LEADERSHIP FOR IT SECURITY & PRIVACY ACROSS HHS

HHS CYBERSECURITY PROGRAM

OFFICE OF INFORMATION SECURITY

SMB Vulnerabilities in Healthcare

11/05/2020

TLP: WHITE, ID#202011051030

Invulnerable

The Wall of Constantinople

Your Network
with SMBv1 Protocol

VS

Mehmed II 27 foot Bronze Cannons

EternalBlue

Agenda

- SMB Overview
- SMB Vulnerabilities
- SMB Exploitation and its Effects
- SMB and Healthcare
- SMB Identification Methods
- SMB Remediation
- Summary
- References

Slides Key:

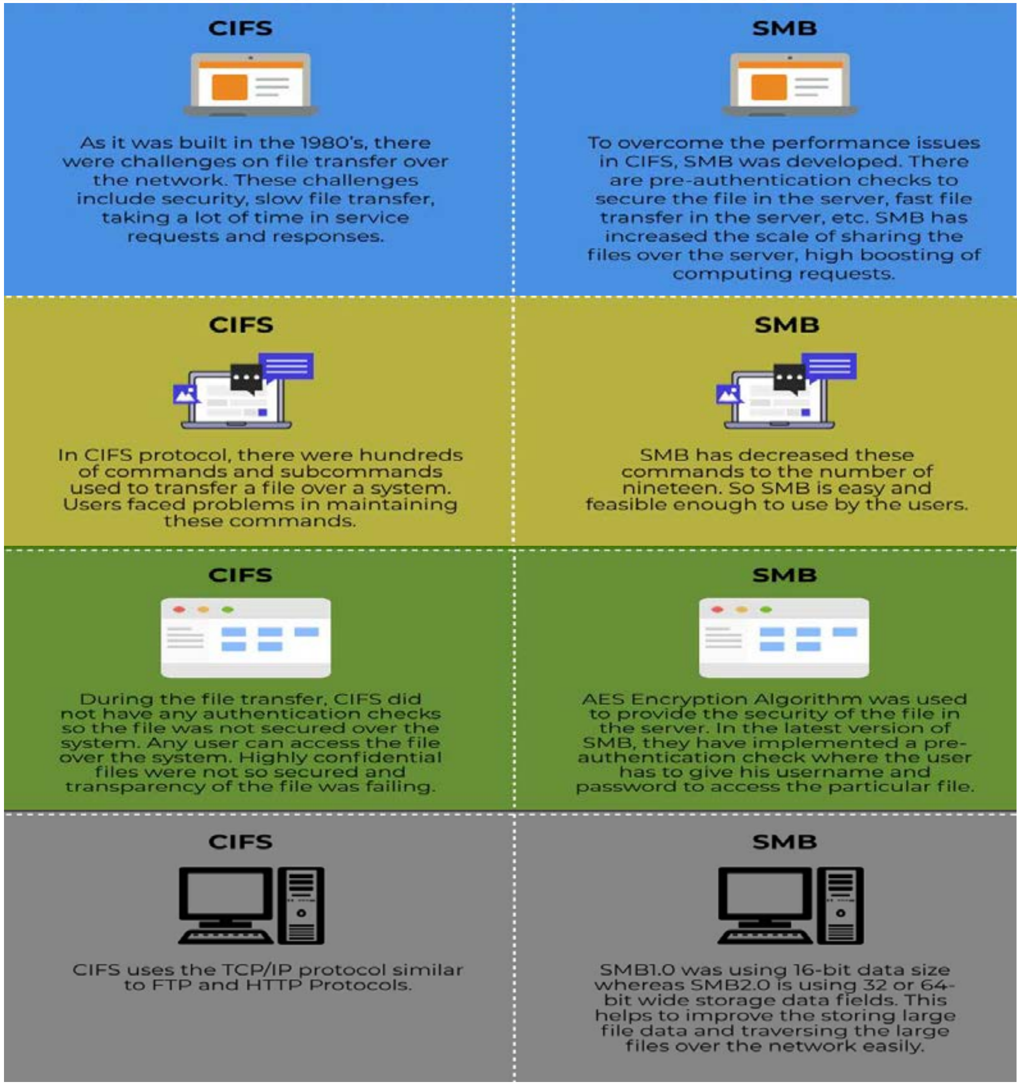
Non-Technical: Managerial, strategic and high-level (general audience)

