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WIRESHARK

Lab nr. 1 (12.02.2021)

We have download from wireshark.org the latest version of Wireshark (64 bit for computer).

Wireshark is open source and free packet analyser. The original name is Ethereal. It can be used for education, network analysis and troubleshooting. It was developed by Gerald Combs. It runs on Linux, macOS, BSD, Solaris and Microsoft Windows.

“Packet analysis, often referred to as packet sniffing or protocol analysis, describes the process of capturing and interpreting live data as it flows across a network in order to better understand what is happening on that network. Packet analysis is typically performed by a packet sniffer, a tool used to capture raw network data going across the wire. Packet analysis can help with the following: λ Understanding network characteristics λ Learning who is on a network λ Determining who or what is utilizing available bandwidth λ Identifying peak network usage times λ Identifying possible attacks or malicious activity λ Finding unsecured and bloated applications”[1] Wireshark works based on 3 process such as: collection[2], conversion[3] and analysis[4]

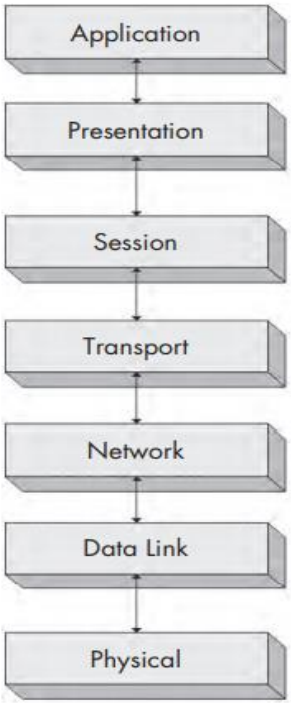
Protocols:

‘’Common protocols include Transmission Control Protocol (TCP), Internet Protocol (IP), Address Resolution Protocol (ARP), and Dynamic Host Configuration Protocol (DHCP). A protocol stack is a logical grouping of protocols that work together’’[5]

Protocols can have easy or difficult structure.

[1] Chris Sanders, Practical Packet Analysis, p.26
[2] collects raw binary data from the wire.
[3] the captured binary data is converted into a readable form
[4] the actual analysis of the captured and converted data
[5] Chris Sanders, Practical Packet Analysis, p.24

OSI model



Source: Chris Sanders, Practical Packet Analysis, p.31

Layer 7- layer seen by end user, it provides the interface.

Layer 6- it handles with encryption and decryption.

Layer 5- it manages the sessions between the computers.

Layer 4- it provides the transport to lower layers.

Layer 3- one of the most complex OSI layers, logical addressing of network hosts.

Layer 2- it provides the means of transporting data across a physical network, provides the addressing scheme that can be used for devices identification (MAC address etc.)

Layer 1- physical medium, through which network

Types of protocols used in layers

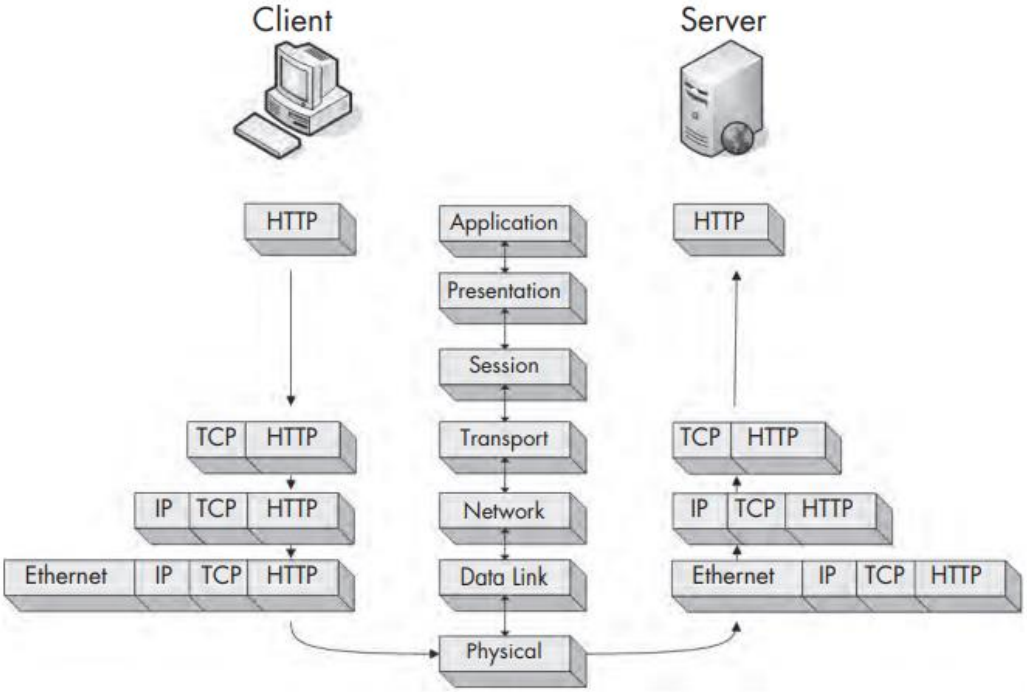
Layer	Protocol
Application	HTTP, SMTP, FTP, Telnet
Presentation	ASCII, MPEG, JPEG, MIDI
Session	NetBIOS, SAP, SDP, NWLink
Transport	TCP, UDP, SPX
Network	IP, IPX
Data link	Ethernet, Token Ring, FDDI, AppleTalk

''Each layer in the OSI model is capable of communicating with only the layers directly above and below it.''[6]

Data encapsulation:

'' Each layer in the stack is responsible for adding a header or footer—extra bits of information that allow the layers to communicate—to the data being communicated'' (..) The encapsulation process creates a protocol data unit (PDU), which includes the data being sent and all header or footer information added to it.''[7] The packet = PDU with header and footer information from all layers.

Encapsulation of data between client and server.



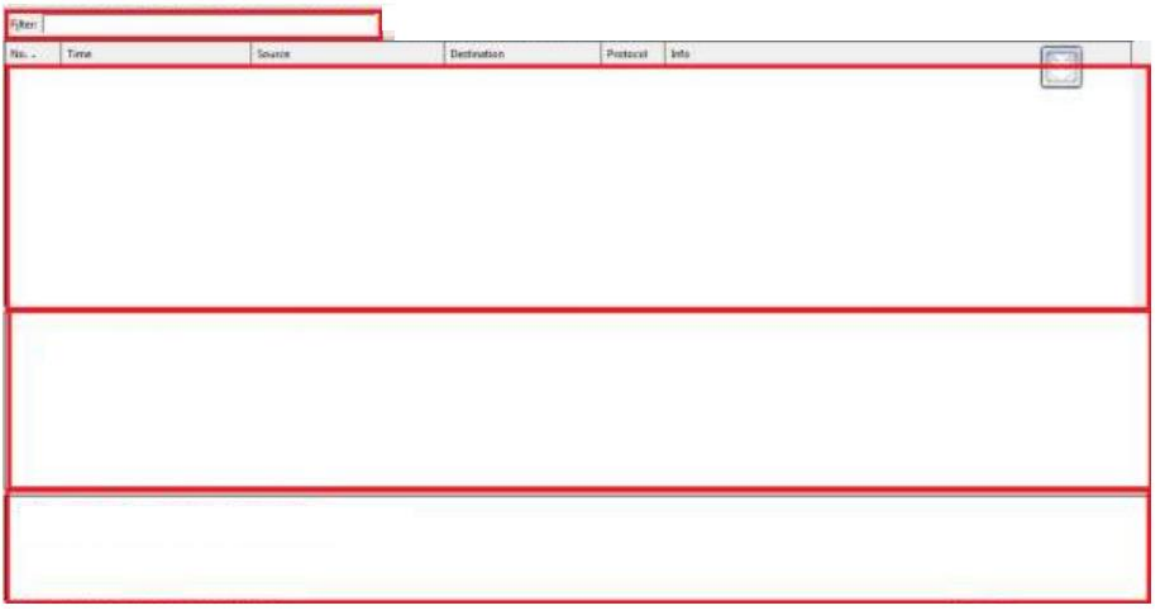
Snapshots from Wireshark:

We have choosen WIFI and in the settings tick off the option which disables presenting what come from other network. At the bottom we see 7 headers such as: no, time, source, destination, protocol, length and info. Time is shown in seconds. The protocols are: DHCP[8] v6, MDNS[9], DNS[10], TCP[11], TSL v.1.2[12] and others.

[6] Chris Sanders, Practical Packet Analysis, p.31.
[7] Chris Sanders, Practical Packet Analysis, p.32.
[8] The Dynamic Host Configuration Protocol is a network management protocol used on Internet Protocol networks, whereby a DHCP server dynamically assigns an IP address and other network configuration parameters to each device on the network, so they can communicate with other IP networks.
[9] Multicast DNS
[10] The Domain Name System is a hierarchical and decentralized naming system for computers, services, or other resources connected to the Internet or a private network. It associates various information with domain names assigned to each of the participating entities

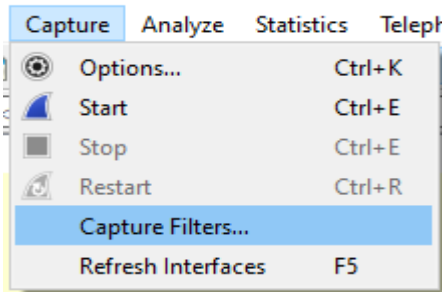
[11] The Transmission Control Protocol is one of the main protocols of the Internet protocol suite.
[12] Transport Layer Security

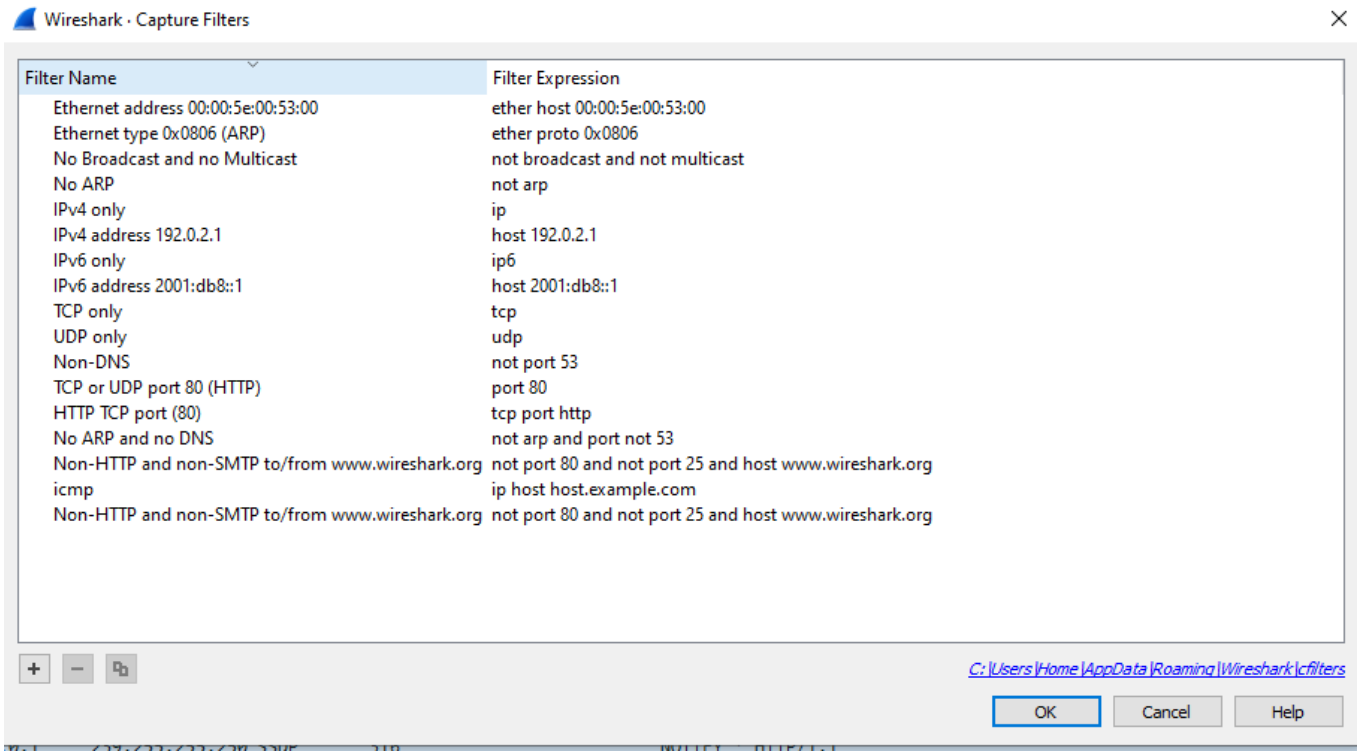
Description of basic windows program:



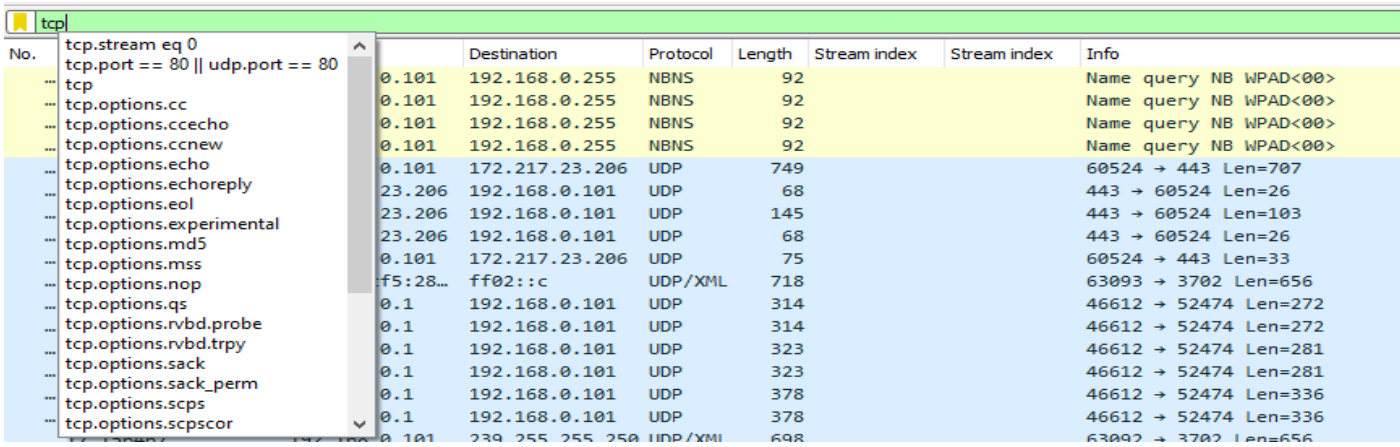
At the top is definition of filter of displaying. Below there is a window with captured packets. In the middle there is a content of highlighted packet. At the bottom there is a content of RAW highlighted packet. When we turned on packet capture, we could see the amount of information was transmitted by our network. The power of Wireshark is in its filters, which allows narrow the results down.

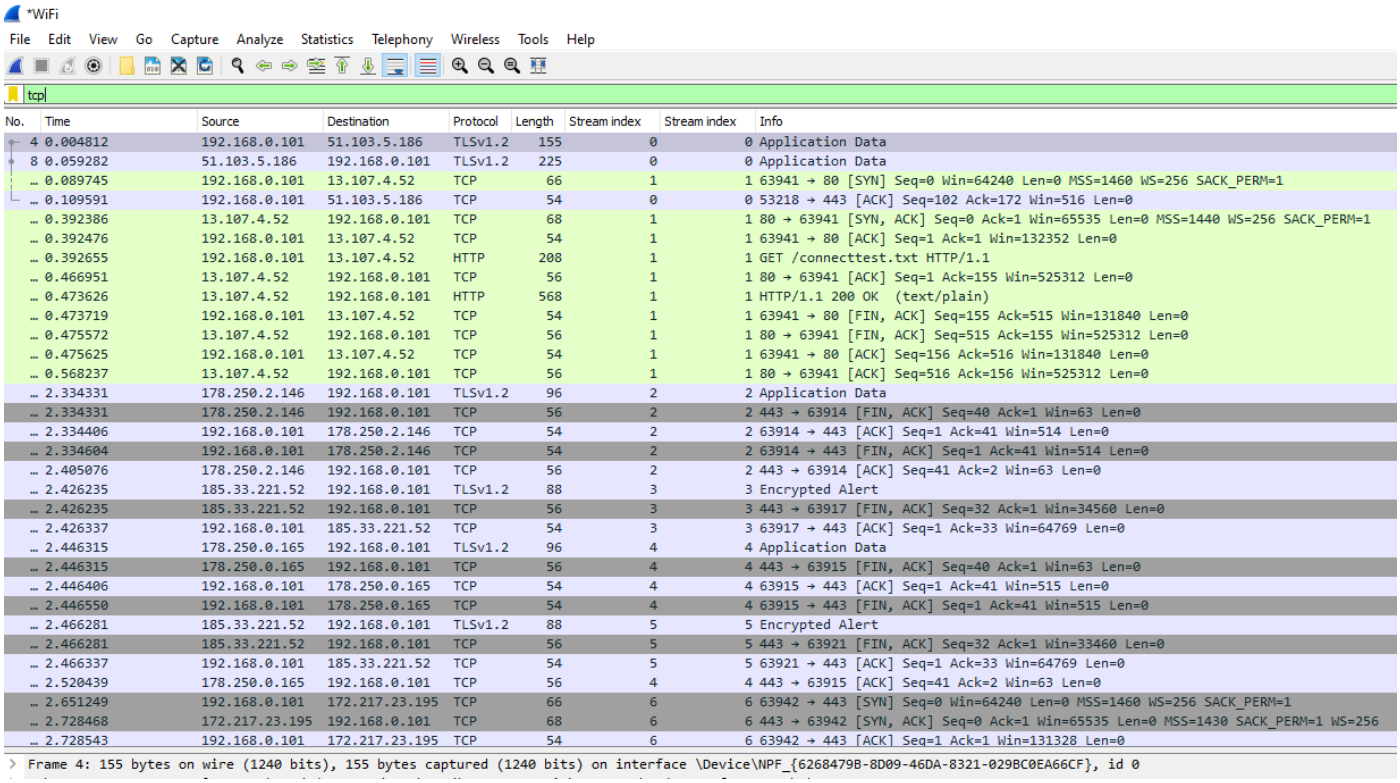
Filters: Options -> Capture Filters





We can choose what is interested in for us for example TCP or we can start write on the green field at the top, we have a menu with some options which we can choose.





Protocols:

Protocol	Protocol
LLMNR	TLSv1.3
LLMNR	TLSv1.3
TCP	TLSv1.3
TCP	TLSv1.3
TCP	TCP
AJP13	TLSv1.3
TCP	TLSv1.3
UDP	TLSv1.3
AJP13	TCP
TCP	TLSv1.3
TCP	TLSv1.3
TCP	TLSv1.3
TCP	TCP
AJP13	TCP
TCP	TCP
TCP	TLSv1.3

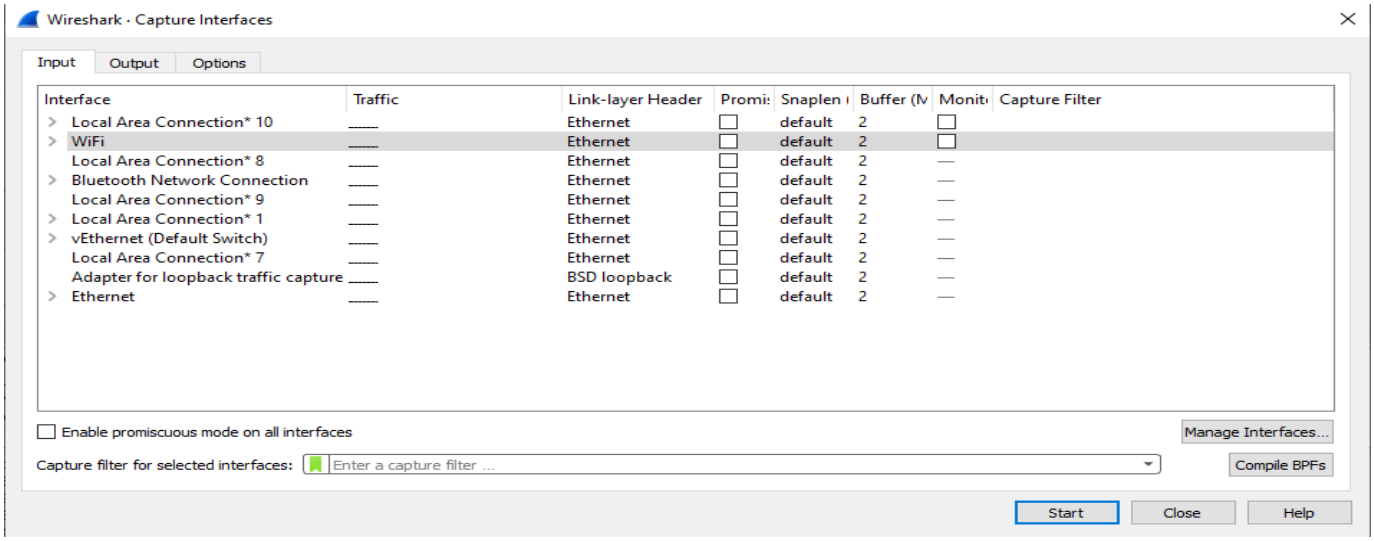
No.	Time	Source	Destination	Protocol	Length	Info
4810	391.979138	91.198.174.208	192.168.0.81	TCP	56	443 → 59146 [ACK] Seq=288315 Ack=2386 Win=42496 Len=0
4811	391.162636	192.168.0.81	192.168.0.69	AJP13	164	AJP13 Error? [TCP segment of a reassembled PDU]
4812	391.166796	192.168.0.69	192.168.0.81	TCP	164	8009 → 59168 [PSH, ACK] Seq=5800 Ack=920 Win=15680 Len=110
4813	391.208676	192.168.0.81	192.168.0.69	TCP	54	59168 → 8009 [ACK] Seq=920 Ack=5910 Win=131072 Len=0
4814	391.398827	192.168.0.81	74.125.71.188	TCP	55	[TCP Keep-Alive] 59116 → 5228 [ACK] Seq=789 Ack=4509 Win=13
4815	391.427468	74.125.71.188	192.168.0.81	TCP	66	[TCP Keep-Alive ACK] 5228 → 59116 [ACK] Seq=4509 Ack=790 Wi
4816	391.669048	192.168.0.81	192.168.0.69	TCP	55	[TCP Keep-Alive] 59117 → 8008 [ACK] Seq=248 Ack=1200 Win=13
4817	391.673350	192.168.0.69	192.168.0.81	TCP	66	[TCP Keep-Alive ACK] 8008 → 59117 [ACK] Seq=1200 Ack=249 Wi
4818	393.232839	192.168.0.81	216.58.204.35	TCP	55	[TCP Keep-Alive] 59138 → 443 [ACK] Seq=2802 Ack=4526 Win=13
4819	393.247254	216.58.204.35	192.168.0.81	TCP	66	[TCP Keep-Alive ACK] 443 → 59138 [ACK] Seq=4526 Ack=2803 Wi
4820	393.263829	192.168.0.81	216.58.204.67	TCP	55	[TCP Keep-Alive] 59147 → 443 [ACK] Seq=1664 Ack=4556 Win=13
4821	393.263943	192.168.0.81	142.250.178.14	TCP	55	[TCP Keep-Alive] 59137 → 443 [ACK] Seq=1879 Ack=5702 Win=13
4822	393.284340	216.58.204.67	192.168.0.81	TCP	66	[TCP Keep-Alive ACK] 443 → 59147 [ACK] Seq=4556 Ack=1665 Wi
4823	393.290674	142.250.178.14	192.168.0.81	TCP	66	[TCP Keep-Alive ACK] 443 → 59137 [ACK] Seq=5702 Ack=1880 Wi

Is it important to open Wireshark with the Promiscuous Mode turned off?

"Promiscuous mode" is a network interface mode in which the NIC reports every packet that it sees"[13] It is not good as we should not see what other people in our neighbourhood doing as we don't have permission to do it. ''If you're connected to a switch as opposed to a hub, broadcast traffic and multicast traffic will go to all ports, but unicast traffic does not. Check your switch to see if you can configure the port you're using for Wireshark to have all traffic sent to it ("monitor" mode), and/or to "mirror" traffic from one port to another"[14]

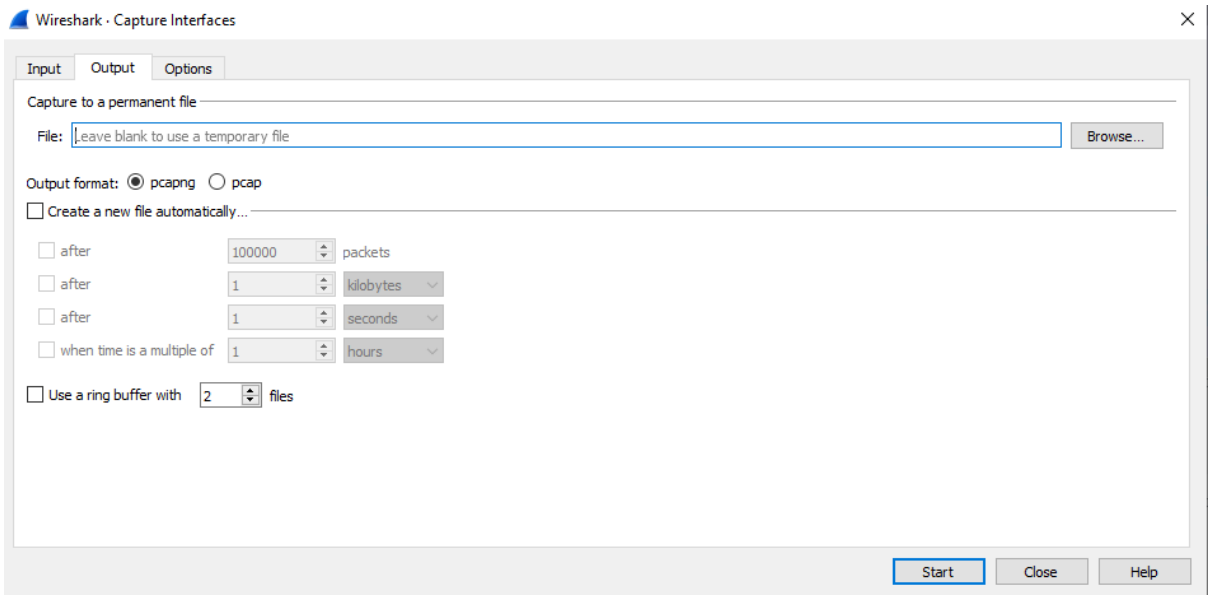
At the bottom, we see a list, we have choosen WIFI and remember tick off option" enable promiscuous on all interfaces'' in the left bottom corner.

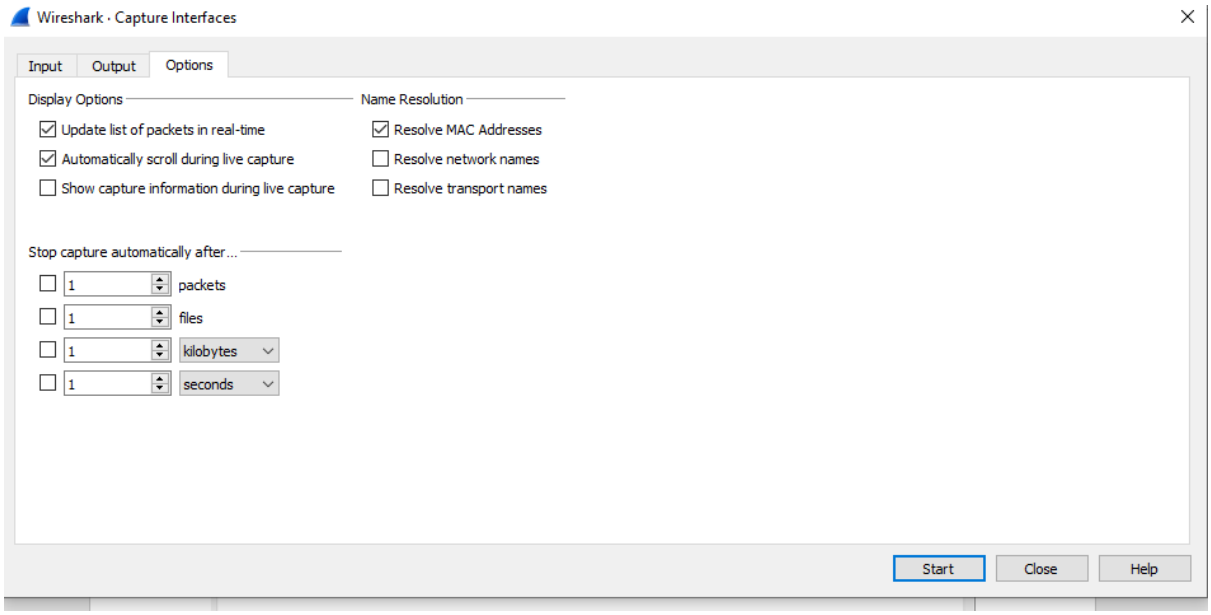
We see 3 tabs such as: input, output and options. In the first one we choose WIFI, we haven't done any changes in 2 others, we have left how was fixed.



[13] https://www.networkworld.com/article/2231903/wireshark-and-promiscuous-mode.html
[14] https://www.networkworld.com/article/2231903/wireshark-and-promiscuous-mode.html

Without changes here:





In the case of having difficulties with this mode, we should use:

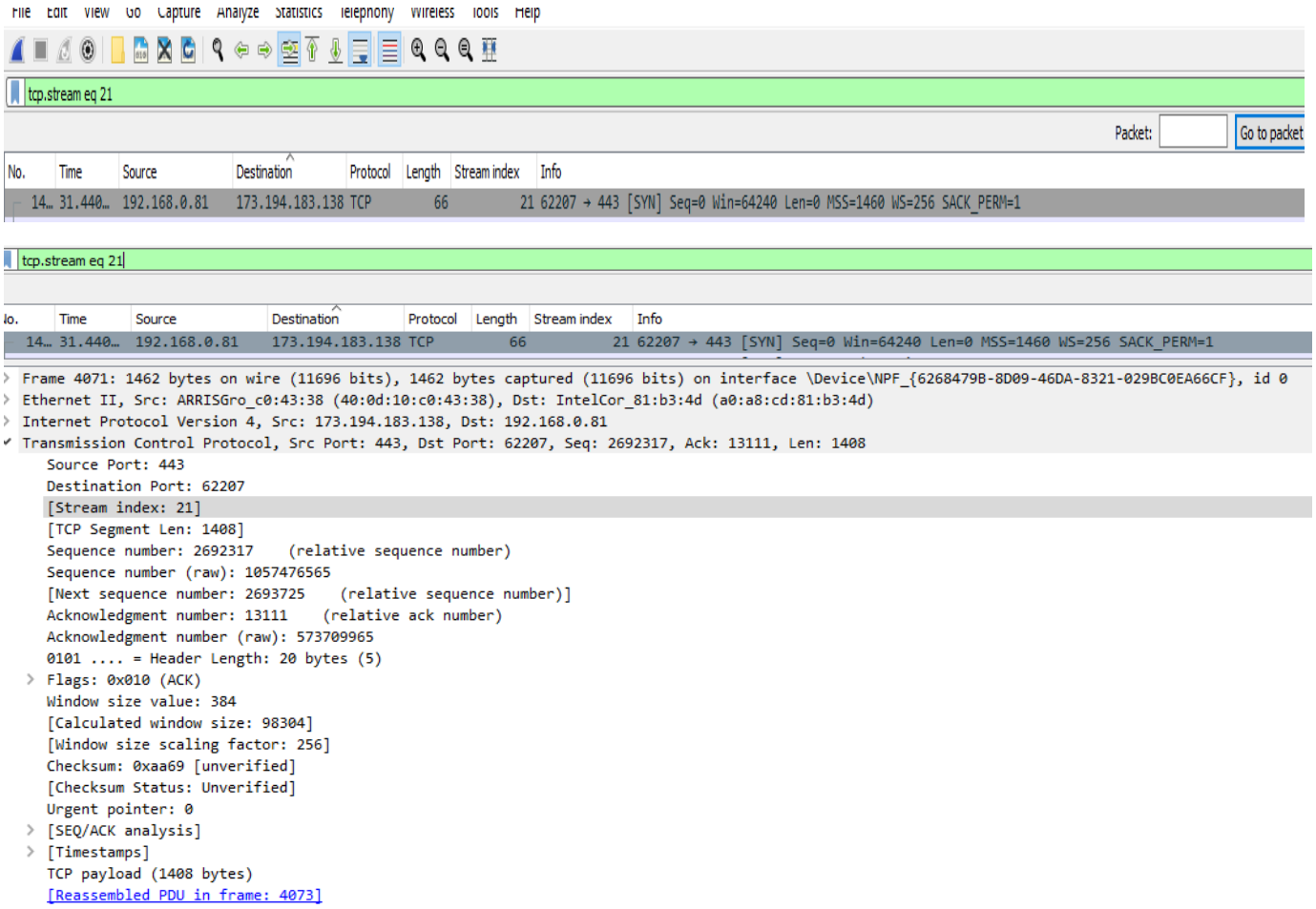
- to check NIC[15]'s manufacturer website if some issues happen,
- to check in Device Manager, the driver's settings to allow manually turn off this mode.

