Packet Capture
Wireshark

SANOG 27

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Kathmandu, Nepal

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APNIC

Why we need to capture packet & how it's related to security?

tcpdump Definition

tcpdump is a utility used to capture and analyze packets on network interfaces. Details about these packets can either be displayed to the screen or they can be saved to a file for later analysis. tcpdump utilizes the libpcap library for packet capturing.

tcpdump command example

```
# tcpdump –nni eth0

# tcpdump –nni eth0 host 10.10.10.10

# tcpdump –nni eth0 dst host 10.10.10.10 and proto tcp

# tcpdump –nni eth0 src net 10.10.10.0/24 and port tcp
and portrange 1-1024
```

-nn = don’t use DNS to resolve IPs and display port no
-i = interface to watch
dst = watch only traffic destined to a net, host or port
src = watch only traffic whose src is a net, host or port
net = specifies network
host = specifies host
port = specifies a port
proto = protocol ie tcp or udp

tcpdump command example

```
# tcpdump –nni eth0 –s0

# tcpdump –nni eth0 not port 22 –s0 –c 1000

# tcpdump –nni eth0 not port 22 and dst host 10.10.10.10
and not src net 10.20.30.0/24
```

-s0 = setting samples length to 0 means use the required length to catch whole packet

-c = no to packets

tcpdump pcaps

```
# tcpdump –nni eth0 -w capture.pcap –vv –c 1000

# tcpdump –nni eth0 –r capture.pcap and port 80
```

-w capture.pcap = save capture packet to capture.pcap

–vv = display number of packet captured

-r caputre.pcap = read capture file

-c = no to packets

tcpdump Output

```
IP 199.59.148.139.443 > 192.168.1.8.54343: Flags [P.],
seq 53:106, ack 1, win 67, options [nop,nop,TS val
854797891 ecr 376933204], length 53


IP 192.168.1.8.54343 > 199.59.148.139.443: Flags [.], ack
106, win 4092, options [nop,nop,TS val 376934736 ecr
854797891], length 0


IP 199.59.148.139.443 > 192.168.1.8.54343: Flags [P.],
seq 106:159, ack 1, win 67, options [nop,nop,TS val
854797891 ecr 376933204], length 53


IP 192.168.1.8.54343 > 199.59.148.139.443: Flags [.], ack
159, win 4091, options [nop,nop,TS val 376934736 ecr
854797891], length 0
```

What is Wireshark?

- Wireshark is a network packet/protocol analyzer.
  - A network packet analyzer will try to capture network packets and tries to display that packet data as detailed as possible.
- Wireshark is perhaps one of the best open source packet analyzers available today for **UNIX** and **Windows**.

About Wireshark

- Formerly known as “Ethereal”
  - Author, Gerald Combs quit Network Integration Services
  - Free
- Requirement
  - Need to install winpcap
  - Latest wireshark installer contains winpcap, don’t worry
  - (On Windows Vista) Need Administrator Privilege to capture
- GUI
  - Dramatically improved

