Wireshark 101

Its all about packets

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Material download & instructions:

https://github.com/rohess/ws-training

We need to talk about Wireshark !

- Learn & understand network protocols
- Analyse network problems
- Find out what happens in your network

Wireshark can help you with this – and it's fun to use

What is Wireshark

- Tool to capture and analyze network packets (all kinds of)
- OpenSource – you can build it yourself
- Highly customizable
- On MacOS, Linux, Windows (based on QT5)
- ARM version for Windows and Mac
- 1.5 Mio downloads per month
- 3100 protocols, 269k fields (last year 3000/250k)
- 2400 authors (last year 2300)
- Two yearly conferences

History

- First iteration started by Gerald Combs in 1997 as Ethereal
- Since 2006 called Wireshark
- 2008 V1.0 & first Sharkfest
- 2023 V4.0 & Wireshark Foundation

Today

- → Install instructions & Sample file download: https://github.com/rohess/ws-training

- Install Wireshark
- Look at the UI
- Filter packets
- Go through a sample capture
- Demo the most common features
- Have a short look at how to capture

Installation

- Recent version of Wireshark, at least 4.0 – current is 4.6.2 (stable) 4.7 (dev)
- On MacOS and Windows – just download the installer and install → https://www.wireshark.org/download.html
- Linux – check installation steps on Github link
  Repo versions tend to be outdated – built it from source ;-)

The capture file

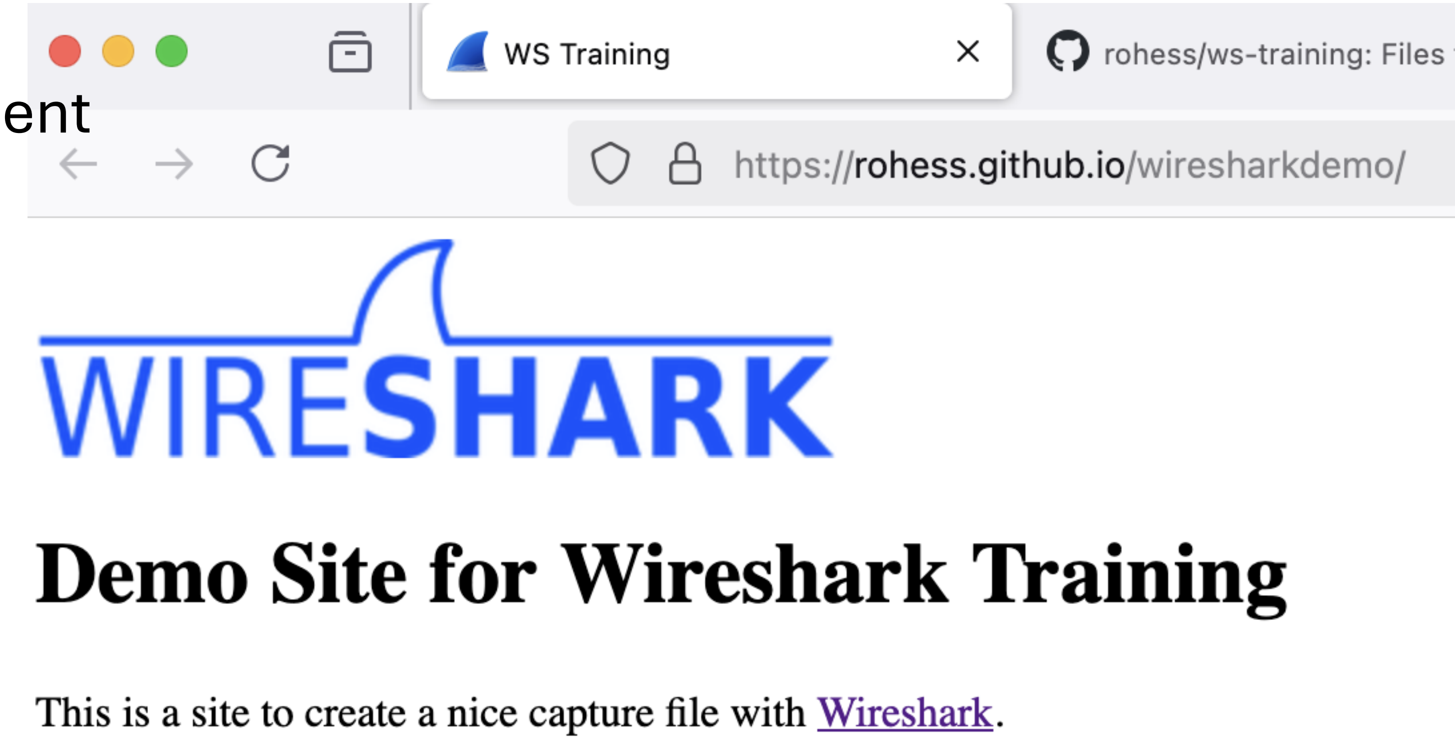
- .pcap format – industry standard for all kind of packet capture software (tcpdump, dumbcap etc.)
- .pcapng format – adds meta data to pcap (file notes, packet notes, custom DNS names + timestamps with microseconds)
- contains interesting traffic & noise -> remove the noise

