Finding Duplications

Duplication tells us the key to troubleshoot the problems

SharkFest'24 US
June 15-20 · Fairfax, VA

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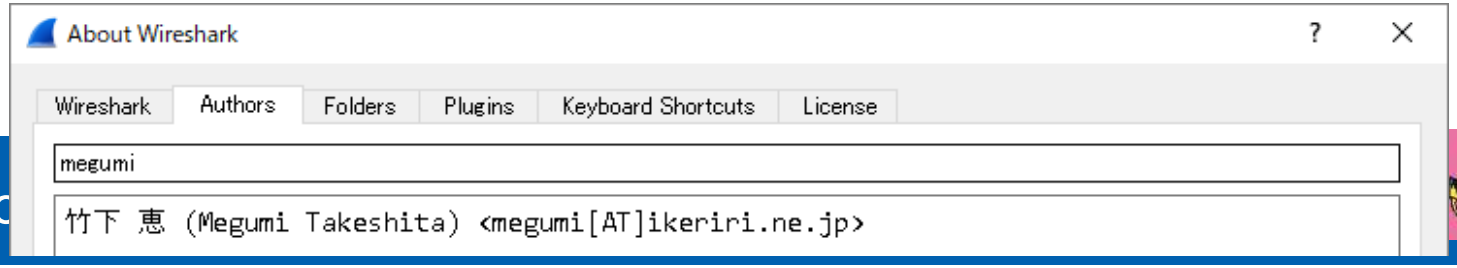
Sample traces and configurations

https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Megumi Takeshita, packet otaku

- Founder, ikeriri network service co., ltd
- Reseller of CACE technologies in 2008
- Worked SE/IS at BayNetwork, Nortel
- Wrote 10+ books about Wireshark
- Instruct Wireshark to JSDF and other company
- lecturer of CHUO University
- Reseller of packet capture / wireless-tools
- One of the contributors to Wireshark
  Translate Wireshark into Japanese



Session Details

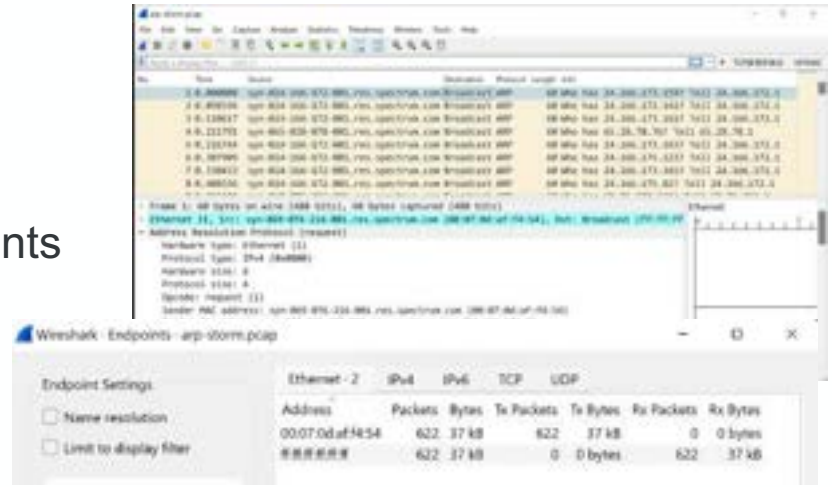
When you troubleshoot or investigate network and security problems, duplications are good indicators to find the clues. We use Wireshark and CLI tools to find, recognize and dissect network/security anomalies to solve the issues. Duplications exist in every layer in a trace file, so we follow each layer to check protocol-specified troubleshooting points.

In this session, you can learn how to find duplications in each layer of a trace file, the meanings implied by duplications in the trace with TIPS and tricks of display filters and major plugins of Wireshark/tshark.

We troubleshoot and investigate the issues using ARP/IP/TCP and major basic protocols. Duplications is one of the best anomalies to understand the packets.

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

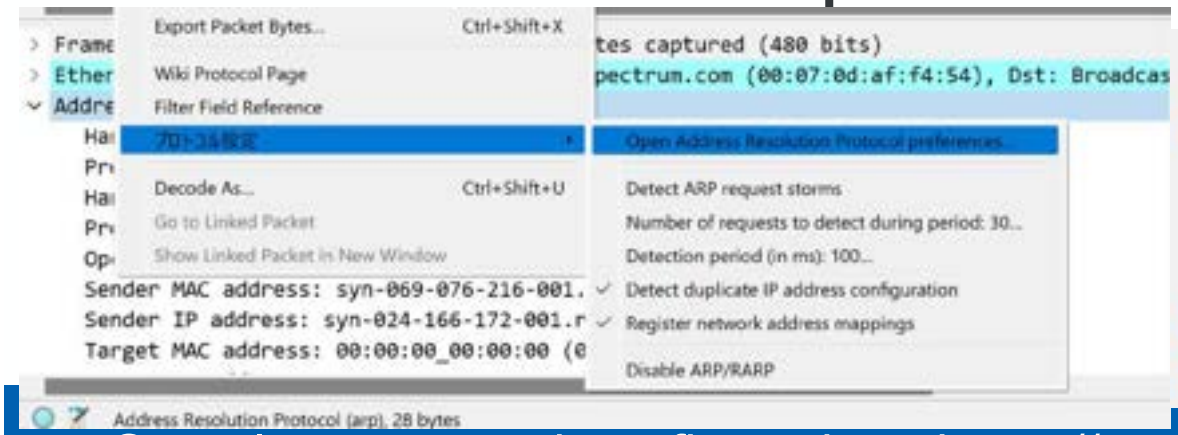
Duplication of ARP

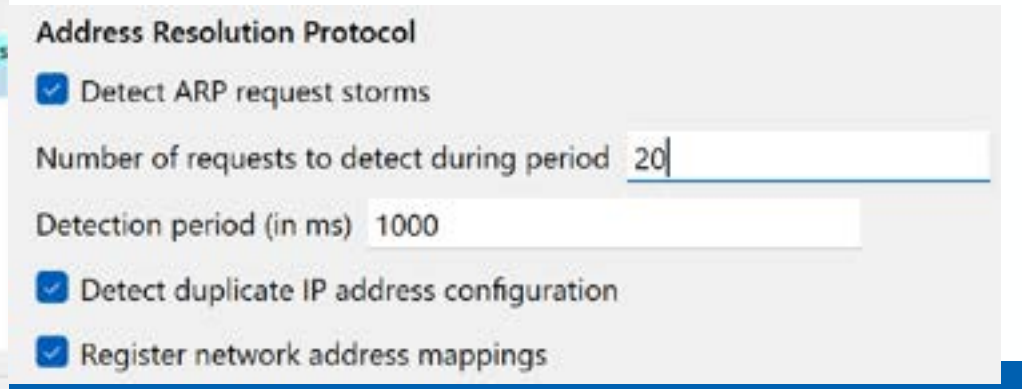


- Open trace file arp-storm.pcap
  https://wiki.wireshark.org/uploads/__moin_import__/attachments/SampleCaptures/arp-storm.pcap
- Statistics>Endpoints>Ethernet
  622packets of broadcast from Cisco_af:f4:54
- Tons of ARP requests use bandwidth and interrupt all nodes in the LAN.
- Misconfiguration of router (bridge mode?) or ARP poisoning attack from the pwned router?

Using Expert Info to find ARP storms

- How about finding duplication,
- Choose ARP in the packet detail pane, right-click Protocol configuration>Open ARP preferences
- Check ”Detect ARP request storms”, set Number of requests as 20 and period as 1000

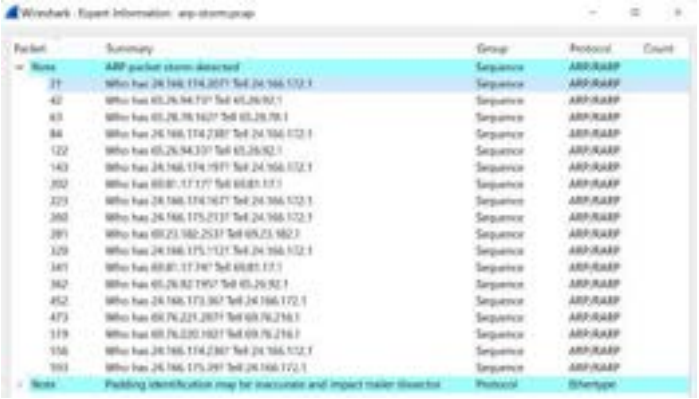


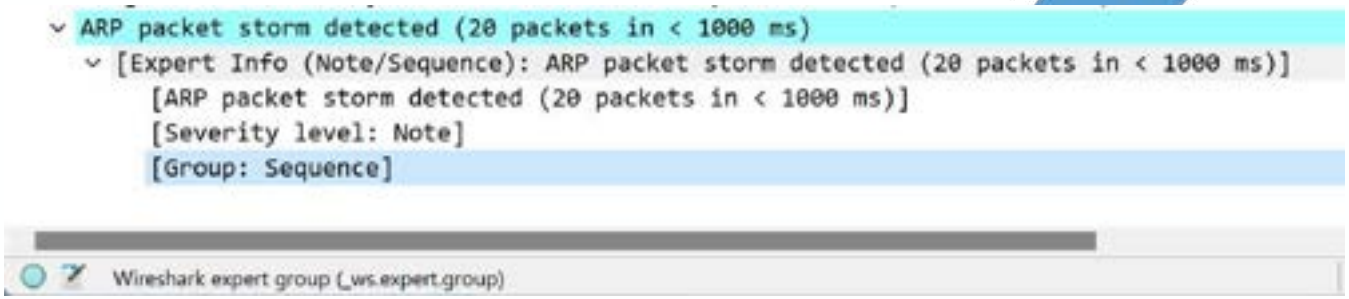


Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Using Expert Info to find ARP storms

- Click blue signal at left side of bottom





- Expert Info tells us “ARP packet storm detected” Open the tree and click and check each packet.
- We find an additional header about “ARP packet storm detected (20 packets in < 1000 ms)”

Wireshark ARP storms settings

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- We need to check the preferences of setting, open the “preferences” text file in your profile of personal configuration.