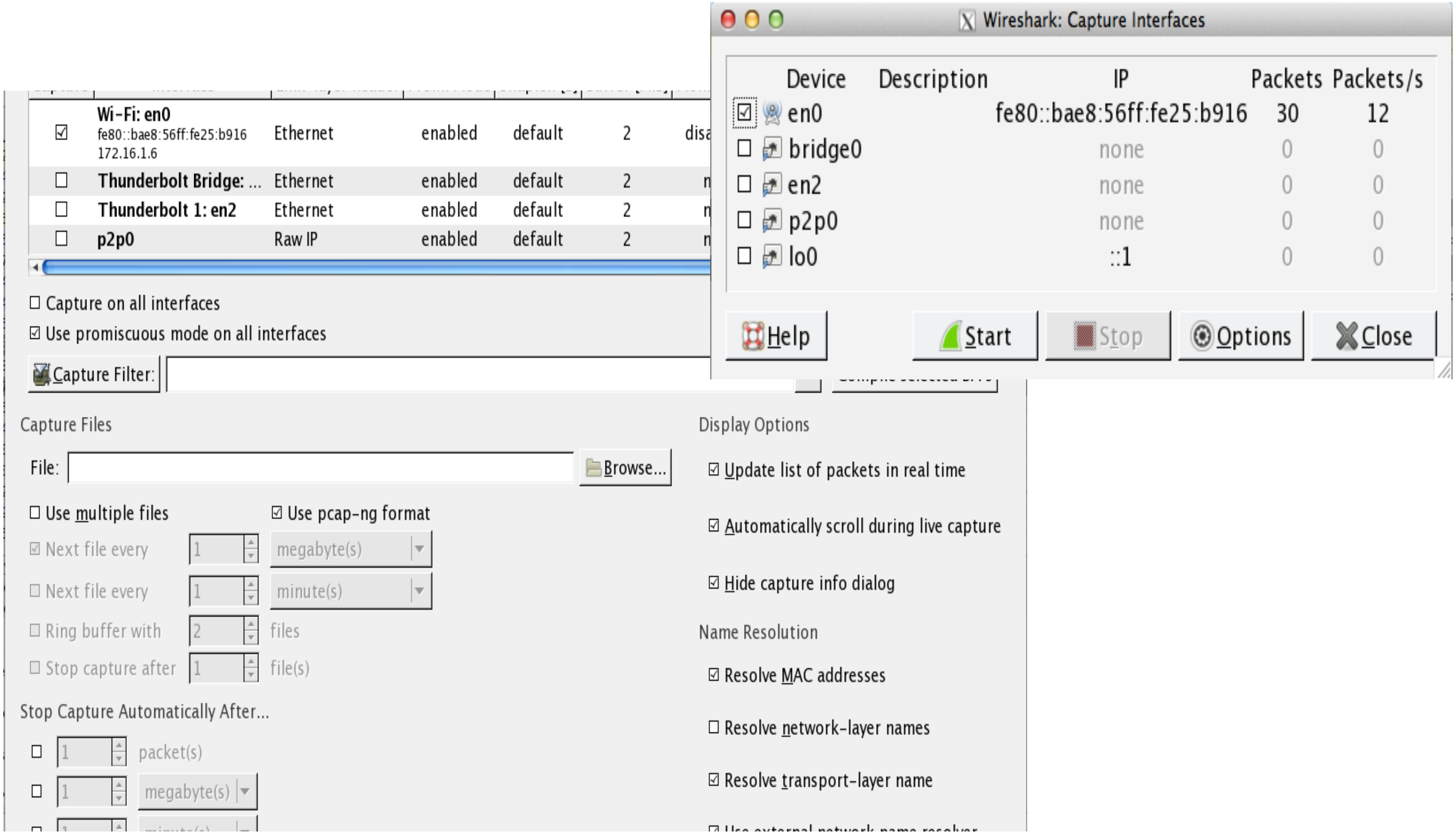
Why Wireshark

- network administrators use it to **troubleshoot network problems**
- network security engineers use it to **examine security problems**
- developers use it to **debug protocol implementations**
- people use it to **learn network protocol** internals
- Wireshark isn't an intrusion detection system.
- Wireshark will not manipulate things on the network, it will only "measure" things from it.

How to Install

- Very straight forward
- Just double-click and follow the instructions.

Capture



Wireshark: Capture Interfaces

	Device	Description	IP	Packets	Packets/s
☑	en0		fe80::bae8:56ff:fe25:b916	30	12
□	bridge0		none	0	0
□	en2		none	0	0
□	p2p0		none	0	0
□	lo0		::1	0	0

☑	Wi-Fi: en0 fe80::bae8:56ff:fe25:b916 172.16.1.6	Ethernet	enabled	default	2	disa
□	Thunderbolt Bridge: ...	Ethernet	enabled	default	2	n
□	Thunderbolt 1: en2	Ethernet	enabled	default	2	n
□	p2p0	Raw IP	enabled	default	2	n

□ Capture on all interfaces

☑ Use promiscuous mode on all interfaces

Capture Filter:

Capture Files

File: Browse...

□ Use multiple files

☑ Use pcap-ng format

☑ Next file every 1 megabyte(s)

□ Next file every 1 minute(s)

□ Ring buffer with 2 files

□ Stop capture after 1 file(s)

Stop Capture Automatically After...

□ 1 packet(s)

□ 1 megabyte(s)