- -> open the sample capture file from https://github.com/rohess/ws-training

What's in it:

Download of a single webpage via Chrome

- DNS requests
- TCP Connection establishment
- TLS negotiation
- HTTP traffic downloading
  - HTML Code
  - Picture
  - favicon
- Connection tear down

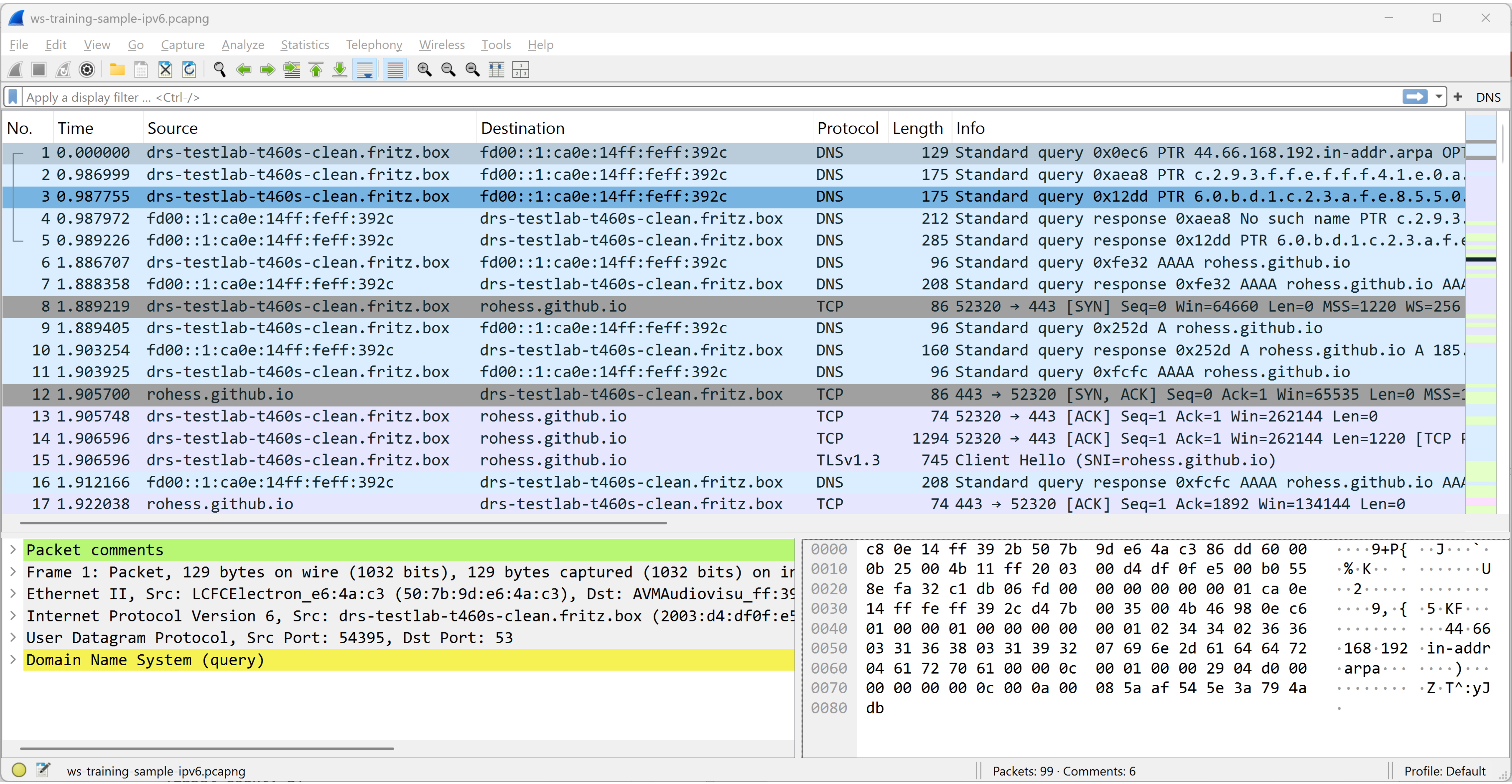

WS Training
rohess/ws-training: Files
https://rohess.github.io/wiresharkdemo/
WIRESHARK

Demo Site for Wireshark Training

This is a site to create a nice capture file with Wireshark.

The Wireshark UI

- Tool bar
    - Capture section
- Initial layout – 3 panes
    - Packet list
    - Packet Details
    - Packet Bytes -> much cooler: Packet Diagram
- Filter bar
    - Filter string
    - Filter buttons
- Packet list
    - Columns – configurable