Technical: Tactical / IOCs; requiring in-depth knowledge (sysadmins, IRT)

SMB Overview

Server Message Block (SMB)

is an enhanced version of CIFS (Common Internet File System) done by Microsoft for the release of Windows 95 in the early 1990s. Due to CIFS challenges with security, slow file transfer, and taking a lot of time responding to service requests and responses, SMB was developed.

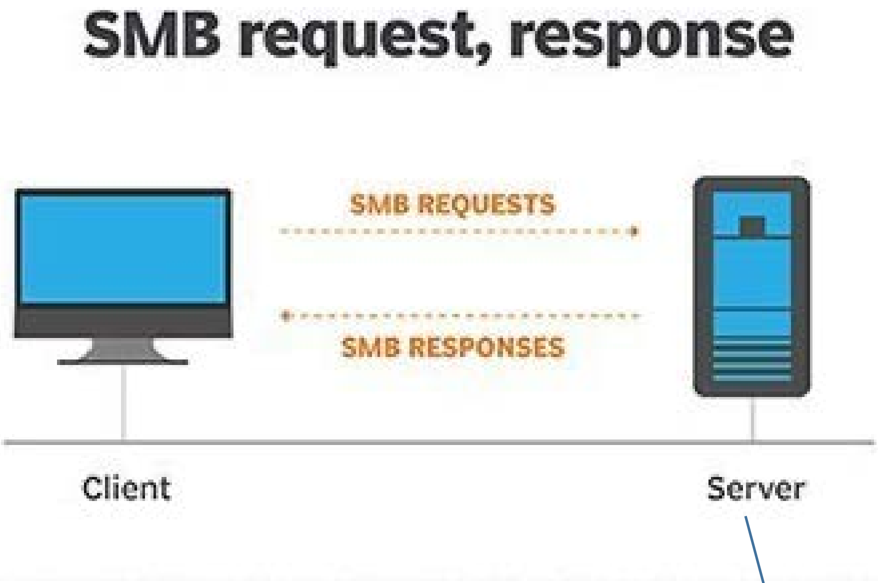


CIFS	SMB
As it was built in the 1980's, there were challenges on file transfer over the network. These challenges include security, slow file transfer, taking a lot of time in service requests and responses.	To overcome the performance issues in CIFS, SMB was developed. There are pre-authentication checks to secure the file in the server, fast file transfer in the server, etc. SMB has increased the scale of sharing the files over the server, high boosting of computing requests.
In CIFS protocol, there were hundreds of commands and subcommands used to transfer a file over a system. Users faced problems in maintaining these commands.	SMB has decreased these commands to the number of nineteen. So SMB is easy and feasible enough to use by the users.
During the file transfer, CIFS did not have any authentication checks so the file was not secured over the system. Any user can access the file over the system. Highly confidential files were not so secured and transparency of the file was failing.	AES Encryption Algorithm was used to provide the security of the file in the server. In the latest version of SMB, they have implemented a pre-authentication check where the user has to give his username and password to access the particular file.
CIFS uses the TCP/IP protocol similar to FTP and HTTP Protocols.	SMB1.0 was using 16-bit data size whereas SMB2.0 is using 32 or 64-bit wide storage data fields. This helps to improve the storing large file data and traversing the large files over the network easily.

Image source: Educba

SMB Overview

SMB is a client-server interaction protocol where clients request a file and the server provides it to the client. SMB gives users the ability to create, modify and delete shared files, folders, and printer access within the network.