Display Options

☑ Update list of packets in real time

☑ Automatically scroll during live capture

☑ Hide capture info dialog

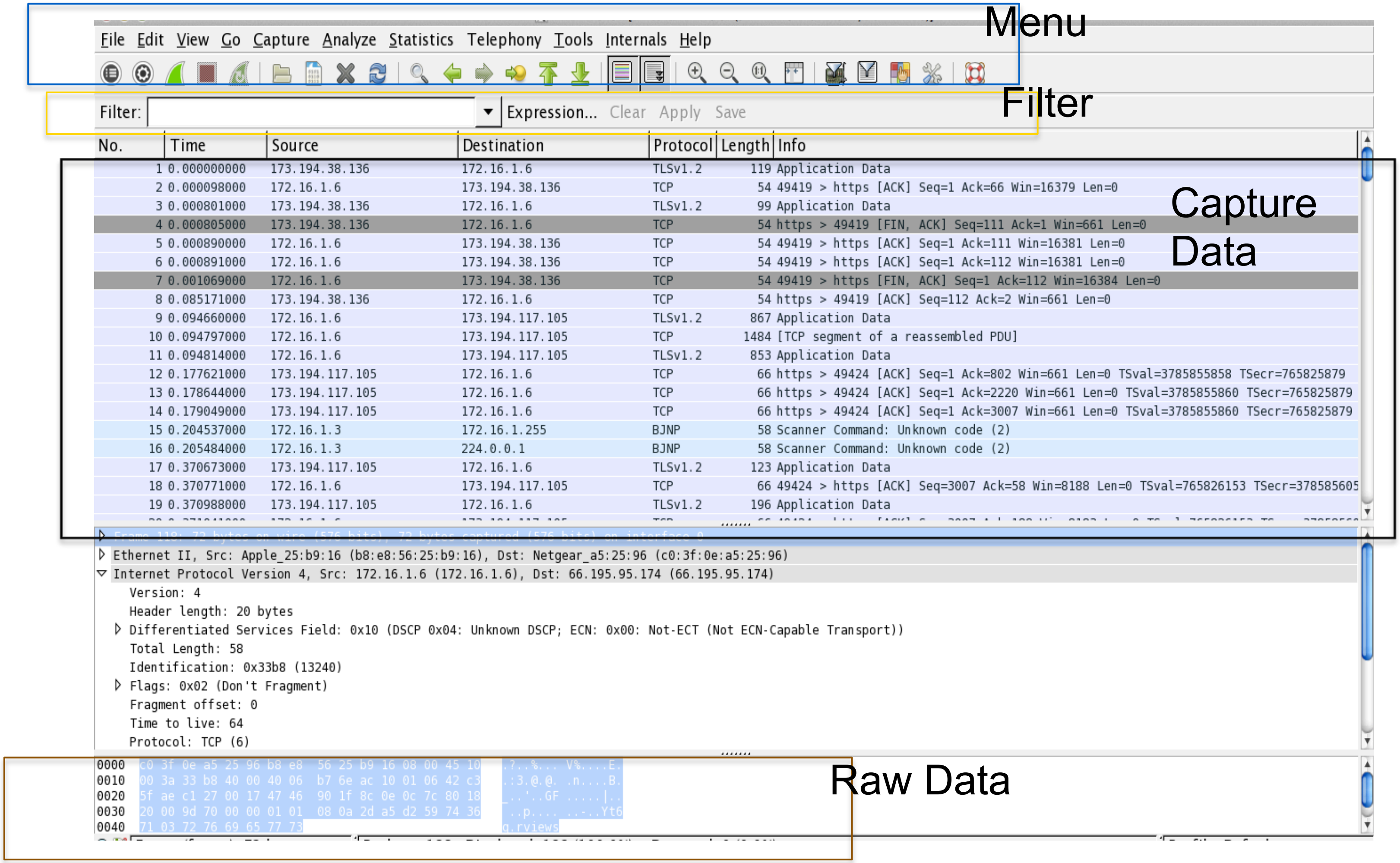
Name Resolution

☑ Resolve MAC addresses

□ Resolve network-layer names

☑ Resolve transport-layer name

Dashboard


Menu
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter
Filter:
Expression... Clear Apply Save
Capture Data
Raw Data

```
No.  Time         Source           Destination      Protocol Length Info
   1 0.000000000  173.194.38.136   172.16.1.6       TLSv1.2   119 Application Data
   2 0.000098000  172.16.1.6       173.194.38.136   TCP        54 49419 > https [ACK] Seq=1 Ack=66 Win=16379 Len=0
   3 0.000801000  173.194.38.136   172.16.1.6       TLSv1.2    99 Application Data
   4 0.000805000  173.194.38.136   172.16.1.6       TCP        54 https > 49419 [FIN, ACK] Seq=111 Ack=1 Win=661 Len=0
   5 0.000890000  172.16.1.6       173.194.38.136   TCP        54 49419 > https [ACK] Seq=1 Ack=111 Win=16381 Len=0
   6 0.000891000  172.16.1.6       173.194.38.136   TCP        54 49419 > https [ACK] Seq=1 Ack=112 Win=16381 Len=0
   7 0.001069000  172.16.1.6       173.194.38.136   TCP        54 49419 > https [FIN, ACK] Seq=1 Ack=112 Win=16384 Len=0
   8 0.085171000  173.194.38.136   172.16.1.6       TCP        54 https > 49419 [ACK] Seq=112 Ack=2 Win=661 Len=0
   9 0.094660000  172.16.1.6       173.194.117.105  TLSv1.2   867 Application Data
  10 0.094797000  172.16.1.6       173.194.117.105  TCP      1484 [TCP segment of a reassembled PDU]
  11 0.094814000  172.16.1.6       173.194.117.105  TLSv1.2   853 Application Data
  12 0.177621000  173.194.117.105  172.16.1.6       TCP        66 https > 49424 [ACK] Seq=1 Ack=802 Win=661 Len=0 TSval=3785855858 TSecr=765825879
  13 0.178644000  173.194.117.105  172.16.1.6       TCP        66 https > 49424 [ACK] Seq=1 Ack=2220 Win=661 Len=0 TSval=3785855860 TSecr=765825879
  14 0.179049000  173.194.117.105  172.16.1.6       TCP        66 https > 49424 [ACK] Seq=1 Ack=3007 Win=661 Len=0 TSval=3785855860 TSecr=765825879
  15 0.204537000  172.16.1.3       172.16.1.255     BJNP       58 Scanner Command: Unknown code (2)
  16 0.205484000  172.16.1.3       224.0.0.1        BJNP       58 Scanner Command: Unknown code (2)
  17 0.370673000  173.194.117.105  172.16.1.6       TLSv1.2   123 Application Data
  18 0.370771000  172.16.1.6       173.194.117.105  TCP        66 49424 > https [ACK] Seq=3007 Ack=58 Win=8188 Len=0 TSval=765826153 TSecr=378585605
  19 0.370988000  173.194.117.105  172.16.1.6       TLSv1.2   196 Application Data
```

```
▷ Frame 118: 72 bytes on wire (576 bits), 72 bytes captured (576 bits) on interface 0
▷ Ethernet II, Src: Apple_25:b9:16 (b8:e8:56:25:b9:16), Dst: Netgear_a5:25:96 (c0:3f:0e:a5:25:96)
▽ Internet Protocol Version 4, Src: 172.16.1.6 (172.16.1.6), Dst: 66.195.95.174 (66.195.95.174)
    Version: 4
    Header length: 20 bytes
  ▷ Differentiated Services Field: 0x10 (DSCP 0x04: Unknown DSCP; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
    Total Length: 58
    Identification: 0x33b8 (13240)
  ▷ Flags: 0x02 (Don't Fragment)
    Fragment offset: 0
    Time to live: 64
    Protocol: TCP (6)
```

```
0000  c0 3f 0e a5 25 96 b8 e8  56 25 b9 16 08 00 45 10   .?..%... V%....E.
0010  00 3a 33 b8 40 00 40 06  b7 6e ac 10 01 06 42 c3   .:3.@.@. .n....B.
0020  5f ae c1 27 00 17 47 46  90 1f 8c 0e 0c 7c 80 18   _..'..GF .....|..
0030  20 00 9d 70 00 00 01 01  08 0a 2d a5 d2 59 74 36    ..p.... ..-..Yt6
0040  71 03 72 76 69 65 77 73                            q.rviews
```