How can you follow a stream?

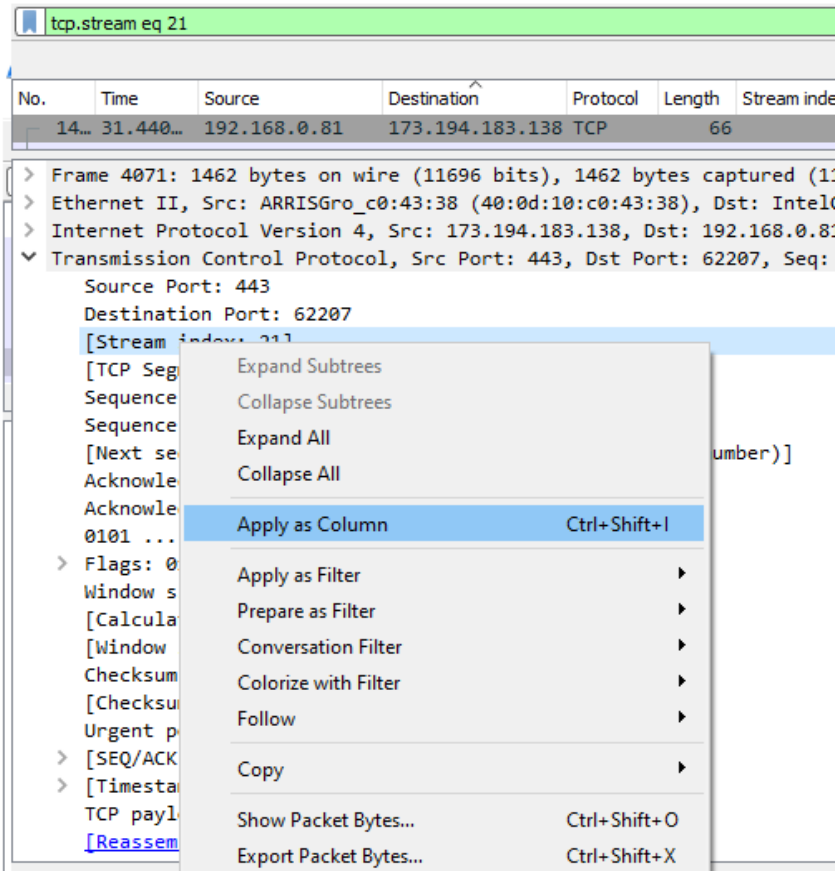
Following streams in Wireshark provides a different view on network traffic: instead of individual packets, one can see data flowing between client & server. Client part is marked as red, server one as blue in Wireshark.

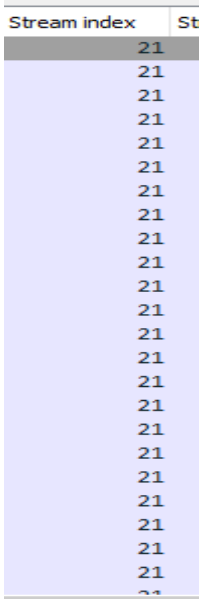
[15] Network Interface Card

I have choosen line 14 and click right mouse and I have choosen follow and TCP Stream (only one option is available)

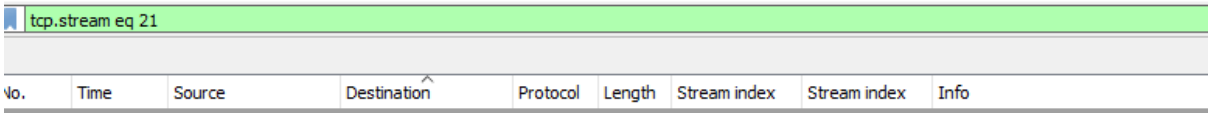


After doing this at the top I have seen green field with info: tcp stream eq 21. TCP because I have choosen the line with this protocol. At the bottom, I need to find Transmission Control Protocol and analyse it. We are focus on STREAM INDEX which here has value 21. When I choose this stream index on mouse I can apply this as a column.





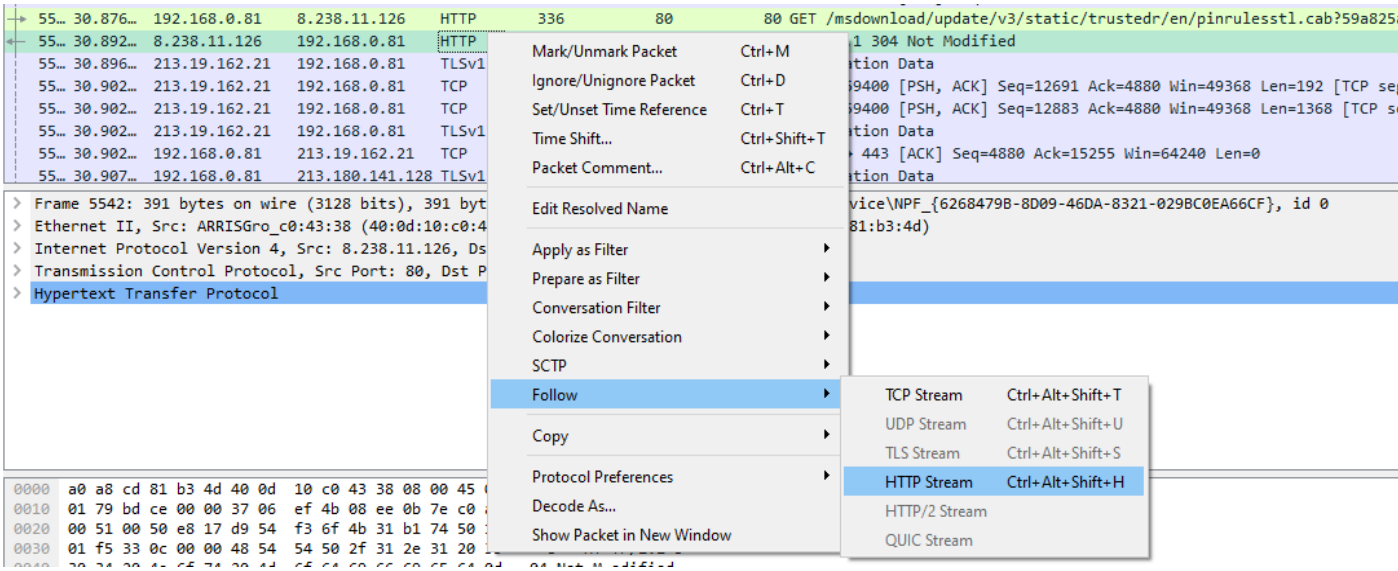
Headers table now:

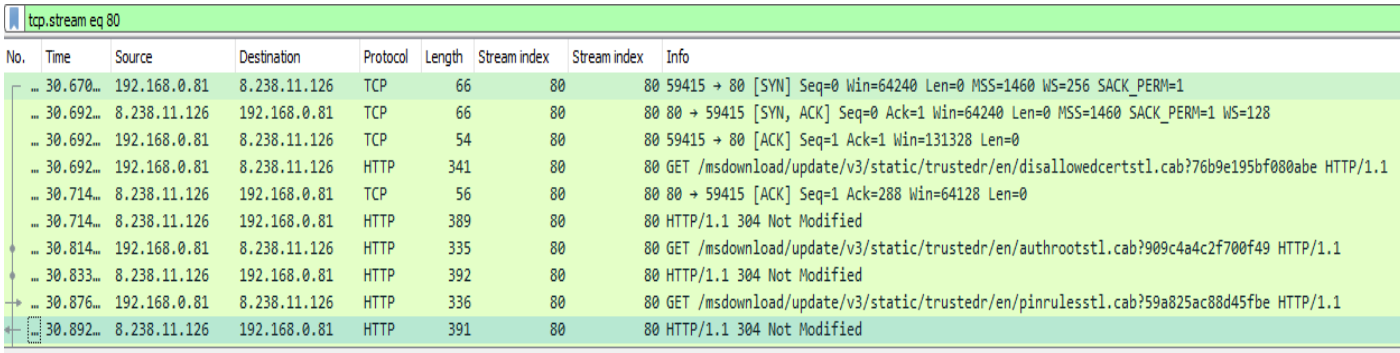


TCP Stream View:

When we analysed, we could see 2 colours: red and blue. Blue is answer from the server, red is answer from the client side. All what we see it is called a **dialogue box.** It is difficult to understand what is in blue because it is **gzip compressed.**

HTTP Stream:



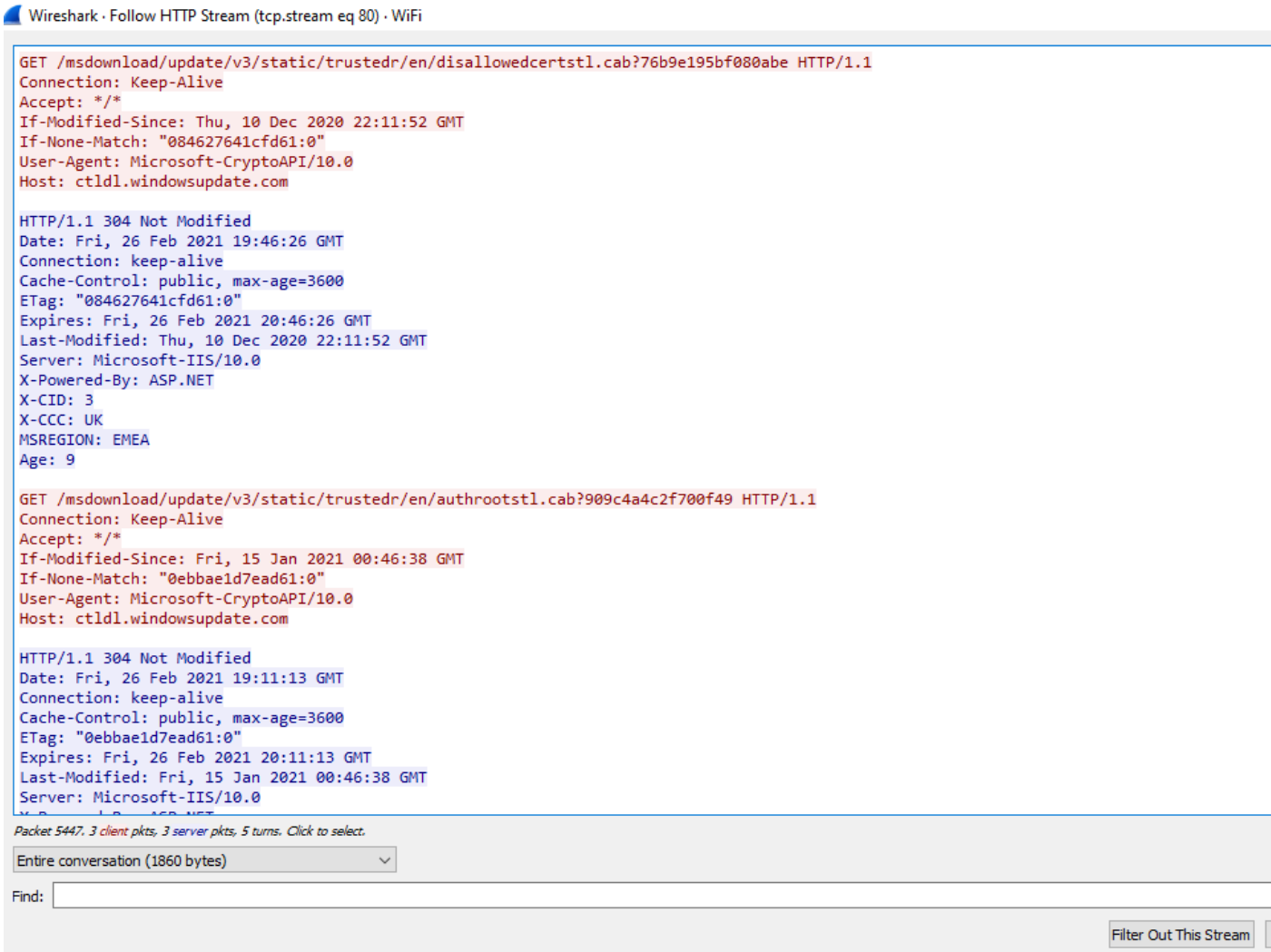


tcp.stream eq 80

No.	Time	Source	Destination	Protocol	Length	Stream index	Stream index	Info
…	30.670…	192.168.0.81	8.238.11.126	TCP	66	80	80	59415 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
…	30.692…	8.238.11.126	192.168.0.81	TCP	66	80	80	80 → 59415 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
…	30.692…	192.168.0.81	8.238.11.126	TCP	54	80	80	59415 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=0
…	30.692…	192.168.0.81	8.238.11.126	HTTP	341	80	80	GET /msdownload/update/v3/static/trustedr/en/disallowedcertstl.cab?76b9e195bf080abe HTTP/1.1
…	30.714…	8.238.11.126	192.168.0.81	TCP	56	80	80	80 → 59415 [ACK] Seq=1 Ack=288 Win=64128 Len=0
…	30.714…	8.238.11.126	192.168.0.81	HTTP	389	80	80	HTTP/1.1 304 Not Modified
…	30.814…	192.168.0.81	8.238.11.126	HTTP	335	80	80	GET /msdownload/update/v3/static/trustedr/en/authrootstl.cab?909c4a4c2f700f49 HTTP/1.1
…	30.833…	8.238.11.126	192.168.0.81	HTTP	392	80	80	HTTP/1.1 304 Not Modified
…	30.876…	192.168.0.81	8.238.11.126	HTTP	336	80	80	GET /msdownload/update/v3/static/trustedr/en/pinrulesstl.cab?59a825ac88d45fbe HTTP/1.1
…	30.892…	8.238.11.126	192.168.0.81	HTTP	391	80	80	HTTP/1.1 304 Not Modified

We see TCP Stream 80 at the bottom. All the screen is on green also stream index is 80 and the same value for all lines, which is normal behaviour. The protocol is HTTP. The last row shows more details. (synchronised, acknowledged, length, etc.)

When we click stream we see dialogue box.



Wireshark · Follow HTTP Stream (tcp.stream eq 80) · WiFi

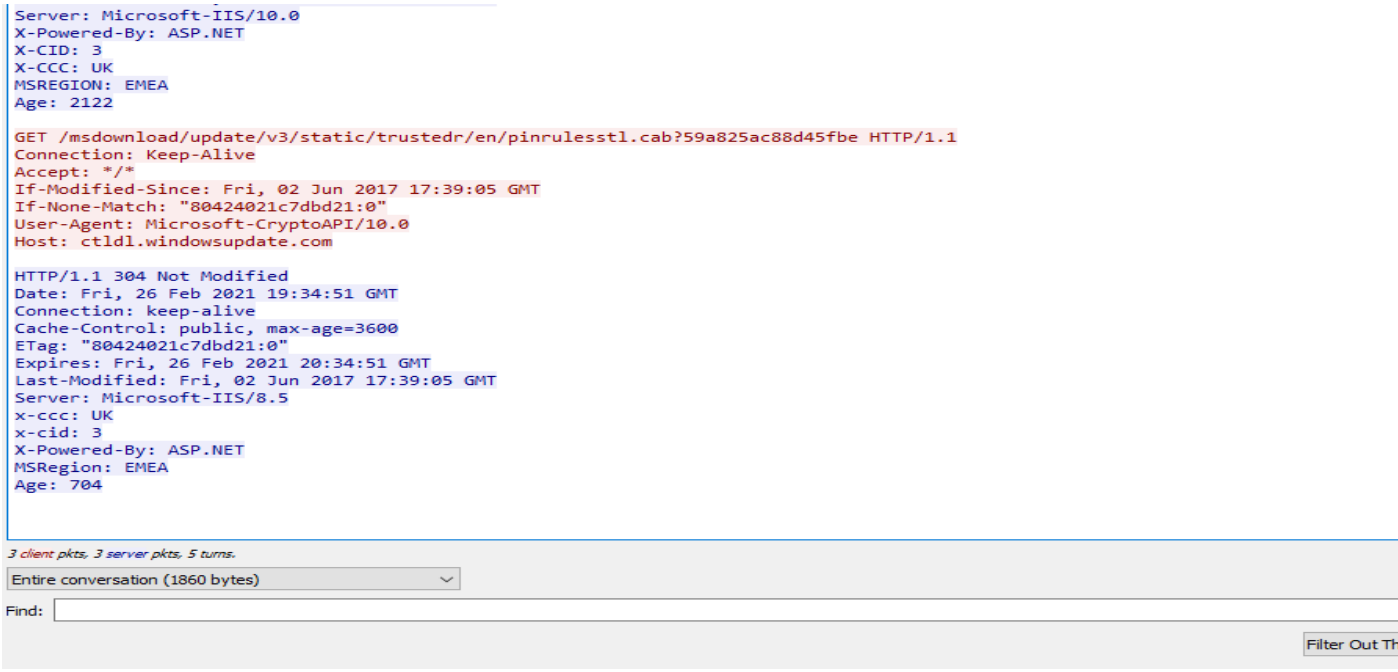
```
GET /msdownload/update/v3/static/trustedr/en/disallowedcertstl.cab?76b9e195bf080abe HTTP/1.1
Connection: Keep-Alive
Accept: */*
If-Modified-Since: Thu, 10 Dec 2020 22:11:52 GMT
If-None-Match: "084627641cfd61:0"
User-Agent: Microsoft-CryptoAPI/10.0
Host: ctldl.windowsupdate.com

HTTP/1.1 304 Not Modified
Date: Fri, 26 Feb 2021 19:46:26 GMT
Connection: keep-alive
Cache-Control: public, max-age=3600
ETag: "084627641cfd61:0"
Expires: Fri, 26 Feb 2021 20:46:26 GMT
Last-Modified: Thu, 10 Dec 2020 22:11:52 GMT
Server: Microsoft-IIS/10.0
X-Powered-By: ASP.NET
X-CID: 3
X-CCC: UK
MSREGION: EMEA
Age: 9

GET /msdownload/update/v3/static/trustedr/en/authrootstl.cab?909c4a4c2f700f49 HTTP/1.1
Connection: Keep-Alive
Accept: */*
If-Modified-Since: Fri, 15 Jan 2021 00:46:38 GMT
If-None-Match: "0ebbae1d7ead61:0"
User-Agent: Microsoft-CryptoAPI/10.0
Host: ctldl.windowsupdate.com

HTTP/1.1 304 Not Modified
Date: Fri, 26 Feb 2021 19:11:13 GMT
Connection: keep-alive
Cache-Control: public, max-age=3600
ETag: "0ebbae1d7ead61:0"
Expires: Fri, 26 Feb 2021 20:11:13 GMT
Last-Modified: Fri, 15 Jan 2021 00:46:38 GMT
Server: Microsoft-IIS/10.0
```

Packet 5447. 3 client pkts, 3 server pkts, 5 turns. Click to select.

Entire conversation (1860 bytes)

Find:

Filter Out This Stream



Blue comes from client, red comes from the server. Content is also compressed, as we can't see more details (structure of html etc)

Summary:

''There is a difference between following a **TCP stream** and a **HTTP stream**. For example, if the data downloaded from the webserver is gzip compressed, following the TCP stream will display the compressed data, while following the HTTP stream will display the decompressed data''[16]

Can you filter to view packets only from specific sources or destinations?

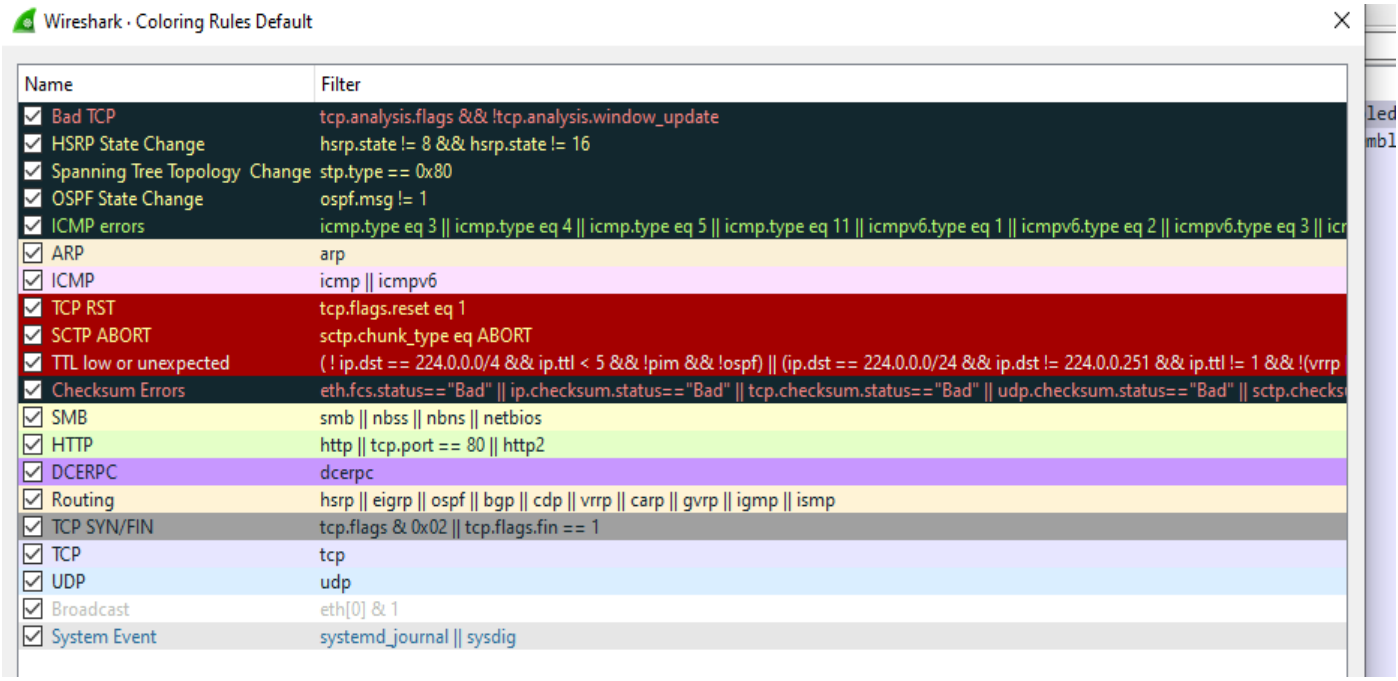
Colour coding:

Purple – TCP traffic

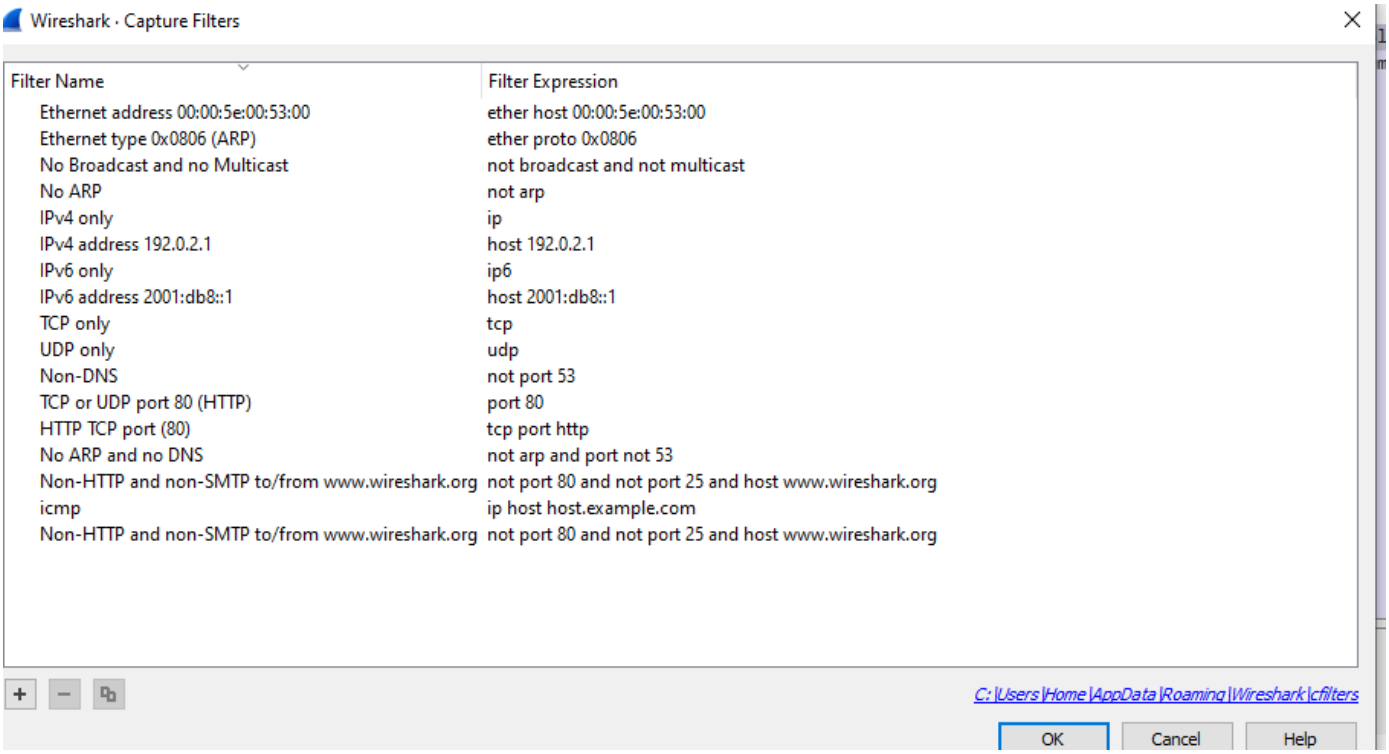
Blue- UDP traffic

Black- packet with errors

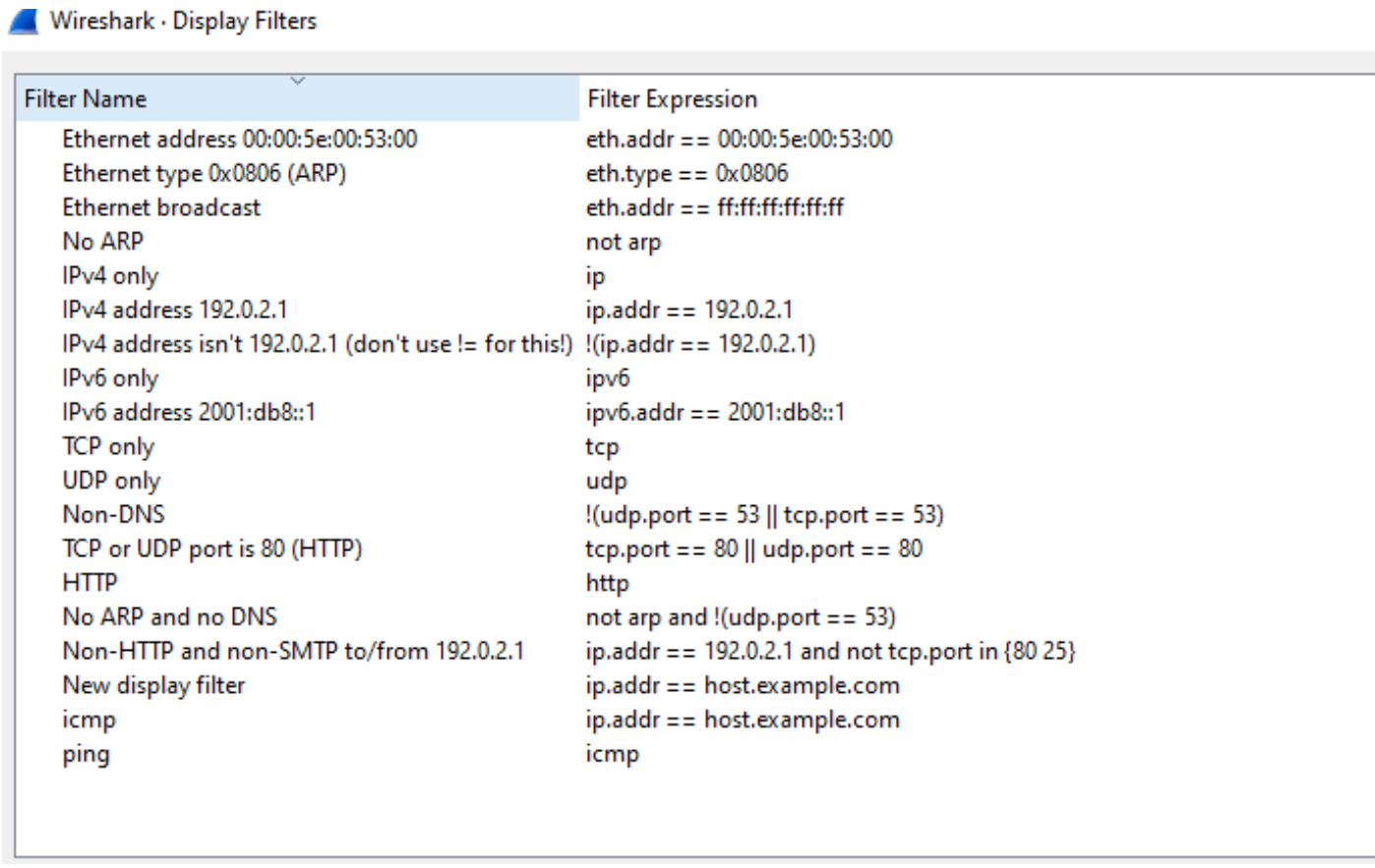
[16] https://blog.didierstevens.com/2017/08/23/wireshark-follow-streams/