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	129	Standard query 0x0ec6 PTR 44.66.168.192.in-addr.arpa OPT
2	0.986999	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	175	Standard query 0xaea8 PTR c.2.9.3.f.f.e.f.f.f.4.1.e.0.a.
3	0.987755	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	175	Standard query 0x12dd PTR 6.0.b.d.1.c.2.3.a.f.e.8.5.5.0.
4	0.987972	fd00::1:ca0e:14ff:feff:392c	drs-testlab-t460s-clean.fritz.box	DNS	212	Standard query response 0xaea8 No such name PTR c.2.9.3.
5	0.989226	fd00::1:ca0e:14ff:feff:392c	drs-testlab-t460s-clean.fritz.box	DNS	285	Standard query response 0x12dd PTR 6.0.b.d.1.c.2.3.a.f.e
6	1.886707	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	96	Standard query 0xfe32 AAAA rohess.github.io
7	1.888358	fd00::1:ca0e:14ff:feff:392c	drs-testlab-t460s-clean.fritz.box	DNS	208	Standard query response 0xfe32 AAAA rohess.github.io AA
8	1.889219	drs-testlab-t460s-clean.fritz.box	rohess.github.io	TCP	86	52320 → 443 [SYN] Seq=0 Win=64660 Len=0 MSS=1220 WS=256
9	1.889405	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	96	Standard query 0x252d A rohess.github.io
10	1.903254	fd00::1:ca0e:14ff:feff:392c	drs-testlab-t460s-clean.fritz.box	DNS	160	Standard query response 0x252d A rohess.github.io A 185.
11	1.903925	drs-testlab-t460s-clean.fritz.box	fd00::1:ca0e:14ff:feff:392c	DNS	96	Standard query 0xfcfc AAAA rohess.github.io
12	1.905700	rohess.github.io	drs-testlab-t460s-clean.fritz.box	TCP	86	443 → 52320 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1
13	1.905748	drs-testlab-t460s-clean.fritz.box	rohess.github.io	TCP	74	52320 → 443 [ACK] Seq=1 Ack=1 Win=262144 Len=0
14	1.906596	drs-testlab-t460s-clean.fritz.box	rohess.github.io	TCP	1294	52320 → 443 [ACK] Seq=1 Ack=1 Win=262144 Len=1220 [TCP F
15	1.906596	drs-testlab-t460s-clean.fritz.box	rohess.github.io	TLSv1.3	745	Client Hello (SNI=rohess.github.io)
16	1.912166	fd00::1:ca0e:14ff:feff:392c	drs-testlab-t460s-clean.fritz.box	DNS	208	Standard query response 0xfcfc AAAA rohess.github.io AA