- Printers
- Scanners
- File system
- Serial Port

PORT 445 ⟷ PORT 139

SMB runs directly over TCP (port 445) or over NetBIOS (usually port 139, rarely port 137 or 138).

SMB Overview

SMB Versions

1984 **SMBv1.0**: Very similar to the CIFS protocol that shares the files over a network to access them among the clients in an effective way. SMB was initially introduced to run on top of NetBIOS and TCP/IP interface. *Version is the most vulnerable.

2006 **SMBv2.0**: Reduced the "chattiness" of SMB1.0 by lessening the number of commands and subcommands used to communicate. SMBv2 helped to store larger file data and communicate the large files over the network in less time.

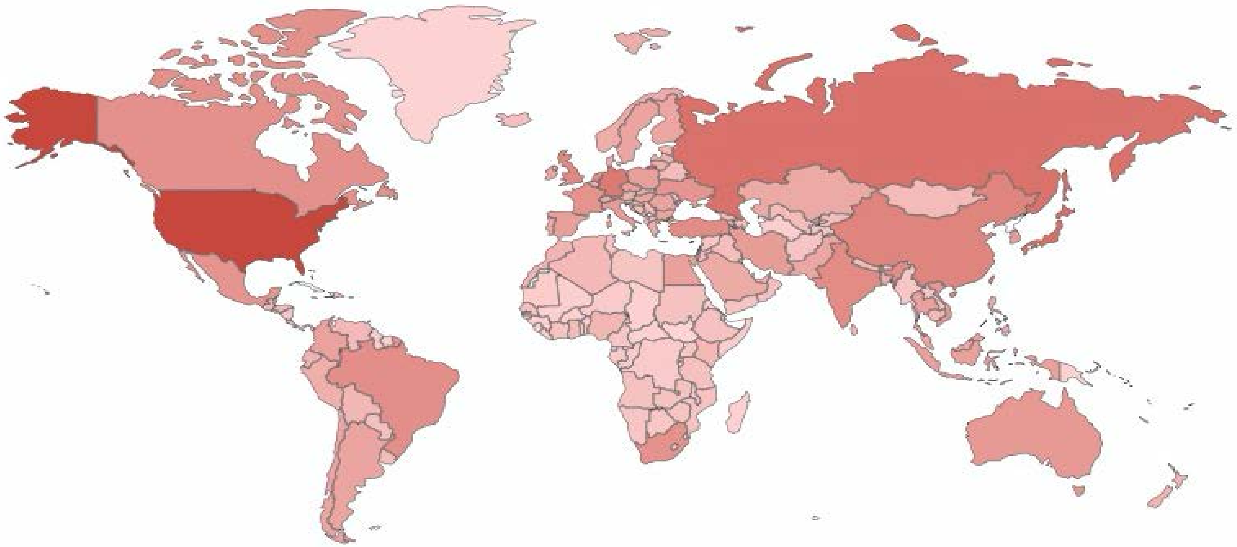
2008 **SMBv2.1:** Introduced with Windows 7 and Server 2008 R2; introduced further performance enhancements with a new opportunistic locking mechanism.

2012 **SMBv3.0**: Introduced in WINDOWS 8 Server and windows server 2012. It was introduced to improve the encryption level end to end. It is sometimes called version 2.2.

2020 **SMBv3.1.1**: Introduced with Windows 10 Server and Windows server 2016. SMB 3.1.1 version uses the AES encryption algorithm to implement pre-authenticated security checks using the SHA-512 hash key. *Most up to date version.