  (C:¥Users¥[username]¥AppData¥Roaming¥Wireshark¥profiles¥[your profile]¥preferences

```
# Attempt to detect excessive rate of ARP requests
# TRUE or FALSE (case-insensitive)
arp.detect_request_storms: TRUE

# Number of requests needed within period to indicate a storm
# A decimal number
arp.detect_storm_number_of_packets: 20

# Period in milliseconds during which a packet storm may be detected
# A decimal number
arp.detect_storm_period: 1000
```

Search text by “arp” to find ARP settings of Wireshark

Find ARP storms by tshark

- We need to override tshark settings

  tshark –r arp-storm.pcap -O arp ← Show ARP packet detail

  -Y arp.packet-storm-detected ← Display filter

  -o “arp.detect_request_storms:TRUE“ ← preferences without space

  -o “arp.detect_storm_number_of_packets:20”

  -o “arp.detect_storm_period: 1000”

- If you just need the frame number and source mac address, add “-T fields –e frame.number –e eth.src”

-

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Find duplication by tshark

```
C:¥Users¥megumi takeshita¥Desktop¥finding_duplications>tshark -r arp-storm.pcap -Y arp.packet-storm-detected -
O arp -o "arp.detect_request_storms:TRUE" -o "arp.detect_storm_number_of_packets:20" -o "arp.detect_storm_per
iod:1000"
Frame 21: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: syn-069-076-216-001.res.spectrum.com (00:07:0d:af:f4:54), Dst: Broadcast (ff:ff:ff:ff:ff:ff
)
Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: syn-024-166-172-001.res.spectrum.com (00:07:0d:af:f4:54)
    Sender IP address: syn-024-166-172-001.res.spectrum.com (24.166.172.1)
    Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)
    Target IP address: syn-024-166-174-207.res.spectrum.com (24.166.174.207)
    ARP packet storm detected (20 packets in < 1000 ms)
        [Expert Info (Note/Sequence): ARP packet storm detected (20 packets in < 1000 ms)]
            [ARP packet storm detected (20 packets in < 1000 ms)]
            [Severity level: Note]
            [Group: Sequence]
```

```
C:¥Users¥megumi takeshita¥Desktop¥finding_duplications>tshark -r arp-storm.pcap -Y arp.packet-storm-detected -
O arp -o "arp.detect_request_storms:TRUE" -o "arp.detect_storm_number_of_packets:20" -o "arp.detect_storm_per
iod:1000" -T fields -e frame.number -e eth.src
21      00:07:0d:af:f4:54
42      00:07:0d:af:f4:54
63      00:07:0d:af:f4:54
84      00:07:0d:af:f4:54
122     00:07:0d:af:f4:54
143     00:07:0d:af:f4:54
202     00:07:0d:af:f4:54
223     00:07:0d:af:f4:54
260     00:07:0d:af:f4:54
281     00:07:0d:af:f4:54
320     00:07:0d:af:f4:54
341     00:07:0d:af:f4:54
362     00:07:0d:af:f4:54
452     00:07:0d:af:f4:54
473     00:07:0d:af:f4:54
519     00:07:0d:af:f4:54
556     00:07:0d:af:f4:54
593     00:07:0d:af:f4:54
```

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tshark –r arp-storm.pcap -O arp
-Y arp.packet-storm-detected
-o “arp.detect_request_storms:TRUE“
-o “arp.detect_storm_number_of_packets:20”
-o “arp.detect_storm_period: 1000”

tshark –r arp-storm.pcap -O arp
-Y arp.packet-storm-detected
-o “arp.detect_request_storms:TRUE“
-o “arp.detect_storm_number_of_packets:2
-o “arp.detect_storm_period: 1000”
-T fields –e frame.number –e eth.src

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Excessive ARP request tells us

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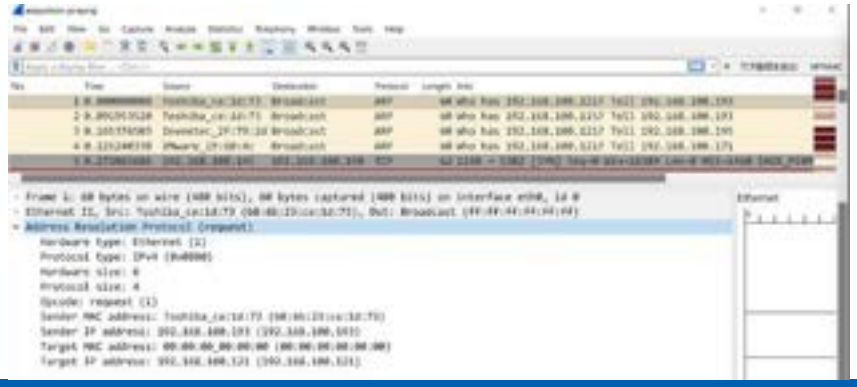
1. Misconfiguration of network devices, such as the bridge mode of the router?
2. MITM attacks such as ARP poisoning.

. Open arppoison.pcapng. This trace file is captured by KaliLinux, using Ettercap to execute ARP poisoning.

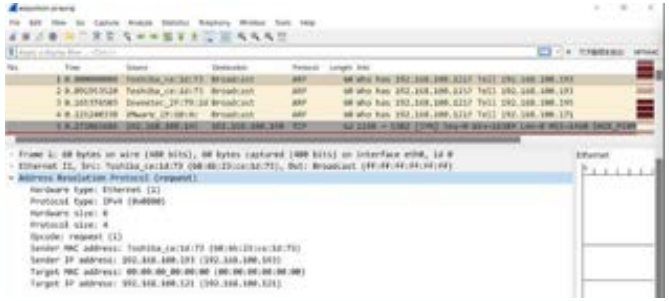


ARP poisoning attack by Etthercap

- Check Expert Info to find the ARP request storm.

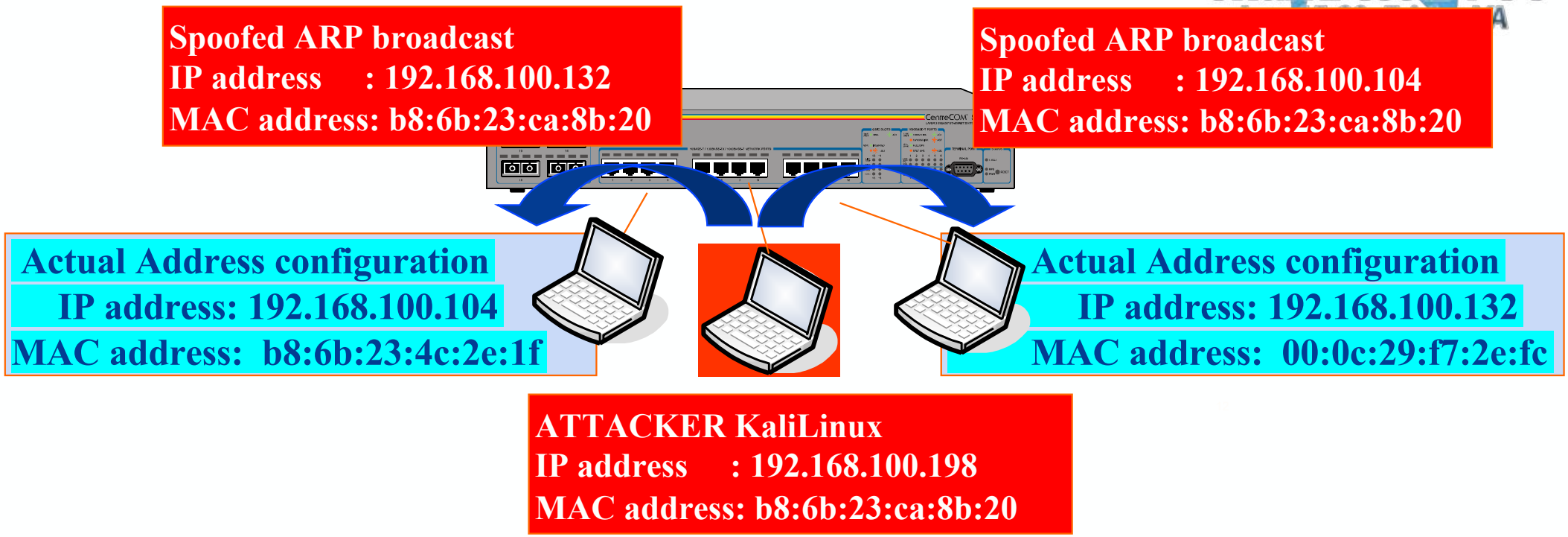
Wireshark · Expert Information · arppoison.pcapng

Severity	Summary	Group	Protocol	Count
Warning	Duplicate IP address configured	Sequence	ARP/RARP	6
Warning	Connection reset (RST)	Sequence	TCP	150
Note	ARP packet storm detected	Sequence	ARP/RARP	2
369	Who has 192.168.100.121? Tell 192.168.100.118	Sequence	ARP/RARP	
445	Who has 192.168.100.121? Tell 192.168.100.106	Sequence	ARP/RARP	
Note	A new tcp session is started with the same ports as an earlier session in t...	Sequence	TCP	133
Note	Padding identification may be inaccurate and impact trailer dissector	Protocol	Ethertype	84
Chat	Connection establish request (SYN)	Sequence	TCP	150



- There are two counts of ARP storm
  as well as Duplicate IP address configured events.
- IP address configuration mistake or
  IP spoofing attack by Man In The Middle?