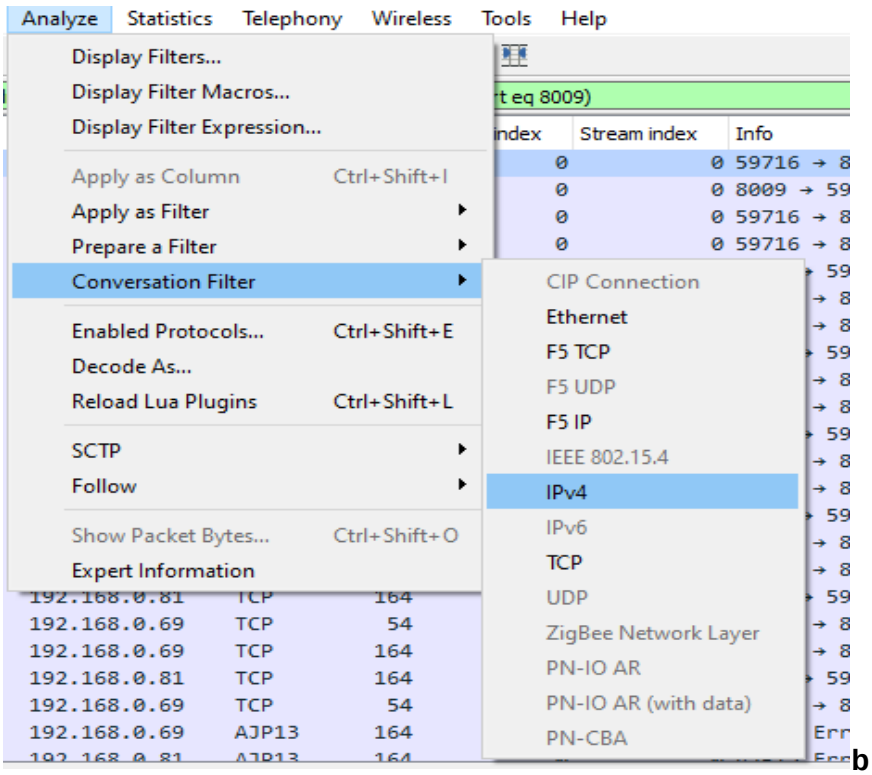


Capture-> Capture Filters



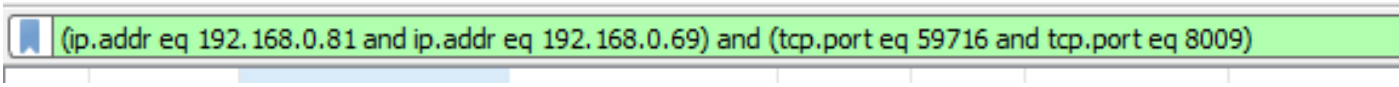
Analyse->Display Filters





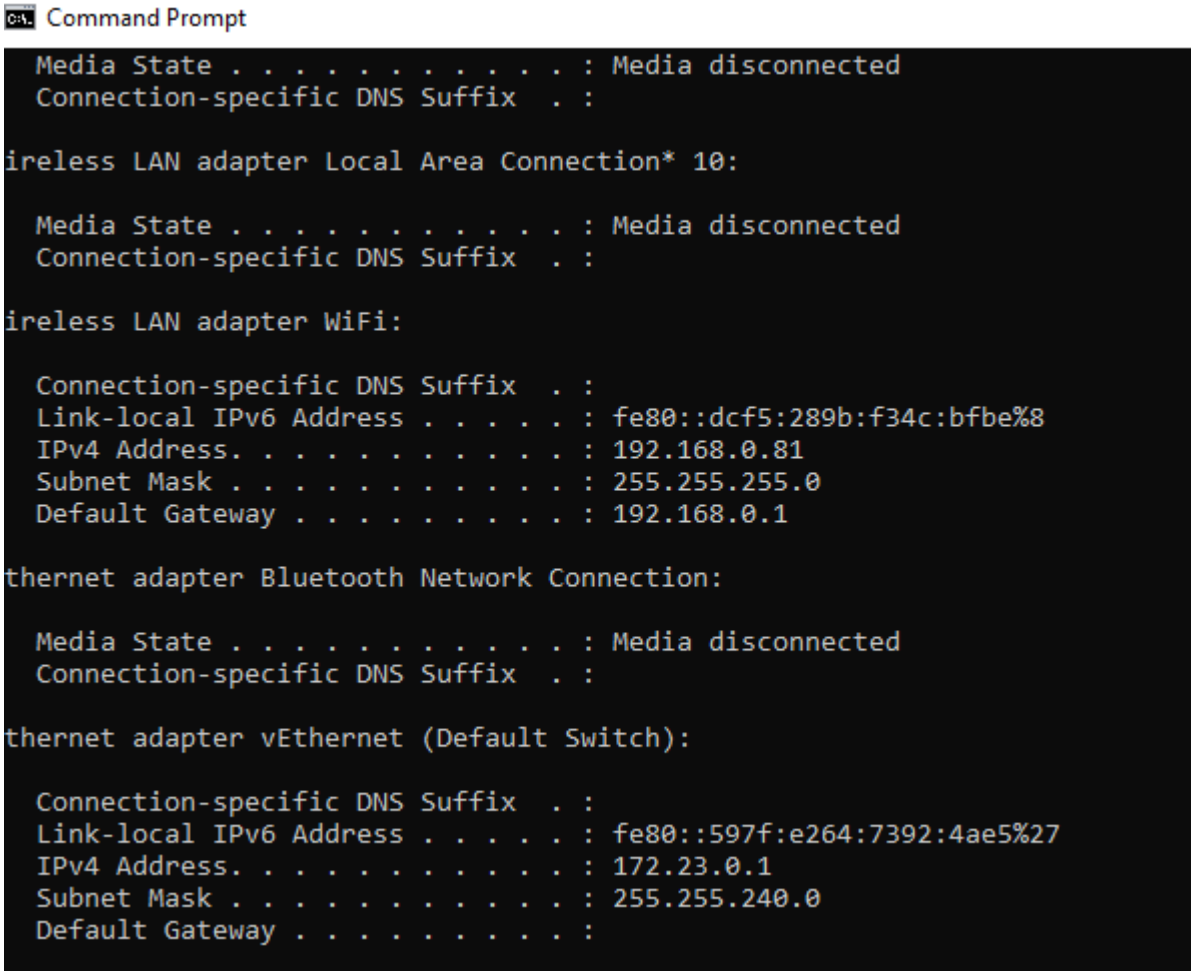
b

In the green field we see:



We see ip address: 192.168.0.81 and ip address 192.168.0.69 and we try investigate how to guess where there are come from. We have used command prompt appropriate command to get this info.

After writing ipconfig in command prompt I see this: (Command prompt runs as ADMIN)



IPV4 Address is: 192.168.0.81

I put in command prompt **arp- a** command line and we see this:

```
C:\Users\Home>arp -a

Interface: 192.168.0.81 --- 0x8
  Internet Address      Physical Address      Type
  192.168.0.1           40-0d-10-c0-43-38     dynamic
  192.168.0.69          f0-ef-86-4a-2e-15     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 169.254.61.64 --- 0x12
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 172.23.0.1 --- 0x1b
  Internet Address      Physical Address      Type
  172.23.15.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
```

We see that physical address[17] can be static[18] or dynamic[19]

We see 3 interfaces[20]; first where we have dynamic and static, second one and third one with static only.

The available options after arp are:

[17] is a memory address that is represented in the form of a binary number on the address bus circuitry.
[18] Address which does not change.
[19] dynamic IP addresses are subject to change, sometimes at a moment's notice. Dynamic addresses are assigned, as needed, by Dynamic Host Configuration Protocol (DHCP) servers.
[20] 172… is class B type of address, 169 …. is automatic Private IP Address (APIPA)

```
C:\Users\Home>arp

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
```

Using other than arp – a option the results are shown below:

```
C:\Users\Home>arp -g

Interface: 192.168.0.81 --- 0x8
  Internet Address      Physical Address      Type
  192.168.0.1           40-0d-10-c0-43-38     dynamic
  192.168.0.69          f0-ef-86-4a-2e-15     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static

Interface: 169.254.61.64 --- 0x12
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 172.23.0.1 --- 0x1b
  Internet Address      Physical Address      Type
  172.23.15.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
```

```
C:\Users\Home>arp -v

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
Example:
  > arp -s 157.55.85.212   00-aa-00-62-c6-09  .... Adds a static entry.
  > arp -a                                    .... Displays the arp table.
```

```
C:\Users\Home>arp -innet_adr

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
Example:
```

```
C:\Users\Home>arp -N_if_addr

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
Example:
  > arp -s 157.55.85.212   00-aa-00-62-c6-09  .... Adds a static entry.
  > arp -a                                    .... Displays the arp table.
```

```
C:\Users\Home>arp -s

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
Example:
  > arp -s 157.55.85.212   00-aa-00-62-c6-09  .... Adds a static entry.
  > arp -a                                    .... Displays the arp table.
```

arp –d when Wireshark is running.

Any changes in command prompt after writing this command.

```
C:\WINDOWS\system32>arp -d
```

ipconfig/ flushdns

```
C:\WINDOWS\system32>ipconfig /flushdns

Windows IP Configuration

Successfully flushed the DNS Resolver Cache.
```

Gratuitous ARP

- is a situation when ARP response was not initiated by ARP request,

- sent as a broadcast,

- it is different than traditional[21] ARP behaviour,

By the use of ipconfig/all I have tried to find MAC address (physical add)

```
Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) Dual Band Wireless-AC 7260
   Physical Address. . . . . . . . . : A0-A8-CD-81-B3-4D
```

```
Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-NKECTCQ
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
```

IP routing is not enabled.

arp gratuitous

no results in command prompt!

*

pathping –g host-list

```
C:\Users\Home>pathping

Usage: pathping [-g host-list] [-h maximum_hops] [-i address] [-n]
                [-p period] [-q num_queries] [-w timeout]
                [-4] [-6] target_name

Options:
    -g host-list     Loose source route along host-list.
    -h maximum_hops  Maximum number of hops to search for target.
    -i address       Use the specified source address.
    -n               Do not resolve addresses to hostnames.
    -p period        Wait period milliseconds between pings.
    -q num_queries   Number of queries per hop.
    -w timeout       Wait timeout milliseconds for each reply.
    -4               Force using IPv4.
    -6               Force using IPv6.

C:\Users\Home>pathping -g host-list
Unable to resolve target system name host-list.
```

[21] ‘’where a node is requesting another node’s MAC address’’
https://www.practicalnetworking.net/series/arp/gratuitous-arp/

netstat

''displays network connections for TCP (both incoming and outgoing), routing table, and a number of network interface and network protocol statistics.''[22] We have seen TCP protocol, foreign addresses[23] and local address[24]. The majority states[25] are established except of 3 lines.

```
C:\Users\Home>netstat

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    192.168.0.81:54115     40.67.254.36:https     ESTABLISHED
  TCP    192.168.0.81:58313     5.62.54.63:http        ESTABLISHED
  TCP    192.168.0.81:58317     52.97.202.98:https     ESTABLISHED
  TCP    192.168.0.81:58823     ws-in-f188:5228        ESTABLISHED
  TCP    192.168.0.81:58825     192.168.0.69:8009      ESTABLISHED
  TCP    192.168.0.81:58890     static:https           ESTABLISHED
  TCP    192.168.0.81:59130     host:https             ESTABLISHED
  TCP    192.168.0.81:59259     mrs04s10-in-f238:https  ESTABLISHED
  TCP    192.168.0.81:59260     lhr25s28-in-f3:https   ESTABLISHED
  TCP    192.168.0.81:59261     lhr25s28-in-f14:https  ESTABLISHED
  TCP    192.168.0.81:59266     lhr48s22-in-f4:https   ESTABLISHED
  TCP    192.168.0.81:59268     cpc25-finc13-2-0-cust8:http  TIME_WAIT
  TCP    192.168.0.81:59269     93.184.221.240:http    TIME_WAIT
  TCP    192.168.0.81:59270     cpc3-stme1-3-0-cust210:http  TIME_WAIT
  TCP    192.168.0.81:59271     52.114.75.150:https    ESTABLISHED
  TCP    192.168.0.81:59272     13.107.21.200:https    ESTABLISHED
  TCP    192.168.0.81:59276     bingforbusiness:https  ESTABLISHED
  TCP    192.168.0.81:59277     bingforbusiness:https  ESTABLISHED
  TCP    192.168.0.81:59279     52.97.211.162:https    ESTABLISHED
  TCP    192.168.0.81:59280     52.97.211.162:https    ESTABLISHED
  TCP    192.168.0.81:59282     204.79.197.222:https   ESTABLISHED
  TCP    192.168.0.81:59285     152.199.19.161:https   ESTABLISHED
  TCP    192.168.0.81:59286     131.253.33.254:https   ESTABLISHED
  TCP    192.168.0.81:59287     51.140.152.167:https   ESTABLISHED
```

nslookup.exe

```
C:\Users\Home>nslookup.exe
Default Server:  cache1.service.virginmedia.net
Address:  194.168.4.100
```

We use for troubleshooting DNS servers. My internet provider is Virgin Media.

[22] https://en.wikipedia.org/wiki/Netstat

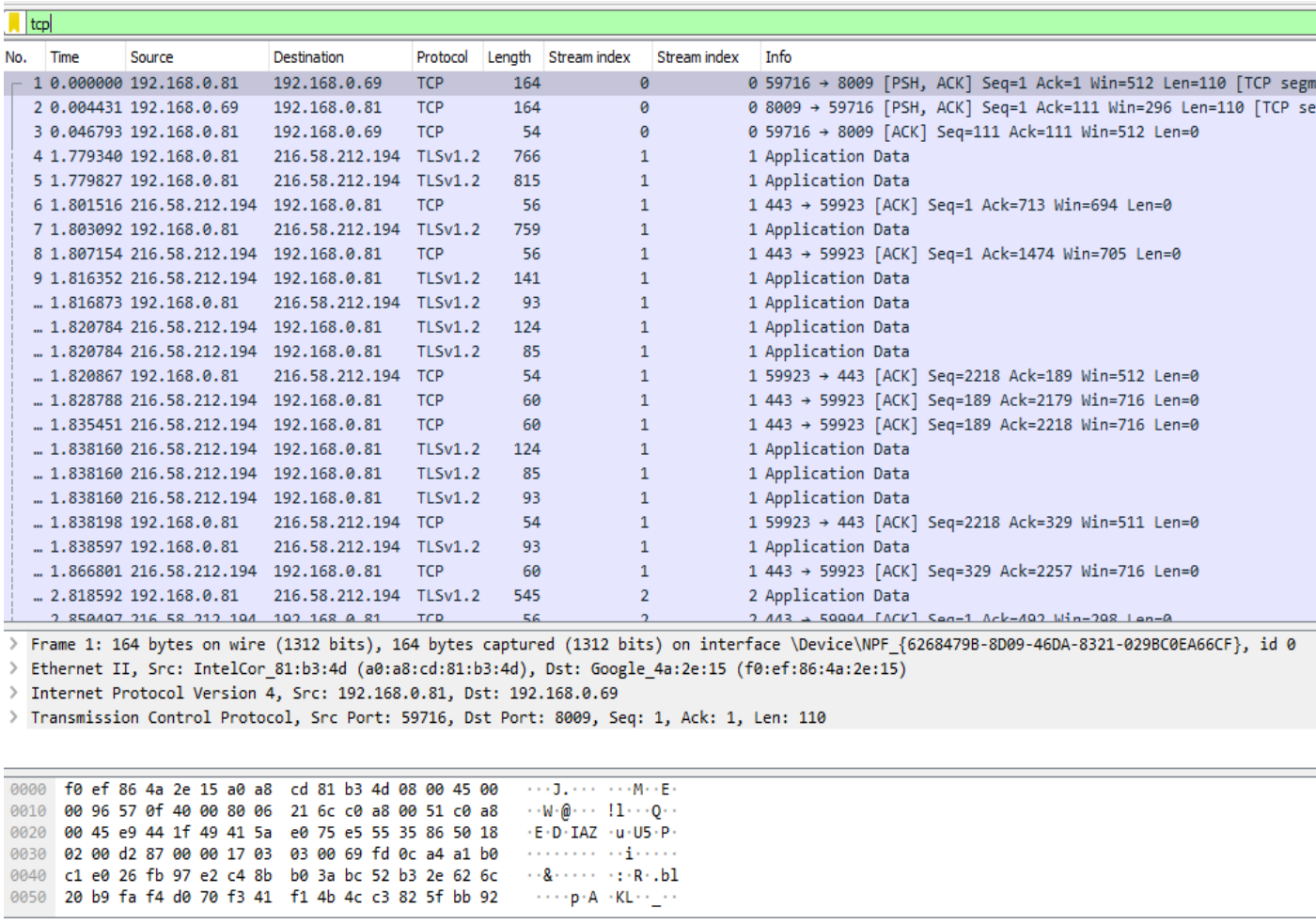
[23] The address and **port** number of the remote end of the connection.
[24] The address details of the local end of the connection.
[25] State of the local socket. ''The possible states are as follows: CLOSE_WAIT, CLOSED, ESTABLISHED, FIN_WAIT_1, FIN_WAIT_2, LAST_ACK, LISTEN, SYN_RECEIVED, SYN_SEND, and TIME_WAIT''

net use

```
> net use
Server:  use
Address:  92.242.132.24

DNS request timed out.
    timeout was 2 seconds.
DNS request timed out.
    timeout was 2 seconds.
*** Request to use timed-out
>
```

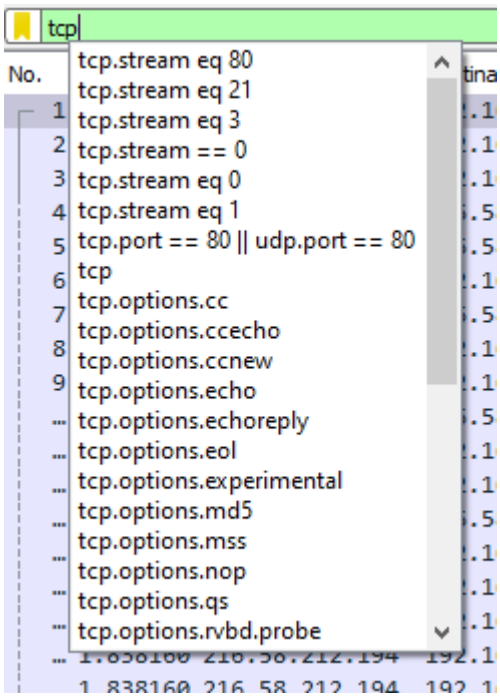
“Execute the net use command alone to show detailed information about currently mapped drives and devices”[26]

We can filter by writing in the field what exactly we are looking for; for example, I wrote TCP

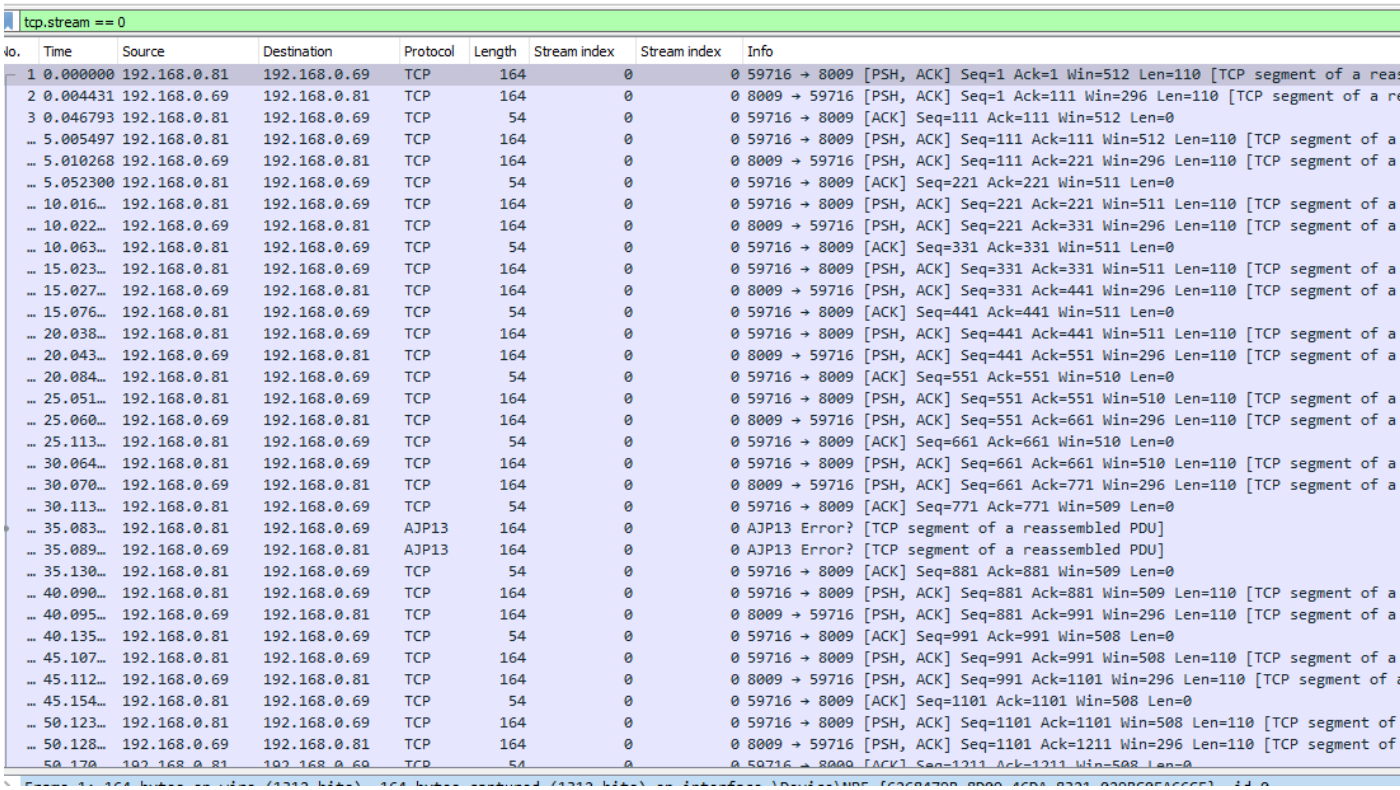


[26] https://www.lifewire.com/net-use-command-2618096

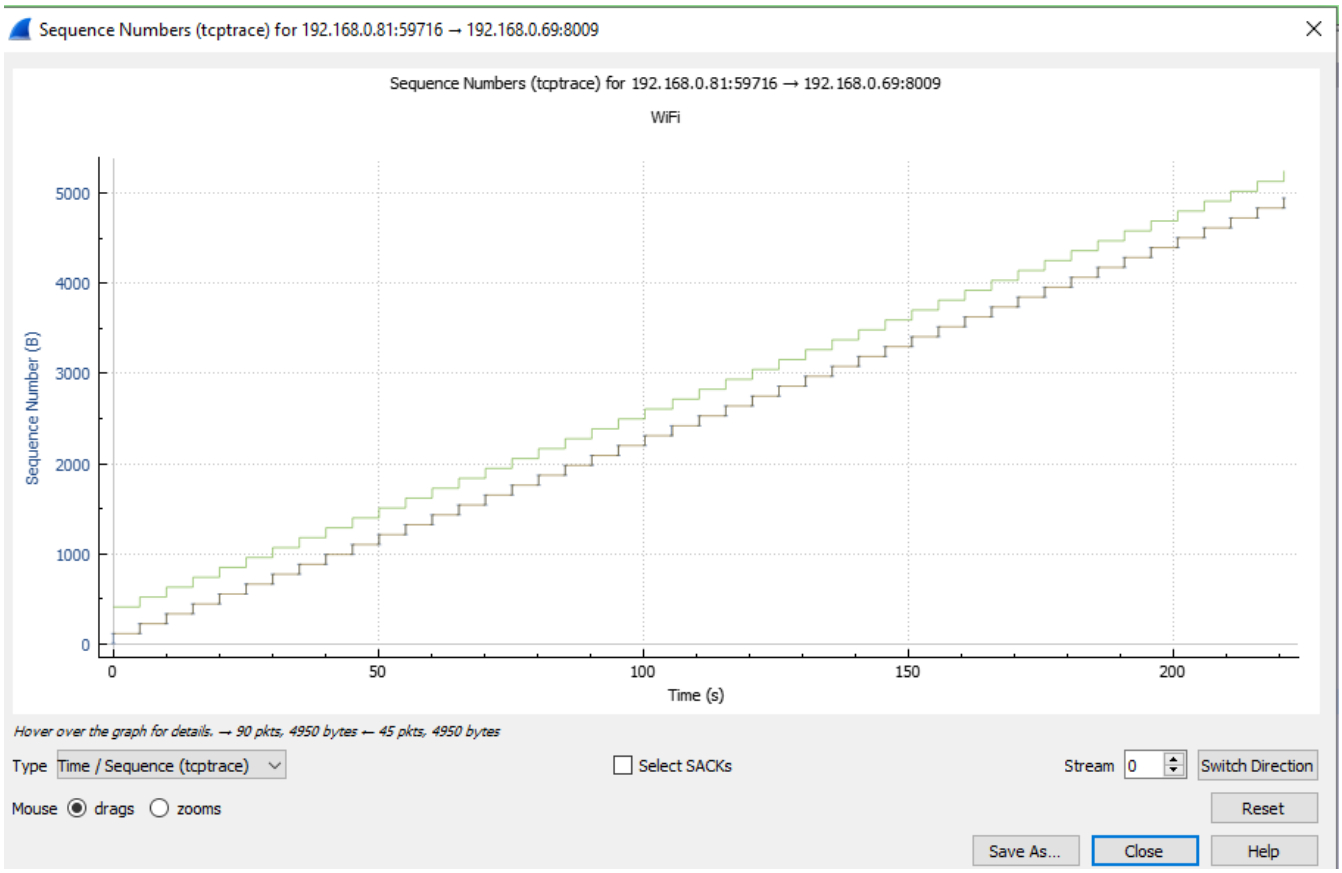
I have seen TCP protocol as filter has been used. We have a list what we are looking for we should select:



For example tcp.stream==0



We have an option to have detailed info.



Should this software be freely available – considering its potential for misuse?

It is controversial subject; it can be used for the network analyses for education purpose, but from the other side allow the hackers to sniffer password, get personal information etc.

''That is also why securing and encrypting data is so important.''[27] ''Packet sniffing programs can be used to perform man-in-the-middle attacks (MITM). This type of attack occurs when "an attacker monitors network packets, modifies them, and inserts them back to the network" (Whitman, et al., 2008)''[28] We should focus on encryption as the best form of protection against any packet interception.

Week 20

ARP

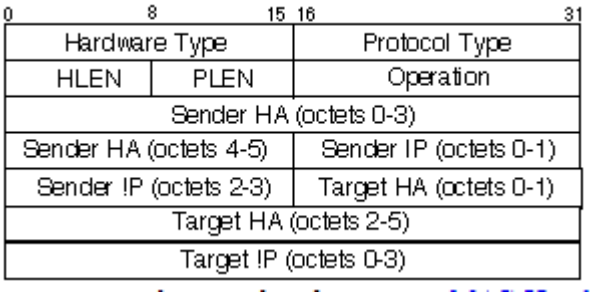
The screenshots from my computer are attached in previous week. ARP means address resolution protocol, which is used by IP mainly by IPV4 to map IP network addresses to the

[27] https://www.ukessays.com/essays/information-technology/the-threat-of-packet-sniffers-information-technology-essay.php

[28] Packet sniffing programs can be used to perform man-in-the-middle attacks (MITM). This type of attack occurs when "an attacker monitors network packets, modifies them, and inserts them back to the network" (Whitman, et al., 2008)

hardware addresses by use a data link protocol. Simple speaking arp helps to find an address of a computer in a network. The address resolution activity is related to an answer from the server which contains the address to a client. The hardware address is known as MAC[29] address. '' Each computer network interface card is allocated a globally unique 6 byte link address when the factory manufactures the card (stored in a PROM).''[30]

Format of arp message



By the help of Powershell 5.0 We can see host name, physical address, IPV4, subnet mask etc.

[29] Medium Access Control
[30] https://erg.abdn.ac.uk/users/gorry/course/inet-pages/arp.html

```
PS C:\WINDOWS\system32> ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-NKECTCQ
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) Ethernet Connection I218-LM
   Physical Address. . . . . . . . . : EC-F4-BB-4B-67-A6
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Npcap Loopback Adapter:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Npcap Loopback Adapter
   Physical Address. . . . . . . . . : 02-00-4C-4F-4F-50
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::8893:6b3b:c872:3d40%18(Preferred)
   Autoconfiguration IPv4 Address. . : 169.254.61.64(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 704774220
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-22-22-D4-EC-F4-BB-4B-67-A6
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

```
Ethernet adapter vEthernet (Default Switch):

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Hyper-V Virtual Ethernet Adapter
   Physical Address. . . . . . . . . : 00-15-5D-DD-4C-D3
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::f8f4:fd19:ec7c:b8ad%25(Preferred)
   IPv4 Address. . . . . . . . . . . : 172.27.128.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.240.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 419435869
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-22-22-D4-EC-F4-BB-4B-67-A6
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled
PS C:\WINDOWS\system32>
```

The same info by command line:

```
Ethernet adapter vEthernet (Default Switch):

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Hyper-V Virtual Ethernet Adapter
   Physical Address. . . . . . . . . : 00-15-5D-DD-4C-D3
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::f8f4:fd19:ec7c:b8ad%25(Preferred)
   IPv4 Address. . . . . . . . . . . : 172.27.128.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.240.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 419435869
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-22-22-D4-EC-F4-BB-4B-67-A6
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled

C:\WINDOWS\system32>s
```

DHCP

Dynamic Host Configuration Protocol

- network management protocol,
- used on IP local area networks,
- must be present on the network,
- ‘’ a device connected to the network requests an IP address from the DHCP server using the DHCP protocol;’’[31]
- uses User Datagram Protocol.

‘’DHCP can assign much more than just the IP address, but assigning the IP address is a primary purpose. Other information commonly assigned by DHCP includes the following: Subnet mask Default gateway DNS server address’’[32]

“Every device on a TCP/IP-based network must have a unique unicast IP address to access the network and its resources. Without DHCP, IP addresses for new computers or computers that are moved from one subnet to another must be configured manually; IP addresses for computers that are removed from the network must be manually reclaimed. With DHCP, this entire process is automated and managed centrally. The DHCP server maintains a pool of IP addresses and leases an address to any DHCP-enabled client when it starts up on the network’’[33]

---

[31] https://en.wikipedia.org/wiki/Dynamic_Host_Configuration_Protocol
[32] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 120
[33] https://docs.microsoft.com/en-us/windows-server/networking/technologies/dhcp/dhcp-top

Benefits of DHCP: reliable IP address configuration, reduced network administration.

Ipconfig /all We are looking for DHCP enabled etc.

DHCP Configuration

```
Ethernet adapter Bluetooth Network Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Bluetooth Device (Personal Area Network)
   Physical Address. . . . . . . . . : A0-A8-CD-81-B3-51
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Ethernet adapter vEthernet (Default Switch):

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Hyper-V Virtual Ethernet Adapter
   Physical Address. . . . . . . . . : 00-15-5D-DD-4C-D3
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::f8f4:fd19:ec7c:b8ad%25(Preferred)
   IPv4 Address. . . . . . . . . . . : 172.27.128.1(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.240.0
   Default Gateway . . . . . . . . . :
   DHCPv6 IAID . . . . . . . . . . . : 419435869
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-22-22-D4-EC-F4-BB-4B-67-A6
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled

C:\WINDOWS\system32>
```

```
   DHCPv6 IAID . . . . . . . . . . . : 419435869
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-22-22-D4-EC-F4-BB-4B-67-A6
```

"**DHCPv6** uses basically the same scheme, but makes the Client ID mandatory and imposes structure on it. The Client ID in DHCPv6 consists of two parts: a DHCP Unique Identifier (DUID) and an Identity Association Identifier (IAID).The DUID identifies the client **system** (rather than just an interface, as in DHCPv4), and the IAID identifies the interface on that system"[34]

[34]https://docs.oracle.com/cd/E19253-01/816-4554/clientid/index.html

Renew DHCP-Assigned Address Lease

```
C:\WINDOWS\system32>ipconfig /renew

Windows IP Configuration

No operation can be performed on Ethernet while it has its media disconnected.
```

Release DHCP-Assigned Address

As media is disconnected any further steps cannot be done.