Image source: Allot.com

Shodan search for “SMB version: 1” port: “445” OS: Windows



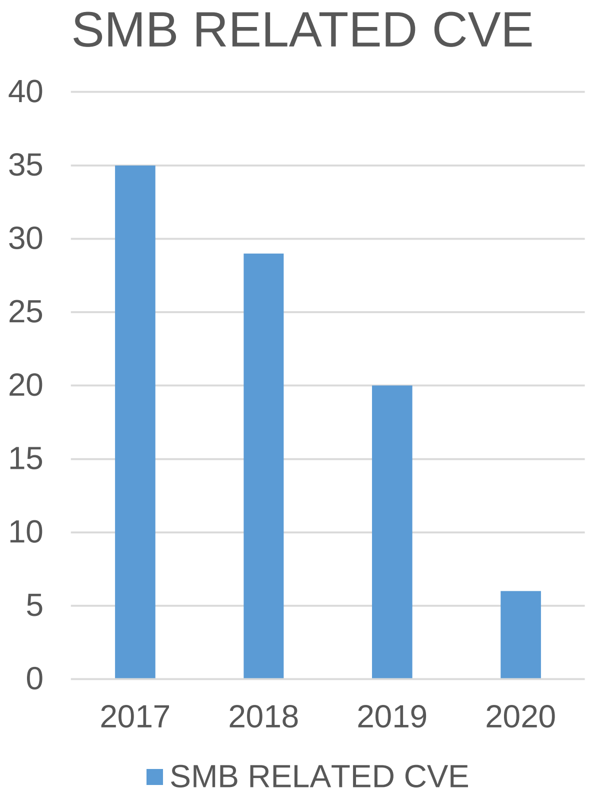
Top Countries	Hosts
United States	270,536
Russia	51,796
Hong Kong	51,351
Germany	48,741
Japan	44,064

SMB Exploitation and its Effects

The Shadow Brokers (hacker group) leaked a developed SMB exploit, also known as EternalBlue. Microsoft was forced to issue a critical security bulletin (MS17-010) on March 14, 2017. EternalBlue was used as the initial compromise vector or as a method of lateral movement for other cyberattacks such as WannaCry, Emotet, NotPetya and TrickBot.

Other related exploits labelled:

- Eternalromance
- Eternalchampion
- Eternalsynergy
- Eternalrocks



SMB Exploitation and its Effects

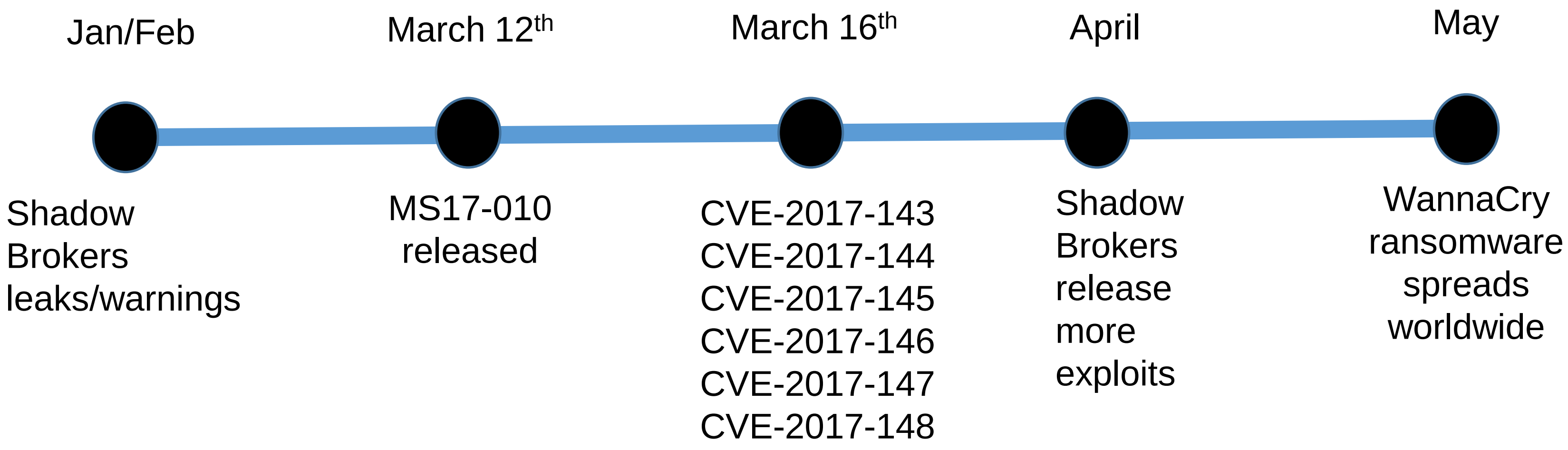
WannaCry	Takes advantage of SMBv1 vulnerability to compromise Windows machines, load malware, and propagate to other machines in a network.
Emotet	Emotet infections are initiated by different mailspam campaigns. Once Emotet is downloaded it can undetectably install Trickbot via SMB vulnerability onto the host system.
TrickBot	Uses standard attack vectors for infection to spread to other clients/servers such as malvertising, spear phishing, network vulnerabilities (SMB and RDP), and secondary payloads.
NotPetya	Malware that uses a variety of techniques to spread to other computers, including EternalBlue and EternalRomance. Known to target mostly Ukrainian industries.