ARP poisoning attack by Etthercap

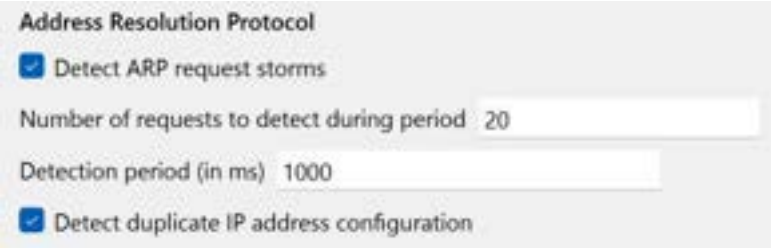


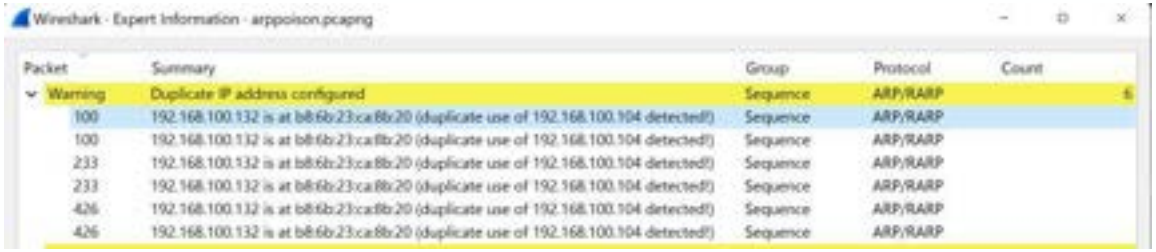
- 192.168.100.104 is used by both **b8:6b:23:4c:2e:1f** and **b8:6b:23:ca:8b:20**
- 192.168.100.132 is used by both **00:0c:29:f7:2e:fc** and **b8:6b:23:ca:8b:20**

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Find duplication of IP address

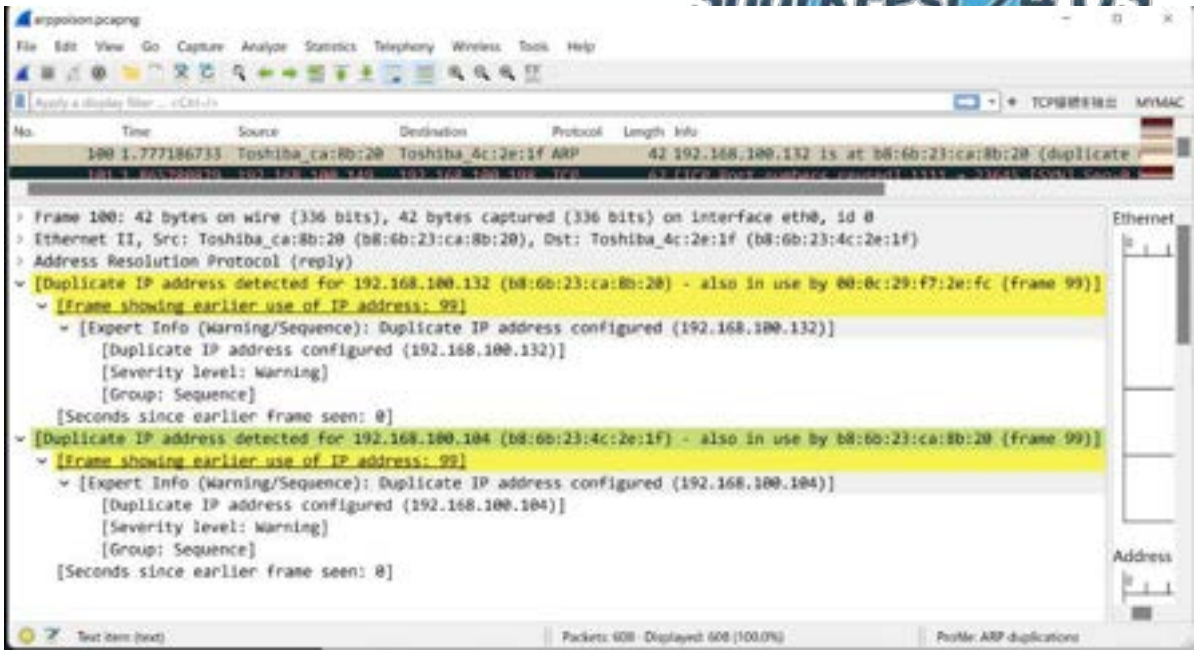
- Wireshark finds duplication of IP address by ARP/RARP dissector by default
- Choose ARP in the packet detail pane, right-click Protocol configuration>Open ARP preference
- Check ON: Detect duplicate IP address configuration
- Also check Warning of Duplicate IP address configured





Find duplication of IP address

- Check frame #100
  192.168.100.104
  192.168.100.132
  are used by two different MAC address, actual PC (blue) and MITM(red)



- 192.168.100.104 is used by both **b8:6b:23:4c:2e:1f** and **b8:6b:23:ca:8b:20**
- 192.168.100.132 is used by both **00:0c:29:f7:2e:fc** and **b8:6b:23:ca:8b:20**

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Find IP address duplications by tshark

- You can find IP address duplications

  tshark –r arppoison.pcapng -O arp ← Show ARP packet detail

  -Y arp.duplicate-address-frame ← Display filter

```
C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r arppoison.pcapng -O arp -Y arp.duplicate-addr
ess-frame
Frame 100: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface eth0, id 0
Ethernet II, Src: Toshiba_ca:8b:20 (b8:6b:23:ca:8b:20), Dst: Toshiba_4c:2e:1f (b8:6b:23:4c:2e:1f)
Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: Toshiba_ca:8b:20 (b8:6b:23:ca:8b:20)
    Sender IP address: 192.168.100.132 (192.168.100.132)
    Target MAC address: Toshiba_4c:2e:1f (b8:6b:23:4c:2e:1f)
    Target IP address: 192.168.100.104 (192.168.100.104)
[Duplicate IP address detected for 192.168.100.132 (b8:6b:23:ca:8b:20) - also in use by 00:0c:29:f7:2e:fc (fr
ame 99)]
[Duplicate IP address detected for 192.168.100.104 (b8:6b:23:4c:2e:1f) - also in use by b8:6b:23:ca:8b:20 (fr
ame 99)]
```

Find IP address duplications by tshark

- We need the set of spoofed and actual sets of IP/MAC address from the trace file

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1:Source and Target IP/MAC address sets sent by ARP request and reply message

```
tshark -r arppoison.pcapng -T fields -e arp.src.proto_ipv4 -e arp.src.hw_mac
tshark -r arppoison.pcapng -T fields -e arp.dst.proto_ipv4 -e arp.dst.hw_mac
```

2: Source and Destination MAC/IP sets from actual header

```
tshark -r arppoison.pcapng -T fields  -e ip.src -e eth.src -Y !arp
tshark -r arppoison.pcapng -T fields  -e ip.dst -e eth.dst -Y !arp
```

Without ARP packet

3: Merge and pick up duplications

Find IP address duplications by tshark

Create list, merge, sort, pick up duplication

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```
tshark -r arppoison.pcapng -T fields -e arp.src.proto_ipv4 -e arp.src.hw_mac >> list.txt
tshark -r arppoison.pcapng -T fields -e arp.dst.proto_ipv4 -e arp.dst.hw_mac >> list.txt
tshark -r arppoison.pcapng -Y !arp -T fields -e ip.src -e eth.src >> list.txt
tshark -r arppoison.pcapng -Y !arp -T fields -e ip.dst -e eth.dst >> list.txt
cat list.txt | sort | uniq | grep -v 00:00:00:00:00:00 >>dup.txt
```

```
C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r arppoison.pcapng -T fields -e arp.src.proto_i
pv4 -e arp.src.hw_mac >> list.txt

C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r arppoison.pcapng -T fields -e arp.dst.proto_i
pv4 -e arp.dst.hw_mac >> list.txt

C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r arppoison.pcapng -Y !arp -T fields -e ip.src
-e eth.src >> list.txt

C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r arppoison.pcapng -Y !arp -T fields -e ip.dst
-e eth.dst >> list.txt

C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>cat list.txt | sort | uniq | grep -v 00:00:00:00:00:00
```

```
192.168.100.104 b8:6b:23:4c:2e:1f
192.168.100.104 b8:6b:23:ca:8b:20
192.168.100.106 b8:6b:23:16:1b:73
192.168.100.110 00:8c:fa:2f:7a:42
192.168.100.113 44:d4:e0:ce:22:09
192.168.100.118 40:40:a7:53:d6:0a
192.168.100.120 00:0c:29:6e:5f:e8
192.168.100.132 00:0c:29:f7:2e:fc
192.168.100.132 b8:6b:23:ca:8b:20
192.168.100.139 00:0c:29:d5:68:3e
```

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Find IP address duplications by tshark

Finally, pick up duplicate IP address entries by Powershell

Get-Content dup.txt | Group-Object -Property { $_.Split()[0] } | Where-Object { $_.Count -gt 1 } | ForEach-Object { $_.Group | Select-Object -Unique }

or

```
awk '{if (ip[$1] && ip[$1] != $2) {print $0; print $1, ip[$1]}
  else ip[$1]=$2}' < dup.txt
```