```
C:\WINDOWS\system32>ipconfig /release

Windows IP Configuration

No operation can be performed on Ethernet while it has its media disconnected.
No operation can be performed on Local Area Connection* 1 while it has its media disconnected.
No operation can be performed on Bluetooth Network Connection while it has its media disconnected.

Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter vEthernet (Default Switch):

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::f8f4:fd19:ec7c:b8ad%25
   IPv4 Address. . . . . . . . . . . : 172.27.128.1
   Subnet Mask . . . . . . . . . . . : 255.255.240.0
   Default Gateway . . . . . . . . . :

Ethernet adapter Npcap Loopback Adapter:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::8893:6b3b:c872:3d40%18
   Autoconfiguration IPv4 Address. . : 169.254.61.64
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . :

Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```

```
Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::dcf5:289b:f34c:bfbe%6
   Default Gateway . . . . . . . . . :

Ethernet adapter Bluetooth Network Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

C:\WINDOWS\system32>
```

DNS

A Gratuitous ARP if possible explained – with source and destination explained.

Ping I have tried ping www.google.com

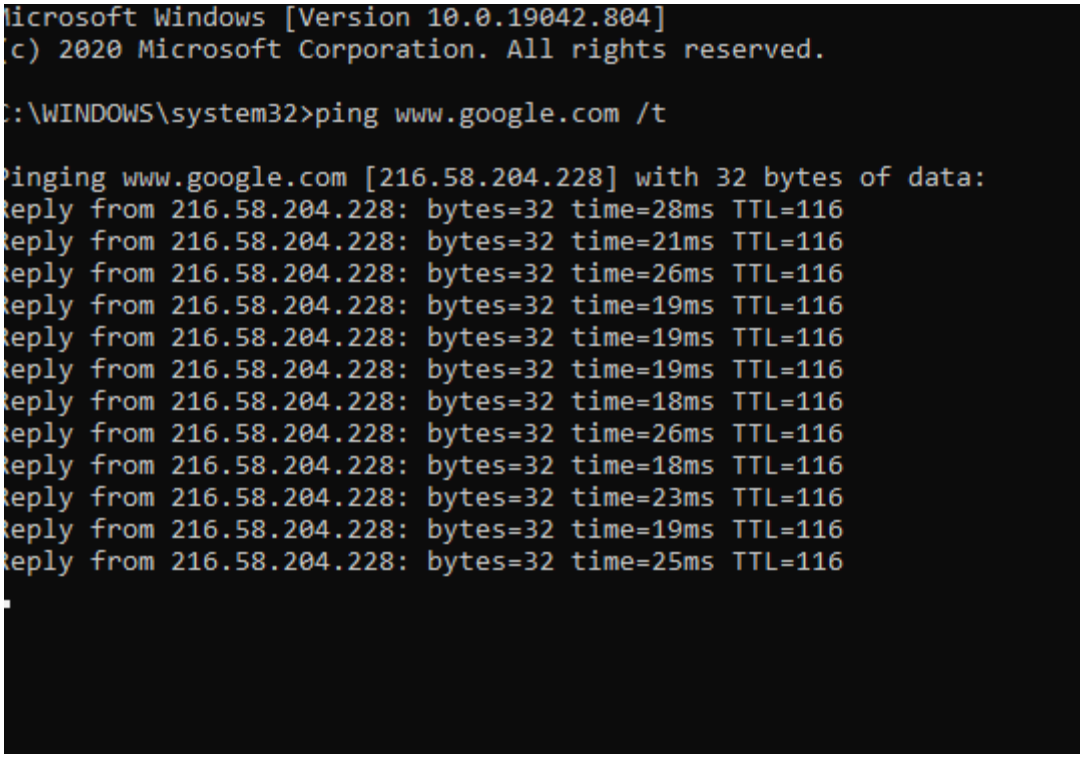
```
C:\WINDOWS\system32>ping google.com

Pinging google.com [216.58.213.110] with 32 bytes of data:
Reply from 216.58.213.110: bytes=32 time=18ms TTL=115
Reply from 216.58.213.110: bytes=32 time=20ms TTL=115
Reply from 216.58.213.110: bytes=32 time=15ms TTL=115
Reply from 216.58.213.110: bytes=32 time=23ms TTL=115

Ping statistics for 216.58.213.110:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 15ms, Maximum = 23ms, Average = 19ms
```

- use to troubleshoot connectivity, name resolution and reachability.
- TTL[35]= time to live (115 seconds)
- there is no loss of data (0%) 4 packets have been sent and 4 have been received.
- At the bottom there is a statistic shows approximate round trip times in milli-seconds; minimum was 15 milliseconds.

Ping www.google.com /t

Parameter	Description
/t	Specifies ping continue sending echo Request messages to the destination until interrupted. To interrupt and display statistics, press CTRL+ENTER. To interrupt and quit this command, press CTRL+C.

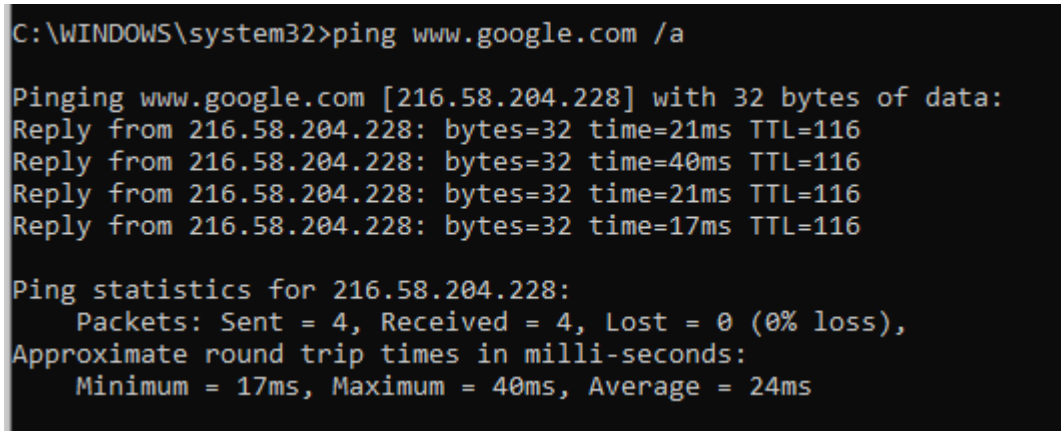
[35] "It is a value on an **ICMP** packet that prevents that packet from propagating back and forth between hosts ad infinitum. Each router that touches the packet decrements the **TTL**. If the **TTL** ever reaches zero, the packet is discarded. It's also a measure of how many hops the packet took'', https://answers.microsoft.com/en-us/windows/forum/windows_xp-networking/what-is-it-ttl-which-shows-on-ping-report-and-the/5eb539d8-b9bc-4a16-bc3e-92fa5ca0bd16



and it will continue until will be disrupted.

Ping www.google.com /a

/a	Specifies reverse name resolution be performed on the destination IP address. If this is successful, ping displays the corresponding host name.



Ping www.google.com /4

/n <count>	Specifies the number of echo Request messages be sent. The default is 4.

```
C:\WINDOWS\system32>ping www.google.com /4

Pinging www.google.com [216.58.204.228] with 32 bytes of data:
Reply from 216.58.204.228: bytes=32 time=21ms TTL=116
Reply from 216.58.204.228: bytes=32 time=21ms TTL=116
Reply from 216.58.204.228: bytes=32 time=17ms TTL=116
Reply from 216.58.204.228: bytes=32 time=19ms TTL=116

Ping statistics for 216.58.204.228:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 17ms, Maximum = 21ms, Average = 19ms
```

Ping www.google.com /R

```
/R              Specifies the round-trip path is traced (available on IPv6 only).
```

```
:\WINDOWS\system32>ping www.google.com /R
ing request could not find host www.google.com. Please check the name and try again.
```

Because available on IPV6, I have used IPV4 that is why it doesn't go through.

Tracert

- diagnostic tool,
- track in real time,
- keeps records time taken for each hop the packet makes during route to the destination.

```
Tracing route to google.com [216.58.213.110]
over a maximum of 30 hops:

  1     3 ms     3 ms     2 ms  192.168.0.1
  2     *        *        *     Request timed out.
  3    21 ms    23 ms    13 ms  hari-core-2a-xe-823-0.network.virginmedia.net [82.2.243.25]
  4     *        *        *     Request timed out.
  5    26 ms    13 ms    20 ms  tele-ic-7-ae2-0.network.virginmedia.net [62.253.175.34]
  6    14 ms    13 ms    15 ms  74-14-250-212.static.virginm.net [212.250.14.74]
  7    14 ms    24 ms    23 ms  108.170.246.161
  8    17 ms    32 ms    14 ms  216.239.57.121
  9    20 ms    17 ms    17 ms  lhr25s02-in-f14.1e100.net [216.58.213.110]

Trace complete.
```

I have tracert www.google.com

- * ** appear when "that the router at that hop doesn't respond to the type of packet you were using for the traceroute "
- max 30 hops
- ms= milliseconds

- 192.168.0.1 is 

(after checking ipconfig /all in command prompt)

Virgin Media is an internet provider

“This diagnostic tool determines the path taken to a destination by sending Internet Control Message Protocol (ICMP) echo Request or ICMPv6 messages to the destination with incrementally increasing time to live (TTL) field values. Each router along the path is required to decrement the TTL in an IP packet by at least 1 before forwarding it. Effectively, the TTL is a maximum link counter. When the TTL on a packet reaches 0, the router is expected to return an ICMP time Exceeded message to the source computer”[36]

Tracert 11.1.0.1

```
Tracing route to 11.1.0.1 over a maximum of 30 hops

  1     3 ms     2 ms     2 ms  192.168.0.1
  2     *        *        *     Request timed out.
  3    10 ms    11 ms    11 ms  hari-core-2a-xe-823-0.network.virginmedia.net [82.2.243.25]
  4     *        *        *     Request timed out.
  5    17 ms    25 ms    20 ms  m686-mp2.cvx1-b.lis.dial.ntli.net [62.254.42.174]
  6    13 ms    15 ms    12 ms  213.46.174.86
  7    15 ms    14 ms    31 ms  100ge11-2.core1.lon2.he.net [184.104.195.109]
  8    84 ms    81 ms    81 ms  100ge15-2.core1.nyc5.he.net [184.105.81.41]
  9   104 ms    98 ms    99 ms  100ge10-1.core2.ash1.he.net [184.105.81.150]
 10     *        *        *     Request timed out.
 11     *        *        *     Request timed out.
 12     *
```

192.168.0.1 is a default gateway

The packet travels through 2 routers 192.168.0.1 and 213.46.174.86 to get to host 11.1.0.1.

* ** appear when “that the router at that hop doesn't respond to the type of packet you were using for the traceroute”

tracert 22.110.0.1

Tracing route to 22.110.0.1 over a maximum of 30 hops.

[36] https://docs.microsoft.com/en-us/windows-server/administration/windows-commands/tracert

```
C:\WINDOWS\system32>tracert 22.110.0.1

Tracing route to 22.110.0.1 over a maximum of 30 hops

  1     3 ms     4 ms     2 ms  192.168.0.1
  2     *        *        *     Request timed out.
  3    13 ms    12 ms    19 ms  hari-core-2a-xe-823-0.network.virginmedia.net [82.2.243.25]
  4     *        *        *     Request timed out.
  5    23 ms    18 ms    13 ms  m686-mp2.cvx1-b.lis.dial.ntli.net [62.254.42.174]
  6    12 ms    13 ms    13 ms  213.46.174.86
  7    14 ms    22 ms    33 ms  100ge11-2.core1.lon2.he.net [184.104.195.109]
  8    83 ms    84 ms    82 ms  100ge15-2.core1.nyc5.he.net [184.105.81.41]
  9    98 ms    94 ms    99 ms  100ge10-1.core2.ash1.he.net [184.105.81.150]
 10     *        *        *     Request timed out.
 11     *        *        *     Request timed out.
 12     *        *        *     Request timed out.
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17
```

IP Internet Protocol

‘’ is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication’’[37]

[37] https://en.wikipedia.org/wiki/IP_address#:~:text=An%20Internet%20Protocol%20address%20(IP,interface%20identification%20and%20location%20addressing

IP Address Lookup

IP: 77.101.226.166

IP Address	77.101.226.166
ASN	5089
City	London
State/Region	England
Country Code	United Kingdom of Great Britain and Northern Ireland
Postal Code	WC2N
ISP	Virgin Media Limited

IP WHOIS Lookup

To clarify, Lookup IP WHOIS information using the IP WHOIS Lookup tool for any allocated IP address. This tool will provide you with the IP Address owners contact information. To clarify, the results will also show the Regional Internet Registry (RIR) who assigns the IP, the assigned owner, location, contact information, and abuse reporting details. Furthermore, other important information includes how many IP Addresses are in the block or blocks assigned to the owner of the IP you're researching.

IPV4

Internet Protocol version 4 (IPv4) defines an IP address as a 32-bit number.

'' Both IP addresses and subnet masks are composed of 32 bits. They are typically presented as four decimal numbers divided by dots (also known as dotted decimal notation), but they can also be represented in binary. For example, consider the IP address of 192.168.1.5 with a subnet mask of 255.255.255.0. Both can be represented in binary as follows:

192.168.1.5 = 1100 0000.1010 1000.0000 0001.0000 0101

255.255.255.0 = 1111 1111.1111 1111.1111 1111.0000 0000''[38]

After ipconfig/all in command

Ethernet adapter Ethernet (Default Switch):

IPv4 Address.: 172.31.48.1(Preferred)

Wireless LAN adapter WiFi:

[38] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 120

IPv4 Address.: 172.31.48.1(Preferred)

172,1,48 and 1 is composed of 8 bits each number;

For example:

172= 0 1 1 1 1 0 1 0

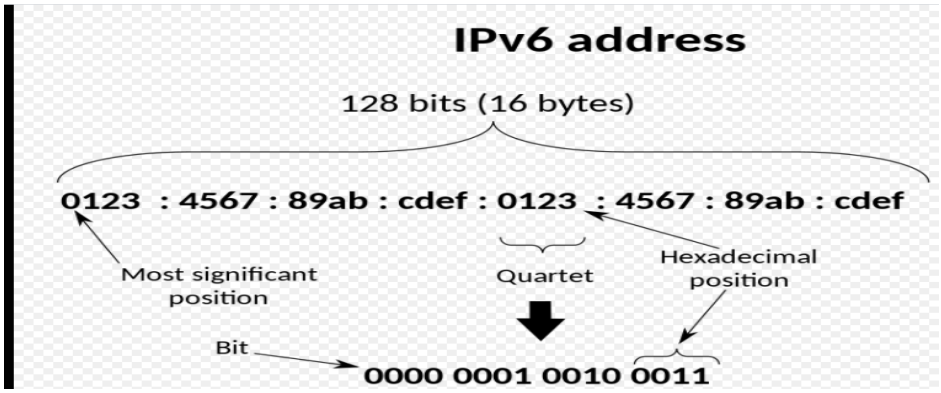
1=0 0 0 0 0 0 0 1

48=0 0 1 1 0 0 0 1

1=0 0 0 0 0 0 0 1

At the end we have 32 bits (IPV4)

IPV6:



‘’the address size was increased from 32 bits in IPv4 to 128 bits, thus providing up to 2^{128} (approximately 3.403×10^{38}) addresses’’[39] … ‘’ IPv6 has facilities that automatically change the routing prefix of entire networks, should the global connectivity or the routing policy change, without requiring internal redesign or manual renumbering.’’[40]

‘’ IPv6 addresses can omit leading zeroes and use zero compression to shorten the way the address is displayed without changing the actual address. IPv6 addresses use 32 hexadecimal characters. Each hexadecimal character rep resents four bits for a total of 128 bits (4 × 128)’’[41]

‘’Instead of displaying groups of zeros, you can use a double colon to replace one or more such zero-value groups. For example, either of the following two IPv6 addresses represents the same address:

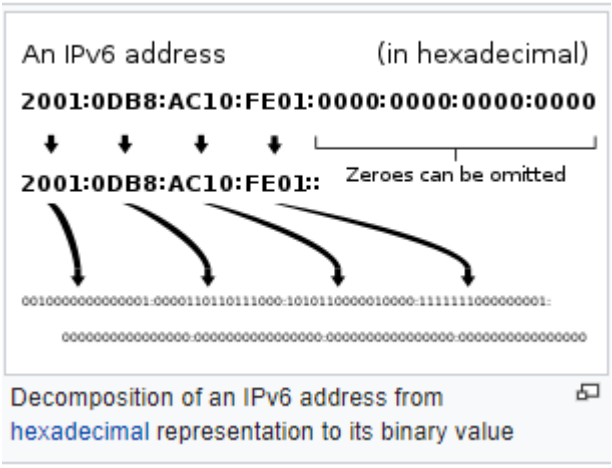
[39] https://en.wikipedia.org/wiki/IP_address#:~:text=An%20Internet%20Protocol%20address%20(IP,interface%20identification%20and%20location%20addressing

[40] https://en.wikipedia.org/wiki/IP_address#:~:text=An%20Internet%20Protocol%20address%20(IP,interface%20identification%20and%20location%20addressing

[41] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 116

FC00::042A:0000:0000:07F5

FC00:0000:0000:0000:042A::07F5’’[42]



Decomposition of an IPv6 address from hexadecimal representation to its binary value

Each number is made up of 16 nr. hexadecimal representation.

```
C:\WINDOWS\system32>netsh interface ipv6

The following commands are available:

Commands in this context:
6to4            - Changes to the `netsh interface ipv6 6to4' context.
?               - Displays a list of commands.
add             - Adds a configuration entry to a table.
delete          - Deletes a configuration entry from a table.
dump            - Displays a configuration script.
help            - Displays a list of commands.
isatap          - Changes to the `netsh interface ipv6 isatap' context.
reset           - Reset the IP configurations.
set             - Sets configuration information.
show            - Displays information.

The following sub-contexts are available:
 6to4 isatap

To view help for a command, type the command, followed by a space, and then
 type ?.
```

[42] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 116

```
C:\WINDOWS\system32>netsh interface ipv6 dump


# ----------------------------------
# IPv6 Configuration
# ----------------------------------
pushd interface ipv6

reset
set interface interface="Ethernet (Kernel Debugger)" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="WiFi" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="Ethernet" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="Local Area Connection* 1" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="Local Area Connection* 10" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="Bluetooth Network Connection" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="Npcap Loopback Adapter" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled
set interface interface="vEthernet (Default Switch)" forwarding=enabled advertise=enabled nud=enabled ignoredefaultroutes=disabled


popd
# End of IPv6 configuration



# ----------------------------------
# ISATAP Configuration
# ----------------------------------
pushd interface isatap



popd
# End of ISATAP configuration



# ----------------------------------
# 6to4 Configuration
# ----------------------------------
pushd interface 6to4

reset
```

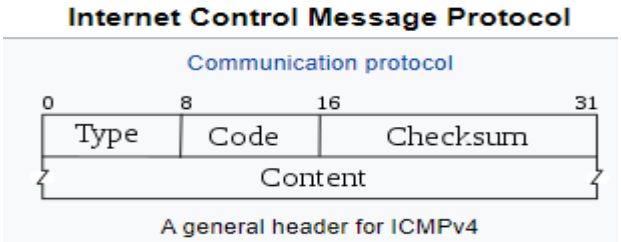
```
C:\WINDOWS\system32>netsh interface ipv6 show

The following commands are available:

Commands in this context:
show addresses - Shows current IP addresses.
show compartments - Shows compartment parameters.
show destinationcache - Shows destination cache entries.
show dnsservers - Displays the DNS server addresses.
show dynamicportrange - Shows dynamic port range configuration parameters.
show excludedportrange - Shows all excluded port ranges.
show global    - Shows global configuration parameters.
show interfaces - Shows interface parameters.
show ipstats   - Displays IP statistics.
show joins     - Displays multicast groups joined.
show neighbors - Shows neighbor cache entries.
show offload   - Displays the offload information.
show potentialrouters - Shows potential routers.
show prefixpolicies - Shows prefix policy entries.
show privacy   - Shows privacy configuration parameters.
show route     - Shows route table entries.
show siteprefixes - Shows site prefix table entries.
show subinterfaces - Shows subinterface parameters.
show tcpstats  - Displays TCP statistics.
show teredo    - Shows Teredo state.
show tfofallback - Shows per-network TCP Fastopen fallback state.
show udpstats  - Displays UDP statistics.
```

```
show udpstats  - Displays UDP statistics.

C:\WINDOWS\system32>netsh interface ipv6 show addresses

Interface 1: Loopback Pseudo-Interface 1

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Preferred     infinite   infinite ::1

Interface 7: WiFi

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Preferred     infinite   infinite fe80::dcf5:289b:f34c:bfbe%7

Interface 14: Ethernet

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Deprecated    infinite   infinite fe80::7035:57aa:2413:1799%14

Interface 13: Local Area Connection* 1

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Deprecated    infinite   infinite fe80::54ac:18bf:dfae:aad7%13

Interface 8: Local Area Connection* 10

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Deprecated    infinite   infinite fe80::e561:5094:732c:800%8

Interface 20: Bluetooth Network Connection

Addr Type  DAD State   Valid Life Pref. Life Address
---------  ----------- ---------- ---------- ------------------------
Other      Deprecated    infinite   infinite fe80::2cce:d60:818b:f99d%20

Interface 27: vEthernet (Default Switch)

Addr Type  DAD State   Valid Life Pref. Life Address
```

ICMP = Internet Control Message Protocol (**ICMP**)

- supporting protocol in the internet protocol suite,
- **“**is used by network devices, including routers, to send error messages and operational information indicating success or failure when communicating with another IP address”[43]

[43] https://en.wikipedia.org/wiki/Internet_Control_Message_Protocol



"The ICMP packet is encapsulated in an IPv4 packet. The packet consists of header and data sections"[44]

ICMP header format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Type								Code								Checksum															
4	32	Rest of header																															

```
C:\WINDOWS\system32>netsh advfirewall firewall add rule name="ICMP Allow incoming V4 echo request" protocol=icmpv4:8,any dir=in action=allow
Ok.
```

```
C:\WINDOWS\system32>netsh advfirewall firewall add rule name= "All ICMP V4" protocol=icmpv4:any,any dir=in action=allow
Ok.
```

```
C:\WINDOWS\system32>netsh advfirewall firewall add rule name= "Open Port 80" dir=in action=allow protocol=TCP localport=80
Ok.
```

Spoofing attack:

= to identify as another by falsifying data.

'' IP spoofing and ARP spoofing in particular may be used to leverage man-in-the-middle attacks against hosts on a computer network''[45]

TCP/IP protocols do not have enough mechanisms for authentication of the source of a message.

ARP cache poisoning = ARP poison routing

Attacker sends ARP messages onto a LAN. "(…) the aim is to associate the attacker's MAC address with the IP address of another host, such as the default gateway, causing any traffic

[44] https://en.wikipedia.org/wiki/Internet_Control_Message_Protocol
[45] https://en.wikipedia.org/wiki/Spoofing_attack

meant for that IP address to be sent to the attacker instead. ARP spoofing may allow an attacker to intercept data frames on a network, modify the traffic, or stop all traffic''[46]

```
C:\WINDOWS\system32>arp -a

Interface: 192.168.0.81 --- 0x7
  Internet Address      Physical Address      Type
  192.168.0.1           40-0d-10-c0-43-38     dynamic
  192.168.0.69          f0-ef-86-4a-2e-15     dynamic
  192.168.0.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 169.254.61.64 --- 0x12
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 172.31.48.1 --- 0x1b
  Internet Address      Physical Address      Type
  172.31.63.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Week 21

IPV4 Packet Structure:

''IPv4 addresses use 32 bits and are displayed in dotted decimal format, such as 192.168.1.1'' [47] IPv4 addresses are matched with a subnet mask. For example, in the case of IPV4 192.168.1.1 is from Class C (private address) which allow us to know what is the subnet mask, in this case the subnet is 255.255.255.0 We can differentiate classes: A, B and C.

'' Class A—1 to 126 (subnet mask 255.0.0.0)

Class B—128 to 191 (subnet mask 255.255.0.0)

[46] https://en.wikipedia.org/wiki/ARP_spoofing

[47] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 116

Class C—192 to 223 (subnet mask 255.255.255.0)''[48]

'' Public vs. private vs. APIPA

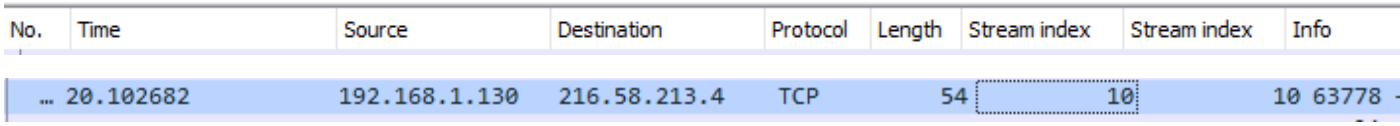
IP addresses used on the Internet are public IP addresses. IP addresses used on internal networks are private IP addresses. Automatic Private IP Addressing (APIPA) addresses are randomly selected private addresses that always start with 169.254. Private IP addresses are formally defined in Request for Comments (RFC) 1918, with the following ranges: 10.0.0.0 through 10.255.255.255 (Class A private IP addresses) 172.16.0.0 through 172.31.255.255 (Class B private IP addresses) 192.168.0.0 through 192.168.255.255 (Class C private IP addresses)''

Features:

- **Version:** 4 for IPV4
- **Header Length:** the length of IP's header
- **Service's type:** a precedence flag and its type. (prioritize traffic)
- **Total length:** IP's header length + data.
- **Identification:** a unique number used to packet's identification.
- **Flags:** helpful when we need to identify if a packet is a part of sequence of highlighted packets.
- **Fragment offset:** it is helpful when we need reassemble the packets in correct order.
- **TTL** (time to live) – shows the packet lifetime, it describes in hops or seconds. It reduces the lifespan of data in network.
- **Protocol:** defines the header of transport layer which encapsulates the IPV4 header.
- **Header Checksum**: checks if IP header is damaged or not.
- **Source IP address: IP** address of the host which was responsible for packet transfer.
- **Destination IP Address:** destination of IP address.
- **Options:** related to source routing and timestamps.
- **Data:** transmitted data.

Screenshots from Wireshark and analyses:

(The highlight on blue it is what we are analysing. We see 9 categories in the header such as: no, time, source, destination, protocol, length, stream node, stream index, info. ''TCP-Transmission Control Protocol (TCP) provides end to end reliability for the delivery of data.''[49] TCP provides formal connectivity before the data's transmitting)



No.	Time	Source	Destination	Protocol	Length	Stream index	Stream index	Info
…	20.102682	192.168.1.130	216.58.213.4	TCP	54	10	10	63778

Info: 63778 → 443 [ACK] Seq=10479 Ack=181348 Win=131328 Len=0

The source is: 192.168.1.30 *(When we open command prompt we can find this info: ipconfig /all

[48] CompTIA A+, Rapid Review, Darril Gibson, Microsoft, page 115.
[49] Ch. Sanders, ''Practical Packet Analysis'', p.151

```
IPv4 Address. . . . . . . . . . . : 192.168.1.130(Preferred)
```

We have seen IPv4[50] address is our source in Wireshark.

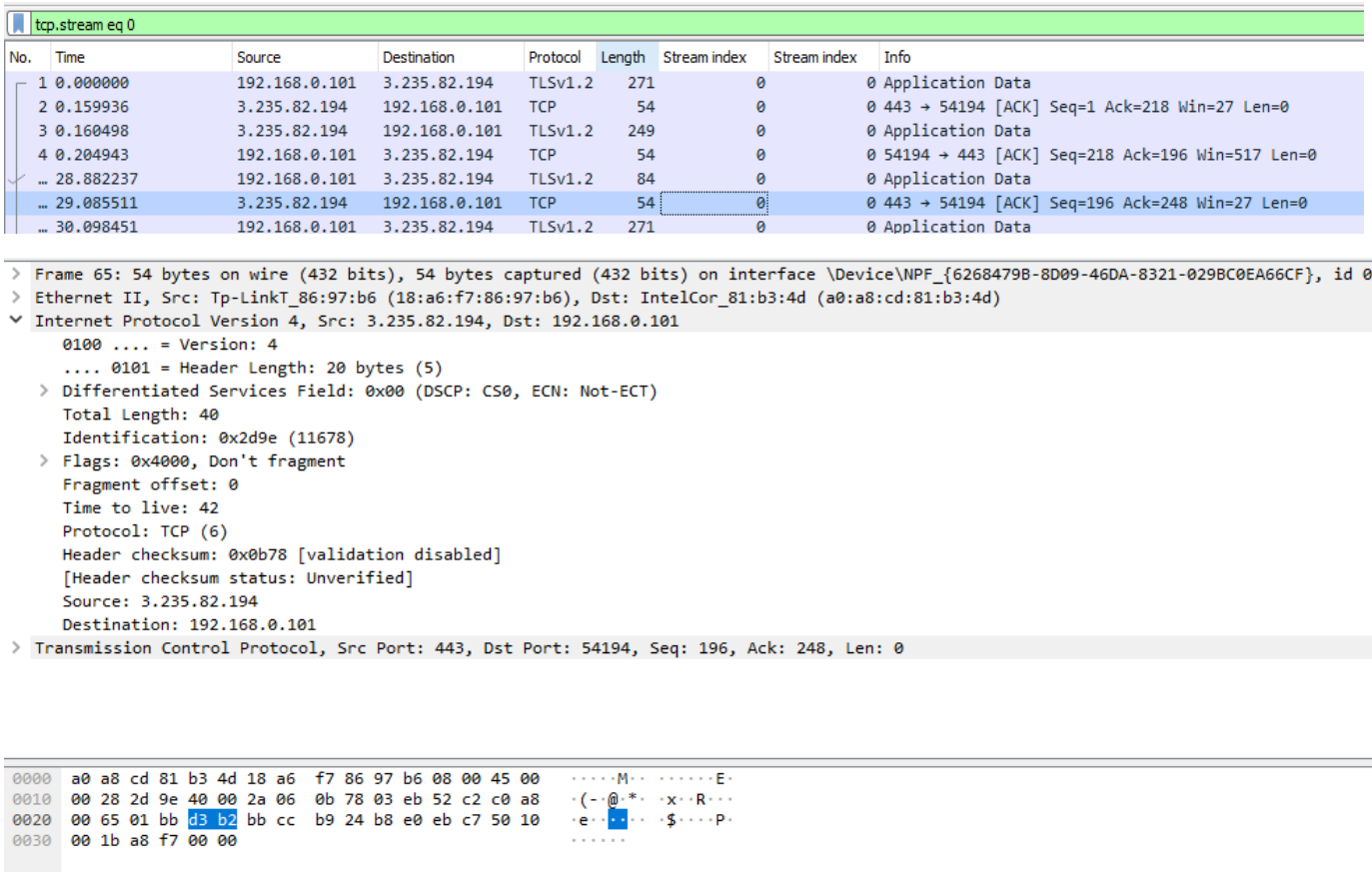
Destination: 216.58.213.4

Protocol: TCP (Transmission Control Protocol allows exchange messages in network)

Length: 54 (size of frame is 54)

Stream index: 10 (it runs from 6-196)

Another screen



Analyses:

Protocol is TCP, length is 54, stream index =0. 54 bytes has been captured. Ethernet II has been used to do it. Source: Tp-LinkT is the name of my WIFI. TTL=42 means 42 seconds was the lifespan of the packet. Header checksum – validation was disabled. Fragmented offset 0 means we haven't started reassemble the packet in order. Destination 192.168.0.101 is default gateway and IPV4, after calling

[50] Is used for identifying devices which are connected to network, 32-bit number, it consists of 2 parts: network portion and host portion.

ipconfig in command prompt:

```
Wireless LAN adapter WiFi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::dcf5:289b:f34c:bfbe%6
   IPv4 Address. . . . . . . . . . . : 192.168.0.101
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.0.1
```

We can use also in command prompt command:

netsh show wlan networks mode=bssid

```
C:\Users\Home>netsh wlan show networks mode=bssid

Interface name : WiFi
There are 1 networks currently visible.