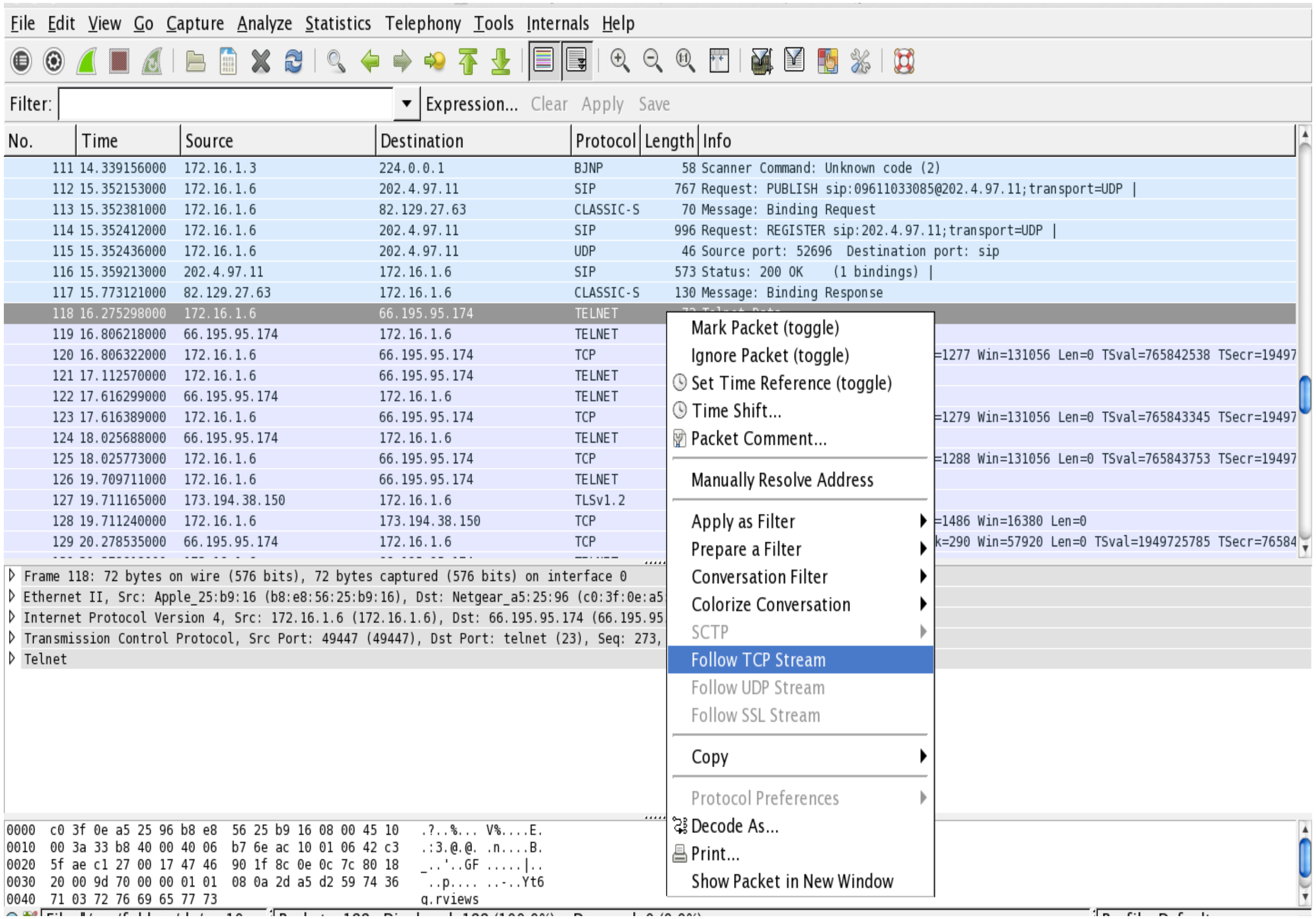
Filters

- Capture filter
  - Capture Traffic that match capture filter rule
  - save disk space
  - prevent packet loss
- Display filter
- Tweak appearance