17	1.922038	rohess.github.io	drs-testlab-t460s-clean.fritz.box	TCP	74	443 → 52320 [ACK] Seq=1 Ack=1892 Win=134144 Len=0

```
> Packet comments
> Frame 1: Packet, 129 bytes on wire (1032 bits), 129 bytes captured (1032 bits) on ir
> Ethernet II, Src: LCFCElectron_e6:4a:c3 (50:7b:9d:e6:4a:c3), Dst: AVMAudiovisu_ff:39
> Internet Protocol Version 6, Src: drs-testlab-t460s-clean.fritz.box (2003:d4:df0f:e5
> User Datagram Protocol, Src Port: 54395, Dst Port: 53
> Domain Name System (query)
```

```
0000  c8 0e 14 ff 39 2b 50 7b  9d e6 4a c3 86 dd 60 00   ····9+P{ ··J···`·
0010  0b 25 00 4b 11 ff 20 03  00 d4 df 0f e5 00 b0 55   ·%·K·· · ·······U
0020  8e fa 32 c1 db 06 fd 00  00 00 00 00 00 01 ca 0e   ··2····· ········
0030  14 ff fe ff 39 2c d4 7b  00 35 00 4b 46 98 0e c6   ····9,·{ ·5·KF···
0040  01 00 00 01 00 00 00 00  00 01 02 34 34 02 36 36   ········ ···44·66
0050  03 31 36 38 03 31 39 32  07 69 6e 2d 61 64 64 72   ·168·192 ·in-addr
0060  04 61 72 70 61 00 00 0c  00 01 00 00 29 04 d0 00   ·arpa··· ····)···
0070  00 00 00 00 0c 00 0a 00  08 5a af 54 5e 3a 79 4a   ········ ·Z·T^:yJ
0080  db                                                 ·
```

ws-training-sample-ipv6.pcapng | Packets: 99 · Comments: 6 | Profile: Default

Packet list

- Time – highly configurable via *View/Time Display Format*
- Source – IP or DNS
- Destination – IP or DNS
- Protocol – TCP/UDP/DNS …
- Length – Packet length on wire
- Info – lots of useful stuff that Wireshark found out via its dissectors

Tools – column width, stop scroll, colorize on/off

How does it work

- Wireshark reads pcap/pcapng file and builds the packet tree.
- Each packet is run through applicable list of dissectors and classified accordingly. Results are shown in the various windows
- If keys are available encrypted payloads are decrypted
- When filters are applied the packet tree is rescanned
  - This is single-threaded and takes time
  - Keep capture files small (10-100Mbytes) – up to 1 GB works