SSID 1 : TP-LINK_8697B7
    Network type            : Infrastructure
    Authentication          : WPA2-Personal
    Encryption              : CCMP
    BSSID 1                 : 18:a6:f7:86:97:b6
         Signal             : 99%
         Radio type         : 802.11n
         Channel            : 3
         Basic rates (Mbps) : 6.5 16 19.5 117
         Other rates (Mbps) : 18 19.5 24 36 39 48 54 156
```

We can see the name of network, what is used for authentication in this case is WPA2, which is good because it is better than WPA. Encryption CCMP which is standard encryption protocol. It is good signal 99% out 100%, channel 3 (we have 13 ones used in Poland) 2 indicators referring to rates, it is in Mbps (megabits per second, it is related to reference to download and upload speeds)

The next command is:

Netsh wlan show interfaces

```
C:\Users\Home>netsh wlan show interfaces

There is 1 interface on the system:

    Name                   : WiFi
    Description            : Intel(R) Dual Band Wireless-AC 7260
    GUID                   : 6268479b-8d09-46da-8321-029bc0ea66cf
    Physical address       : a0:a8:cd:81:b3:4d
    State                  : connected
    SSID                   : TP-LINK_8697B7
    BSSID                  : 18:a6:f7:86:97:b6
    Network type           : Infrastructure
```

BSSID is ''the MAC address of the radio interface the client device is currently connected to'' [51] MAC is the abbreviation of Media Access Control, unique number associated with NIC (Network Interface Card) SSID is the name of my WIFI, it is visible because I haven't changed what was set by the default. State connected means I have net connection.

TCP:

Source port 443 means: is used for secure web browser communication, name =https (http protocol over TLS/SSL) "Web servers offering to accept and establish secure connections listen on this port for connections from web browsers desiring strong communication security."[52]

Destination port 54194 means: "TCP guarantees delivery of data packets on port 54194 in the same order in which they were sent. Guaranteed communication over TCP port 54194 is the main difference between TCP and UDP. UDP port 54194 would not have guaranteed communication as TCP. UDP on port 54194 provides an unreliable service and datagrams may arrive duplicated, out of order, or missing without notice.''[53]

Sequence 196 means: number of the first byte of data in TCP transferred packet.

And len 0 means: because 192.168.0.1 only acknowledges the data, there is no data transfer in this case.

Abbreviations:

SYN – means synchronise, it happened when clients request a connection.

SYN/ACK – synchronise/acknowledgement, there are bits in TCP header; SYN starts TCP session, ACK highlights the ACK number in TCP header is acknowledging the data.

[51] https://help.datto.com/s/article/KB115005592546#:~:text=The%20BSSID%20is%20the%20MAC,MAC%20addresses%20assigned%20to%20it

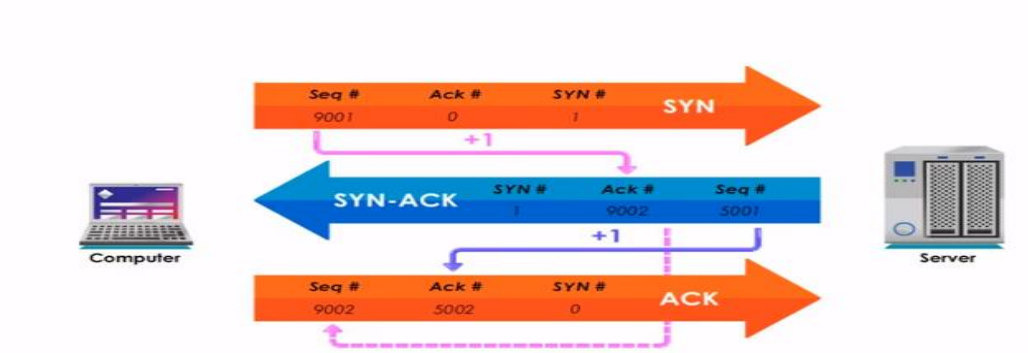
[52] https://www.grc.com/port_443.htm

[53] https://www.adminsub.net/tcp-udp-port-finder/54194

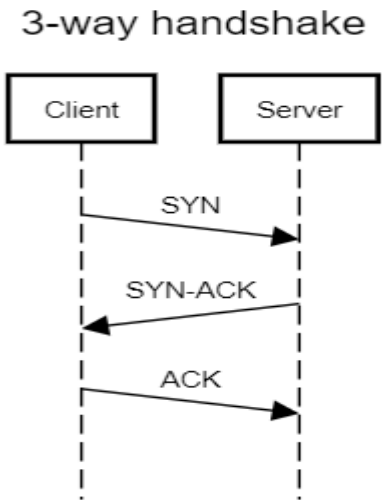
3-way handshake:

TCP is a connection between 2 hosts such as: server and client. “The TCP defines a 3-way handshake mechanism to initiate the connection.”[54]

- Client starts by sending SYN packet.
- Server responds with a packet included ACK (acknowledgment) that it received client SYN and SYN was directed to the client.
- Client should reply with ACK that SYN has been received.

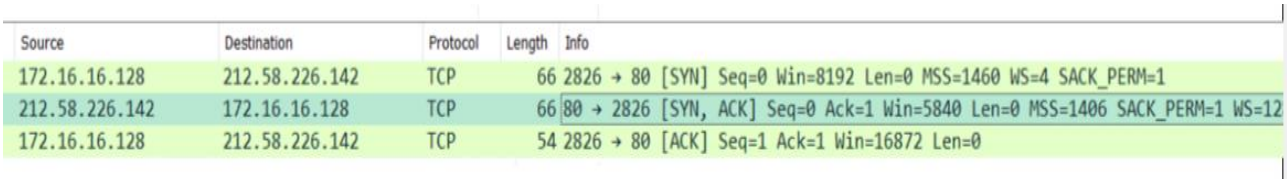


based on: https://www.youtube.com/watch?v=xMtP5ZB3wSk



based on: https://codeburst.io/basic-tcp-analysis-with-wireshark-b99ed54fa499

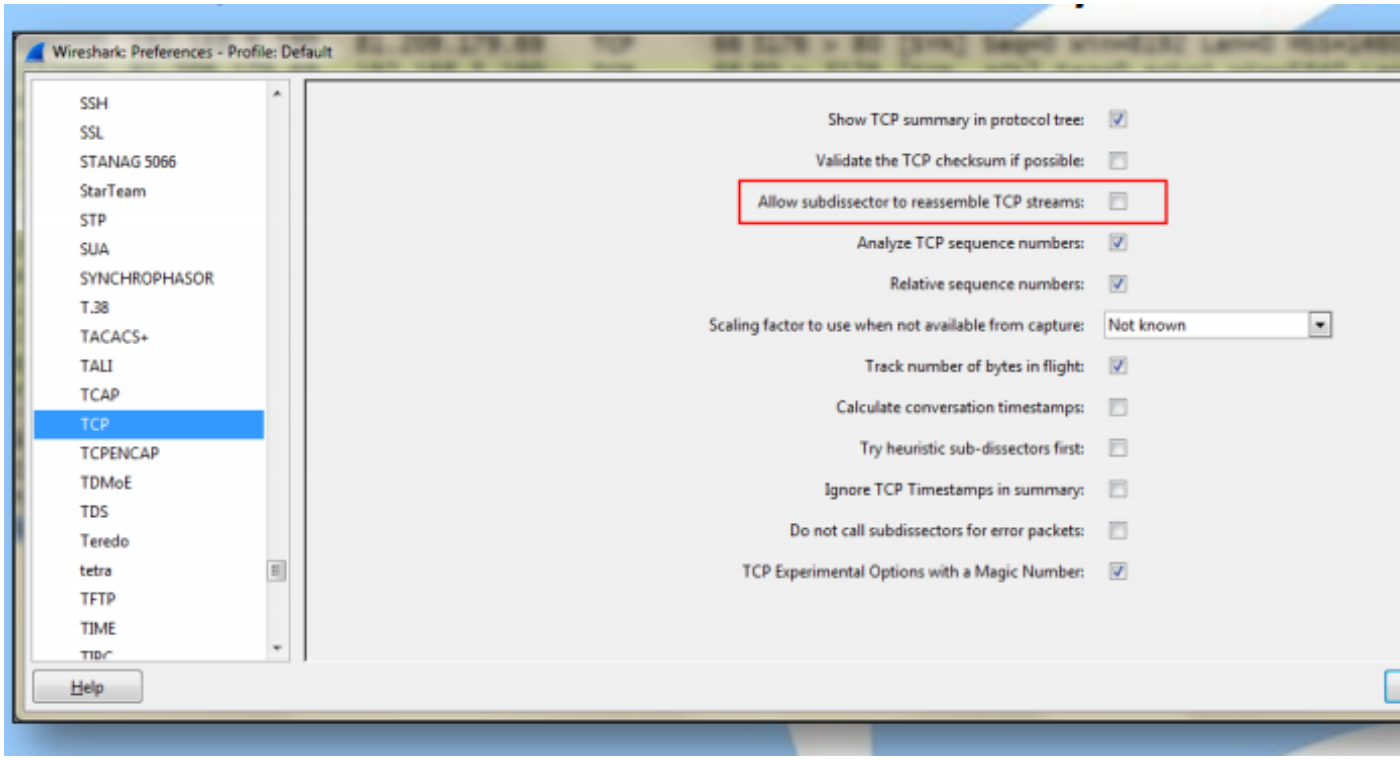
For example, in Wireshark we can see this 3 handshake, we have 3 lines and on each one we can notice status such as: on the firs SYN only, on the second SYN and ACK and on third just ACK.



Source	Destination	Protocol	Length	Info
172.16.16.128	212.58.226.142	TCP	66	2826 → 80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=4 SACK_PERM=1
212.58.226.142	172.16.16.128	TCP	66	80 → 2826 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1406 SACK_PERM=1 WS=12
172.16.16.128	212.58.226.142	TCP	54	2826 → 80 [ACK] Seq=1 Ack=1 Win=16872 Len=0

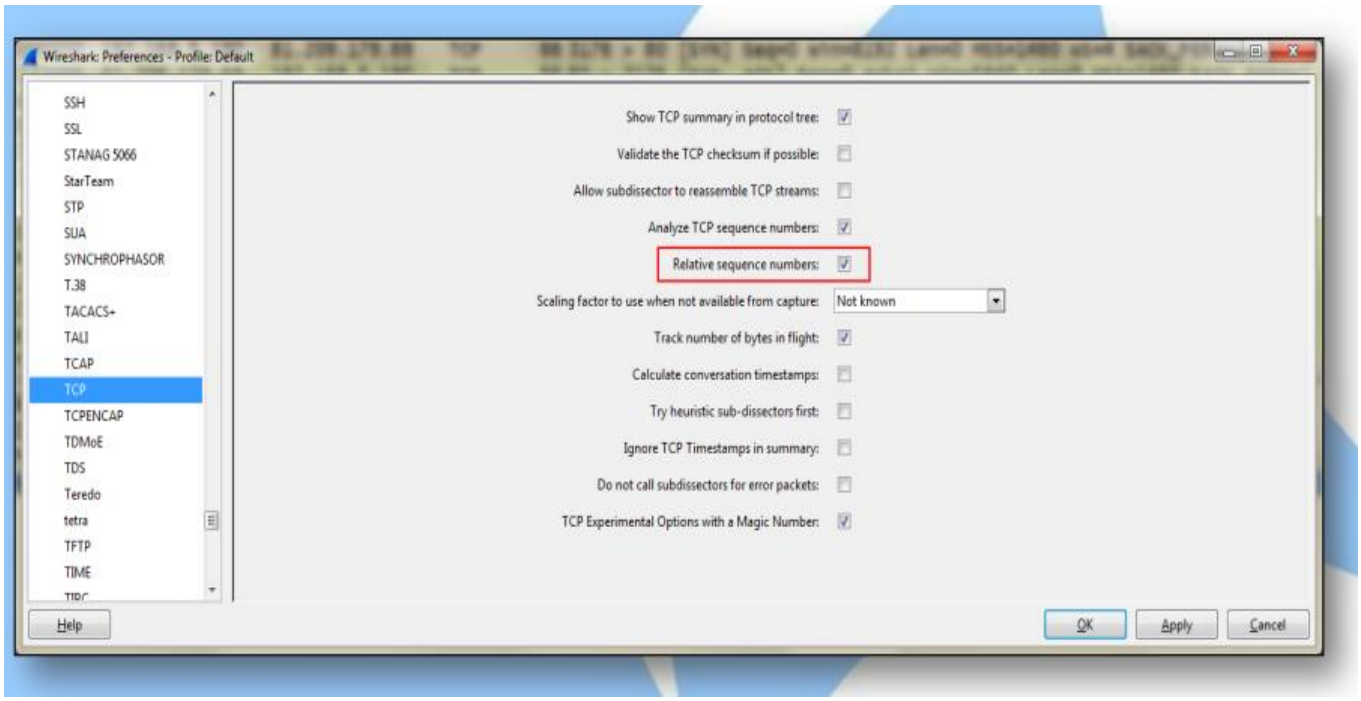
[54] https://codeburst.io/basic-tcp-analysis-with-wireshark-b99ed54fa499

It is important to turn on reassemble TCP streams.

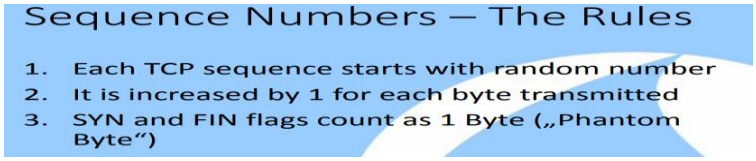


Based on: B5-TCP Analysis First step, presentation Power Point, slide 13/34.

Later turn on: RELATIVE SEQUENCE NUMBERS

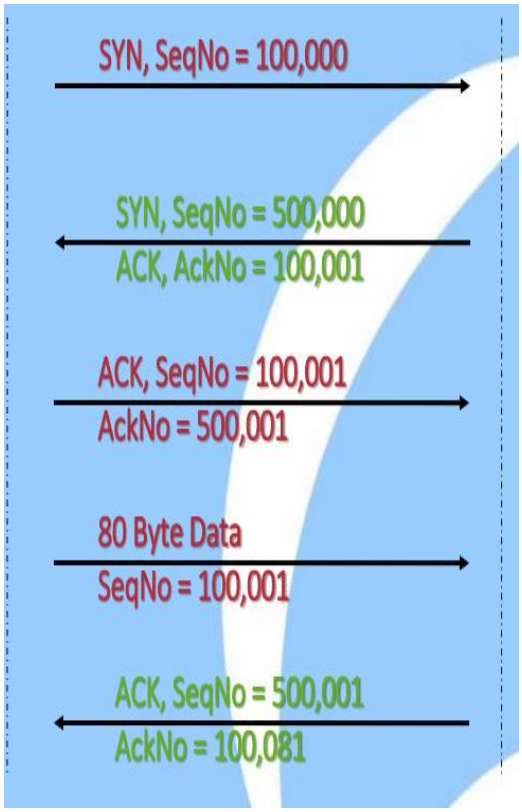


Based on: B5-TCP Analysis First step, presentation Power Point, slide 13/34.



Based on: B5-TCP Analysis First step, presentation Power Point, slide 13/34.

For instance:



Based on: B5-TCP Analysis First step, presentation Power Point, slide 13/34.

We can observe on this schema that AckNo and SeqNo has been increased by 1. Moreover, we should also consider that every direction has own number and relative sequence numbers look identical for 2 directions.

Wireshark – screenshots:

192.168.0.101	13.107.4.52	TCP	66	19	19 50290 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13.107.4.52	192.168.0.101	TCP	68	19	19 80 → 50290 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1440 WS=256 SACK_PERM=1
192.168.0.101	13.107.4.52	TCP	54	19	19 50290 → 80 [ACK] Seq=1 Ack=1 Win=132352 Len=0
192.168.0.101	13.107.4.52	HTTP	208	19	19 GET /connecttest.txt HTTP/1.1
13.107.4.52	192.168.0.101	TCP	56	19	19 80 → 50290 [ACK] Seq=1 Ack=155 Win=525312 Len=0
13.107.4.52	192.168.0.101	HTTP	568	19	19 HTTP/1.1 200 OK (text/plain)
192.168.0.101	13.107.4.52	TCP	54	19	19 50290 → 80 [FIN, ACK] Seq=155 Ack=515 Win=131840 Len=0
13.107.4.52	192.168.0.101	TCP	56	19	19 80 → 50290 [FIN, ACK] Seq=515 Ack=155 Win=525312 Len=0
192.168.0.101	13.107.4.52	TCP	54	19	19 50290 → 80 [ACK] Seq=156 Ack=516 Win=131840 Len=0
13.107.4.52	192.168.0.101	TCP	56	19	19 80 → 50290 [ACK] Seq=516 Ack=156 Win=525312 Len=0

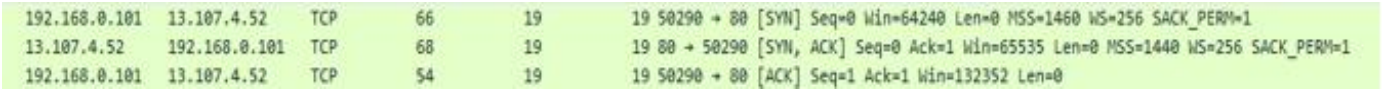
```
    Capture Length: 56 bytes (448 bits)
    [Frame is marked: False]
    [Frame is ignored: False]
    [Protocols in frame: eth:ethertype:ip:tcp:vssmonitoring]
    [Coloring Rule Name: HTTP]
    [Coloring Rule String: http || tcp.port == 80 || http2]
> Ethernet II, Src: Tp-LinkT_86:97:b6 (18:a6:f7:86:97:b6), Dst: IntelCor_81:b3:4d (a0:a8:cd:81:b3:4d)
> Internet Protocol Version 4, Src: 13.107.4.52, Dst: 192.168.0.101
v Transmission Control Protocol, Src Port: 80, Dst Port: 50290, Seq: 516, Ack: 156, Len: 0
    Source Port: 80
    Destination Port: 50290
    [Stream index: 19]
    [TCP Segment Len: 0]
    Sequence number: 516    (relative sequence number)
    Sequence number (raw): 4024584630
    [Next sequence number: 516    (relative sequence number)]
    Acknowledgment number: 156    (relative ack number)
    Acknowledgment number (raw): 2817646949
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window size value: 2052
    [Calculated window size: 525312]
    [Window size scaling factor: 256]
    Checksum: 0x4d71 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  > [SEQ/ACK analysis]
  > [Timestamps]
> VSS Monitoring Ethernet trailer, Source Port: 0
```

```
v Flags: 0x010 (ACK)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Nonce: Not set
      .... 0... .... = Congestion Window Reduced (CWR): Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...1 .... = Acknowledgment: Set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
      .... .... ..0. = Syn: Not set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ·····A····]
    Window size value: 2052
    [Calculated window size: 525312]
    [Window size scaling factor: 256]
    Checksum: 0x4d71 [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0

  v [SEQ/ACK analysis]
      [This is an ACK to the segment in frame: 2281]
      [The RTT to ACK the segment was: 0.070218000 seconds]
      [iRTT: 0.072353000 seconds]