```
PS C:¥Users¥megumitakeshita¥Desktop¥finding_duplications> Get-Content dup.txt | Group-Object -Property { $_.S
plit()[0] } | Where-Object { $_.Count -gt 1 } | ForEach-Object { $_.Group | Select-Object -Unique }
192.168.100.104 b8:6b:23:4c:2e:1f
192.168.100.104 b8:6b:23:ca:8b:20
192.168.100.132 00:0c:29:f7:2e:fc
192.168.100.132 b8:6b:23:ca:8b:20
```

IP address duplications tells us

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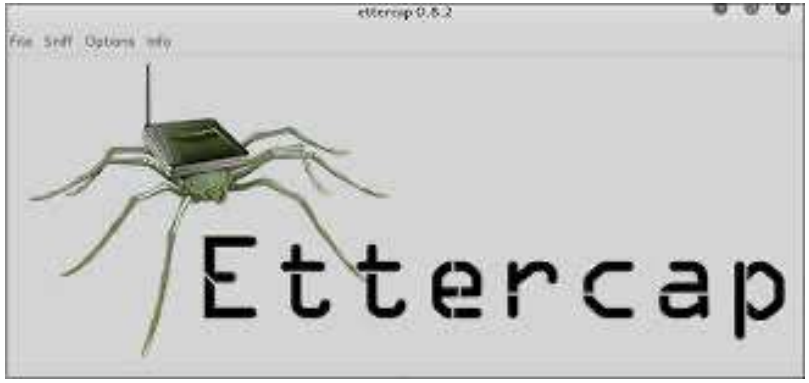
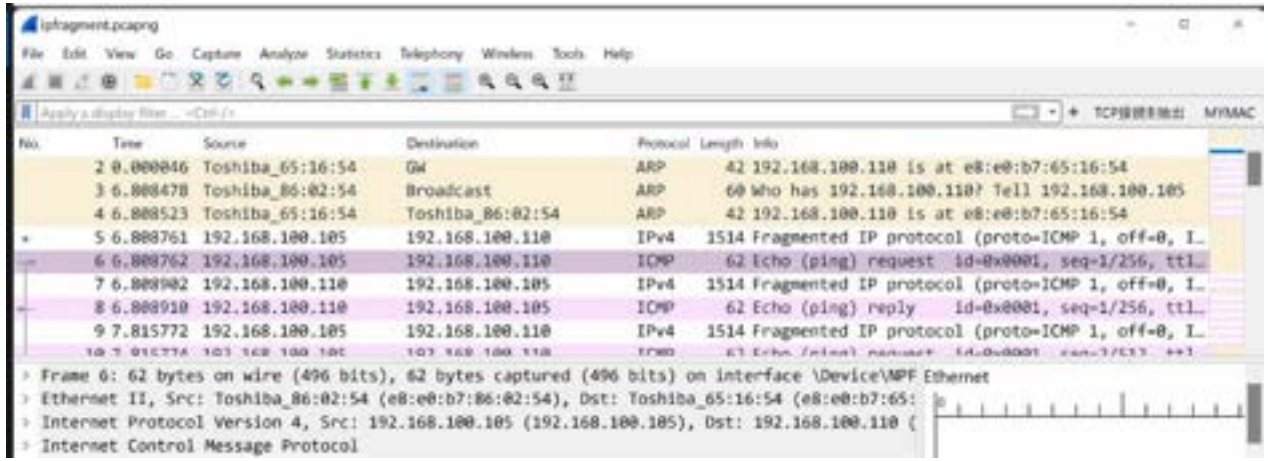
1. Misconfiguration of address settings client-side in usual, sometimes happens in DHCP
2. MITM attacks such as ARP poisoning.



Duplication of IPID

- All IP packets have their unique IP Identification fields (Basically)
- We can easily find the same IPID value in the fragmented IPv4 packets. open ipfragment.pcapng and check IP header in frame #5



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Duplication of IPID

- This is a simple ping packet that is over MTU size.

```
    5 6.808761  192.168.100.105    192.168.100.110    IPv4   1514 Fragmented IP prot
    6 6.808762  192.168.100.105    192.168.100.110    ICMP     62 Echo (ping) reque
> Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface \De
> Ethernet II, Src: Toshiba_86:02:54 (e8:e0:b7:86:02:54), Dst: Toshiba_65:16:54 (e8:e0:b7:65:
v Internet Protocol Version 4, Src: 192.168.100.105 (192.168.100.105), Dst: 192.168.100.110 (
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0x4888 (18568)
  > 001. .... = Flags: 0x1, More fragments
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 128
    Protocol: ICMP (1)
    Header Checksum: 0x8270 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.100.105 (192.168.100.105)
    Destination Address: 192.168.100.110 (192.168.100.110)
    [Reassembled IPv4 in frame: 6]
> Data (1480 bytes)
```

```
    5 6.808761  192.168.100.105    192.168.100.110    IPv4   1514 Fragmented IP pro
    6 6.808762  192.168.100.105    192.168.100.110    ICMP     62 Echo (ping) reque
> Frame 6: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface \Device\NPF
> Ethernet II, Src: Toshiba_86:02:54 (e8:e0:b7:86:02:54), Dst: Toshiba_65:16:54 (e8:e0:b7:65:
v Internet Protocol Version 4, Src: 192.168.100.105 (192.168.100.105), Dst: 192.168.100.110 (
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 48
    Identification: 0x4888 (18568)
  > 000. .... = Flags: 0x0
    ...0 0000 1011 1001 = Fragment Offset: 1480
    Time to Live: 128
    Protocol: ICMP (1)
    Header Checksum: 0xa763 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.100.105 (192.168.100.105)
    Destination Address: 192.168.100.110 (192.168.100.110)
  > [2 IPv4 Fragments (1508 bytes): #5(1480), #6(28)]
> Internet Control Message Protocol
```

- Check IPID field value between frame #5 and #6
- Also check for DF/MF flags and offset fields.

Finding fragments

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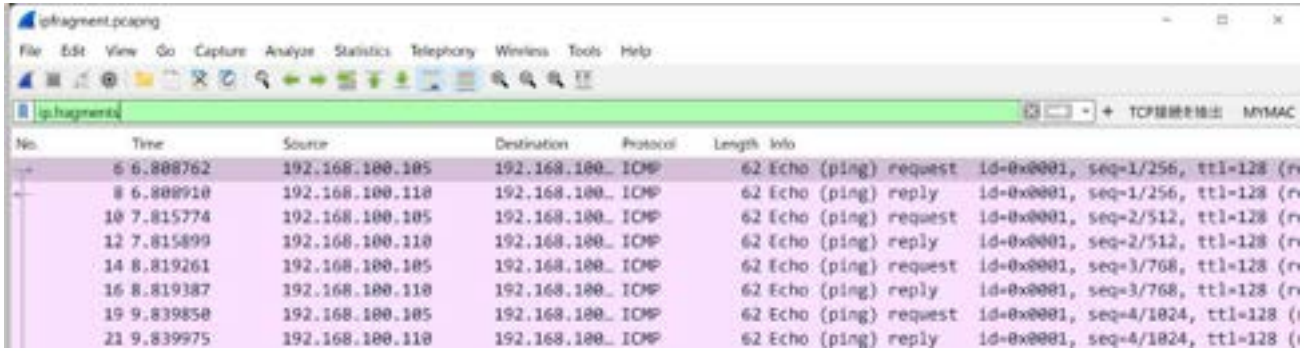
- Open [IPv4 fragments] header in #6

```
[2 IPv4 Fragments (1508 bytes): #5(1480), #6(28)]
    [Frame: 5, payload: 0-1479 (1480 bytes)]
    [Frame: 6, payload: 1480-1507 (28 bytes)]
    [Fragment count: 2]
    [Reassembled IPv4 length: 1508]
    [Reassembled IPv4 data [truncated]: 080064730001000
```

- Wireshark adds generated fields about the fragment, also set “ ▪ ” icons at related frames in packet list pane.
- We can use the display filter string “ip.fragments” to find IP fragments, too.

Finding fragments

- Set “ip.fragments” to find fragments



ip.fragment.count
ip.fragment.error
ip.fragment.multipletails
ip.fragment.overlap
ip.fragment.overlap.conflict
ip.fragment.toolongfragment
ip.fragments

- We can also use the count, error, multipletails, overlap, overlap.conflict, toolongfragment fields to find fragments
- Sometimes, long fragments are used for DoS attacks.

Finding fragments using tshark

- When you need frame number, source and destination IP address, IPID and counts on IP fragments

  tshark -r ipfragment.pcapng -T fields -e frame.number -e ip.src -e ip.dst –e ip.id -e ip.fragment.count -Y ip.fragment.count

