Advanced Wireshark Tips and Tricks

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  - Network Engineering team, BC/BS of Alabama

Advanced Wireshark Tips and Tricks

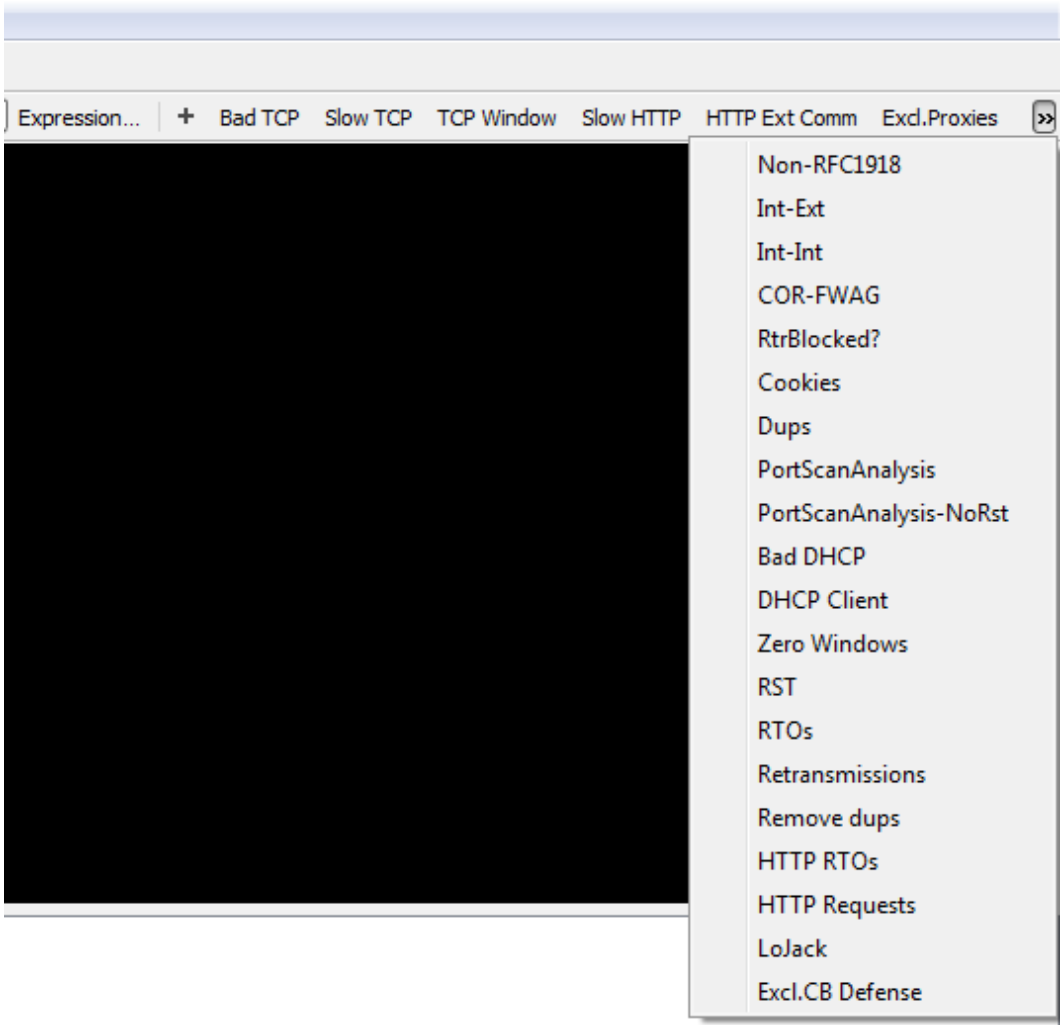
- Topics:
  - Local SSL Decryption
  - Custom column headers
  - Advanced filters
  - Tracking down Application Delay issues and root causes
    - Graphically displaying server response times
  - MAC Address Resolution
    - Know exactly what leg of your network (and even src/dst interfaces) each packet is sourced from
    - Instead of this:

Address
a8:9d:21:68:60:00,7c:0e:ce:03:20:c0

    - you'll see something like this:

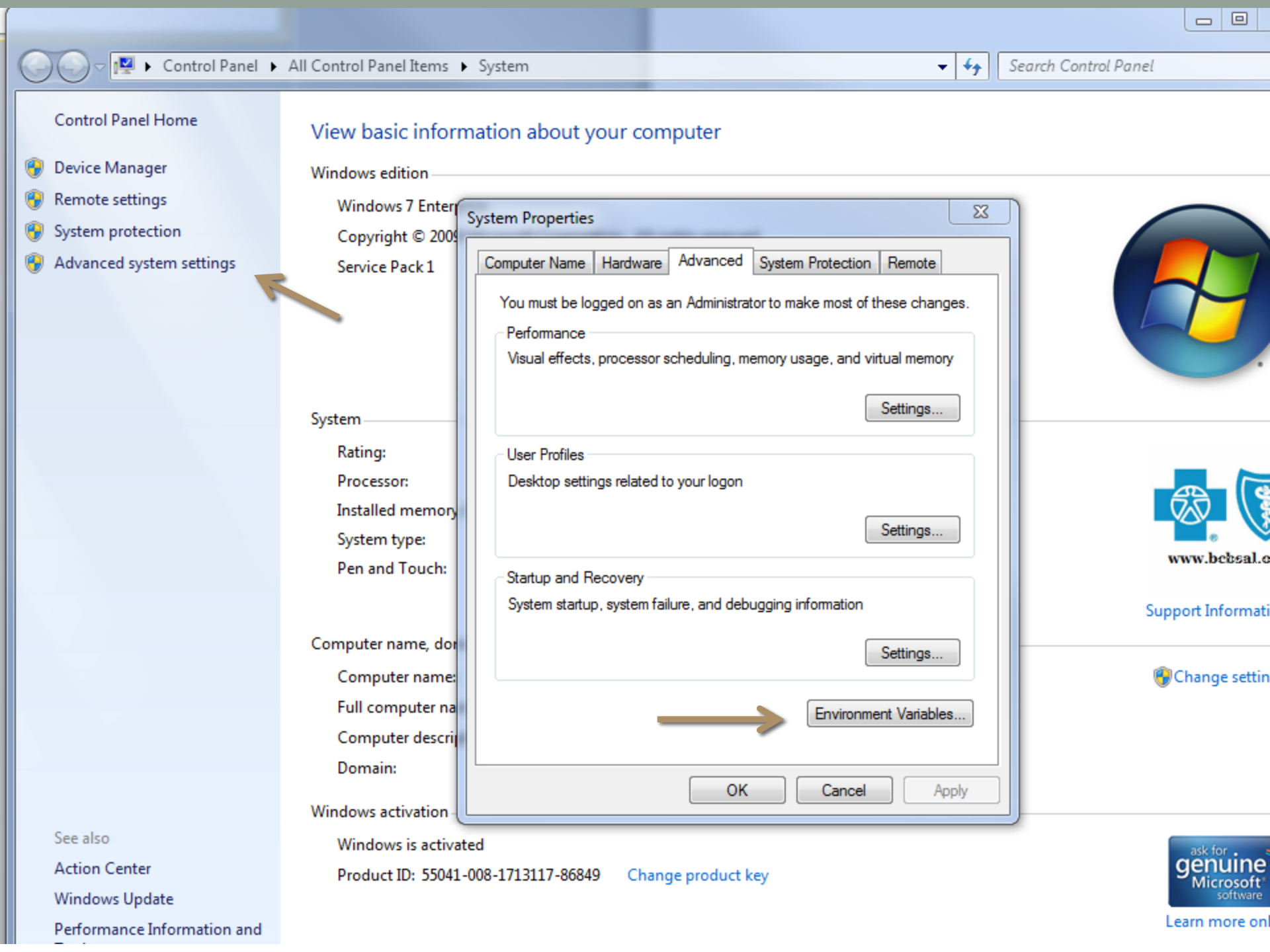
Source MAC	Destination MAC
bx-rivc-cr-g45-rt-cor12_Te1/1	bx-rivc-cr-d54-rt-cd36_Te1/1

Advanced Wireshark Tips and Tricks



Local SSL Decryption

- Useful for debugging applications that run over SSL (HTTP, SMTP, POP3, IMAP, FTP, etc).
- Learning about SSL. What better way to understand something than to take it apart and put it back together again?
  - Haven’t you ever wondered what all your browser extensions are sending home?