  v [Timestamps]
      [Time since first frame in this TCP stream: 0.194863000 seconds]
      [Time since previous frame in this TCP stream: 0.059957000 seconds]
v VSS Monitoring Ethernet trailer, Source Port: 0
    Src Port: 0
```

Analysis based on https://www.youtube.com/watch?v=HCHFX5O1IaQ

Conclusions:

Initial packet is:



The port which we want to achieve is 80. Stream index =19, Sequence number = 516 (relative).

Windows size value =2052, this is where I am advertising the size of my TCP receive buffer; I can receive 2052 bytes at once, acknowledged.

Calculated Window Size –=525312, (2052*256=525312; windows size value * Windows size scaling factor)

Flags:

0 means false, only acknowledgement **=1** means true, all others are false, have not been set.

It is important to catch TCP handshake because we can calculate true window, we can have delta time (time between packets) and initial roundtrip time (Go to Edit -> Preferences -> User Interface -> Columns. Click "Add", name it "Relative Time" and select "Relative Time" as Field Type)

Timestamp

"While packets are captured, each packet is timestamped. These timestamps will be saved to the capture file, so they will be available for later analysis"[55]

Ghost (Phantom) byte = "causes the sequence number and acknowledgment number fields to increment by 1 even though no data is exchanged. This phantom byte can be confusing when you have just learned that the sequence number field increments only when data is sent."[56]

TCP Connection Teardown:[57]

In brief:

[55] https://cse.sc.edu/~pokeefe/tutorials/wireshark/ChWorkTimeFormatsSection.html
[56] https://packetlife.net/blog/2010/jun/7/understanding-tcp-sequence-acknowledgment-numbers/
[57] based on https://www2.hawaii.edu/~esb/1998fall.ics451/nov02.html

Independent shutdown on every side,

Closure the connection on condition that second side send FIN,

FIN packets have been acknowledged.

More detailed:

Every handshake has teardown, it happened when connection between 2 sides is closed. FIN is the indicator which defines end of connection. 4 packets are used in this process.

Process:

1) Host A sends FIN and ACK flag set.
2) Host B responds with ACK packet and send own FIN/ACK.
3) Host A responds with ACK packet and ending the communication.

Tcp_teardown in Wireshark

TCP resets:

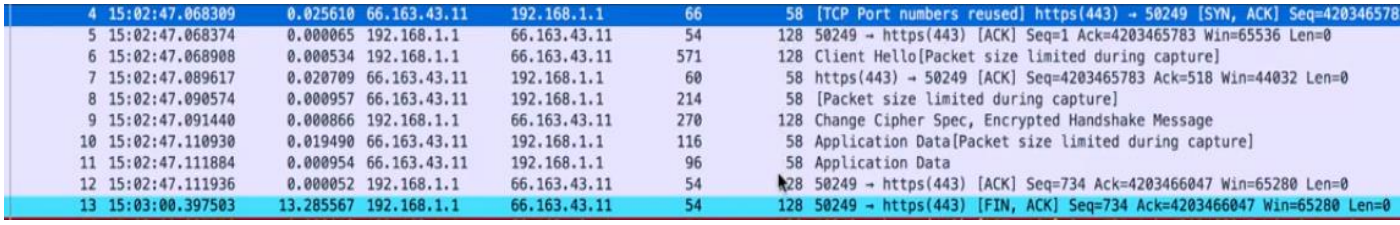
RST flag is used to signalise that was disruption, the connection was failed or finished suddenly.

Window in Wireshark to look what is happening: Tcp_refuseconnection.pcapng in Wireshark

RESET – can happen in any point of TCP connection. This is abortive release.

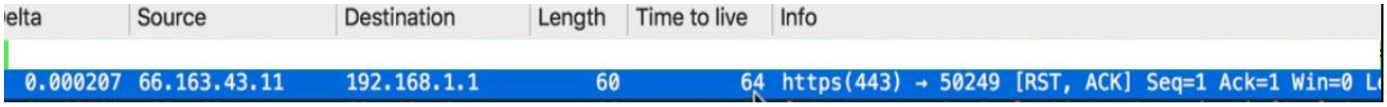
Analysis:

The client starts from 443 SYN there was no connection (RST) we try again and after this was retransmission (TCP Retransmission) after that 25 milliseconds later the connection was successful; we can observe SYN ACK and connection being established. In line 13 we can see that client sent FIN to a server. It happened after some seconds of inactivity.



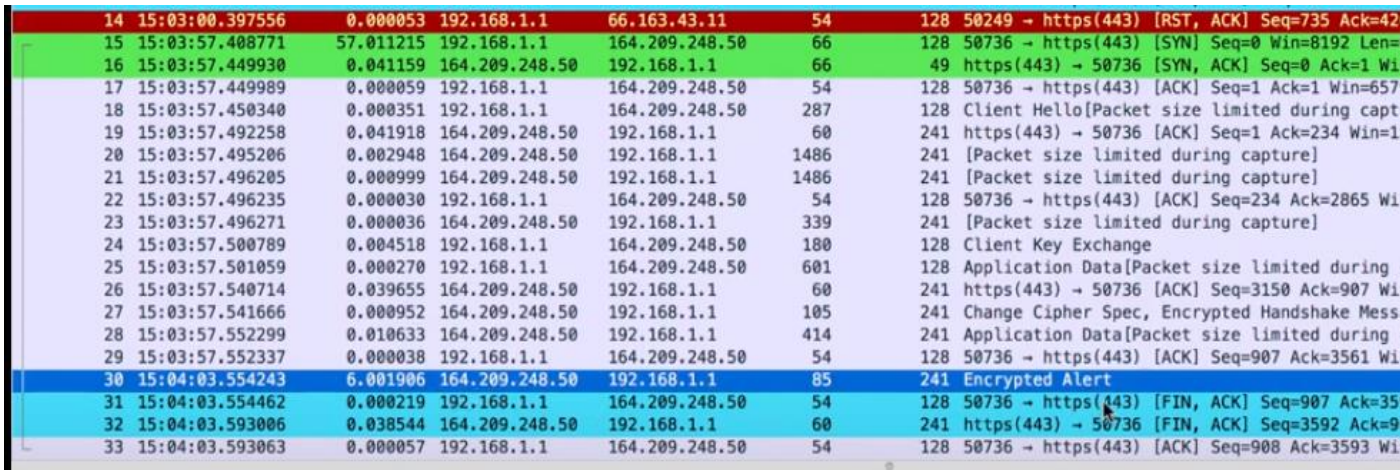
4	15:02:47.068309	0.025610	66.163.43.11	192.168.1.1	66	58	[TCP Port numbers reused] https(443) → 50249 [SYN, ACK] Seq=420346578
5	15:02:47.068374	0.000065	192.168.1.1	66.163.43.11	54	128	50249 → https(443) [ACK] Seq=1 Ack=4203465783 Win=65536 Len=0
6	15:02:47.068908	0.000534	192.168.1.1	66.163.43.11	571	128	Client Hello[Packet size limited during capture]
7	15:02:47.089617	0.020709	66.163.43.11	192.168.1.1	60	58	https(443) → 50249 [ACK] Seq=4203465783 Ack=518 Win=44032 Len=0
8	15:02:47.090574	0.000957	66.163.43.11	192.168.1.1	214	58	[Packet size limited during capture]
9	15:02:47.091440	0.000866	192.168.1.1	66.163.43.11	270	128	Change Cipher Spec, Encrypted Handshake Message
10	15:02:47.110930	0.019490	66.163.43.11	192.168.1.1	116	58	Application Data[Packet size limited during capture]
11	15:02:47.111884	0.000954	66.163.43.11	192.168.1.1	96	58	Application Data
12	15:02:47.111936	0.000052	192.168.1.1	66.163.43.11	54	128	50249 → https(443) [ACK] Seq=734 Ack=4203466047 Win=65280 Len=0
13	15:03:00.397503	13.285567	192.168.1.1	66.163.43.11	54	128	50249 → https(443) [FIN, ACK] Seq=734 Ack=4203466047 Win=65280 Len=0

The reset was sent by a firewall (TTL=64) it did not get to a server.

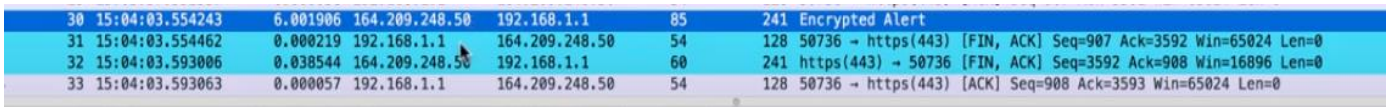


elta	Source	Destination	Length	Time to live	Info
0.000207	66.163.43.11	192.168.1.1	60	64	https(443) → 50249 [RST, ACK] Seq=1 Ack=1 Win=0 L

We can see a second connection, lines 15,16,17 we have a handshake.



14	15:03:00.397556	0.000053	192.168.1.1	66.163.43.11	54	128	50249 → https(443) [RST, ACK] Seq=735 Ack=42
15	15:03:57.408771	57.011215	192.168.1.1	164.209.248.50	66	128	50736 → https(443) [SYN] Seq=0 Win=8192 Len=
16	15:03:57.449930	0.041159	164.209.248.50	192.168.1.1	66	49	https(443) → 50736 [SYN, ACK] Seq=0 Ack=1 Wi
17	15:03:57.449989	0.000059	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [ACK] Seq=1 Ack=1 Win=657
18	15:03:57.450340	0.000351	192.168.1.1	164.209.248.50	287	128	Client Hello[Packet size limited during capt
19	15:03:57.492258	0.041918	164.209.248.50	192.168.1.1	60	241	https(443) → 50736 [ACK] Seq=1 Ack=234 Win=1
20	15:03:57.495206	0.002948	164.209.248.50	192.168.1.1	1486	241	[Packet size limited during capture]
21	15:03:57.496205	0.000999	164.209.248.50	192.168.1.1	1486	241	[Packet size limited during capture]
22	15:03:57.496235	0.000030	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [ACK] Seq=234 Ack=2865 Wi
23	15:03:57.496271	0.000036	164.209.248.50	192.168.1.1	339	241	[Packet size limited during capture]
24	15:03:57.500789	0.004518	192.168.1.1	164.209.248.50	180	128	Client Key Exchange
25	15:03:57.501059	0.000270	192.168.1.1	164.209.248.50	601	128	Application Data[Packet size limited during
26	15:03:57.540714	0.039655	164.209.248.50	192.168.1.1	60	241	https(443) → 50736 [ACK] Seq=3150 Ack=907 Wi
27	15:03:57.541666	0.000952	164.209.248.50	192.168.1.1	105	241	Change Cipher Spec, Encrypted Handshake Mess
28	15:03:57.552299	0.010633	164.209.248.50	192.168.1.1	414	241	Application Data[Packet size limited during
29	15:03:57.552337	0.000038	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [ACK] Seq=907 Ack=3561 Wi
30	15:04:03.554243	6.001906	164.209.248.50	192.168.1.1	85	241	Encrypted Alert
31	15:04:03.554462	0.000219	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [FIN, ACK] Seq=907 Ack=35
32	15:04:03.593006	0.038544	164.209.248.50	192.168.1.1	60	241	https(443) → 50736 [FIN, ACK] Seq=3592 Ack=9
33	15:04:03.593063	0.000057	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [ACK] Seq=908 Ack=3593 Wi



30	15:04:03.554243	6.001906	164.209.248.50	192.168.1.1	85	241	Encrypted Alert