Apply Filters

- ip.addr == 10.0.0.1 [Sets a filter for any packet with 10.0.0.1, as either the source or dest]
- ip.addr==10.0.0.1 && ip.addr==10.0.0.2 [sets a conversation filter between the two defined IP addresses]
- http or dns [sets a filter to display all http and dns]
- tcp.port==4000 [sets a filter for any TCP packet with 4000 as a source or dest port]
- tcp.flags.reset==1 [displays all TCP resets]
- http.request [displays all HTTP GET requests]
- tcp contains rviews [displays all TCP packets that contain the word ‘rviews’. Excellent when searching on a specific string or user ID]
- !(arp or icmp or dns) [masks out arp, icmp, dns, or whatever other protocols may be background noise. Allowing you to focus on the traffic of interest]

Follow TCP Stream



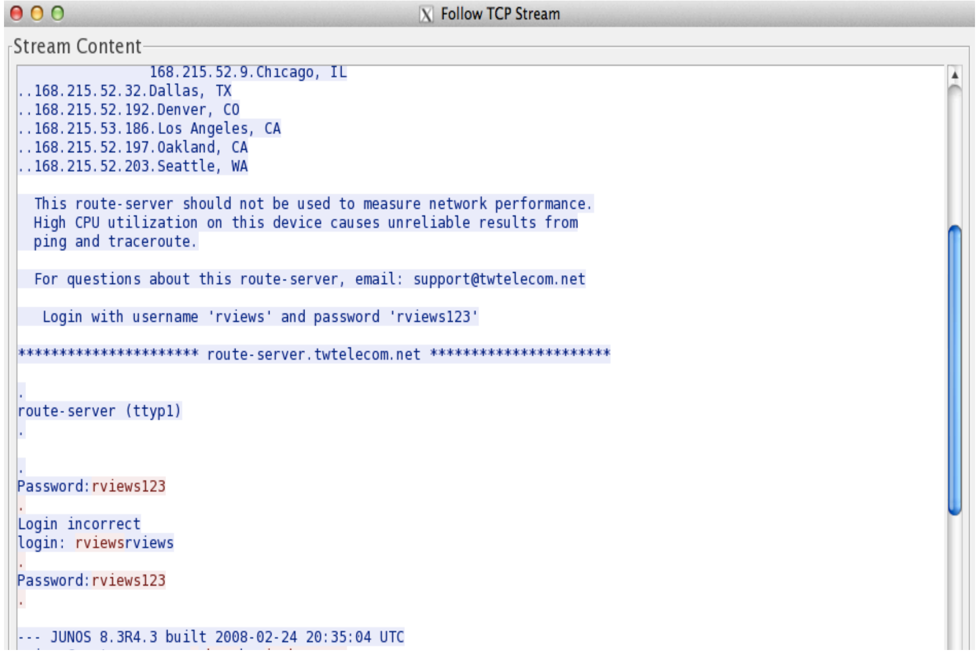
```
No.   Time          Source          Destination     Protocol  Length Info
  111 14.339156000  172.16.1.3      224.0.0.1       BJNP          58 Scanner Command: Unknown code (2)
  112 15.352153000  172.16.1.6      202.4.97.11     SIP          767 Request: PUBLISH sip:09611033085@202.4.97.11;transport=UDP |
  113 15.352381000  172.16.1.6      82.129.27.63    CLASSIC-S     70 Message: Binding Request
  114 15.352412000  172.16.1.6      202.4.97.11     SIP          996 Request: REGISTER sip:202.4.97.11;transport=UDP |
  115 15.352436000  172.16.1.6      202.4.97.11     UDP           46 Source port: 52696  Destination port: sip
  116 15.359213000  202.4.97.11     172.16.1.6      SIP          573 Status: 200 OK    (1 bindings) |
  117 15.773121000  82.129.27.63    172.16.1.6      CLASSIC-S    130 Message: Binding Response
  118 16.275298000  172.16.1.6      66.195.95.174   TELNET
  119 16.806218000  66.195.95.174   172.16.1.6      TELNET
  120 16.806322000  172.16.1.6      66.195.95.174   TCP                 =1277 Win=131056 Len=0 TSval=765842538 TSecr=19497
  121 17.112570000  172.16.1.6      66.195.95.174   TELNET
  122 17.616299000  66.195.95.174   172.16.1.6      TELNET
  123 17.616389000  172.16.1.6      66.195.95.174   TCP                 =1279 Win=131056 Len=0 TSval=765843345 TSecr=19497
  124 18.025688000  66.195.95.174   172.16.1.6      TELNET
  125 18.025773000  172.16.1.6      66.195.95.174   TCP                 =1288 Win=131056 Len=0 TSval=765843753 TSecr=19497
  126 19.709711000  172.16.1.6      66.195.95.174   TELNET
  127 19.711165000  173.194.38.150  172.16.1.6      TLSv1.2
  128 19.711240000  172.16.1.6      173.194.38.150  TCP                 =1486 Win=16380 Len=0
  129 20.278535000  66.195.95.174   172.16.1.6      TCP                 k=290 Win=57920 Len=0 TSval=1949725785 TSecr=76584
```

```
▷ Frame 118: 72 bytes on wire (576 bits), 72 bytes captured (576 bits) on interface 0
▷ Ethernet II, Src: Apple_25:b9:16 (b8:e8:56:25:b9:16), Dst: Netgear_a5:25:96 (c0:3f:0e:a5
▷ Internet Protocol Version 4, Src: 172.16.1.6 (172.16.1.6), Dst: 66.195.95.174 (66.195.95
▷ Transmission Control Protocol, Src Port: 49447 (49447), Dst Port: telnet (23), Seq: 273,
▷ Telnet
```

```
0000  c0 3f 0e a5 25 96 b8 e8  56 25 b9 16 08 00 45 10   .?..%... V%....E.
0010  00 3a 33 b8 40 00 40 06  b7 6e ac 10 01 06 42 c3   .:3.@.@. .n....B.
0020  5f ae c1 27 00 17 47 46  90 1f 8c 0e 0c 7c 80 18   _..'..GF .....|..
0030  20 00 9d 70 00 00 01 01  08 0a 2d a5 d2 59 74 36    ..p.... ..-..Yt6
0040  71 03 72 76 69 65 77 73                            q.rviews
```