```
C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r ipfragment.pcapng -T fields -e frame.number -
e ip.src -e ip.dst -e ip.id -e ip.fragment.count -Y ip.fragment.count
6       192.168.100.105 192.168.100.110 0x4888  2
8       192.168.100.110 192.168.100.105 0x2527  2
10      192.168.100.105 192.168.100.110 0x4889  2
12      192.168.100.110 192.168.100.105 0x252a  2
14      192.168.100.105 192.168.100.110 0x488a  2
16      192.168.100.110 192.168.100.105 0x252c  2
19      192.168.100.105 192.168.100.110 0x488b  2
21      192.168.100.110 192.168.100.105 0x252d  2
36      192.168.100.110 192.168.100.105 0x252e  2
38      192.168.100.105 192.168.100.110 0x488c  2
```

Duplication of IPID in another case

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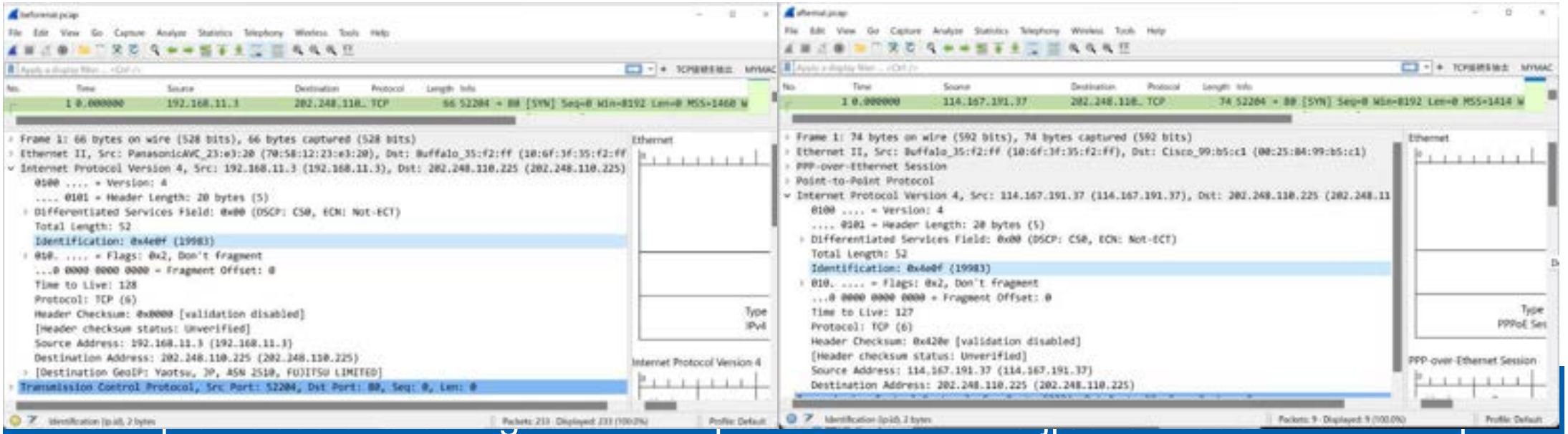
- Open two trace file

  beforenat.pcap before NAT packet captured at LAN

  afternat.pcap post NAT process captured at WAN

- Check the IPID field in the IP header of both



IPID before NAT and after NAT

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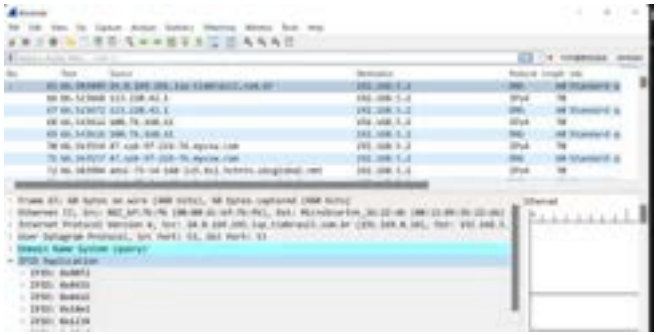
- IPID does not change during the NAT process
- We can use IPID to determine the same packet before and after the NAT process

IPID duplications tells us

1. IP fragments, misconfiguration of MTU,
   or frame size settings in clients, routers and so on
2. Different data link header but the same IP packets
   before NAT and after NAT
   IPID does not change during the NAT process.
3. Broken routers and network devices.
4. DoS/DDoS attack (dos.pcap)



Duplication of seq/ack number

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- TCP retransmission / duplicate ACK are very common events during TCP communications.
- Use the display filter to find TCP Retransmission and D_ACK

Name	Explanations	Display Filter
TCP retransmission	Same sequence number Max: 5 times (Windows11)	tcp.analysis.retransmission
TCP duplicate ACK	Same acknowledge number Max: 3 times (Fast retransmission)	tcp.analysis.duplicate_ack

- Open tcp-download.pcapng and check the Expert Info window

Duplication of seq/ack number

- Open the Expert Information window to count the number of TCP retransmission, D_ACK, fast retransmission

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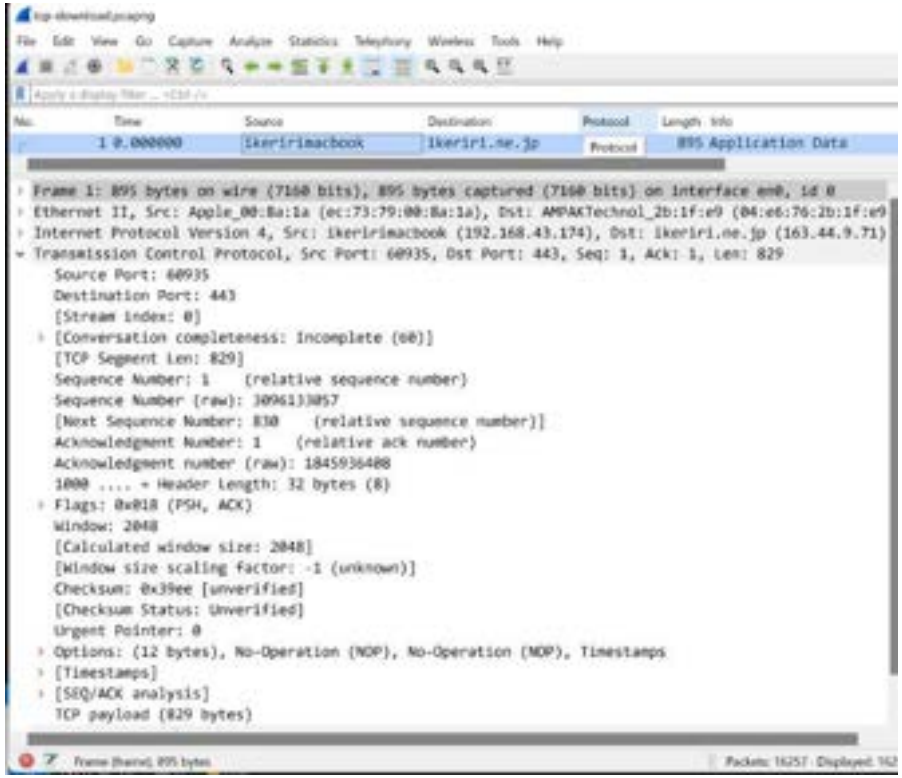
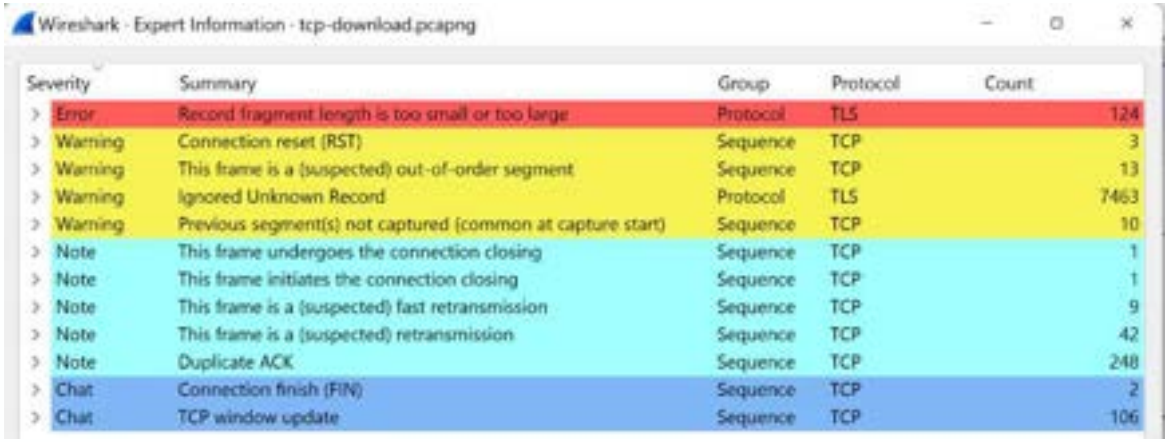




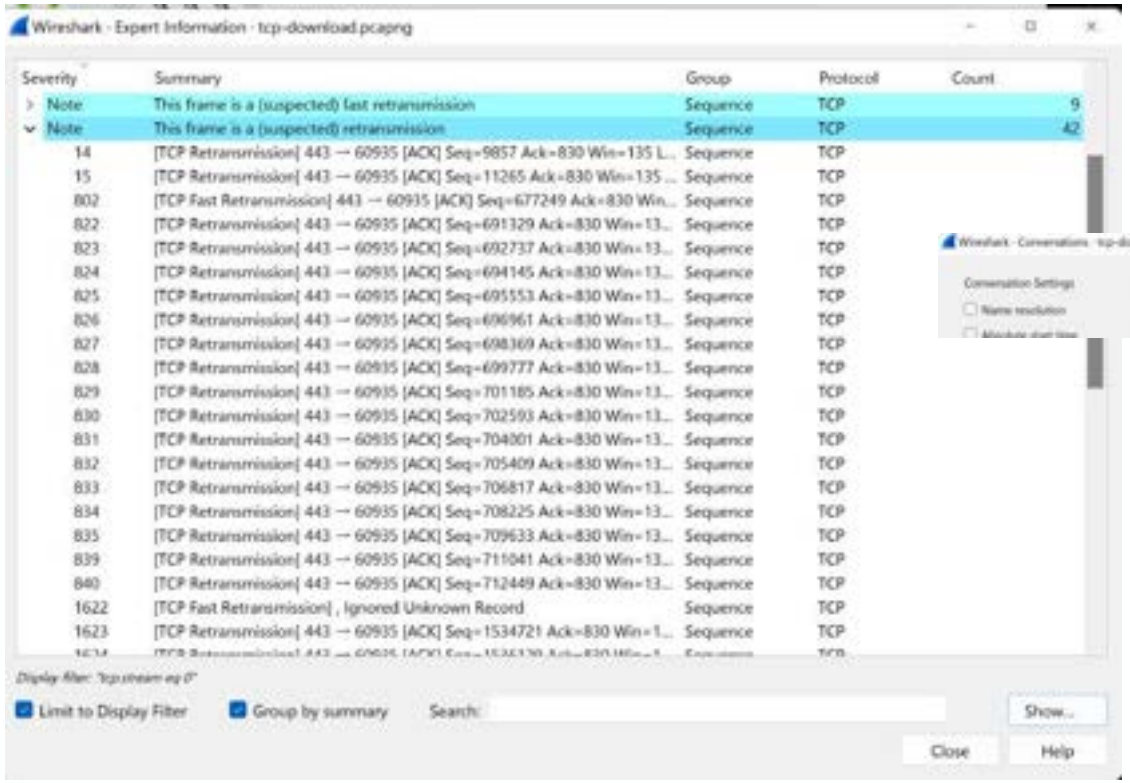
Severity	Summary	Group	Protocol	Count
Error	Record fragment length is too small or too large	Protocol	TLS	124
Warning	Connection reset (RST)	Sequence	TCP	3
Warning	This frame is a (suspected) out-of-order segment	Sequence	TCP	13
Warning	Ignored Unknown Record	Protocol	TLS	7463
Warning	Previous segment(s) not captured (common at capture start)	Sequence	TCP	10
Note	This frame undergoes the connection closing	Sequence	TCP	1
Note	This frame initiates the connection closing	Sequence	TCP	1
Note	This frame is a (suspected) fast retransmission	Sequence	TCP	9
Note	This frame is a (suspected) retransmission	Sequence	TCP	42
Note	Duplicate ACK	Sequence	TCP	248
Chat	Connection finish (FIN)	Sequence	TCP	2
Chat	TCP window update	Sequence	TCP	106

1 TCP connection using TLS(HTTP)

18MB file download using WiFi

TCP Retransmission Rate

- Expert Info tells us the count of retransmission
  ”This frame is a (suspected) retransmission”



Statistics>Conversations>TCP and count the packets from the server (from port 443)

12,253 packets are sent from the server and 42 packets may be retransmission.

42/12253≒0.00342..

Retransmission Rate: 0.34%

TCP retransmission Rate by tshark

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- Counting retransmission rate

  (1) All TCP packets from server

  tshark -r tcp-download –Y tcp.srcport==443 | wc –l

  (2) retransmitted TCP packets from the server

  tshark -r tcp-download

  –Y “tcp.srcport==443 and tcp.analysis.retransmission” | wc –l

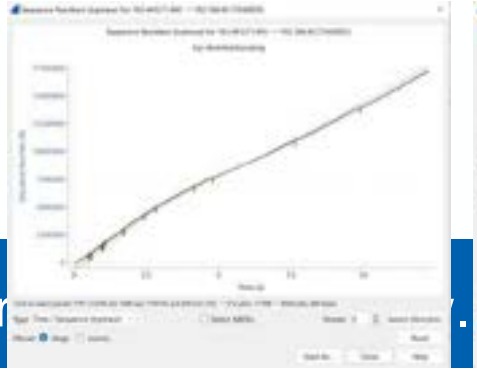
```
C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r tcp-download.pcapng -Y tcp.srcport==443 | wc
-l
12253

