/protocols/conn/mac-logging

# Uncomment this to source zkg's package state
# @load packages

@load protocols/smb
```

Check that Zeek is running:

```
(root@TAC) - [/home/taccentral]
# sudo /opt/zeek/bin/zeekctl status

Hint: Run the zeekctl "deploy" command to get started.
Name      Type      Host      Status  Pid      Started
zeek      standalone localhost stopped
```

Deploy Zeek with the updated configuration:

```
(root@TAC) - [/opt/zeek/base/protocols/smb]
# sudo /opt/zeek/bin/zeekctl deploy

checking configurations ...
installing ...
creating policy directories ...
installing site policies ...
generating standalone-layout.zeek ...
generating local-networks.zeek ...
generating zeekctl-config.zeek ...
generating zeekctl-config.sh ...
stopping ...
stopping zeek ...
starting ...
starting zeek ...
```

Confirm Zeek Is Monitoring the Correct Interface

Zeek needs to be running on the network interface where the attack traffic flows. Check your network interfaces:

```
(root@TAC) - [/opt/zeek/base/protocols/smb]
# sudo /opt/zeek/bin/zeek -C -i vboxnet0 /opt/zeek/share/zeek/site/local.zeek

listening on vboxnet0
```


Analyze Zeek Logs

Connection Logs (conn.log): This log will contain details about network connections, including those to the SMB service (port 445):

```
(root@TAC) - [ /home/taccentral ]
# cat /opt/zeek/logs/current/conn.log | grep 445

1735076431.846090    CKy3nr2XfQeB6xPYZ9    192.168.56.1    39695    192.168.56.111    445    tcp-    -    -    -
    OTH    T    T    0    C    0    0    0    0    0    -
1735076431.846451    C51DHP3MuW3YDM8TD1    192.168.56.1    39695    192.168.56.111    445    tcpdce_rpc,ntlm,smb    0.6
95459    0    7013    SHR    T    T    0    ^hCdCaCf    00    128    13681    -
```

5.2 Key Finding Using IDS for MS17-010

Log Breakdown (Connection 1)

```
1735076431.846090    CKy3nr2XfQeB6xPYZ9    192.168.56.1    39695    192.168.56.111
445    tcp-    -    -    OTH    T    T    0    C    0    0    0    0    -
```

Timestamp (1735076431.846090): The exact time the connection was initiated, in epoch format.

Connection UID (CKy3nr2XfQeB6xPYZ9): A unique identifier for this connection.

Source IP and Port (192.168.56.1:39695): The attacker's IP and ephemeral port.

Destination IP and Port (192.168.56.111:445): The victim's IP and SMB port.

Protocol (tcp-): Indicates a TCP-based connection.

Connection State (OTH): Denotes "Other" – likely a non-standard or unexpected behaviour in the TCP handshake, which may suggest malicious activity.

Log Breakdown (Connection 2)

```
1735076431.846451    C51DHP3MuW3YDM8TD1    192.168.56.1    39695    192.168.56.111
445    tcpdce_rpc,ntlm,smb    0.695459    0    7013    SHR    T    T    0    ^hCdCaCf    00
128    13681    -
```

Timestamp (1735076431.846451): Slightly after the first connection – likely part of the same attack session.

Service (tcpdce_rpc,ntlm,smb): Indicates that the traffic is related to SMB, NTLM (authentication protocol), and DCE/RPC (a remote procedure call protocol often exploited in MS17-010 attacks).

Duration (0.695459): The connection lasted ~0.7 seconds.

Bytes Transferred (7013): The attacker sent 7013 bytes during this session.

Connection State (SHR): Indicates "Server Handshake Reset" – the server reset the connection after a handshake attempt, often a sign of probing or exploitation.

6. Full Content Data

6.1 Reconstructed Data

The reconstructed data flows highlight the interactions between the attacker and victim machines, showcasing the various stages of the MS17-010 exploit. The following flows were observed and correlated with other data sources to demonstrate the attack's progression:

Connection Establishment

- **Event:** The attacker established a connection to the victim on **port 445 (SMB)**.
- **Network Logs:** Zeek's conn.log file shows an initiated connection

```
1735076431.846451 C51DHP3MuW3YDM8TD1 192.168.56.1 39695 192.168.56.111
445 tcpdce_rpc,ntlm,smb 0.695459 0 7013 SHR T T 0 ^hCdCaCf 00
128 13681 -
```

Correlations:

- **Alert Data:** Snort flagged malformed SMB packets during this connection.
- **Statistical Data:** High SMB traffic (226 frames) confirms the significance of this connection.

Exploit Delivery

- **Event:** The EternalBlue exploit was delivered using malformed SMB packets.
- **Network Logs:** Zeek logs indicate SMB and dce_rpc activities, typical of exploitation attempts.
- **Packet Capture:** Wireshark showed malformed SMB packets targeting port 445

Payload Execution

- **Event:** A bind shell was established on **port 4448**, allowing the attacker remote access to victim
- **Network Logs:** Zeek's conn.log recorded a connection to port 4448:

```
1735076431.846451 C51DHP3MuW3YDM8TD1 192.168.56.1 39695 192.168.56.111
4448 tcp - - - -
```

Packet Capture: Wireshark captured traffic indicating reverse or bind shell activity.

Correlations: Redline revealed injected processes (rundll32.exe, lsass.exe) initiating outbound connections.

6.2 Correlation with Other Data Types

The reconstructed data flows were correlated with other data sources to provide a complete picture of the attack:

Statistical Data

- **High SMB Traffic:** Significant SMB traffic (226 frames, 47,987 bytes) aligns with the attack's focus on exploiting the SMBv1 protocol.
- **Malformed Packets:** Malformed SMB packets confirm the use of EternalBlue for exploitation.

Session Tracking

- **Connection States:** Non-standard connection states (OTH, SHR) in session logs indicate irregular SMB activity.
- **Duration Analysis:** Sessions lasting under a second highlight rapid exploitation attempts.

Alert Data

- **Snort Alerts:** Malformed SMB packets were flagged as potential MS17-010 exploit attempts.
- **IoCs:** Alerts for unauthorized access and unusual outbound traffic (e.g., port 4448) matched observed data flows.

Memory and File Analysis

- **Injected Processes:** Redline's analysis of RamCap.raw revealed injected memory sections (rundll32.exe, lsass.exe) tied to the exploit.
- **Open Files:** Evidence of file access correlates with SMB data packets in the capture.

Demonstration of Evidence

This section demonstrates the critical findings and how they support the conclusion:

1. **Exploit Detection:**
 - Malformed SMB packets and Zeek logs confirm the use of EternalBlue.
2. **Payload Delivery:**
 - Evidence of a bind shell on port 4448 aligns with network logs and memory analysis.
3. **Post-Exploitation:**
 - Injected processes and file access show the attack's impact on the victim system.
4. **Timeline Reconstruction:**
 - Combining network, session, and memory data provides a chronological view of the attack.

7. Conclusion

The reconstructed data flows and their correlation with other data types provide clear evidence of the MS17-010 exploitation. The attack leveraged SMBv1 to execute malicious payloads, establish a bind shell, and access files on the victim machine.

This analysis demonstrates the importance of correlating network, session, and memory data for comprehensive forensic investigations.

7.1 Summary of Findings

The forensic investigation into the MS17-010 exploit revealed critical insights into the attack's methodology and impact. By analysing network traffic, memory dumps, and intrusion detection alerts, the following findings were established:



1. **Exploit Detection:**
 - The attacker exploited the MS17-010 vulnerability (EternalBlue) by sending malformed SMB packets to the victim's machine on port 445. This was confirmed through Zeek session logs and packet captures.
2. **Payload Execution:**
 - A bind shell was established on port 4448, allowing remote control over the victim machine. Network logs, packet analysis, and memory artifacts corroborated this activity.
3. **Indicators of Compromise (IoCs):**
 - Injected memory sections in critical processes (rundll32.exe, lsass.exe, svchost.exe) were identified, indicating the execution of malicious payloads.
 - Snort flagged SMB traffic anomalies, including malformed packets and unauthorized access attempts.
4. **Post-Exploitation Activity:**
 - File access operations and potential data exfiltration were observed through SMB data flows, with evidence of interaction with sensitive files like bankdetails.txt.
5. **Network Behaviour:**
 - Significant SMB traffic and malformed packets indicated the use of EternalBlue.
 - Irregular connection states and session durations highlighted suspicious activity.

This investigation demonstrates the critical need for timely patching of vulnerabilities, proactive monitoring, and robust incident response protocols to mitigate similar attacks.

7.2 Recommendations & Future Steps

Patch Management:

Immediately apply security updates to address known vulnerabilities like MS17-010 on all systems, particularly legacy environments such as Windows XP.

Disable SMBv1 Protocol:

SMBv1 should be permanently disabled on all systems to prevent exploitation through outdated protocols.

Intrusion Detection and Monitoring:

Deploy and configure robust intrusion detection systems (e.g., Snort or Zeek) to flag anomalies like malformed packets and unauthorized access attempts.

Network Segmentation:

Isolate legacy systems from critical assets through VLANs or firewalls to minimize the attack surface.

Incident Response Preparedness:

Establish and regularly update incident response plans. Conduct simulations to ensure teams are ready to handle active threats effectively.

Memory and File Forensics:

Train security teams in memory forensics tools like Redline and Volatility to identify injected processes and malware artifacts.

Future Steps:

- 1. Forensic Training and Capability Development:**
 - Enhance training in advanced forensic tools and techniques, including network and memory analysis, to detect and mitigate sophisticated attacks.
- 2. Automated Threat Detection:**
 - Integrate AI-based tools for real-time monitoring of anomalous network traffic and suspicious behaviour in endpoint systems.
- 3. Legacy System Hardening:**
 - Deploy additional security controls (e.g., endpoint detection and response tools) on legacy systems until they can be retired or replaced.
- 4. Enhanced Logging and Auditing:**
 - Enable detailed logging of all network and system activities, ensuring that comprehensive logs are available for forensic analysis.
- 5. Collaboration and Threat Intelligence Sharing:**
 - Participate in cybersecurity threat intelligence sharing programs to stay updated on emerging threats and vulnerabilities.

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