Follow TCP Stream

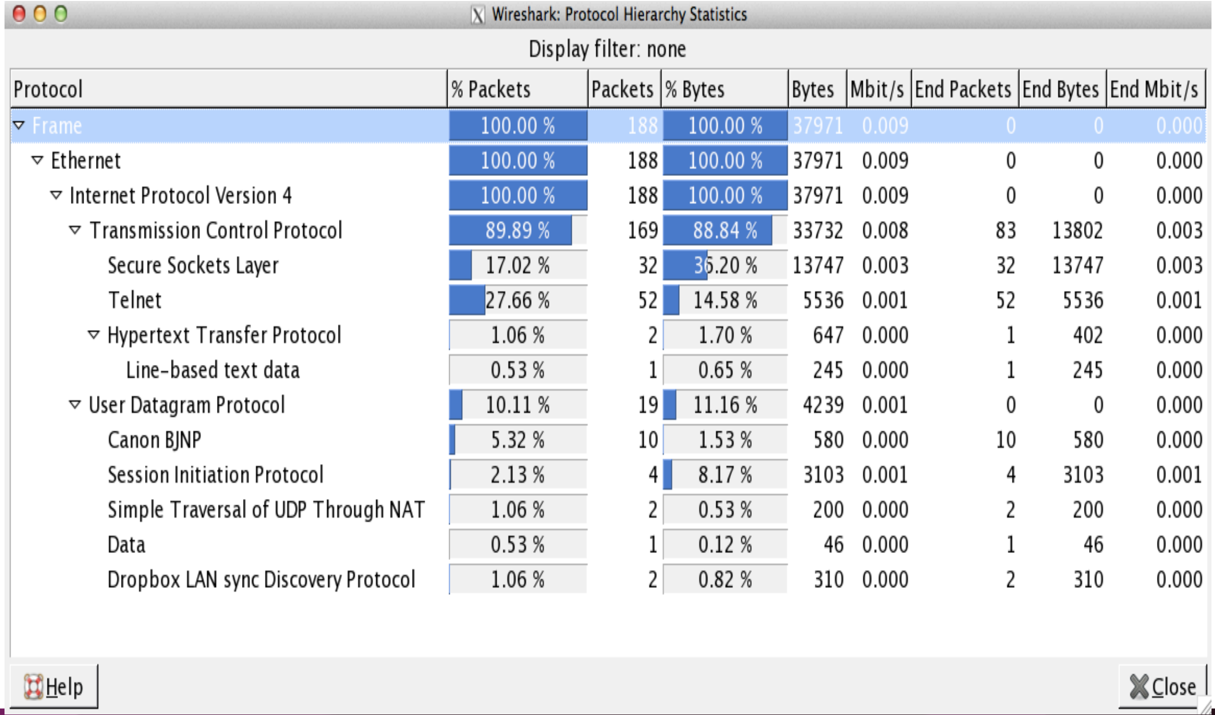
- Build TCP Stream
  - Select TCP Packet -> Follow TCP Stream



```
                168.215.52.9.Chicago, IL
..168.215.52.32.Dallas, TX
..168.215.52.192.Denver, CO
..168.215.53.186.Los Angeles, CA
..168.215.52.197.Oakland, CA
..168.215.52.203.Seattle, WA

  This route-server should not be used to measure network performance.
  High CPU utilization on this device causes unreliable results from
  ping and traceroute.

  For questions about this route-server, email: support@twtelecom.net

   Login with username 'rviews' and password 'rviews123'

********************** route-server.twtelecom.net **********************


.
route-server (ttyp1)
.


.
Password:rviews123
.
Login incorrect
login: rviewsrviews
.
Password:rviews123
.

--- JUNOS 8.3R4.3 built 2008-02-24 20:35:04 UTC
```