C:¥Users¥megumitakeshita¥Desktop¥finding_duplications>tshark -r tcp-download.pcapng -Y "tcp.srcport==443 and
tcp.analysis.retransmission" | wc -l
42
```

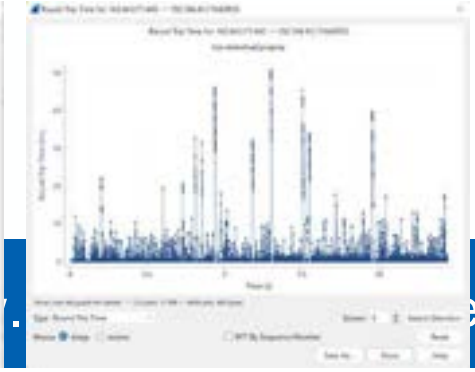
- The percentage (frequency) of TCP retransmissions is important

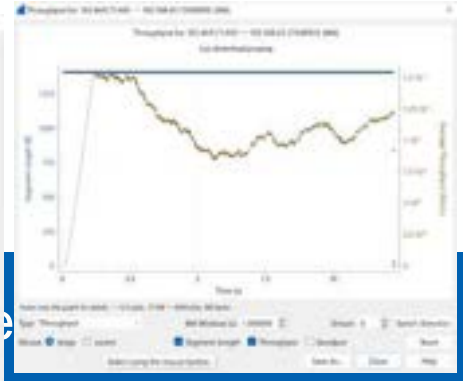
  42/12253≒0.0034 Retransmission Rate: 0.34%

Duplication of sequence number by tshark

- Threadshould of TCP Retransmission rate
  https://wireshark.marwan.ma/lists/ethereal-users/200601/msg00149.html
- It depends on the application, but TCP is designed with some retransmissions. Some applications may break 0.5%, but less than 1% is excellent, 3-5% is acceptable, and over 5% may be excessive retransmission.
- Open Statistics>Conversations>TCP and pick up the stream, then create TCP stream graph may help us TCP connection.







Calculate TCP Retransmission rate by Post Dissector

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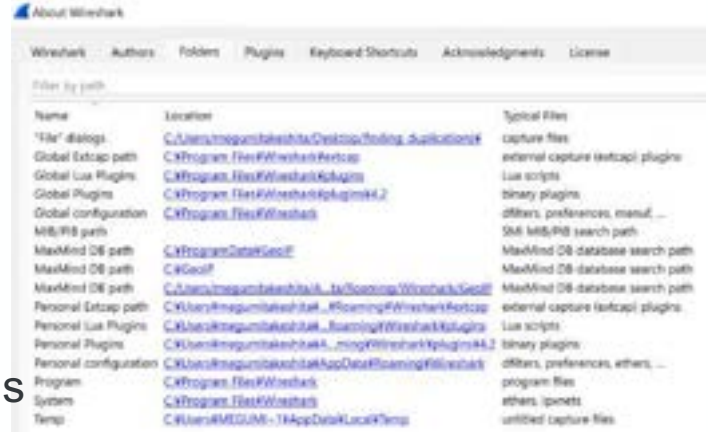
- Wireshark can add Post Dissector to dissect packets after Wireshark finished dissection.
- Dissectors are used for analyzing new protocols, but Post Dissectors are used for additional analyzing process after Wireshark finished packet Dissections.
- We can create a Post Dissector by Lua script to calcurate TCP retransmittion rate in each connection.
  (It's not so difficult; we have GPTs!!)

Lua support of Wireshark



- Help>About Wireshark>Folder tab
  Check Personal Lua Plugins location
  C:¥Users¥megumitakeshita¥AppData¥Roaming¥Wireshark¥plugins

Install Visual Studio Code and Extensions

（https://azure.microsoft.com/ja-jp/products/visual-studio-code）

- Install VS Code and Lua Extensions
- Recommend to install Lua Debug
  it supports the completion for variable, functions and so on.

Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

TCP retransmission Rate by Post Dissector

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Recommend to read and Wireshark Developer Guide

Proto object used for Dissector/PostDissector

Field object is used for Wireshark field

Proto.init() is necessary function for initializing Dissector

Proto.dissector is used for describing packet analysing process.

TreeItem is used for Wireshark Dissection tree entry in packet detail pane

1. Define Post Dissector, display filter name is retrans, and Name is "Retransmission Analysis"

```
-- Define a new Proto for the Post Dissector
local retrans_proto = Proto("retrans", "Retransmission Analysis")
```

TCP retransmission Rate by Post Dissector

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2.Define Wireshark fields used in post dissecting

```
-- Define the fields to extract
local ip_src_f = Field.new("ip.src")
local retrans_f = Field.new("tcp.analysis.retransmission")
```

TCP retransmission Rate by Post Dissector

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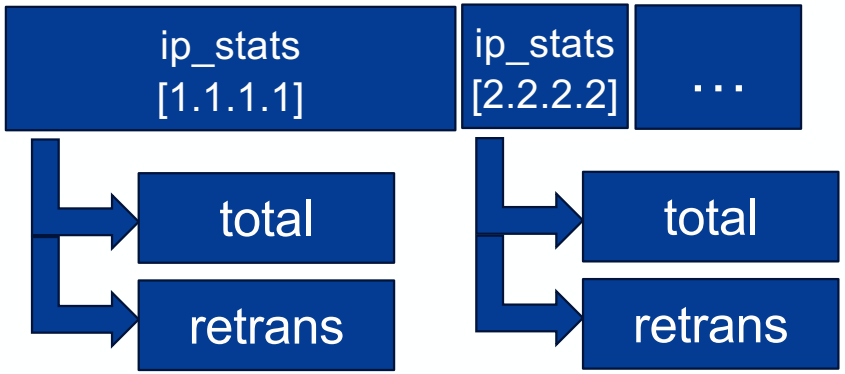
3. Define the init function to process Post Dissector.

```
-- Initialize function to reset the table
function retrans_proto.init()
    ip_stats = {}
end
```

TCP retransmission Rate by Post Dissector

4. Define a helper function
   to count retransmissions by each ip address.

```
-- Function to add counts to the table
local function add_ip_count(ip, is_retrans)
  if not ip_stats[ip] then
      ip_stats[ip] = { total = 0, retrans = 0 }
  end
  ip_stats[ip].total = ip_stats[ip].total + 1
  if is_retrans then
      ip_stats[ip].retrans = ip_stats[ip].retrans + 1
  end
end
```



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TCP retransmission Rate by Post Dissector

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Now we describe the analyzing process using Wireshark API,

Proto.dissector function has three parameters: tvb, pinfo, TreeItem

tvb means Testy Virtual buffer, actual packet data objectz

pinfo means dissected packet data, we can refer like pinfo.src_ipz

TreeItem means the object of Wireshark dissection trees in the packet detail pane.

5.Define dissector function (buffer as tvb, pinfo and tree as TreeItem)

```
-- Dissector function
function retrans_proto.dissector(buffer, pinfo, tree)
-- extract fields from definitions
    local ip_src = ip_src_f()
    local is_retrans = retrans_f()
```

TCP retransmission Rate by Post Dissector

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6. Calculate the retransmission rate in an easy way
   (It is accurate all packets are TCP, there are no Non-TCP packets)

$$\text{Retransmission rate} = \frac{\text{TCP retransmission packets (tcp.analysis.retransmission)}}{\text{all TCP packets by each source IP address}}$$

```
    if ip_src then
        add_ip_count(tostring(ip_src), is_retrans ~= nil)
    end
    -- Create a subtree for retransmission analysis
    local subtree = tree:add(retrans_proto, "Retransmission Analysis")
```

TCP retransmission Rate by Post Dissector

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```
    -- Add statistics to the subtree
    for ip, stats in pairs(ip_stats) do
        local retrans_ratio = (stats.retrans / stats.total) * 100
        local ip_node = subtree:add(retrans_proto, "IP: " .. ip)
        ip_node:add(retrans_proto, string.format("Total Packets: %d", stats.total))
        ip_node:add(retrans_proto, string.format("Retransmissions: %d", stats.retrans))
        ip_node:add(retrans_proto, string.format("Retransmission Ratio: %.2f%%",
retrans_ratio))
    end
end
```

TCP retransmission Rate by Post Dissector

7.Register this Proto as PostDissector

```
-- Register the dissector as a postdissector
register_postdissector(retrans_proto)
```

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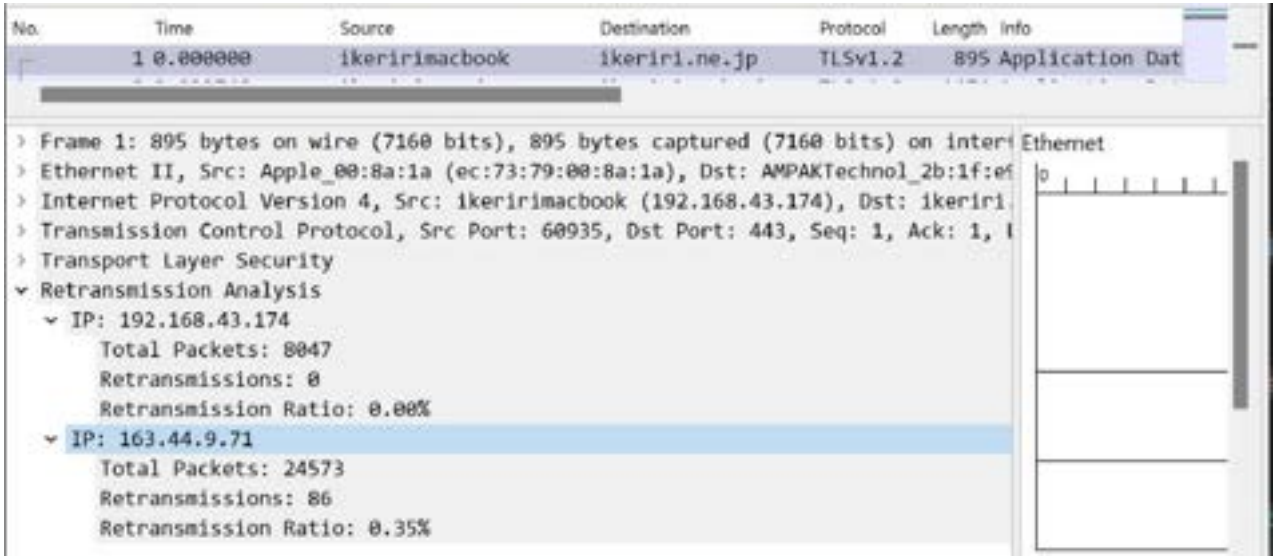
TCP retransmission Rate by Post Dissector