SMB Exploitation and its Effects

EternalBlue	(SMBv1) server in various versions of Microsoft Windows mishandles specially crafted packets from remote attackers, allowing them to execute arbitrary code on the target computer.
EternalRomance	A RCE attack that exploits CVE-2017-0145 against the legacy SMBv1 file-sharing protocol.
EternalChampion	Triggers a race condition in how SMBv1 handles transactions. CVE-2017-0146
EternalSynergy	Proof of Concept (POC) that shows that incoming SMB messages are copied by an initial handler into the corresponding transaction buffer. CVE-2017-0146
EternalRocks	Uses seven NSA tools where WannaCry, for example, only used two (EternalBlue and another called DoublePulsar).

SMB Exploitation and its Effects

2017



Jan/Feb

Shadow Brokers leaks/warnings

March 12th

MS17-010 released

March 16th

CVE-2017-143
CVE-2017-144
CVE-2017-145
CVE-2017-146
CVE-2017-147
CVE-2017-148

April

Shadow Brokers release more exploits

May

WannaCry ransomware spreads worldwide

SMB Vulnerabilities

CVE-2017-143

MS17-010 once published initiated a series of additional vulnerabilities associated with SMBv1.

The SMBv1 server affects:

- 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
- Windows 10 Gold, 1511, and 1607
- Windows Server 2016

This vulnerability allows remote attackers to execute arbitrary code via crafted packets.

This vulnerability is related to the following other vulnerabilities:

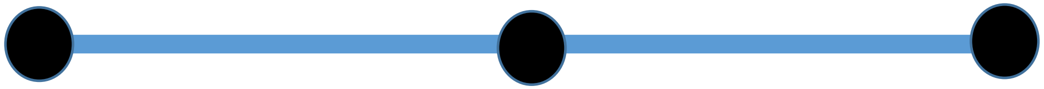
VULNERABILITY
CVE-2017-0144
CVE-2017-0145
CVE-2017-0146
CVE-2017-0147
CVE-2017-0148

SMB and Healthcare

National Health Service (UK)

The WannaCry ransomware targeted computers running Microsoft Windows operating system by encrypting data and demanding ransom payment in the Bitcoin cryptocurrency. The initial infection was likely through an exposed vulnerable internet-facing SMB port according to the Lessons learned review of the WannaCry Ransomware Cyber Attack.

NHS



NHS Digital alerts Department of Health and Social Care at 13:00, 12 May

NHS England declared a major incident at 16:00 on 12 May

Kill switch discovered on the evening of 12 May: stopped further spread of malware

1,220

pieces of diagnostic equipment across the NHS were affected by WannaCry.

https://www.england.nhs.uk/wp-content/uploads/2018/02/lessons-learned-review-wannacry-ransomware-cyber-attack-cio-review.pdf

Healthcare Devices

The Clinical Information Center (CIC) Pro workstations are connected to CARESCAPE, a real-time monitoring network for medical facilities, so they can interact with and display data from other devices on the network, including telemetry servers and bedside monitors.