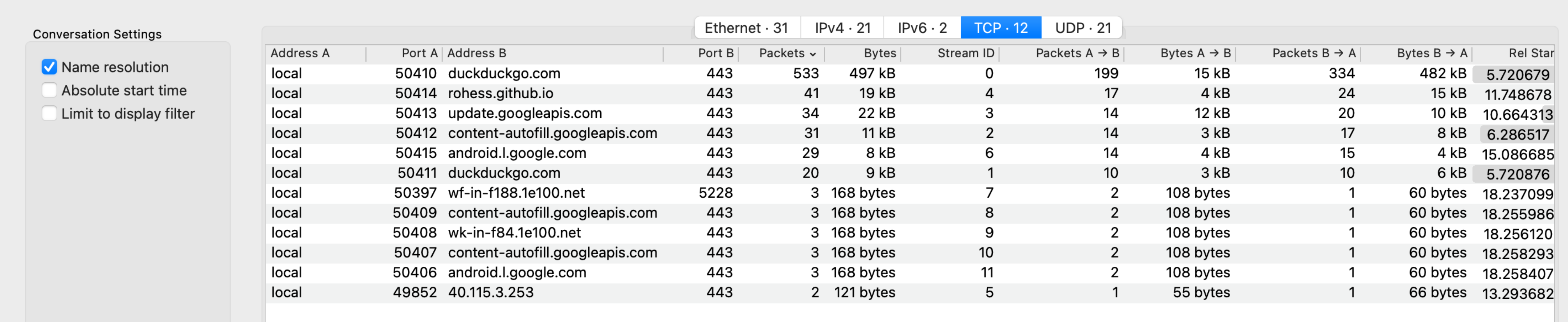
A better packet list

- Switch time display format to time of the day in UTC Time of the Day
- Add columns for Source and Destination Port
- Use Payload length instead of length
- Show Stream index

Investigation – prep steps

1. Reduce size of capture file by removing unnecessary data
2. Pick out the relevant packets based on characteristics (target systems, ports, number of packets)
3. Create the right views to inspect these packets
4. Form a hypothesis in your head how the packet streams should look like
5. Look at the packets and find the delta to your expectations and ask AI for explanations

Statistics/Conversations



Conversation Settings

☑ Name resolution

□ Absolute start time

□ Limit to display filter

Address A	Port A	Address B	Port B	Packets ⌄	Bytes	Stream ID	Packets A → B	Bytes A → B	Packets B → A	Bytes B → A	Rel Star
local	50410	duckduckgo.com	443	533	497 kB	0	199	15 kB	334	482 kB	5.720679
local	50414	rohess.github.io	443	41	19 kB	4	17	4 kB	24	15 kB	11.748678
local	50413	update.googleapis.com	443	34	22 kB	3	14	12 kB	20	10 kB	10.664313
local	50412	content-autofill.googleapis.com	443	31	11 kB	2	14	3 kB	17	8 kB	6.286517
local	50415	android.l.google.com	443	29	8 kB	6	14	4 kB	15	4 kB	15.086685
local	50411	duckduckgo.com	443	20	9 kB	1	10	3 kB	10	6 kB	5.720876
local	50397	wf-in-f188.1e100.net	5228	3	168 bytes	7	2	108 bytes	1	60 bytes	18.237099
local	50409	content-autofill.googleapis.com	443	3	168 bytes	8	2	108 bytes	1	60 bytes	18.255986
local	50408	wk-in-f84.1e100.net	443	3	168 bytes	9	2	108 bytes	1	60 bytes	18.256120
local	50407	content-autofill.googleapis.com	443	3	168 bytes	10	2	108 bytes	1	60 bytes	18.258293
local	50406	android.l.google.com	443	3	168 bytes	11	2	108 bytes	1	60 bytes	18.258407
local	49852	40.115.3.253	443	2	121 bytes	5	1	55 bytes	1	66 bytes	13.293682

Investigation

- Open Statistics/Conversations
- Check TCP & UDP
- Select TCP – look for the stream with the most packets
- Follow TCP Stream – show encrypted stream
- Follow TLS Stream – works only if you have captured the encryption keys
- As it’s a http2 stream, you will have sub streams within the connection
- You can check the decrypted content, and you can also download the objects of the web page

Filtering

- Manual or automatically created from your packets
- There are capture filters and display filters
- Filter for protocols:

```
tcp, udp, dns, http
```

- Filter for numerical values:

```
tcp.stream in {5..8}
ip.addr eq 192.168.1.1
udp.dstport == 53
```

- Filter for string:

```
ip.host matches "github.io”
tls.handshake.extensions_server_name == "rohess.github.io”
```

- **`&&, ||, normal parenthesis rules`**

More to see

- Check timing - Set Time Reference
- Add GeoIP resolution – only for IPv4
- I/O Graph
- Filter buttons