- Copy tcp-download-postdissector.lua into your personal plugin folder at Wireshark personal Configuration

  (e.x. C:¥Users¥megumitakeshita¥AppData¥Roaming¥Wireshark¥plugins)

- Close all Wireshark apps and reopen tcp-download.pcapng



Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Duplication ACK and Fast retransmission

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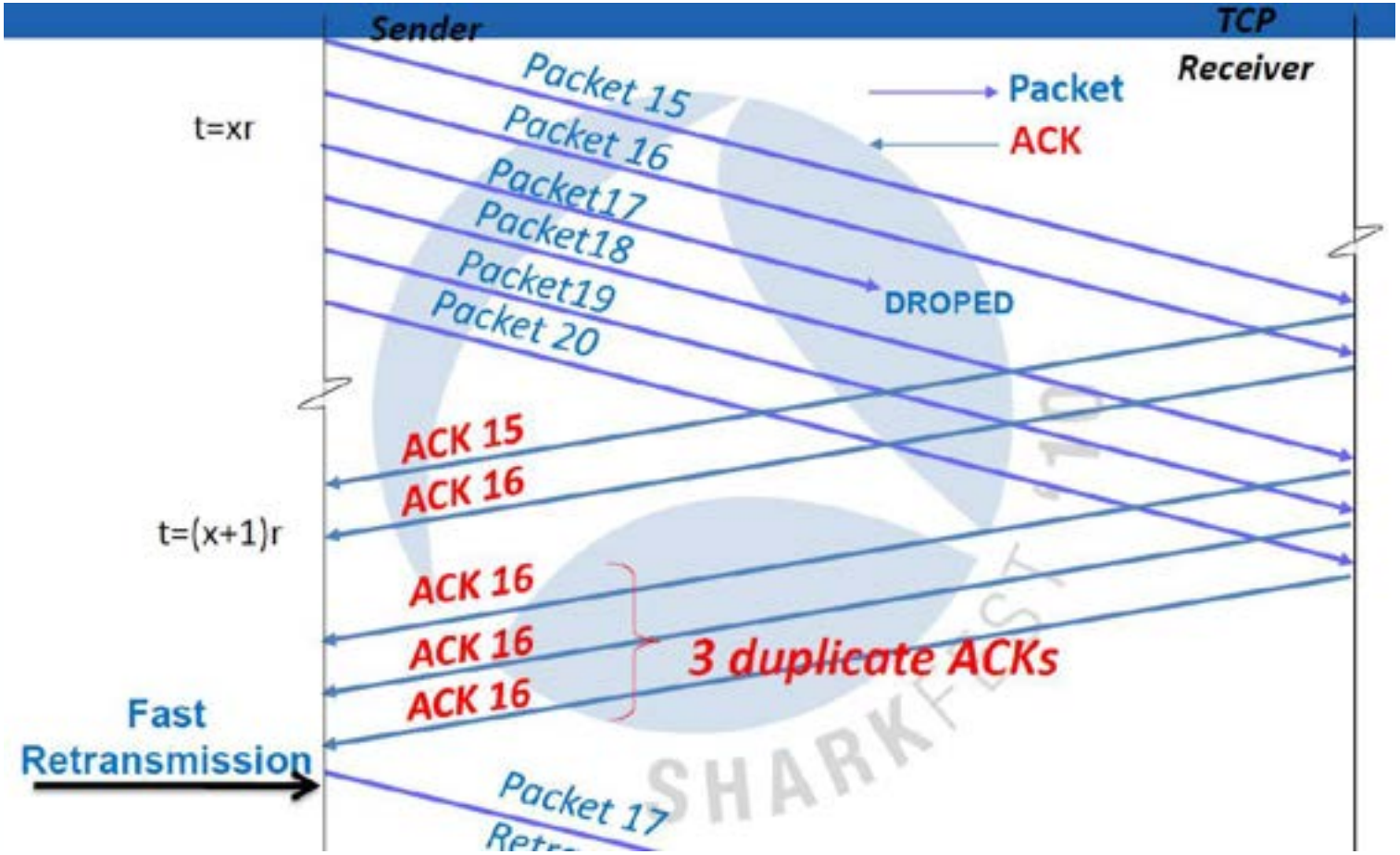
- We capture the trace on the client side, and check the retransmission from the server
- Next, think about Duplication ACK
- The client sends Duplication ACK if the expected segment has not arrived during the RTO timer and sends again if the client does not receive the segment
- If the server receives 3 continueous Duplicate ACK, Server TCP thinks the segment was lost and sends the lost segment immediately (Fast retransmission)

Fast Retransmission algorithm



Frequency of Duplication ACK / Fast retransmission

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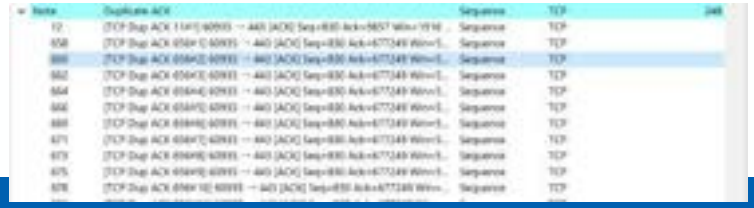
- Total ACK frame from the client side 4004pkts (tcp.ack and tcp.srcport==60935)
- The same ACK number means Duplicate ACK 248pkts (tcp.analysis.duplicate_ack) 248/4004=0.0619.. 6.19%
- Three continuous Duplicate ACK causes Fast retransmission 9pkts (tcp.analysis.fast_retransmission) 9/4004=0.00224.. 0.224%
- The rate of D_ACK seems bigger than expected, but fast retransmission rate is under 1%(0.224%), it's OK.



Sequence/Acknoledgement number duplications tells us

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1. It is a common event in TCP connection; don't worry.
2. Count the rate of duplication

TCP retransmission (from Server) tcp.analysis.retransmission
Duplicate ACK (from Client side) tcp.analysis.duplicate_ack
Fast Retransmission (from Client side) tcp.analysis.fast_retransmission
under 1% Excellent 1-5% Acceptable over 5% latency or quality

Use tracert to count the latency between the client and server,
Use pathping to check the quality (lost %) of the circuit.

Appendix
Duplication of Port number

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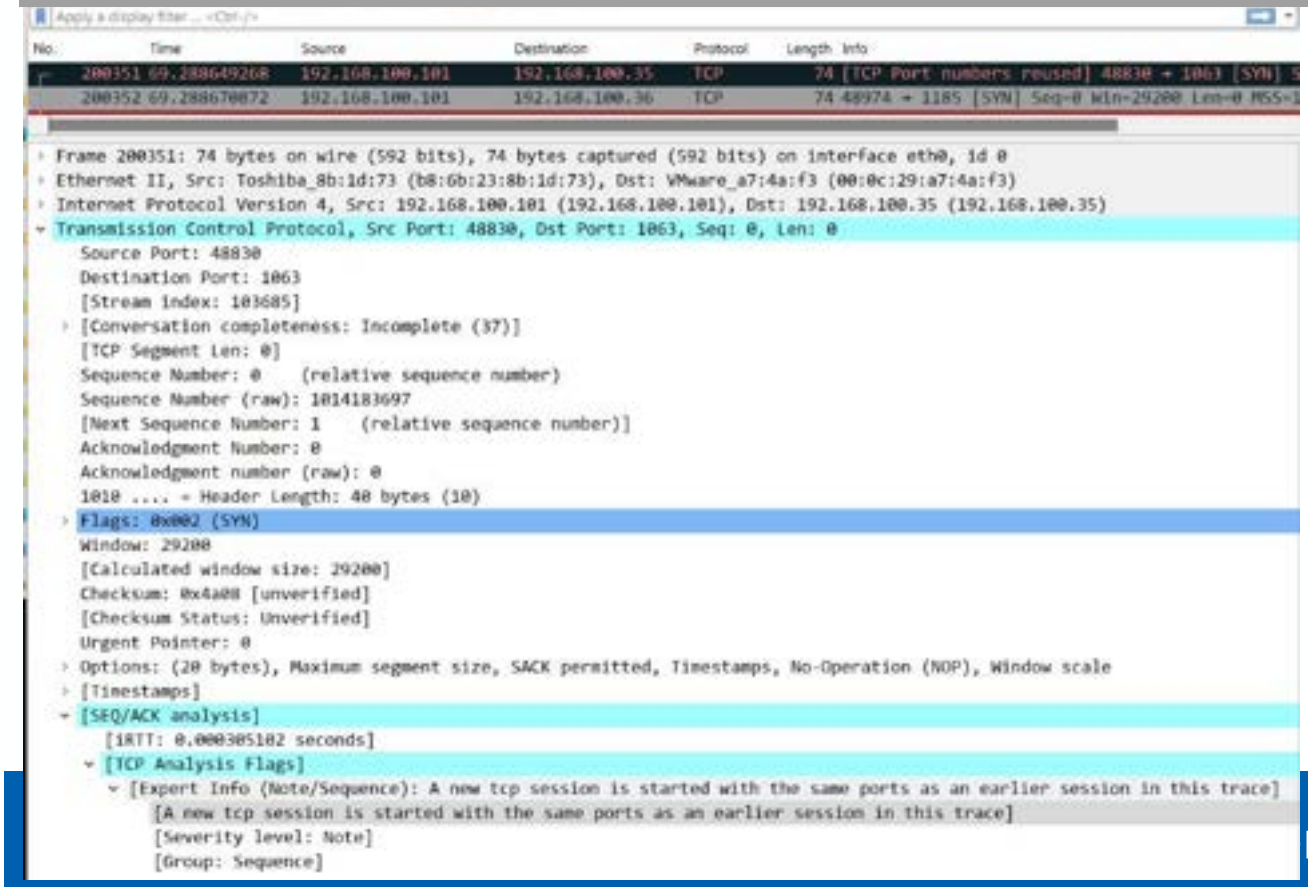
[TCP Port numbers reused] 48830 → 1063 [SYN] Seq=0 Win=29200