Use “Statistics”

- What protocol is used in your network
  - Statistics -> Protocol Hierarchy



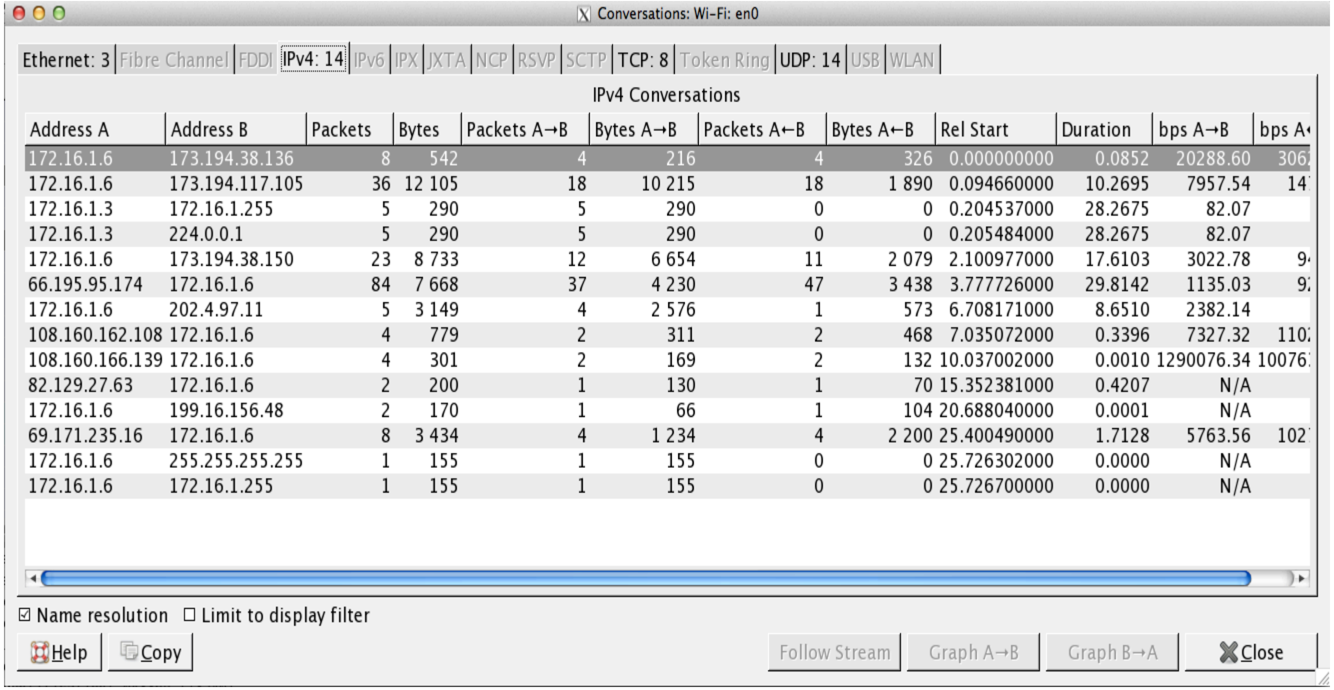
Wireshark: Protocol Hierarchy Statistics

Display filter: none

Protocol	% Packets	Packets	% Bytes	Bytes	Mbit/s	End Packets	End Bytes	End Mbit/s
▽ Frame	100.00 %	188	100.00 %	37971	0.009	0	0	0.000
▽ Ethernet	100.00 %	188	100.00 %	37971	0.009	0	0	0.000
▽ Internet Protocol Version 4	100.00 %	188	100.00 %	37971	0.009	0	0	0.000
▽ Transmission Control Protocol	89.89 %	169	88.84 %	33732	0.008	83	13802	0.003
Secure Sockets Layer	17.02 %	32	36.20 %	13747	0.003	32	13747	0.003
Telnet	27.66 %	52	14.58 %	5536	0.001	52	5536	0.001
▽ Hypertext Transfer Protocol	1.06 %	2	1.70 %	647	0.000	1	402	0.000
Line-based text data	0.53 %	1	0.65 %	245	0.000	1	245	0.000
▽ User Datagram Protocol	10.11 %	19	11.16 %	4239	0.001	0	0	0.000
Canon BJNP	5.32 %	10	1.53 %	580	0.000	10	580	0.000
Session Initiation Protocol	2.13 %	4	8.17 %	3103	0.001	4	3103	0.001
Simple Traversal of UDP Through NAT	1.06 %	2	0.53 %	200	0.000	2	200	0.000
Data	0.53 %	1	0.12 %	46	0.000	1	46	0.000
Dropbox LAN sync Discovery Protocol	1.06 %	2	0.82 %	310	0.000	2	310	0.000