Image source: GE Healthcare

Processor Box

CVE-2020-6963 attackers have the ability to read and write access to all files on the system and affects CIC versions 4.x and 5.x, CSCS version 1.x, Apex Telemetry Server versions 4.2 and earlier, as well as CARESCAPE Telemetry Server versions 4.3 and earlier.

Ultrasound Products

Select Ultrasound products are affected by the Microsoft Windows SMBv1 vulnerabilities. The exploitability of the vulnerabilities depends on the actual configuration and deployment environment of each product.

Listens on network ports 139/tcp, 445/tcp or 3389/tcp.

Image source: Siemens Healthineers

SMB Identification Methods

DETECT

- PowerShell
- Registry Editor

ENABLE/DISBALE

- PowerShell
- Registry Editor
- Group Policy

AUDIT SMBv1 Usage

- PowerShell

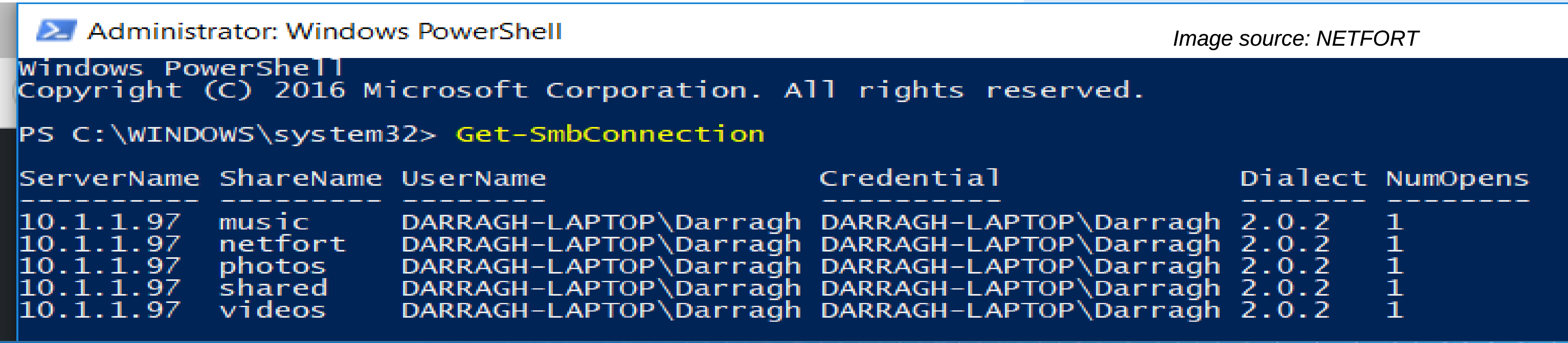


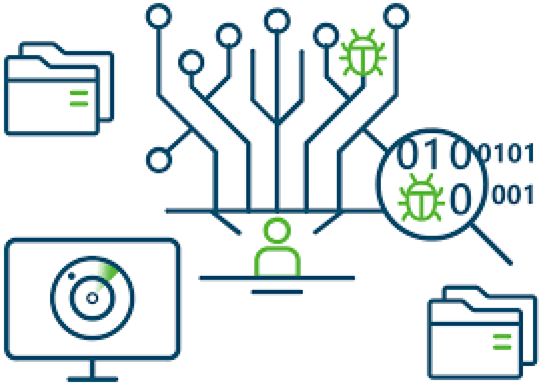
Image source: NETFORT

```
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\WINDOWS\system32> Get-SmbConnection

ServerName ShareName UserName                Credential              Dialect NumOpens
---------- --------- --------                ----------              ------- --------
10.1.1.97  music     DARRAGH-LAPTOP\Darragh DARRAGH-LAPTOP\Darragh 2.0.2   1
10.1.1.97  netfort   DARRAGH-LAPTOP\Darragh DARRAGH-LAPTOP\Darragh 2.0.2   1
10.1.1.97  photos    DARRAGH-LAPTOP\Darragh DARRAGH-LAPTOP\Darragh 2.0.2   1
10.1.1.97  shared    DARRAGH-LAPTOP\Darragh DARRAGH-LAPTOP\Darragh 2.0.2   1
10.1.1.97  videos    DARRAGH-LAPTOP\Darragh DARRAGH-LAPTOP\Darragh 2.0.2   1
```

SMB Identification Methods, Continued

Vulnerability Scanner

Various vulnerability scanners may help with this, but need to know which systems to query.