Open tcp-portdup.pcapng go to frame #200351 we find [Expert Info (Note/Sequence): A new tcp session is started with the same ports as an earlier session in this trace]

riri.ne.jp/sharkfest/sf24ikeriri.zip

Duplication of Port number

- Sake-san's comments in ASK Wireshark https://ask.wireshark.org/question/26247/tcp-port-numbers-reused/ "The wireshark note "[TCP Port numbers reused]" means that in the packet capture file, there is a new connection for a 5-tuple (ip-src,ip-dst,protocol,srcport,dstport) that was seen before…"
- Open Expert info and find [TCP Port numbers reused] [A new tcp session is started with the same ports as an earlier session in this trace] display filter is tcp.analysis.reused_port

Note	A new tcp session is started with the same ports as an earlier session in this trace	Sequence	TCP	4
200351	[TCP Port numbers reused] 48830 → 1063 [SYN] Seq=0 Win=29200 Len=0 MSS=14...	Sequence	TCP	
218093	[TCP Port numbers reused] 44244 → 28201 [SYN] Seq=0 Win=29200 Len=0 MSS=1...	Sequence	TCP	
218117	[TCP Port numbers reused] 41282 → 28201 [SYN] Seq=0 Win=29200 Len=0 MSS=1...	Sequence	TCP	
231234	[TCP Port numbers reused] 48524 → 125 [SYN] Seq=0 Win=29200 Len=0 MSS=146...	Sequence	TCP	

Duplication of Port number

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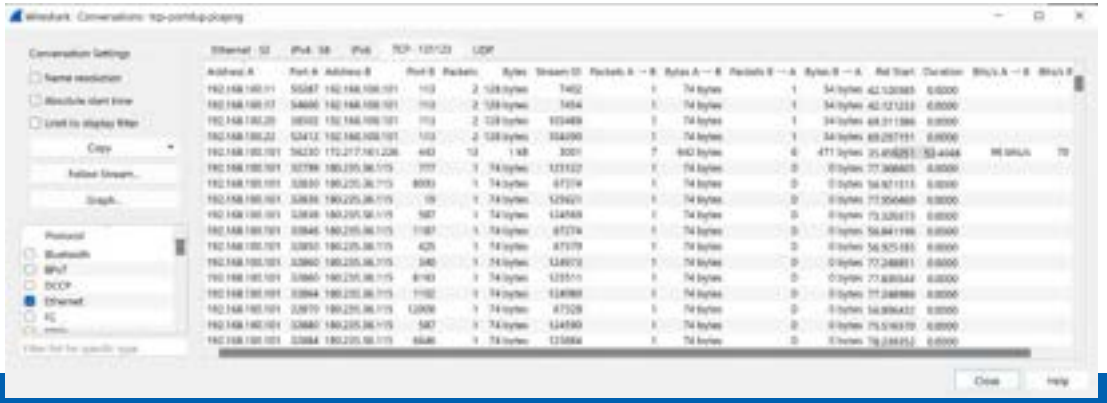
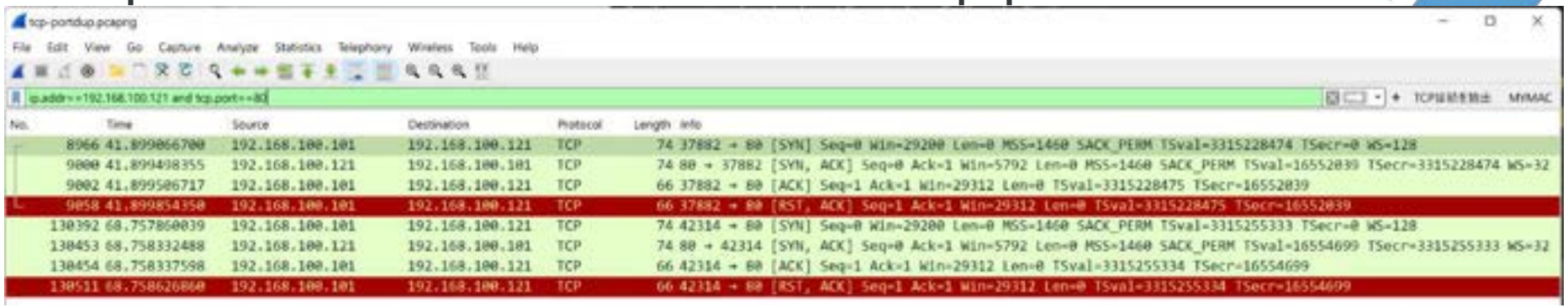
- The server uses well-known or registered port numbers, The client uses private port numbers from 49152 to 65535
- If you capture huge traffic for the long term (1month of office traffic), ip.src, ip.dst, protocol, srcport and dstport are duplicated by chance
- But why this trace records 4 TCP Port number reused? click Statistics>Conversations>TCP, there are 131123 TCP connections, and most of them are not completed half connection
- This trace is a capture of TCP port scan by nmap



Sample traces and configurations https://www.ikeriri.ne.jp/sharkfest/sf24ikeriri.zip

Duplication of Port number

- Ex. “ip.addr==192.168.100.121 and tcp.port==80”



- This trace captured TCP connect scan, accessing a lot of port in a short term, so sometimes there are duplication of port numbers.
- Connection reset (RST) 112149
- Connection establish (SYN) 131142

Sample traces and configurations https://www.ikenmiki.jp/sharkfest/2024-ikenmiki.zip

Port number duplications tells us

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It merely happens Port number duplications,

1. It happens by accident in a long-term huge trace file
2. Port scan
3. Multi-layer NAT/NAPT at WAN side

duplications are good indicators to find the clues of network/security troubleshooting

USE WIRESHARK

USE WIRESHARK

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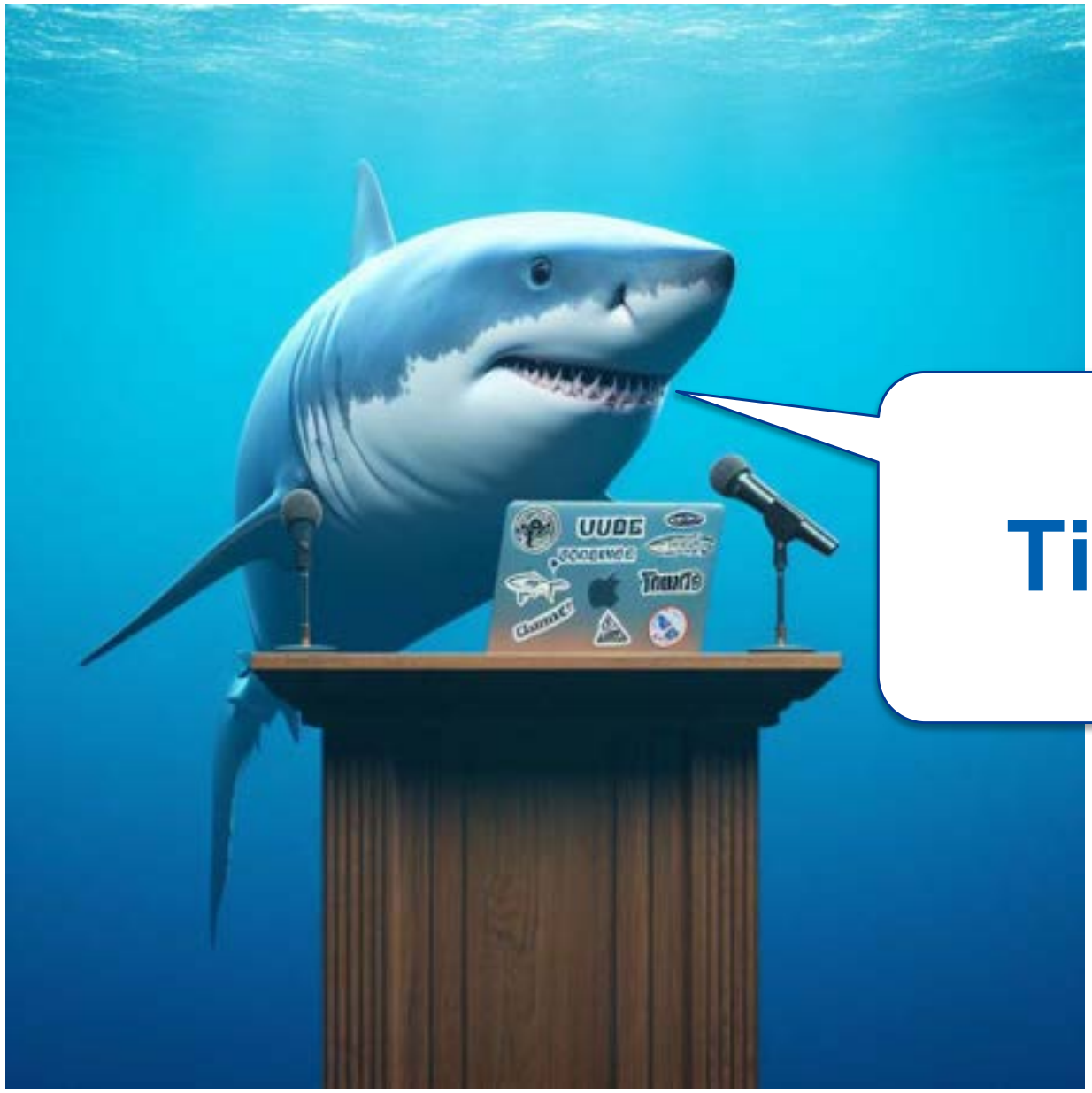
Thank you for watching.

Please complete the Google form survey

trace files and Wireshark profiles are here:
https://www.ikeriri.ne.jp/sharkfest/
sf24ikeriri.zip

ikeriri network service
http://www.ikeriri.ne.jp



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Time for Q & A