Use “Statistics”

- Which host most chatty
  - Statistics -> Conversations



Conversations: Wi-Fi: en0
Ethernet: 3 | Fibre Channel | FDDI | IPv4: 14 | IPv6 | IPX | JXTA | NCP | RSVP | SCTP | TCP: 8 | Token Ring | UDP: 14 | USB | WLAN

IPv4 Conversations

Address A	Address B	Packets	Bytes	Packets A→B	Bytes A→B	Packets A←B	Bytes A←B	Rel Start	Duration	bps A→B	bps A←
172.16.1.6	173.194.38.136	8	542	4	216	4	326	0.000000000	0.0852	20288.60	306
172.16.1.6	173.194.117.105	36	12 105	18	10 215	18	1 890	0.094660000	10.2695	7957.54	14
172.16.1.3	172.16.1.255	5	290	5	290	0	0	0.204537000	28.2675	82.07	
172.16.1.3	224.0.0.1	5	290	5	290	0	0	0.205484000	28.2675	82.07	
172.16.1.6	173.194.38.150	23	8 733	12	6 654	11	2 079	2.100977000	17.6103	3022.78	9
66.195.95.174	172.16.1.6	84	7 668	37	4 230	47	3 438	3.777726000	29.8142	1135.03	9
172.16.1.6	202.4.97.11	5	3 149	4	2 576	1	573	6.708171000	8.6510	2382.14	
108.160.162.108	172.16.1.6	4	779	2	311	2	468	7.035072000	0.3396	7327.32	110
108.160.166.139	172.16.1.6	4	301	2	169	2	132	10.037002000	0.0010	1290076.34	10076
82.129.27.63	172.16.1.6	2	200	1	130	1	70	15.352381000	0.4207	N/A	
172.16.1.6	199.16.156.48	2	170	1	66	1	104	20.688040000	0.0001	N/A	
69.171.235.16	172.16.1.6	8	3 434	4	1 234	4	2 200	25.400490000	1.7128	5763.56	102
172.16.1.6	255.255.255.255	1	155	1	155	0	0	25.726302000	0.0000	N/A	
172.16.1.6	172.16.1.255	1	155	1	155	0	0	25.726700000	0.0000	N/A	

☑ Name resolution ☐ Limit to display filter

Need CLI?

- If you stick to character based interface, try tshark.exe
- C:\program files\wireshark\tshark.exe

Tcpdump & Wireshark

- tcpdump -i <interface> -s 65535 -w <some-file>

Exercise

- Install Wireshark into your PC
- Run wireshark and Capture inbound/outbound traffic
- Download capture files from
  - Follow the instructor's guide.

Exercise 1: Good Old Telnet

- File
  - telnet.pcap
- Question
  - Reconstruct the telnet session.
- Q1: Who logged into 192.168.0.1
  - Username ___________, Password ___________ .
- Q2: After logged in what did the user do?
  - Tip
  - telnet traffic is not secure

Exercise 2: Massive TCP SYN

- File
  - massivesyn1.pcap and massivesyn2.pcap
- Question
  - Point the difference with them.
- Q1: massivesyn1.pcap is a __________ attempt.
- Q2: massivesyn2.pcap is a __________ attempt.
- Tip
  - Pay attention to Src IP

Exercise 3: Chatty Employees

- File
  - chat.dmp
- Question
- Q1: What kind protocol is used? ________
- Q2: This is conversation between _____@hotmail.com and _______@hotmail.com
- Q3: What do they say about you(sysadmin)?
- Tip
  - Your chat can be monitored by network admin.

Exercise 4: Suspicious FTP activity

- File
  - ftp1.pcap
- Question
  - Q1: 10.121.70.151 is FTP ______ .
  - Q2: 10.234.125.254 is FTP ______ .
  - Q3: FTP Err Code 530 means __________ .
  - Q4: 10.234.125.254 attempt ________.
- Tip
  - How many login error occur within a minute?

Exercise 5: Unidentified Traffic

- File
  - Foobar.pcap
- Question
  - Q1: see what’s going on with wireshark gui
    - Statistics -> Conversation List -> TCP (*)
  - Q2: Which application use TCP/6346? Check the web.

Exercise 6: Covert channel

- File
  - covertinfo.pcap
- Question
  - Take a closer look! This is not a typical ICMP Echo/Reply…
  - Q1: What kind of tool do they use? Check the web.
  - Q2: Name other application which tunneling user traffic.

Exercise 7: Analyze Malware

- File
  - malware.pcap
- Questions:
  - Q1: Find the bad HTTP traffic
  - Q2: Is there any malware in the HTTP traffic?
  - Q3: Upload one sample malware to https://www.virustotal.com/
    - Does all antivirus detect the malware?
- Tips
  - Filter with **`http contains "in DOS mode”`**
  - Export all the files

Exercise 8: SIP

- File
  - sip_chat.pcap
- Questions:
  - Q1: Can we listen to SIP voice?
  - Q2: How!!

LAB