Network Tap

Capture network traffic by using a SPAN\Mirror port and detect version from a network traffic monitoring application.

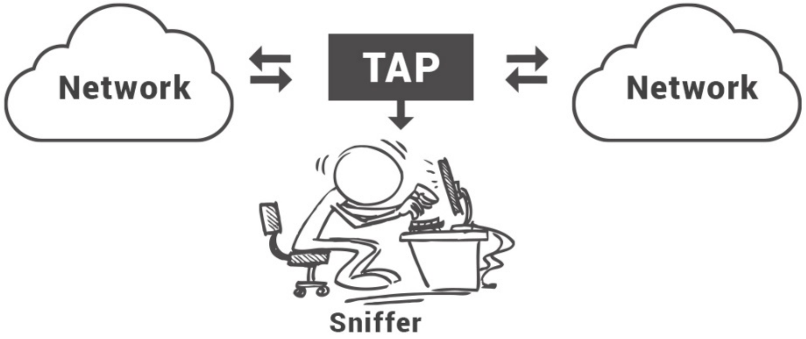
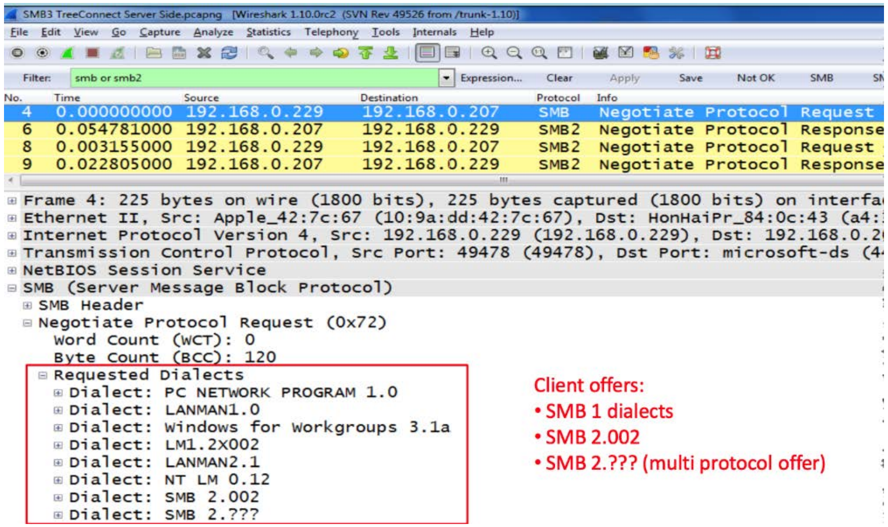


Image source: Leutert NetServices

SMB Identification Methods Continued

Detect SMB Version/Dialect Negotiation Request through filters.

https://sharkfestus.wireshark.org/sharkfest.13/presentations/NAP-03_Microsoft-SMB-Troubleshooting_Rolf-Leutert.pdf



SMB3 TreeConnect Server Side.pcapng [Wireshark 1.10.0rc2 (SVN Rev 49526 from /trunk-1.10)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Expression... Clear Apply Save Not OK SMB SM