31	15:04:03.554462	0.000219	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [FIN, ACK] Seq=907 Ack=3592 Win=65024 Len=0
32	15:04:03.593006	0.038544	164.209.248.50	192.168.1.1	60	241	https(443) → 50736 [FIN, ACK] Seq=3592 Ack=908 Win=16896 Len=0
33	15:04:03.593063	0.000057	192.168.1.1	164.209.248.50	54	128	50736 → https(443) [ACK] Seq=908 Ack=3593 Win=65024 Len=0

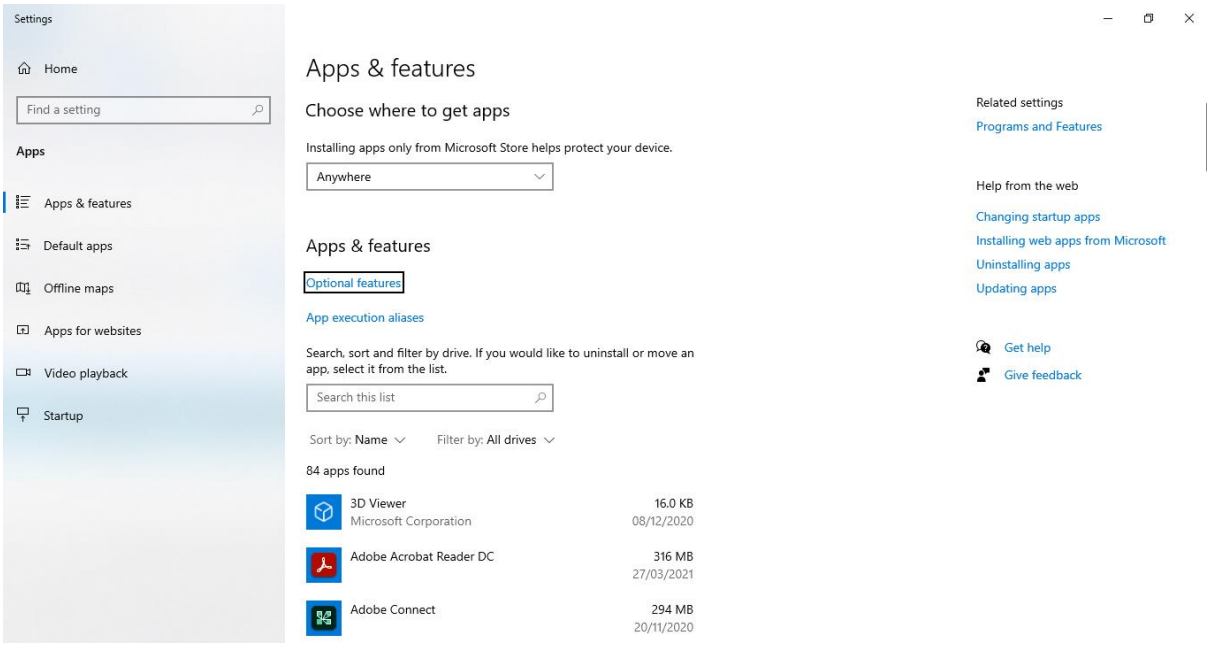
30	15:04:03.554243	6.001906	164.209.248.50	192.168.1.1	85	241	Encrypted Alert

There is encrypted alert (line 30); TCP can get FIN, it is time to teardown and allows resource to be used for something else.

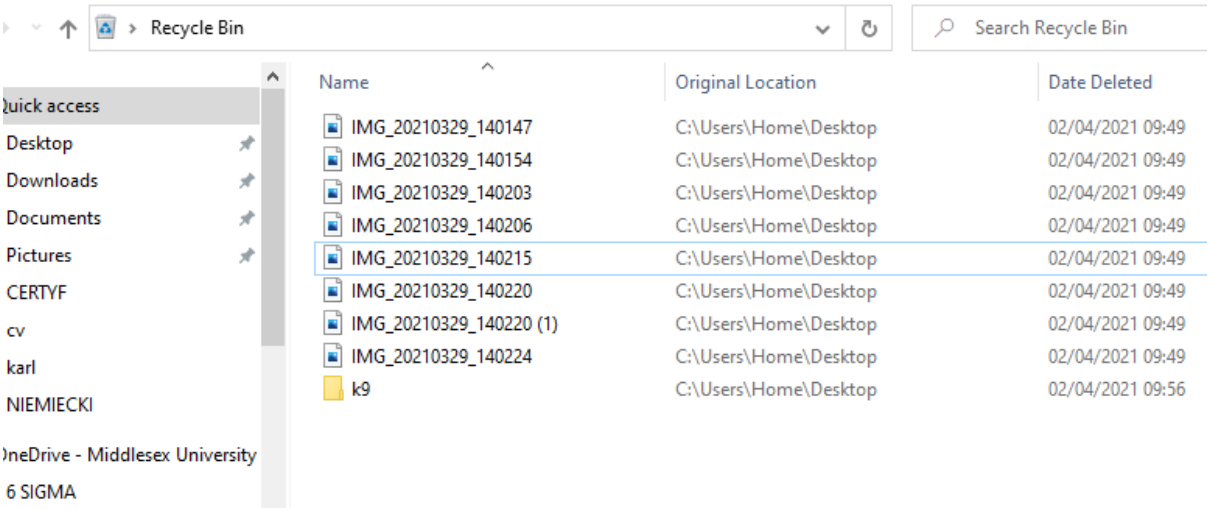
Week 22

Tips against computer slowlessness:

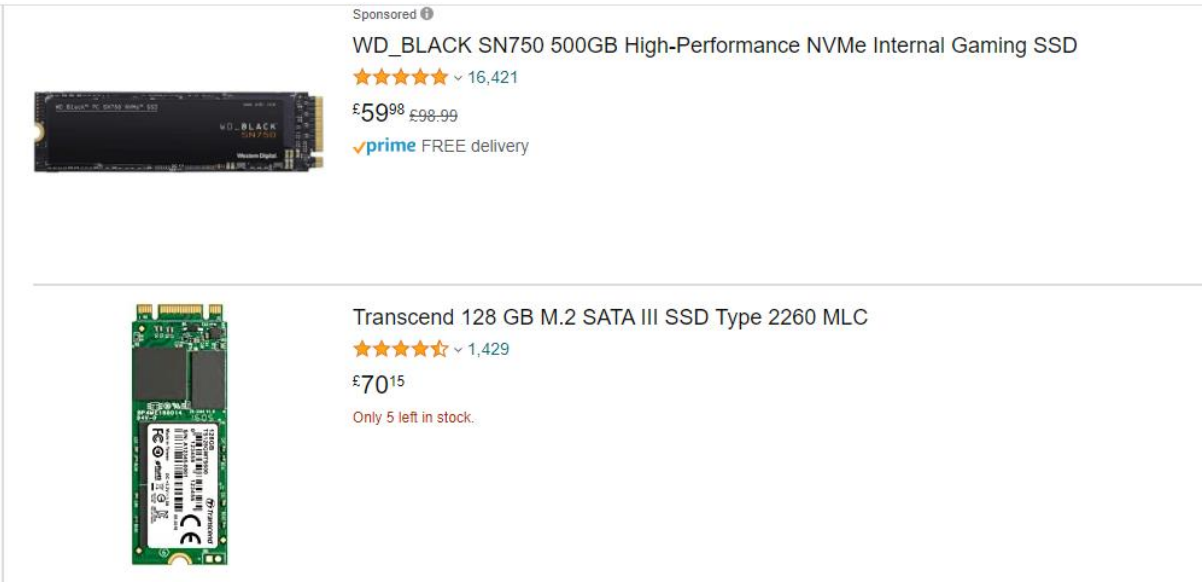
- Uninstall unused programs,



- Delete temporary files,



- Buy solid SSD,

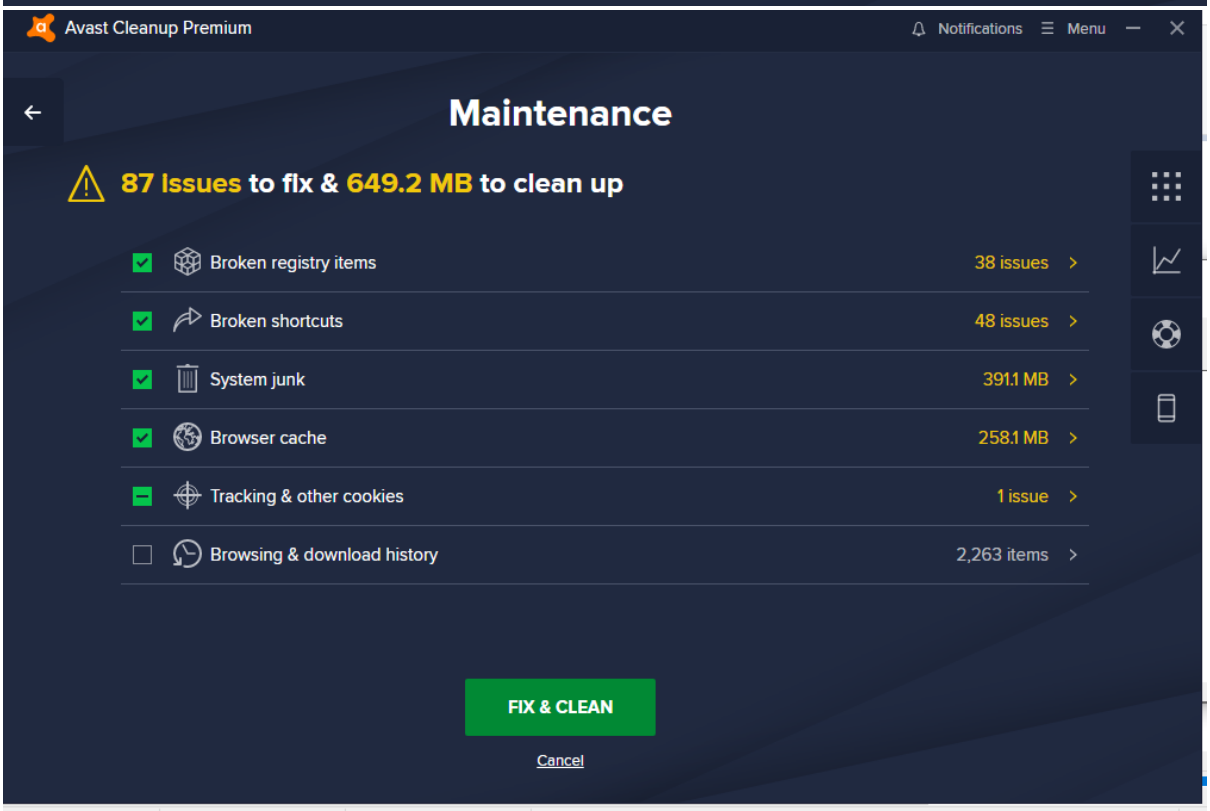


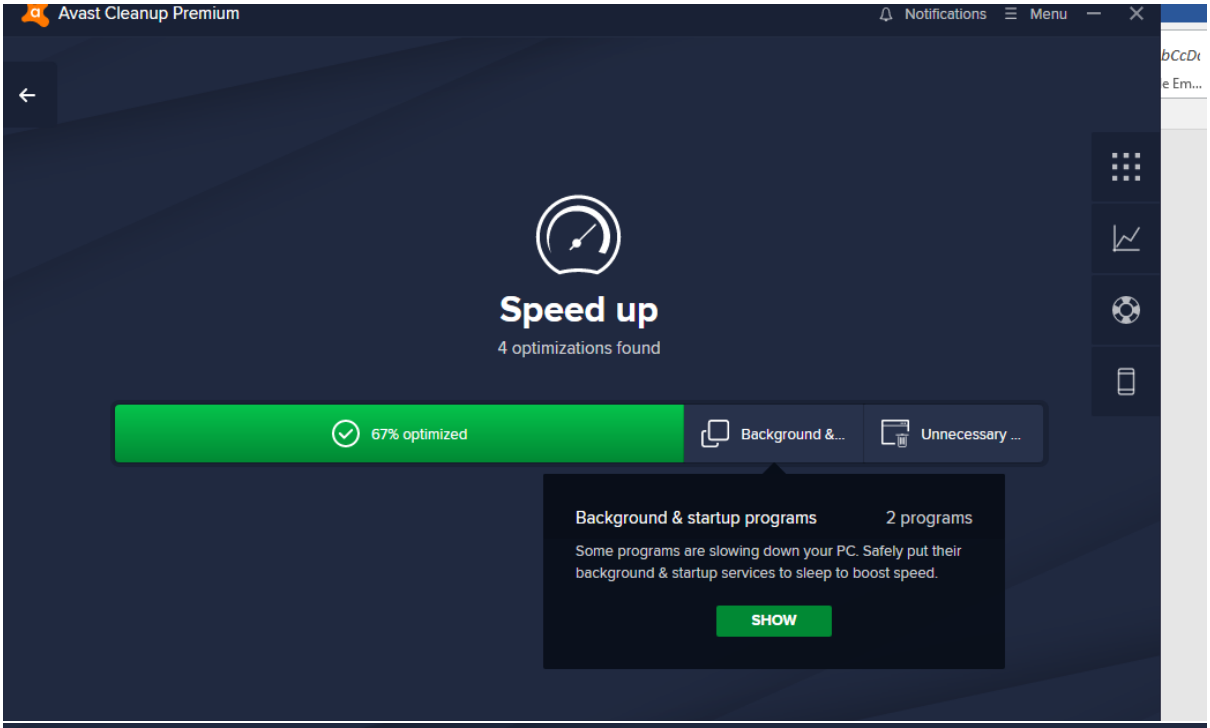
"The first question is whether you should choose a SATA drive or a more modern M.2 model. SATA SSDs use the same data and power connectors as a regular hard disk, so they're pretty much guaranteed to work with any system made in the past ten years. The catch is that the SATA interface is limited to around 550MB/sec - and on older systems, some or all ports may only support half that data rate."[58]

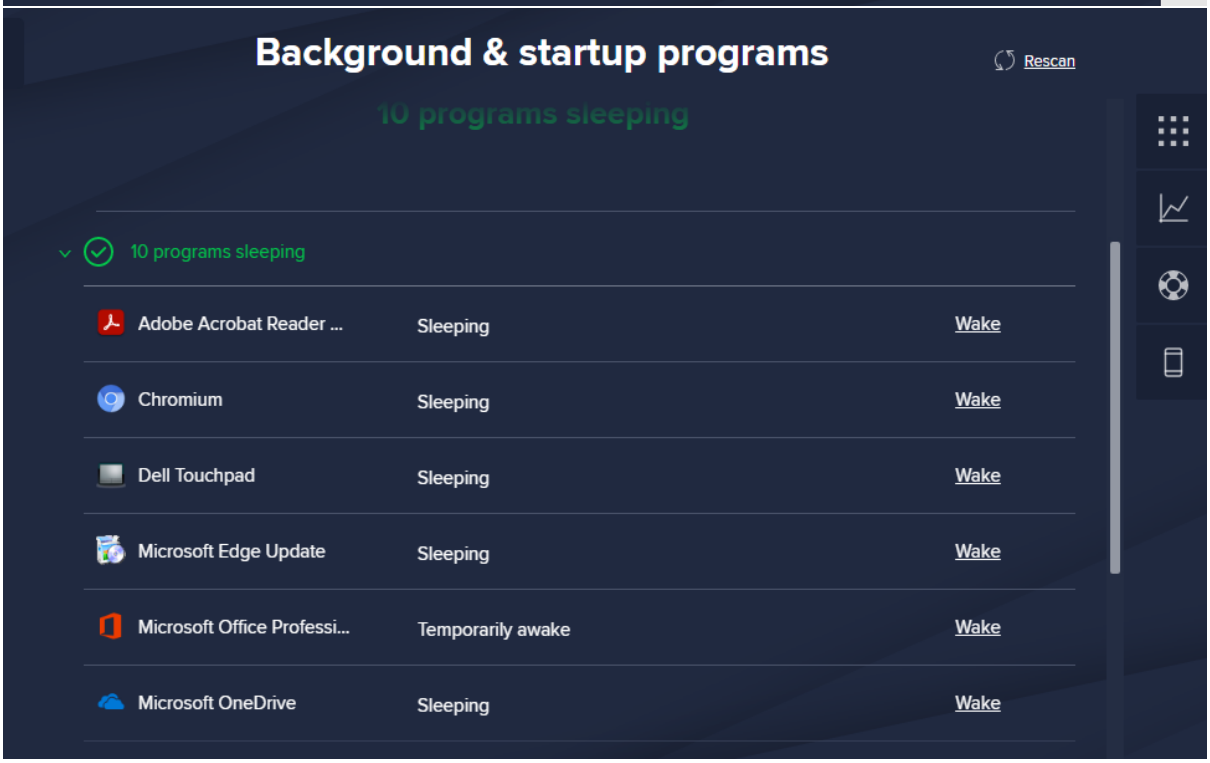
- Stop unnecessary start-ups,
- Buy more RAM,
- Run disk clean up, AVAST CLEANUP PREMIUM

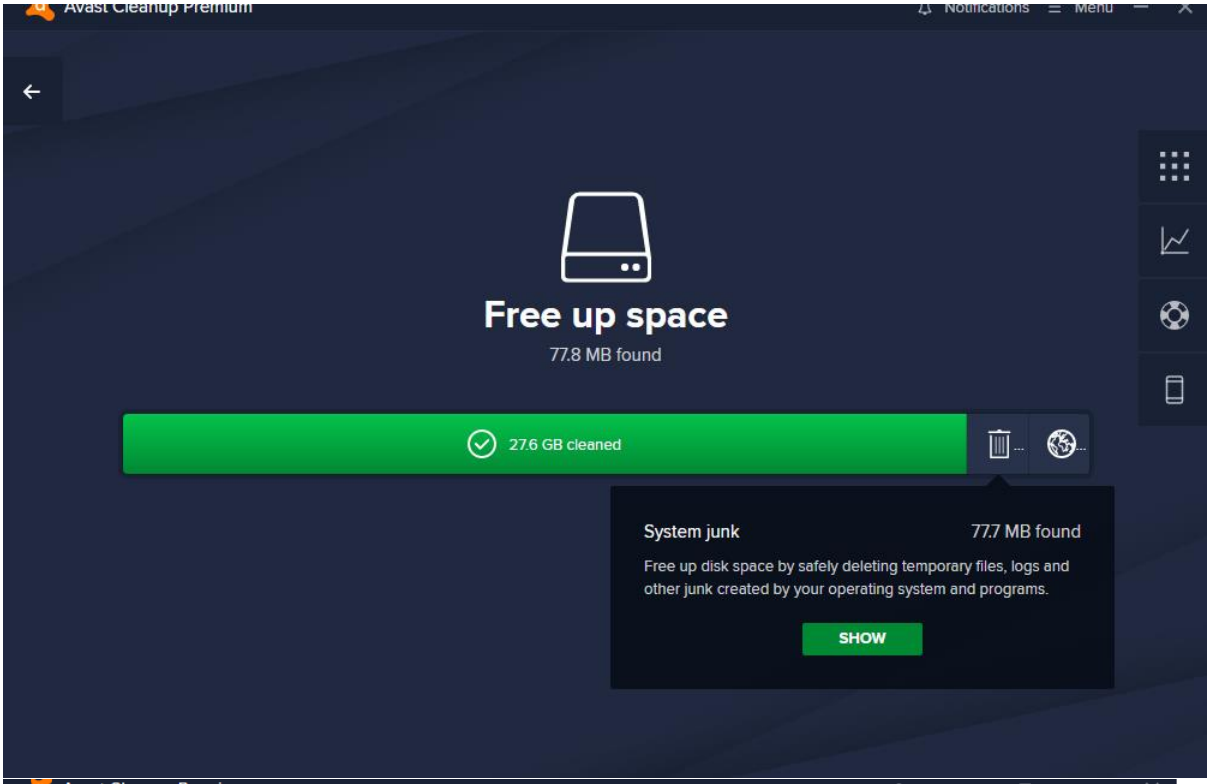
[58] https://www.itpro.co.uk/ssds/29494/how-to-pick-the-perfect-ssd-for-your-needs-and-budget

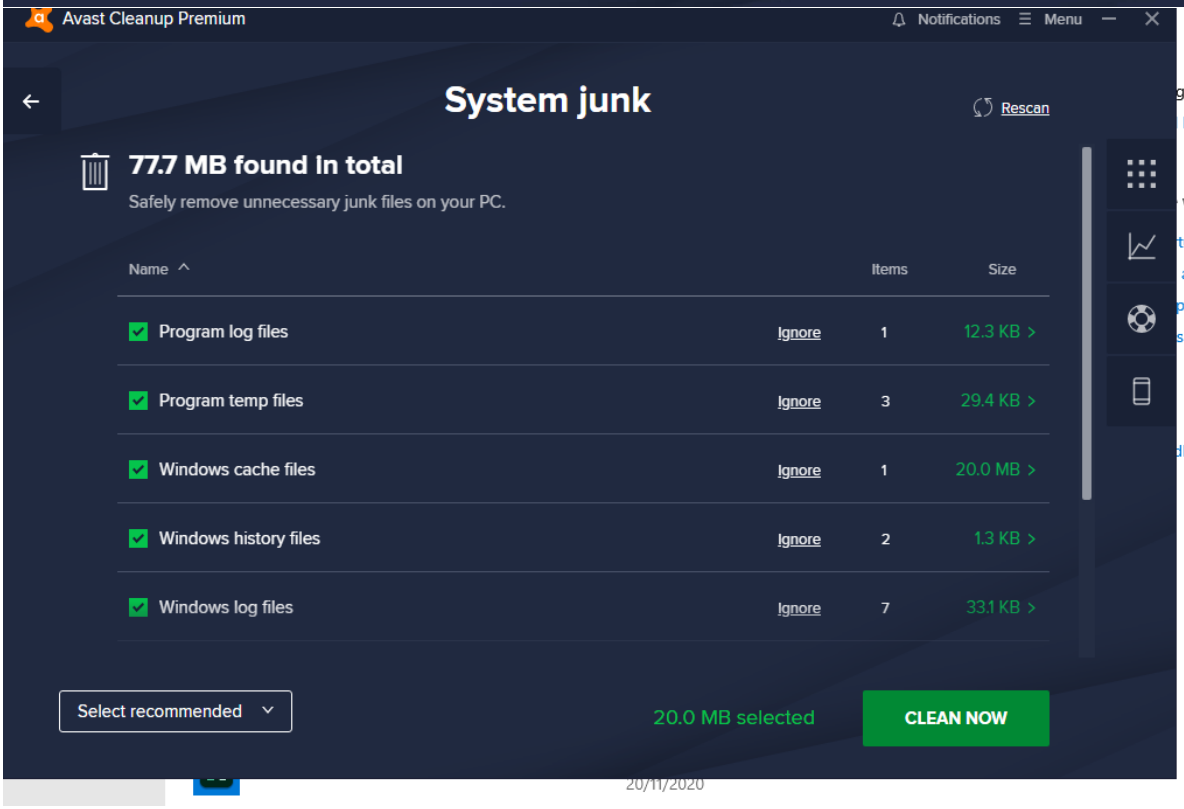

Avast Cleanup Premium
Notifications
Menu
92%
TUNED UP
0%
100%
Maintenance
LAST RUN:
4 HOURS AGO
Automatic Maintenance ON
Speed up
67% OPTIMIZED
4 optimizations found
Free up space
ALL CLEANED
Fix problems
2 PROBLEMS FIXED

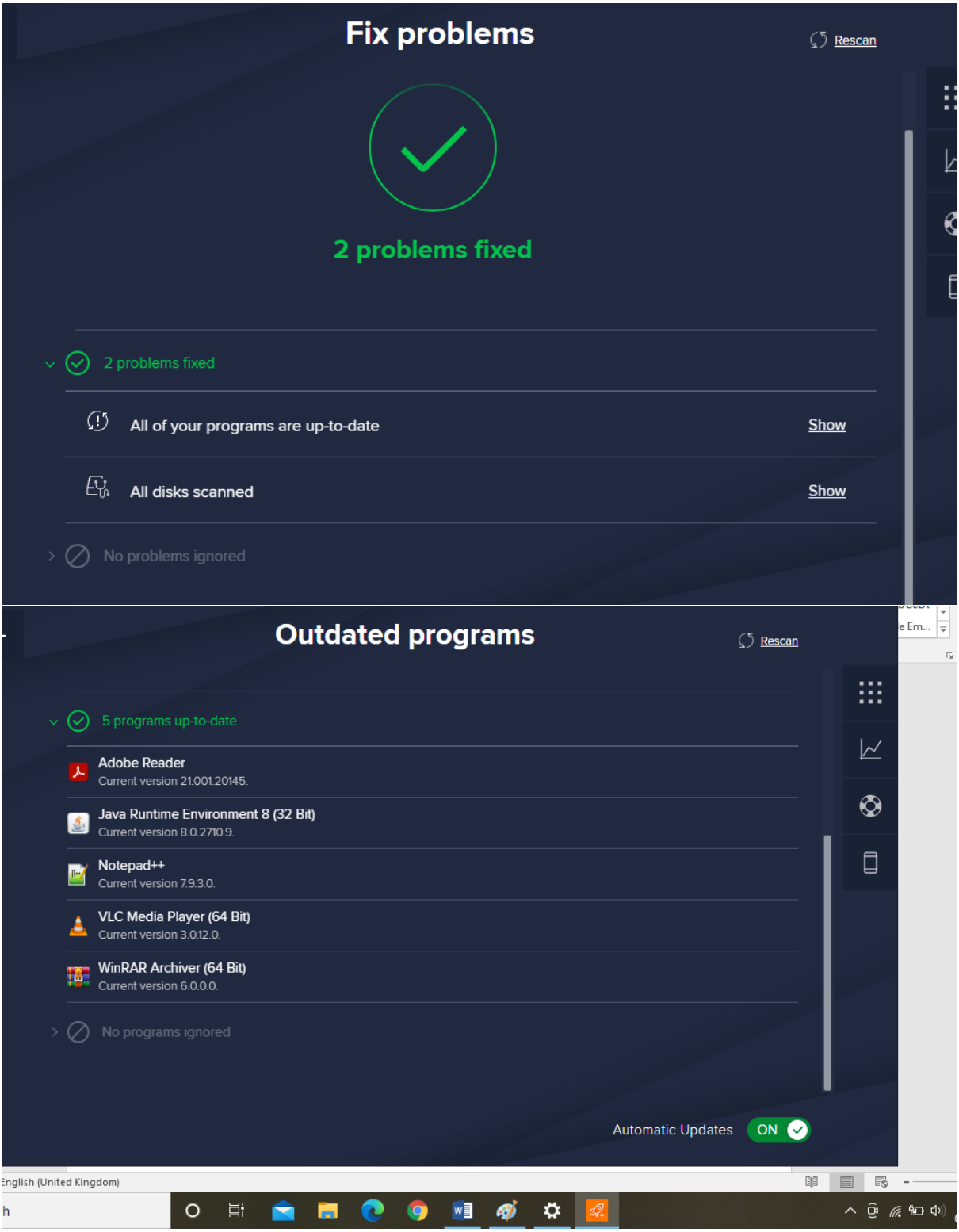

Avast Cleanup Premium
Notifications
Menu
Maintenance
87 Issues to fix & 649.2 MB to clean up
Broken registry items
38 issues
Broken shortcuts
48 issues
System junk
391.1 MB
Browser cache
258.1 MB
Tracking & other cookies
1 issue
Browsing & download history
2,263 items
FIX & CLEAN
Cancel

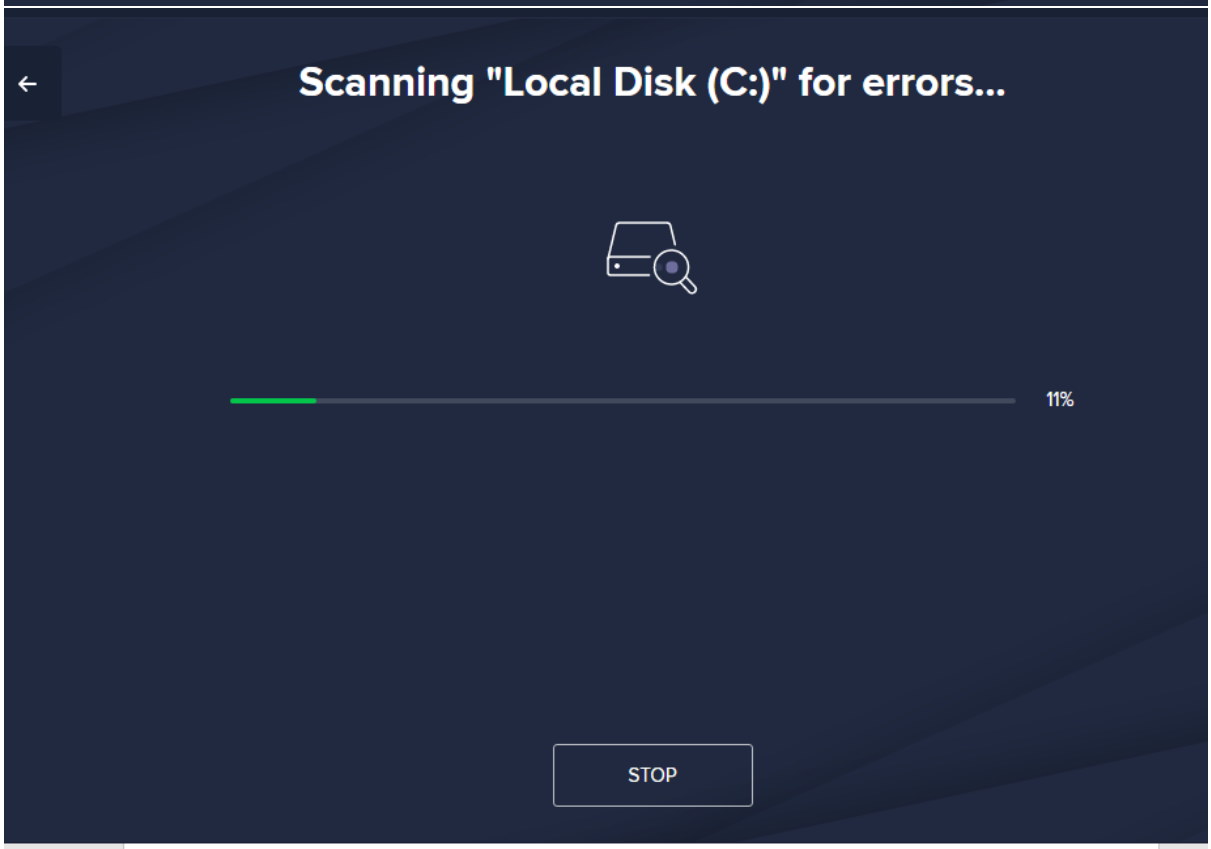

Avast Cleanup Premium
Notifications
Menu
Speed up
4 optimizations found
67% optimized
Background &...
Unnecessary ...
Background & startup programs
2 programs
Some programs are slowing down your PC. Safely put their background & startup services to sleep to boost speed.
SHOW


Background & startup programs
Rescan
10 programs sleeping
10 programs sleeping
Adobe Acrobat Reader ...
Sleeping
Wake
Chromium
Sleeping
Wake
Dell Touchpad
Sleeping
Wake
Microsoft Edge Update
Sleeping
Wake
Microsoft Office Professi...
Temporarily awake
Wake
Microsoft OneDrive
Sleeping
Wake

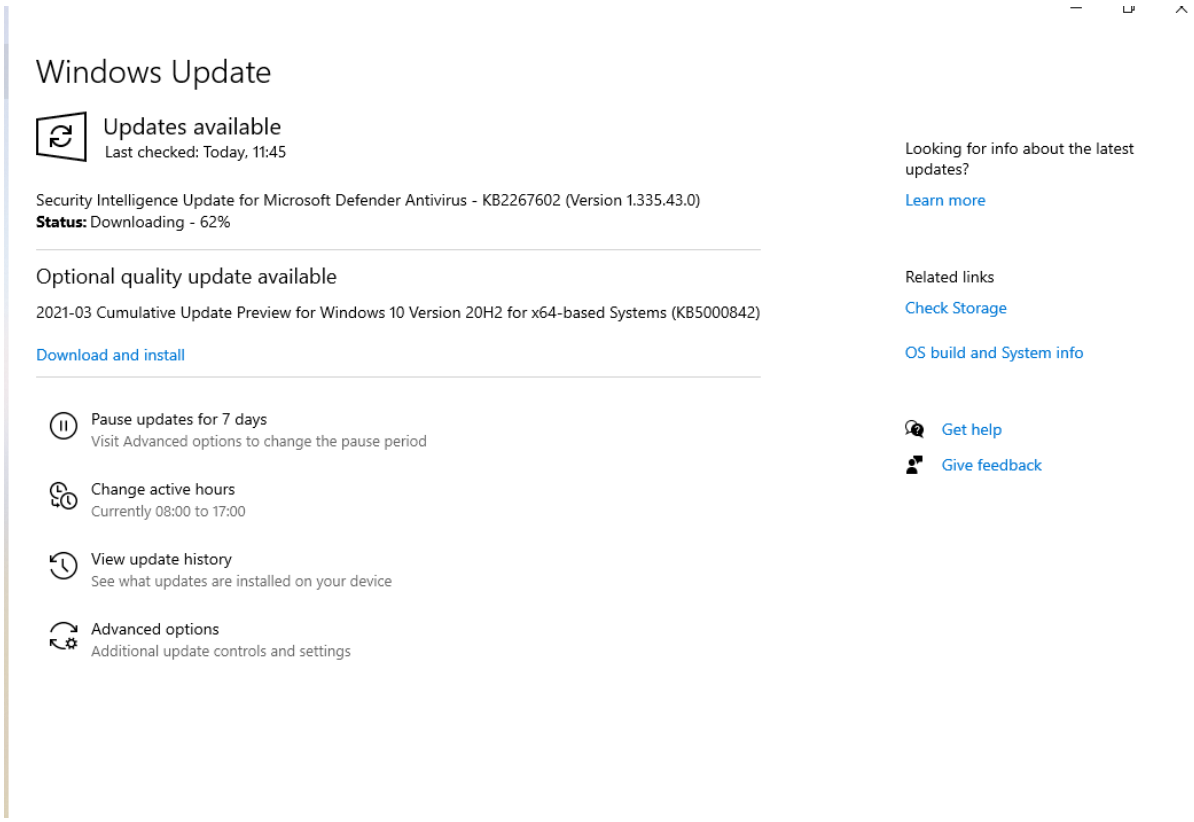

Avast Cleanup Premium
Notifications
Menu
Free up space
77.8 MB found
27.6 GB cleaned
System junk
77.7 MB found
Free up disk space by safely deleting temporary files, logs and other junk created by your operating system and programs.
SHOW


Avast Cleanup Premium
Notifications
Menu
System junk
Rescan
77.7 MB found in total
Safely remove unnecessary junk files on your PC.
Name
Items
Size
Program log files
Ignore
1
12.3 KB
Program temp files
Ignore
3
29.4 KB
Windows cache files
Ignore
1
20.0 MB
Windows history files
Ignore
2
1.3 KB
Windows log files
Ignore
7
33.1 KB
Select recommended
20.0 MB selected
CLEAN NOW


Fix problems
Rescan
2 problems fixed
2 problems fixed
All of your programs are up-to-date
Show
All disks scanned
Show
No problems ignored
Outdated programs
Rescan
5 programs up-to-date
Adobe Reader
Current version 21.001.20145.
Java Runtime Environment 8 (32 Bit)
Current version 8.0.2710.9.
Notepad++
Current version 7.9.3.0.
VLC Media Player (64 Bit)
Current version 3.0.12.0.
WinRAR Archiver (64 Bit)
Current version 6.0.0.0.
No programs ignored
Automatic Updates
ON

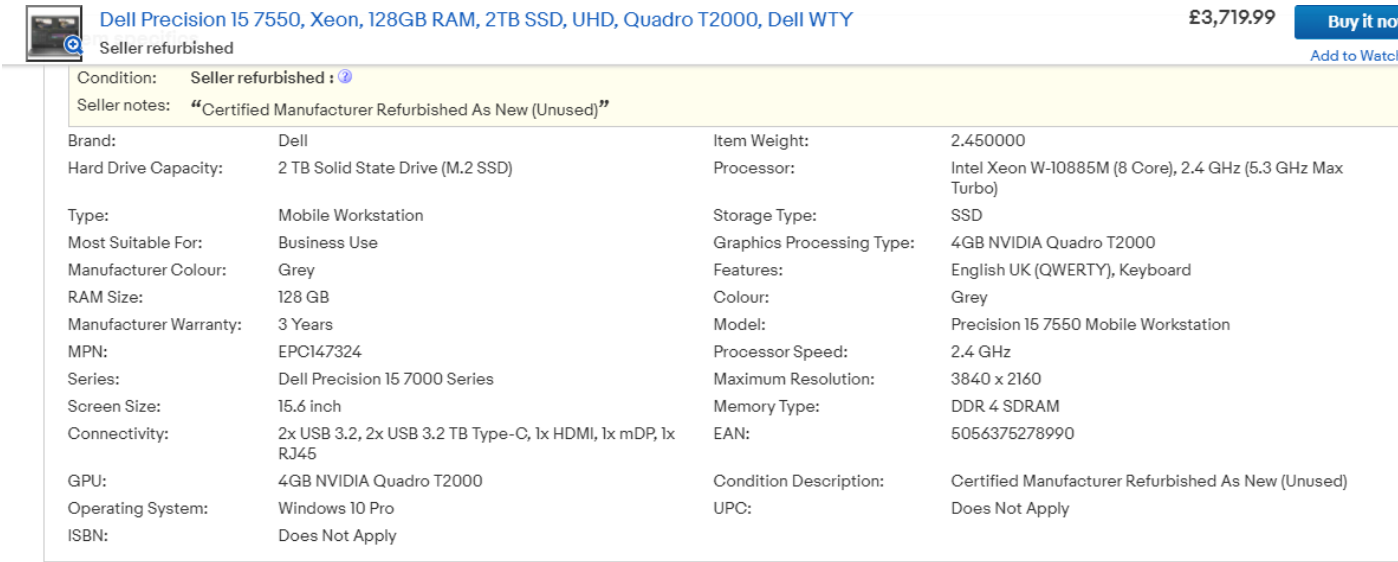


- Vacuum,
- Updates



- Think about new PC

For example, this type of Dell



Features:

RAM size: 128 GB

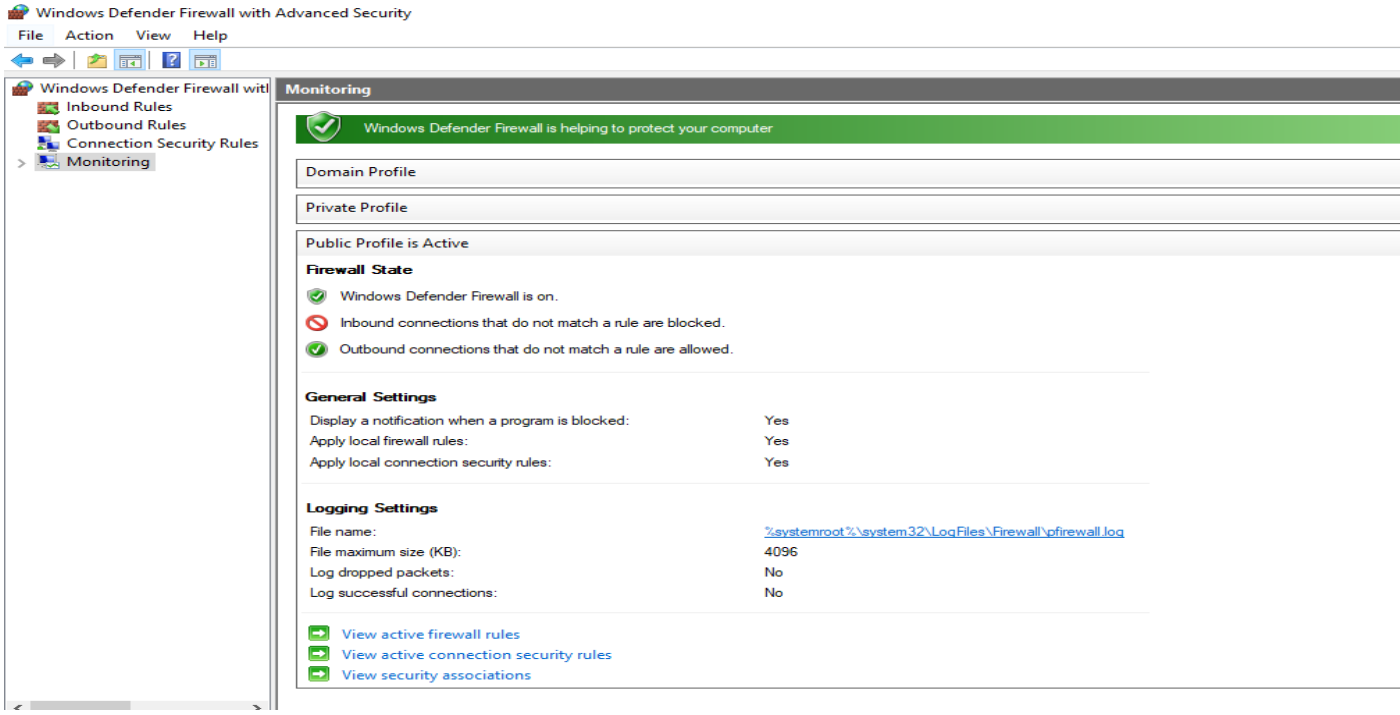
GPU: 4GB NVIDIA Quadro T2000

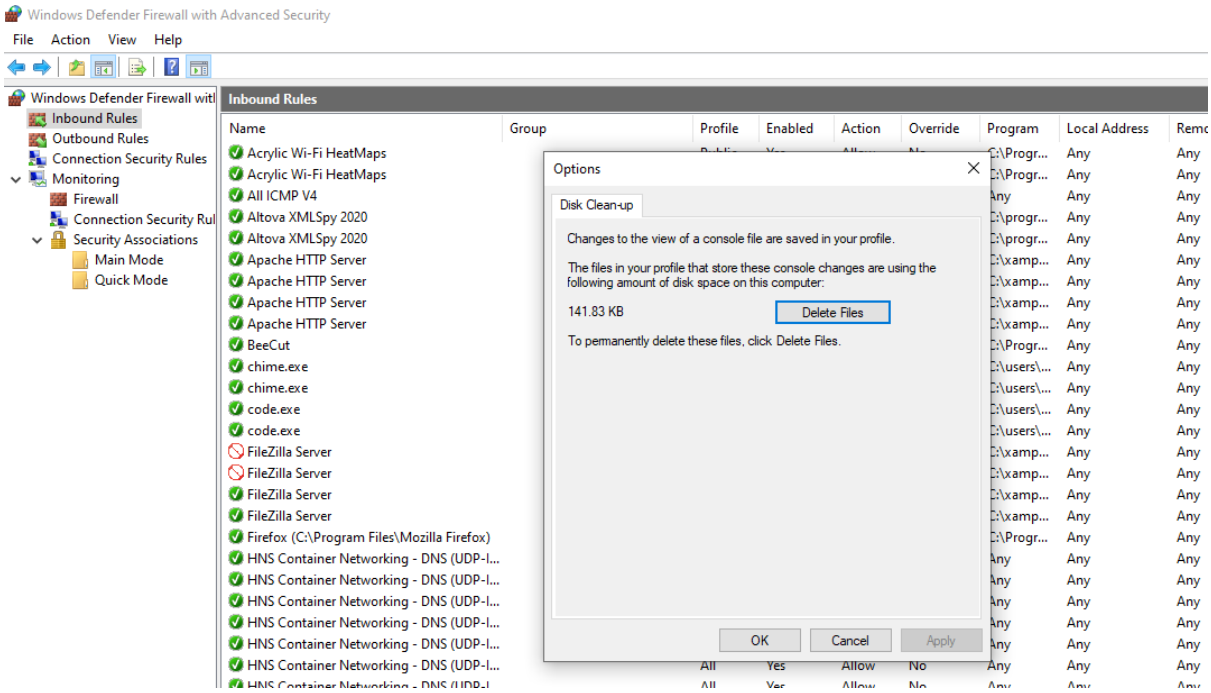
Storage type: SSD

Memory type: DDR 4 SDRAM

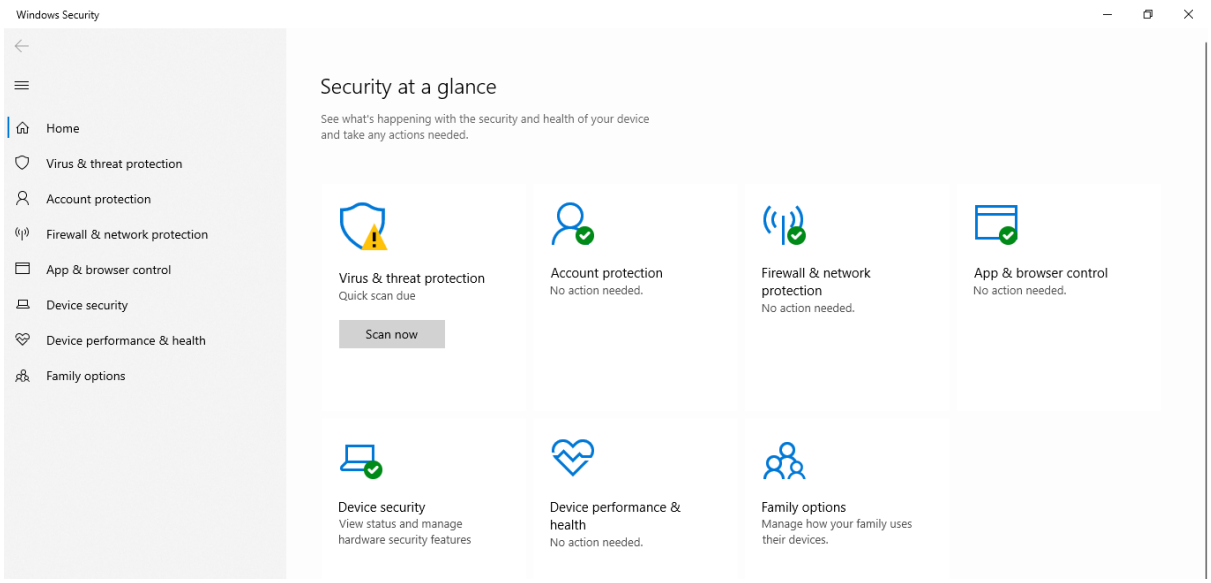
How else might you identify adware, a worm or data mining on your machine?

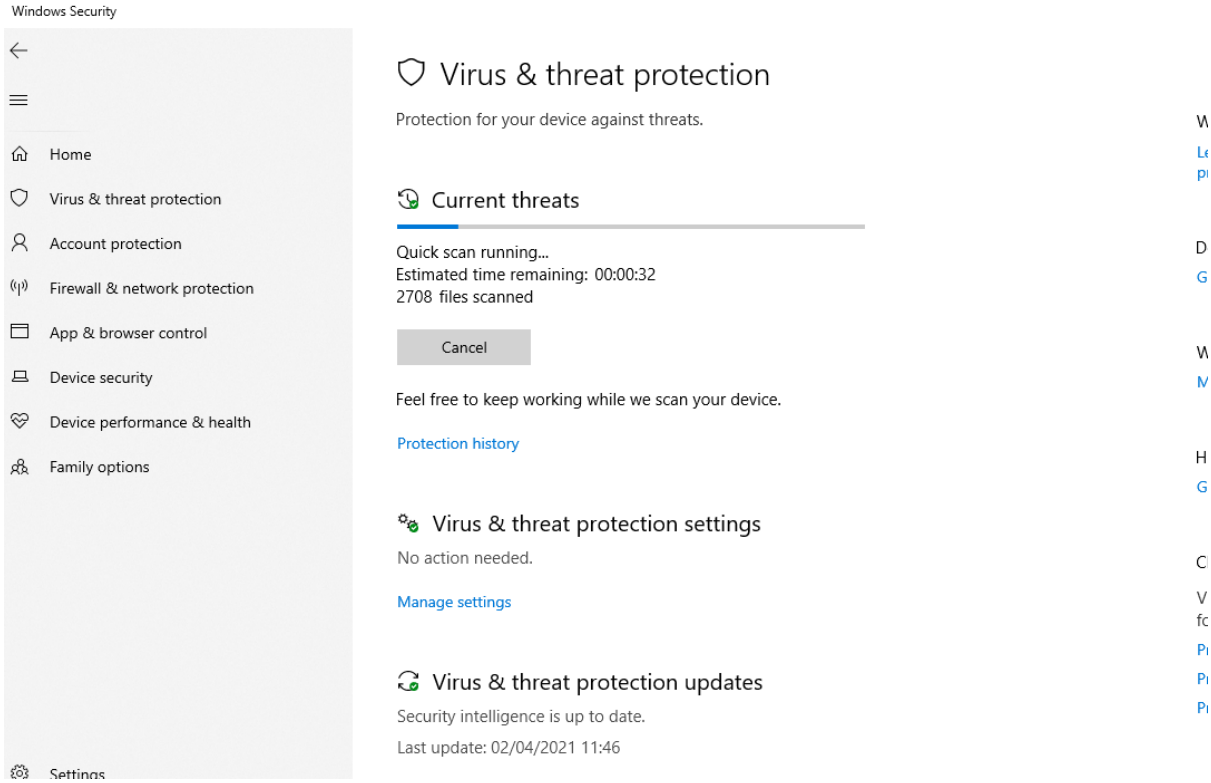
Windows Defender:

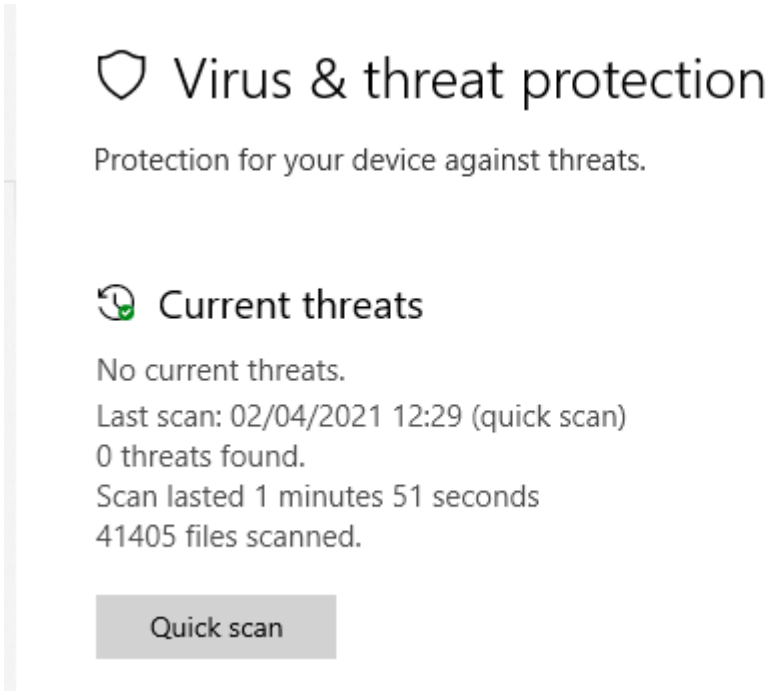


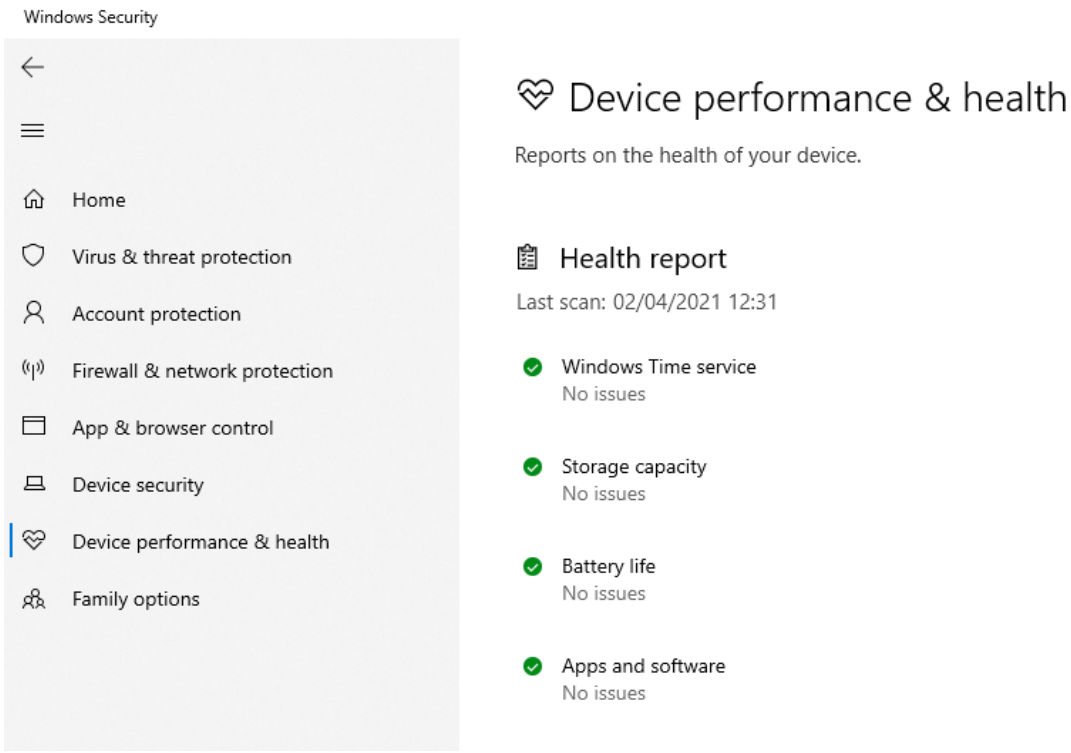


Windows Security







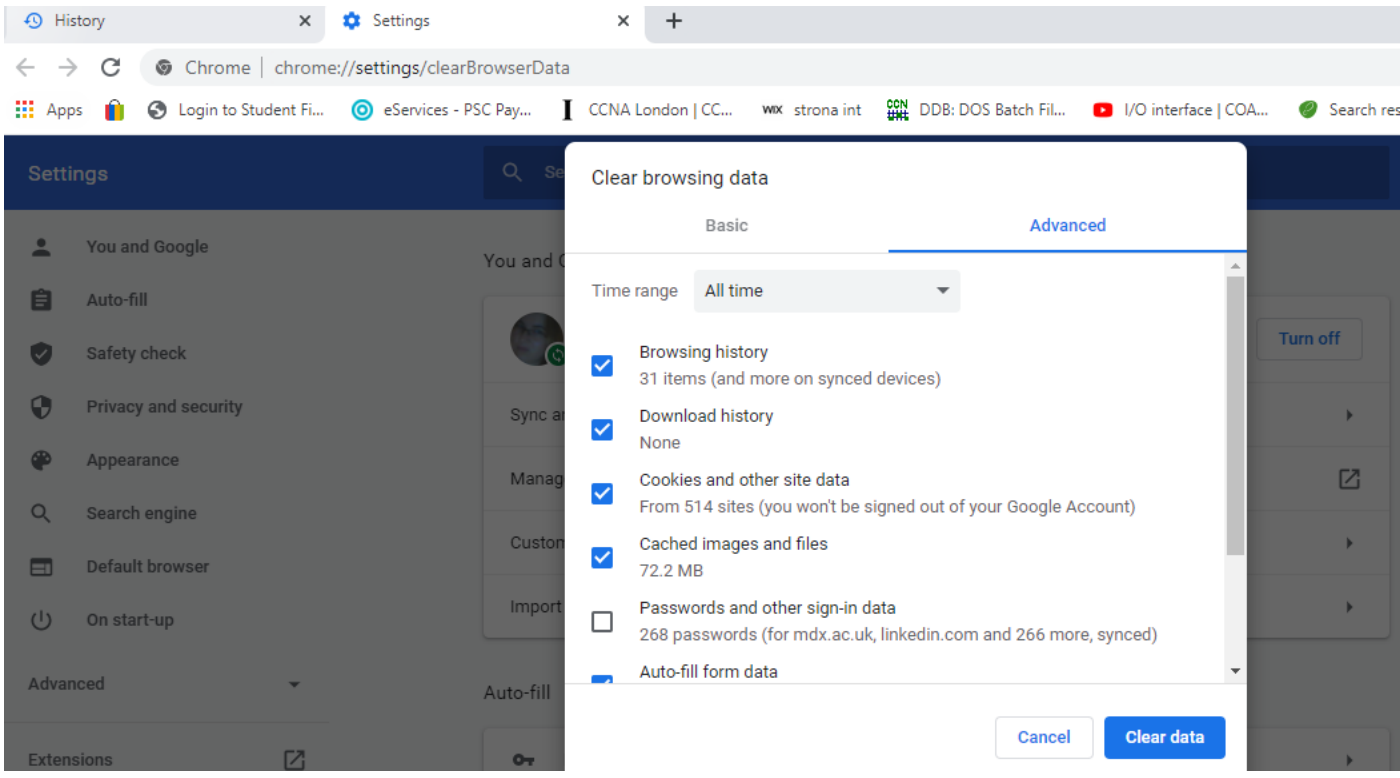


Performance monitor

See how computer deals with all

For example

Clear browsing data in Google Chrome

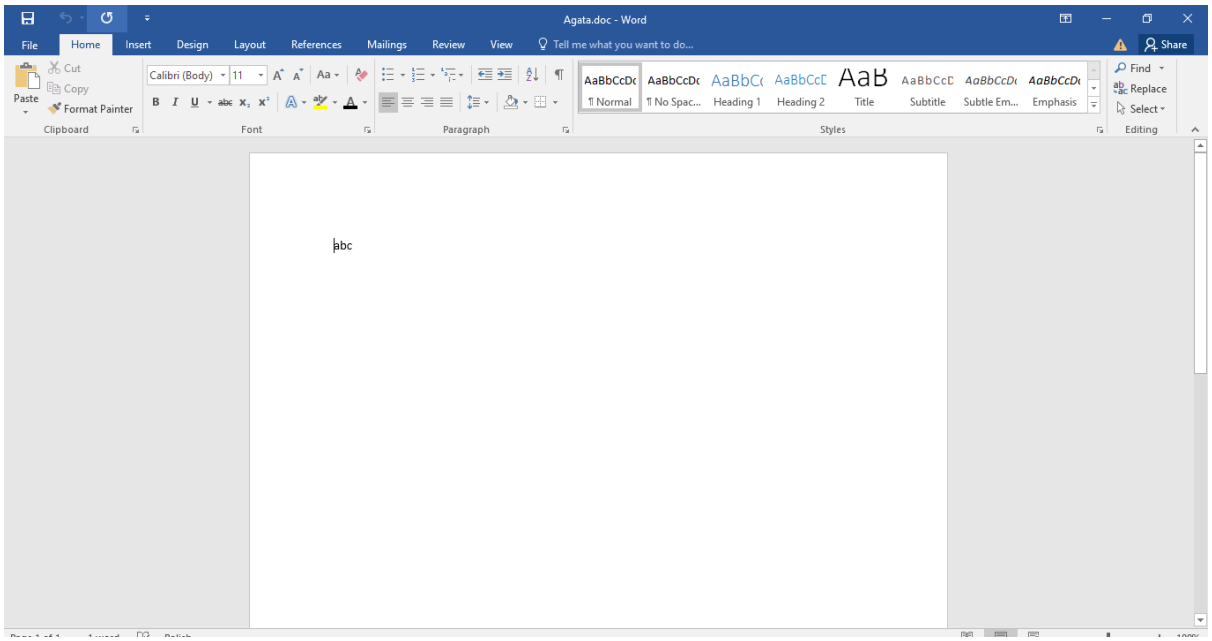


Find an image for Windows 3.1 that runs in Virtual Box – Install it – look at the difference between Win10 and Win3.1

Week 23

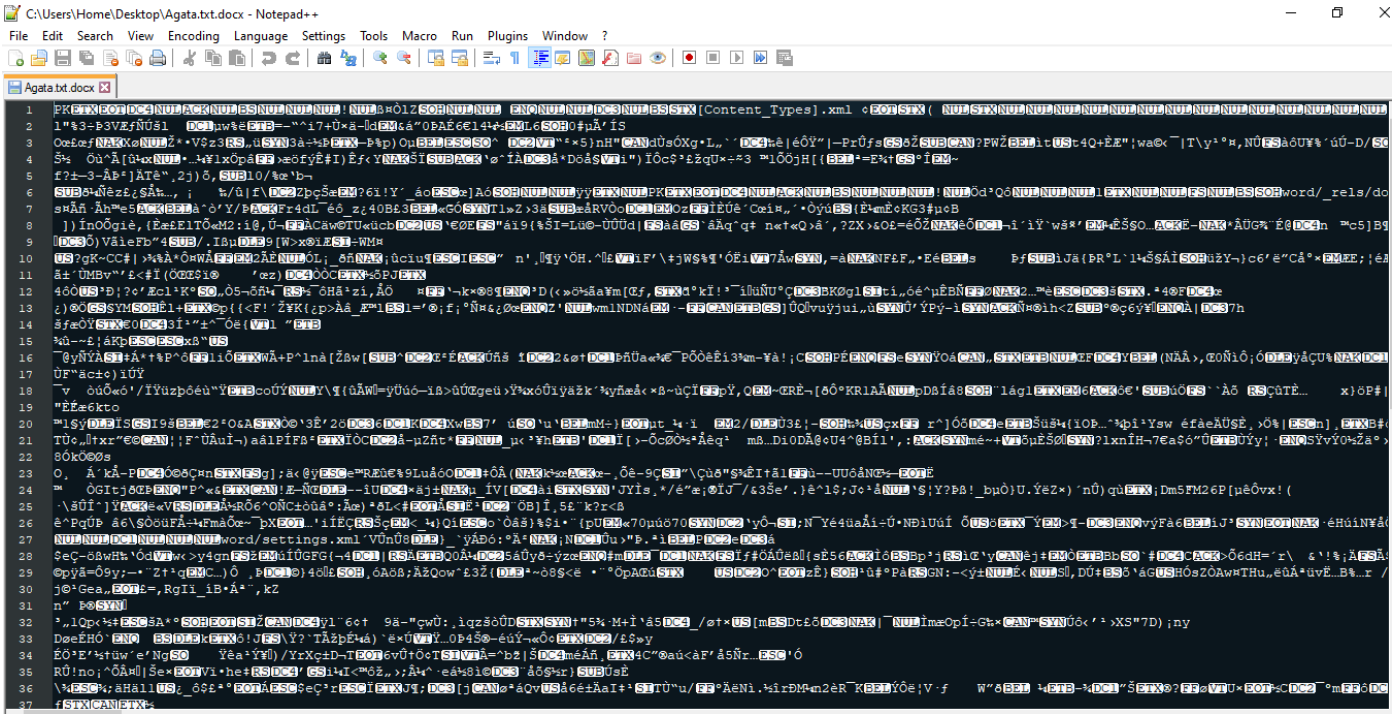
1. Change a .doc extension on a word document to .txt and view in notepad or a similar simple editor

Agata.doc



In Notepad opening the same document

In Notepad ++



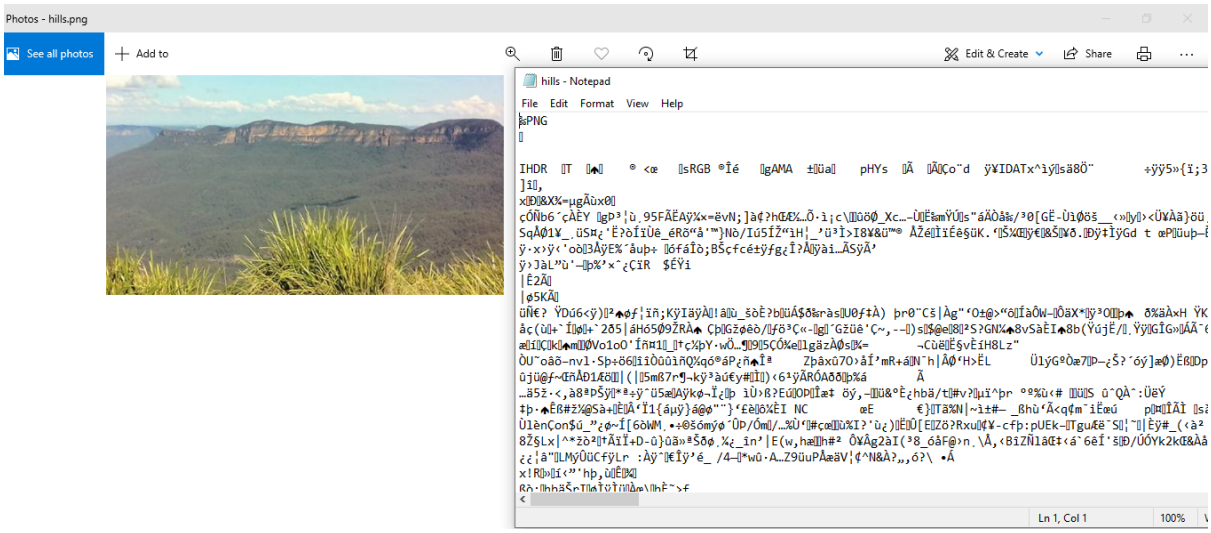
2. Try the same with a .docx document

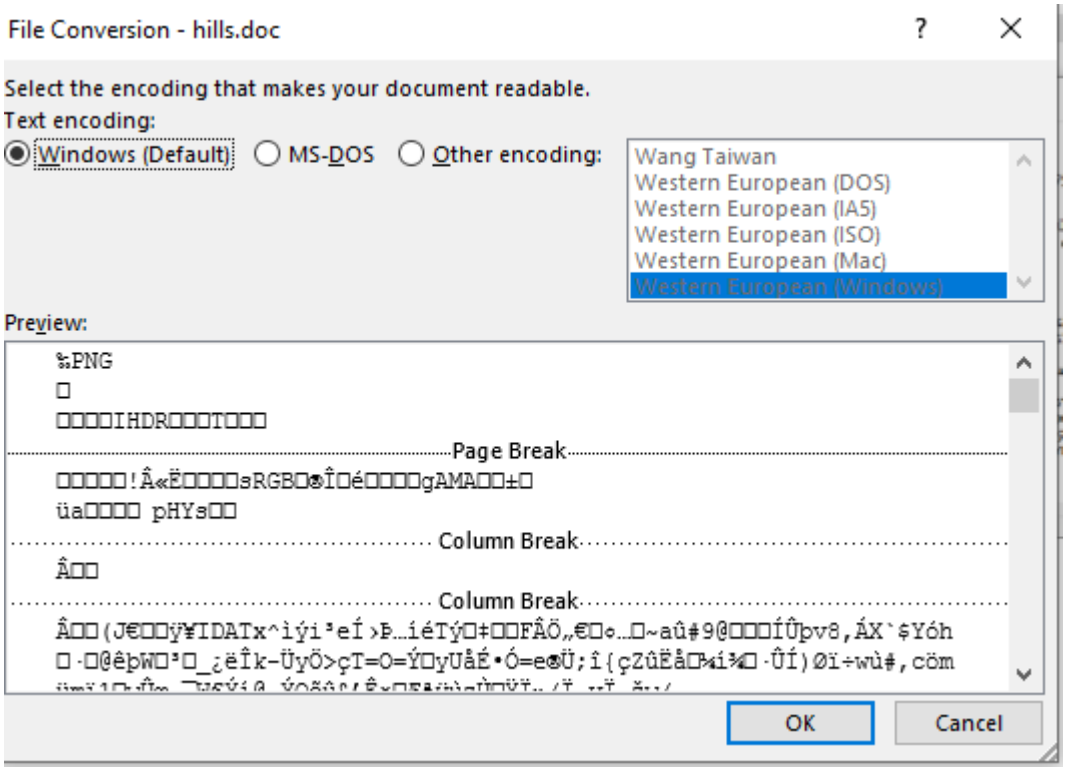
3. Change a .docx extension on a word document to .zip and try to extract.

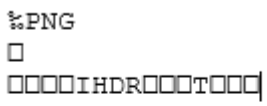
Could you recover a message? NO

4) Try changing a .jpg extension to.txt, open the file in notepad or a similar simple editor

How can we tell this is a jpg file from the data in the file?

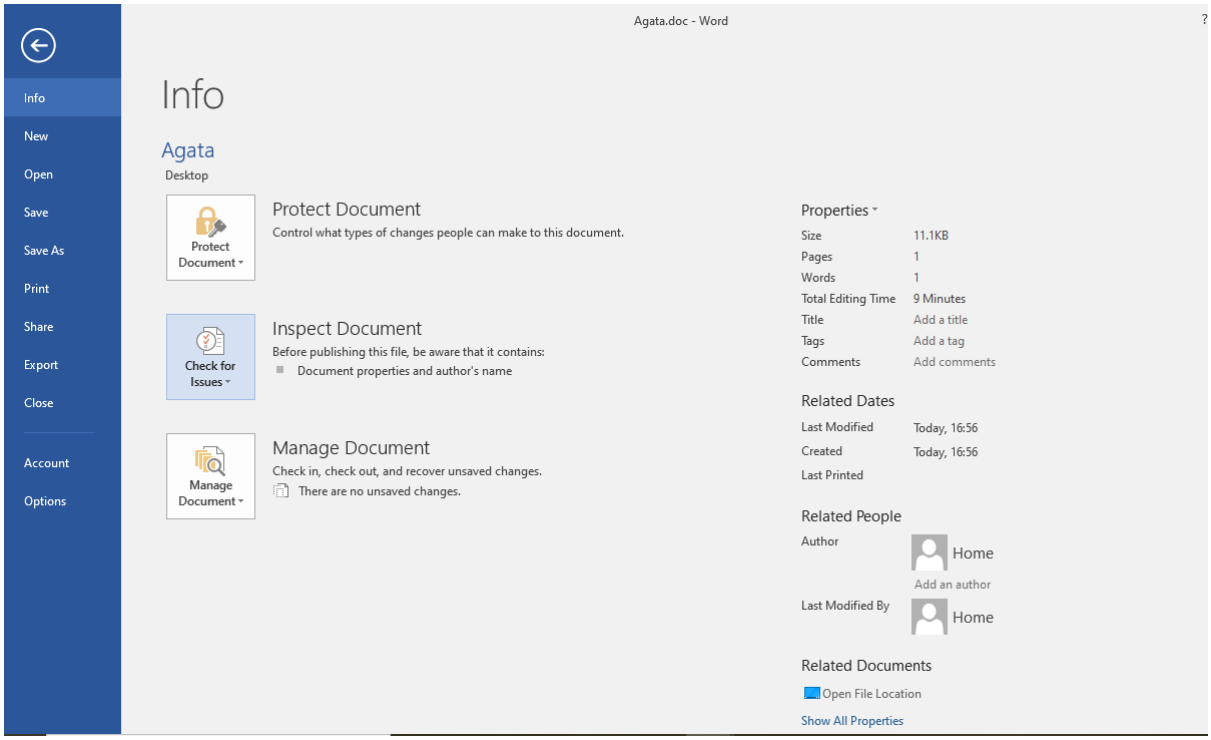


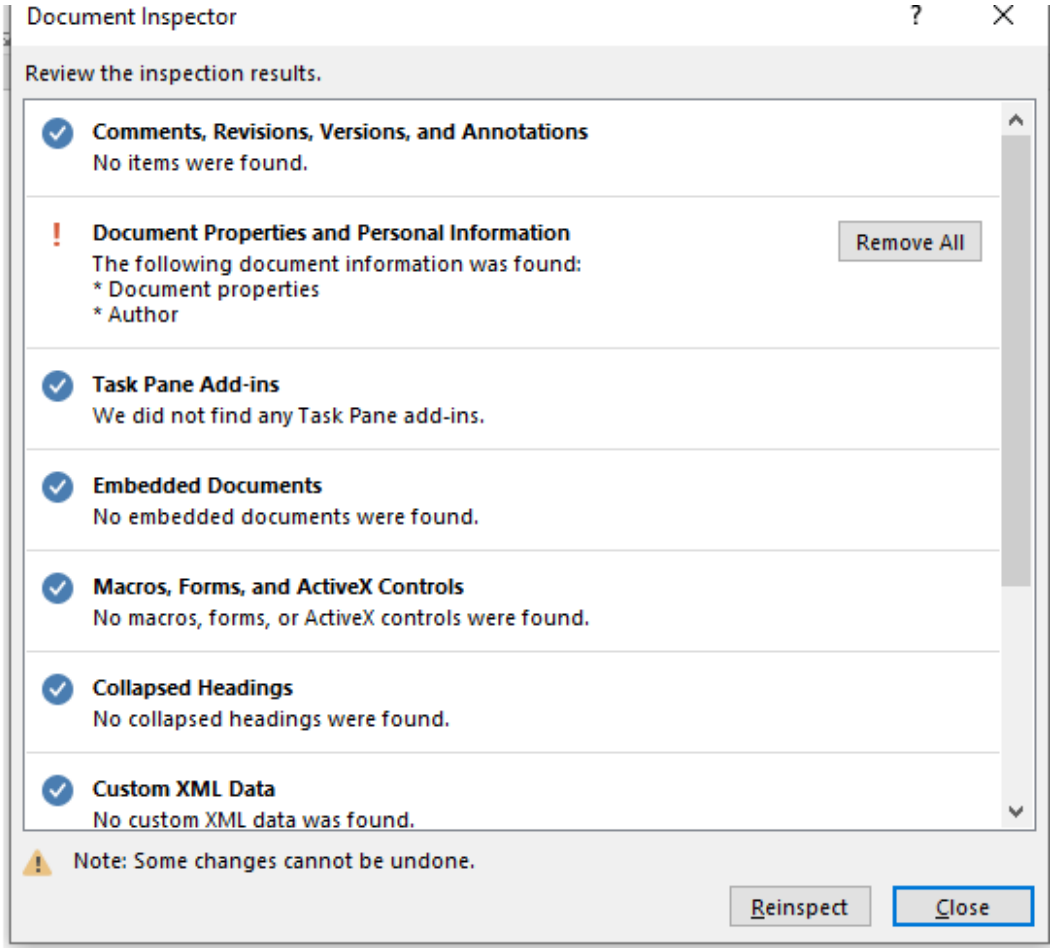




6. What metadata can be hidden in a word document?

“Most Word documents contain hidden metadata that shows the history of the document. Metadata is data about the document or file that is embedded within the file's details. That data shows when the document was first created, who authored the document, total editing time, and the last time the document was modified.”[59]





Remove all and we can send.

7. How can you access this?

I have tried opening Test 1 by FreeWordExcel

Dictionary Attack:

Brute Force Attack


FREE Word and Excel password recovery Wizard
Recovery
Pause to stop the recovery and
ecovery where you left off.
Your password has been found!
Average speed - 300000 passwords/sec.
ATTENTION: Your password is written above in quotation marks!
Click on password to copy it to the clipboard.
'fred'
Please support us by clicking the "Recommend", "+1", "retweet" on the main page of.
FreeWordExcelPassword.com
Your support is very important to us!
OK
English
Back
Next

Test 2

By brute force attack

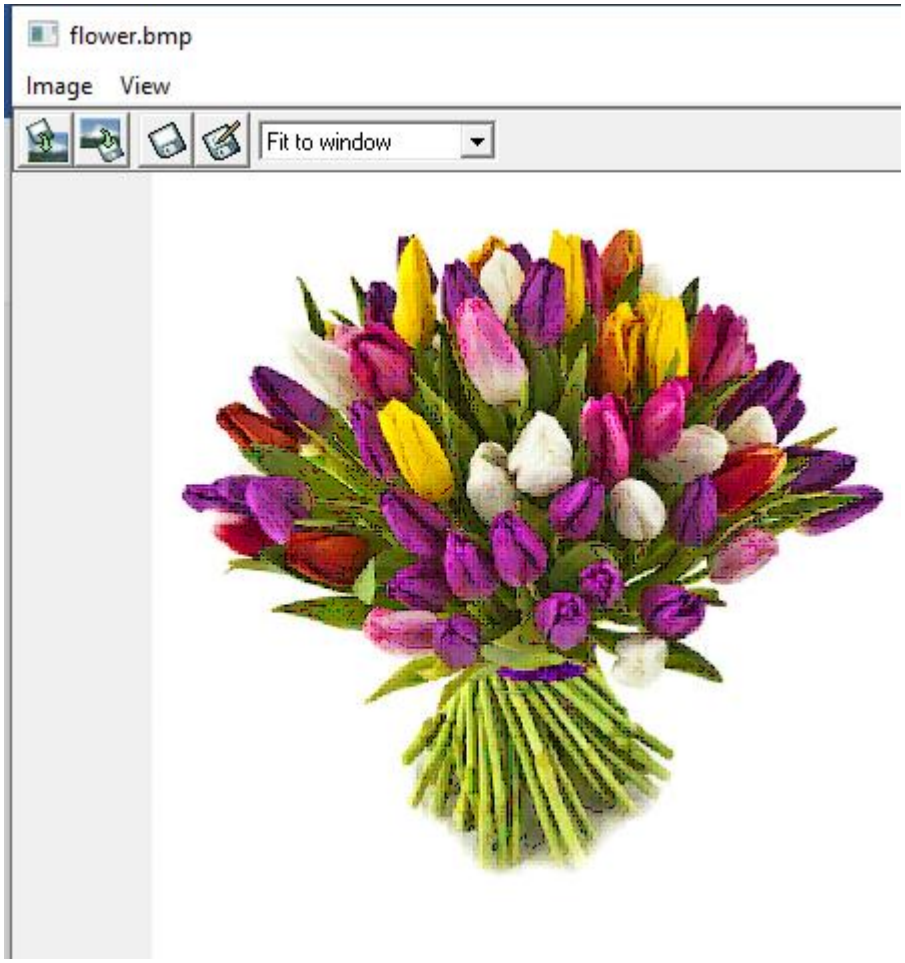
''Hide in Picture''