Capturing

- On your system
- Start browser via *Tools/TLS Keylog launcher* (make sure its not already running)
- Capture on the right interface (or just all)
- Disable promiscuous mode
- Clear browser cache, and if DNS is relevant also DNS Cache of the browser (chrome://net-internals/#dns)
- Afterwards Edit/Inject TLS Keys

Advanced stuff

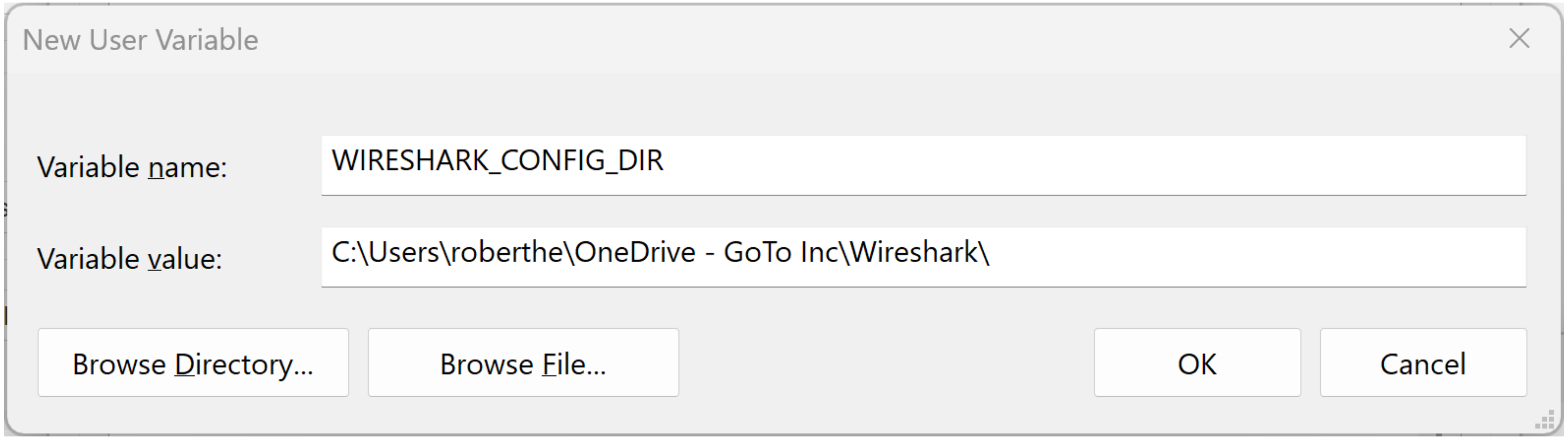
- Build columns with rules in it
- Get capture files via Command Line or via Mirror/Span port capture
- Get Captures from Mobile device
  - On iOS use a Mac connected via USB
  - On Android use the app Pcapdroid - supports decryption

Profiles

Contains: Display Filters, Columns, coloring Rules, Layout, Disabled Protocols, Decode as Rules, I/O Graphs, Recent files

Load from a shared drive to have the same config everywhere

Profile directory is set via env variable



Variable name: WIRESHARK_CONFIG_DIR

Variable value: C:\Users\roberthe\OneDrive - GoTo Inc\Wireshark\

Legal ramifications

- It's not always legal in Germany:

    Vorbereiten des Ausspähens und Abfangens von Daten" (§202c des deutschen StGB) aus dem Jahr 2007

    Wikipedia: https://de.wikipedia.org/wiki/Vorbereiten_des_Aussp%C3%A4hens_und_Abfangens_von_Daten

- Do it in your own network to learn and analyse
- If you capture outside: written customer consent / data is PII

References

Beware of the AI – it does lie sometimes

- https://wiki.wireshark.org/
- The Ultimate PCAP – 90+ protocols - Johannes Weber – DNS, IPv6 & more
- Sharkfest Retros – tons of great talks
- Chris Greer – YouTube tutorials

Have fun & thanks