Filter: smb or smb2

```
No. Time        Source         Destination    Protocol Info
4   0.000000000 192.168.0.229  192.168.0.207  SMB      Negotiate Protocol Request
6   0.054781000 192.168.0.207  192.168.0.229  SMB2     Negotiate Protocol Response
8   0.003155000 192.168.0.229  192.168.0.207  SMB2     Negotiate Protocol Request
9   0.022805000 192.168.0.207  192.168.0.229  SMB2     Negotiate Protocol Response

⊞ Frame 4: 225 bytes on wire (1800 bits), 225 bytes captured (1800 bits) on interfa
⊞ Ethernet II, Src: Apple_42:7c:67 (10:9a:dd:42:7c:67), Dst: HonHaiPr_84:0c:43 (a4:
⊞ Internet Protocol Version 4, Src: 192.168.0.229 (192.168.0.229), Dst: 192.168.0.2
⊞ Transmission Control Protocol, Src Port: 49478 (49478), Dst Port: microsoft-ds (4
⊞ NetBIOS Session Service
⊟ SMB (Server Message Block Protocol)
  ⊞ SMB Header
  ⊟ Negotiate Protocol Request (0x72)
      Word Count (WCT): 0
      Byte Count (BCC): 120
    ⊟ Requested Dialects
      ⊞ Dialect: PC NETWORK PROGRAM 1.0
      ⊞ Dialect: LANMAN1.0
      ⊞ Dialect: Windows for Workgroups 3.1a
      ⊞ Dialect: LM1.2X002
      ⊞ Dialect: LANMAN2.1
      ⊞ Dialect: NT LM 0.12
      ⊞ Dialect: SMB 2.002
      ⊞ Dialect: SMB 2.???
```

Client offers:
- SMB 1 dialects
- SMB 2.002
- SMB 2.??? (multi protocol offer)

Image source: Wireshark Sharkfest

If certain features are enabled in the extraction of logs, SMB versions can be displayed through search.

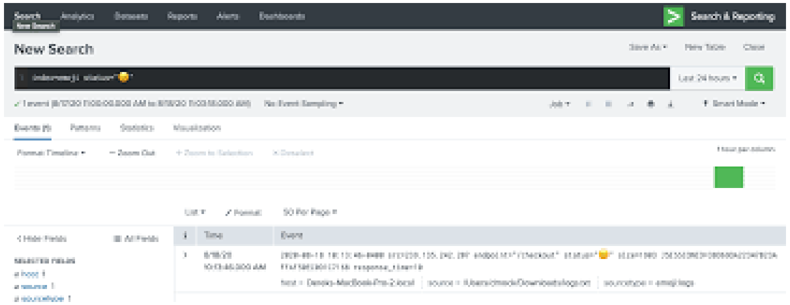
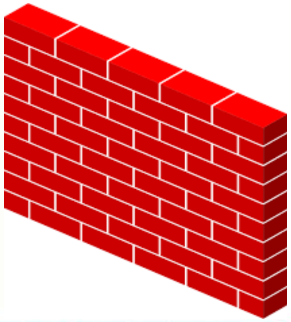


Image source: Splunk Blog

SMB Remediation Options

Patch	Use recommended patches for specific systems and vulnerabilities.
Isolate and/or Replace	Disconnect the system(s) from network and use as standalone until patches can be administered.
Port Filter	Perimeter hardware and appliance firewalls that are positioned at the edge of the Network should block unsolicited communication from the known NETBIOS and SMB Ports 137-139 and 445.

Continue to do NOTHING = 

Summary

75% of unpatched vulnerabilities among SMBs are more than one year old, according to Alert Logic research. It's only a matter of time before there is another attack. As a recap, remember it only takes one determined attacker and one system to gain access to your wall or network. In order for Healthcare to prevent SMBv1 as the initial compromise vector or as a method of lateral movement for other cyber attacks, assessments and remediation's are needed. Let's be proactive!

Reference Materials

References

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- [MS-SMB2]: Server Message Block (SMB) Protocol Versions 2 and 3
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  - https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2017-0144
- CVE-2017-0145
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- The Leaked NSA Spy Tool That Hacked the World
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Questions

Upcoming Briefs

- ***TrickBot and Ryuk***
- ***Chinese State-sponsored Cyber Activity***

Product Evaluations

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Questions