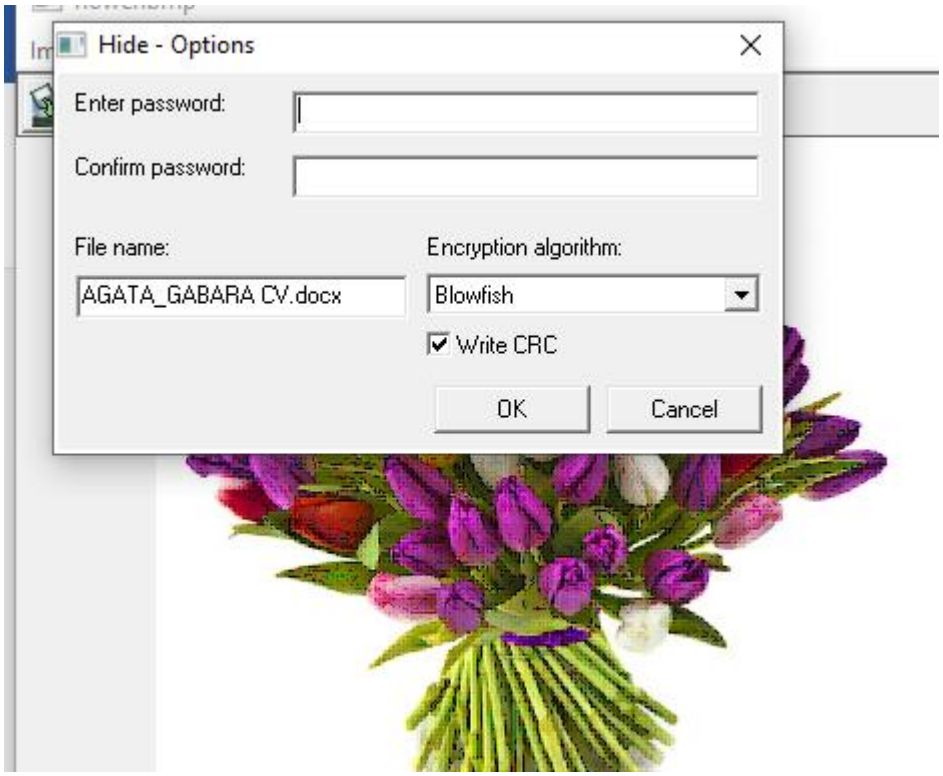
- type of steganography program, it allows hide any kind of file inside bitmap pictures.
- it doesn't look suspiciously,
- it is possible to set a password to hide files, without the password it is not possible to discover if something was hidden.

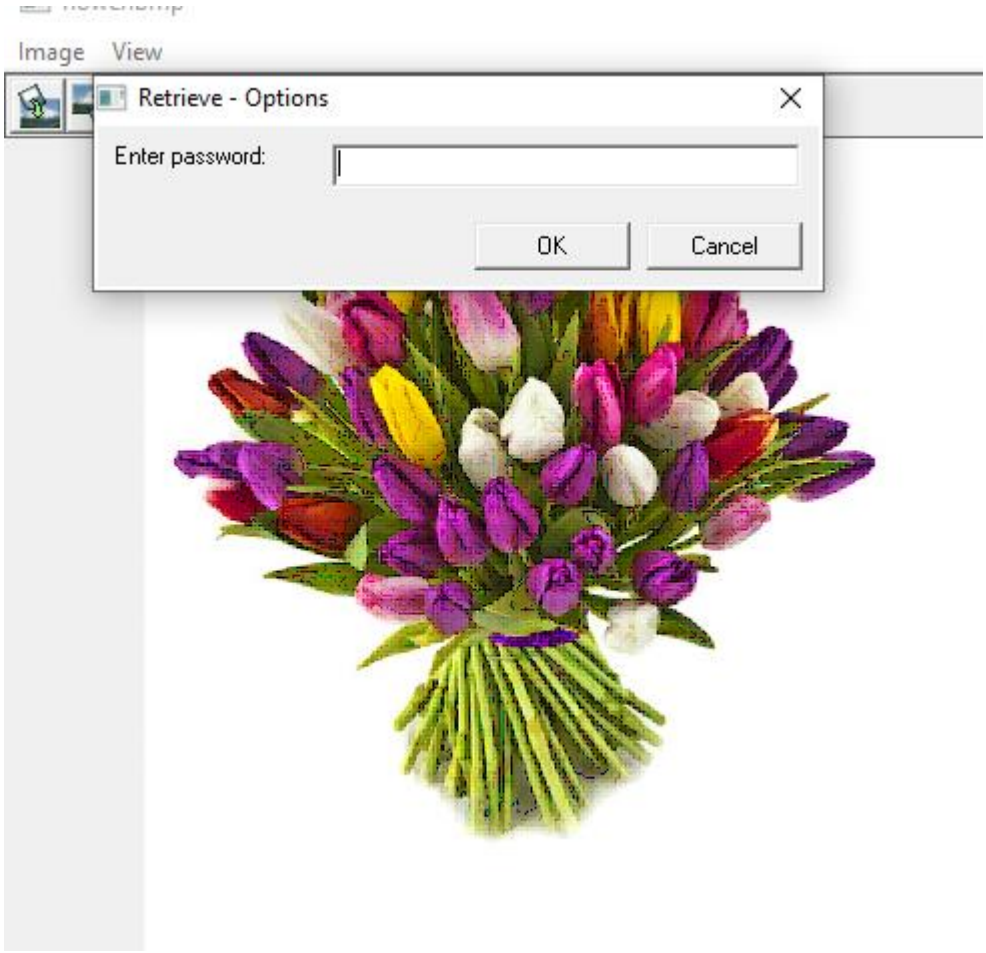
I have created flowers with extension bmp and save on desktop and I open a program and hide inside flowers my doc file called AGATA_ GABARA CV

I set up a password and when I choose option retrieve I need to put a password to check if something was hidden or not. In the case of wrong password, it is communique that nothing was hidden.

Screenshots:


flower.bmp
Image View
Fit to window


Hide - Options
Enter password:
Confirm password:
File name:
AGATA_GABARA CV.docx
Encryption algorithm:
Blowfish
Write CRC
OK
Cancel



What types of files can you hide? images, text files, video files, software files, .exe, .bat

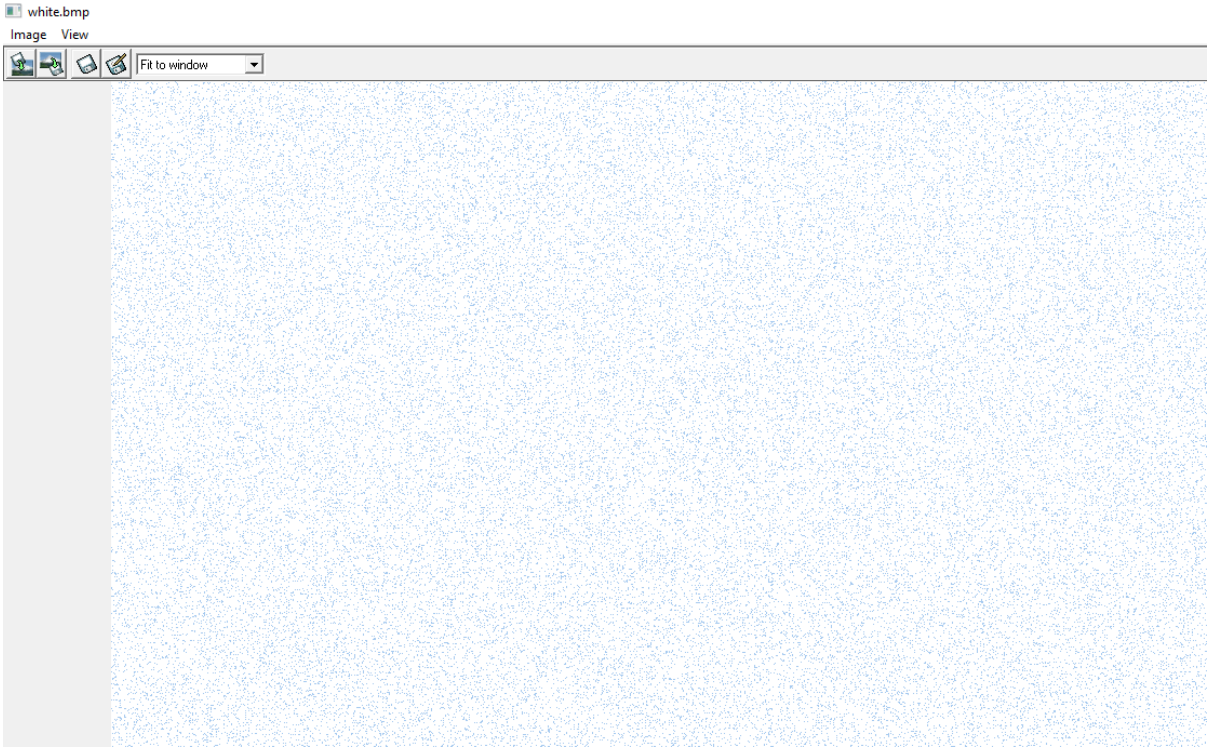
What difference does the size ratio of the marked file to embedded file make?

How can you tell if this software is Robust or Fragile? fragile, because it does not have an encryption,

What happens if you mark a file that is all white or black?

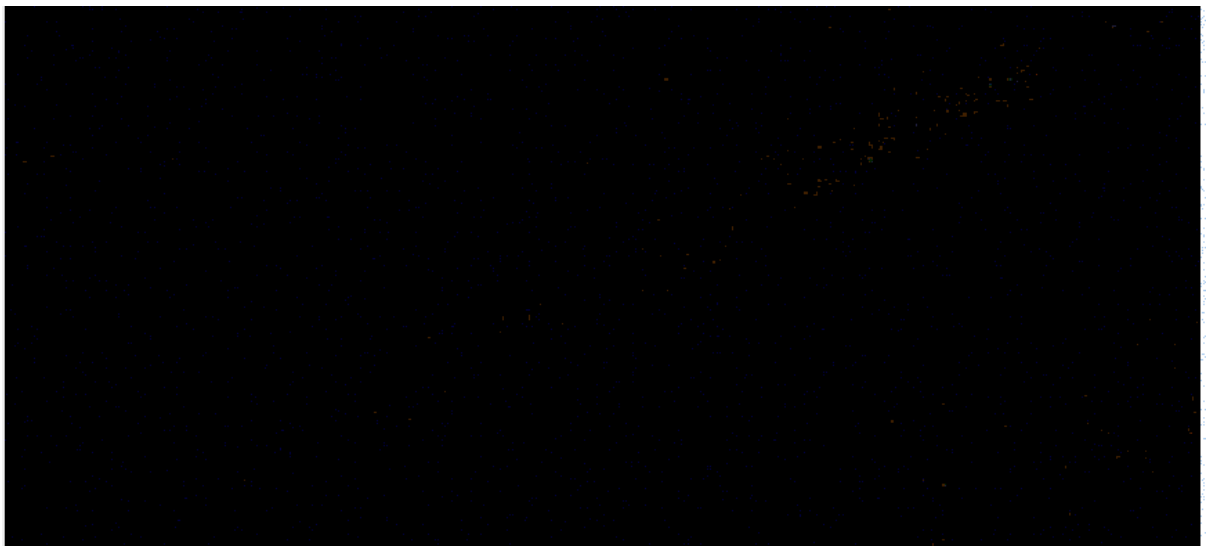
I have white bmp and I hide word file

I see this:



The background is not white it includes some blue dots.

In the case of black



There are some dots on the black background.

How secure is steganography as a protection system? it is not safe and it is not encryption.

Have there been any recent stories about steganography in the real world?

2010 – Russian spy hid codes in online photos

“In 2011, a suspected al-Qaeda member was arrested in Berlin, Germany in May. This suspect

was he found with a memory card with a password-protected folder. Examiners discovered hidden files were contained in the protected folder. However, as the German newspaper Die Zeit reported, digital forensics examiners from the German Federal Criminal Police (BKA) claimed to have eventually uncovered its contents (Gallagher, 2012). The examiners reported that a video was uncovered and appeared to be a pornographic video. Within that video, forensic examiners were able to reveal 141 separate text files (Gallagher, 2012). They claim that the documents contained details regarding al-Qaeda operations and future operating plans. Among these documents were three documents labelled "Future Works," "Lessons Learned," and "Report on Operations" (Gallagher, 2012)2[60]

“A Russian hacker group named Advanced Persistent Threat (APT) 29, used steganography in 2015 to disguise communication within pictures on GitHub (Bell, 2015). 2[61]

Can you think of any novel or interesting applications of steganography?

Creation tools:

- QuickStego
- OpenStego
- Xiao Steganography
- Camouflage
- Our Secret
- Steganofile
- Steghide
- OpenPuff
- SteganPEG
- SilentEye

Week 24 DRP

Part 1 Main goals of this plan

The major goals of this plan are the following:

- To minimize disruption impact.
- To keep update personnel with all emergency procedures.
- To deliver smooth restoration of service.

[60] www.researchgate.net/publication/326098434_Digital_steganography_and_its_existence_in_cybercrime

[61] www.researchgate.net/publication/326098434_Digital_steganography_and_its_existence_in_cybercrime

- Update the software accordingly.
- Keep staff duties per plan.
- Limit extra costs.

Part 2 Personnel

First Name, Last Name	Position in company	Address	Mobile / Email

Part 3 VHD – features

Name	Number	Manufacturer	Length	Comments

Part 4 Inventory

Name	Serial Number	Cost	Manufacturer	Own/leased

- Personal computers
- USB cables
- VCR players
- Video capture devices
- Video playback machines
- Software
- Telephones
- Printers
- Heaters
- Chairs
- Tables
- Lamps

This list will be check every … months.

Part 5 Backup procedures

- Personal Computer
    - It is recommended that all personal computers should be backed up. Copies of the personal computer files should be uploaded to the server on … (date) at … (time). It corresponds with the normal saving data system procedure.

- Carbonite (Cloud backup solution)
    - It is recommended that all should be send to the cloud. It will be saved on the server. It is recommended to choose full back up; Carbonite offers 3 types of backup such as: full, incremental and differential. It is recommending also add encryption key and set email notification on the status of backup.

      (based on: https://www.youtube.com/watch?v=pmxIbEWTdhs)

Part 6 Disaster recovery procedures

At this stage we should differentiate 3 types of procedures such as: emergency response guideline, backup operations guideline and recovery one.

Emergency Dealing
To evidence emergency response to natural disaster, or any other activity in order to save lives and reduce damages.

Backup Dealing
To ensure that essential data processing tasks can be executed after the disruption.

Recovery Dealing
To enable quick data's restoration process after a disaster.

Example of checklist

1) Initiation schedule.

    - Inform management,
    - Contact disaster team,
    - Define the level of disaster,
    - Put into practice application recovery plan,
    - Progress's observation,
    - Keep updated other staff

2) Follow –up checklist.

    - Tasks of each member,
    - List all staff mobile numbers and emails,
    - Define applications to be run,
    - Check what was backup recently and what was not and make notes accordingly,
    - Take copies of system and operational documentation and procedural manuals,
    - Inform insurance provider about the disaster and make steps accordingly.

Recovery guidelines after an accident.

a) Inform Disaster Recovery Services of the need to utilize service and of recovery plan selection.

   These telephone numbers are in service from … am until … pm Monday through Friday.

   Disaster notification number: ……

1. Inform power and telephone service suppliers and plan any essential service connections.
2. Inform ……. immediately on condition that any related plans will change.

Part 7 System's restoring

Before You Start*:* localize the tapes, equipment, and information from the off-site storage location.

- All tapes from the most recent complete save operation
- The most recent tapes from saving security data (SAVSECDTA or SAVSYS)
- PTF list
- Tape list from daily, weekly and most recent save operation.
- The Backup and Recovery book
- Telephone directory
- Modem manual
- Tool kits

Part 8 Rebuilding

- Disaster recovery plan,
- Run recovery test (highlight of areas which should be under test)
- Record of plan changes