Control Panel ▸ All Control Panel Items ▸ System
Search Control Panel
Control Panel Home
Device Manager
Remote settings
System protection
Advanced system settings
View basic information about your computer
Windows edition
Windows 7 Enter
Copyright © 200
Service Pack 1
System
Rating:
Processor:
Installed memory
System type:
Pen and Touch:
Computer name, do
Computer name:
Full computer na
Computer descri
Domain:
Windows activation
Windows is activated
Product ID: 55041-008-1713117-86849
Change product key
See also
Action Center
Windows Update
Performance Information and
System Properties
Computer Name
Hardware
Advanced
System Protection
Remote
You must be logged on as an Administrator to make most of these changes.
Performance
Visual effects, processor scheduling, memory usage, and virtual memory
Settings...
User Profiles
Desktop settings related to your logon
Settings...
Startup and Recovery
System startup, system failure, and debugging information
Settings...
Environment Variables...
OK
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Apply
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Support Informati
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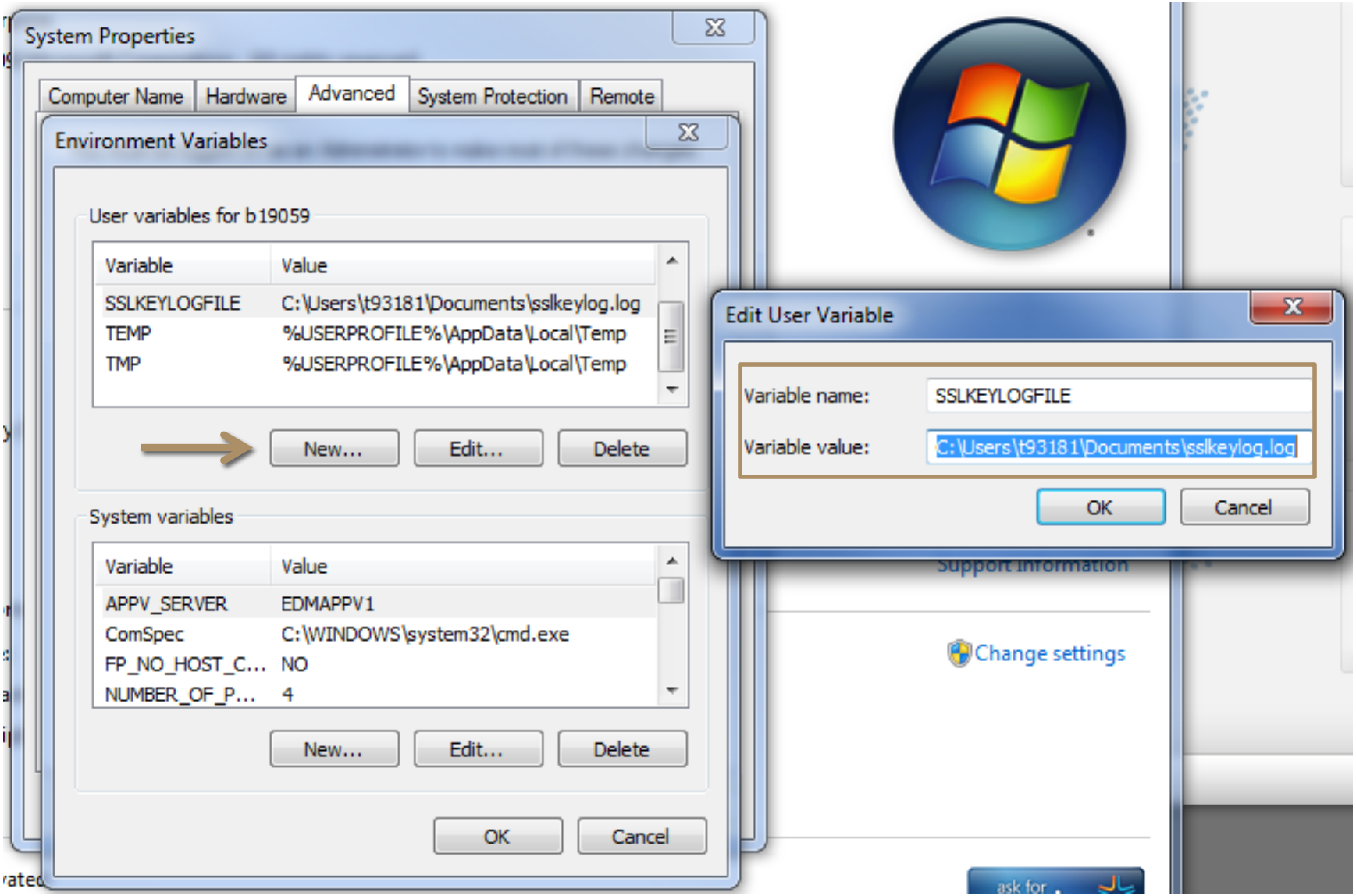
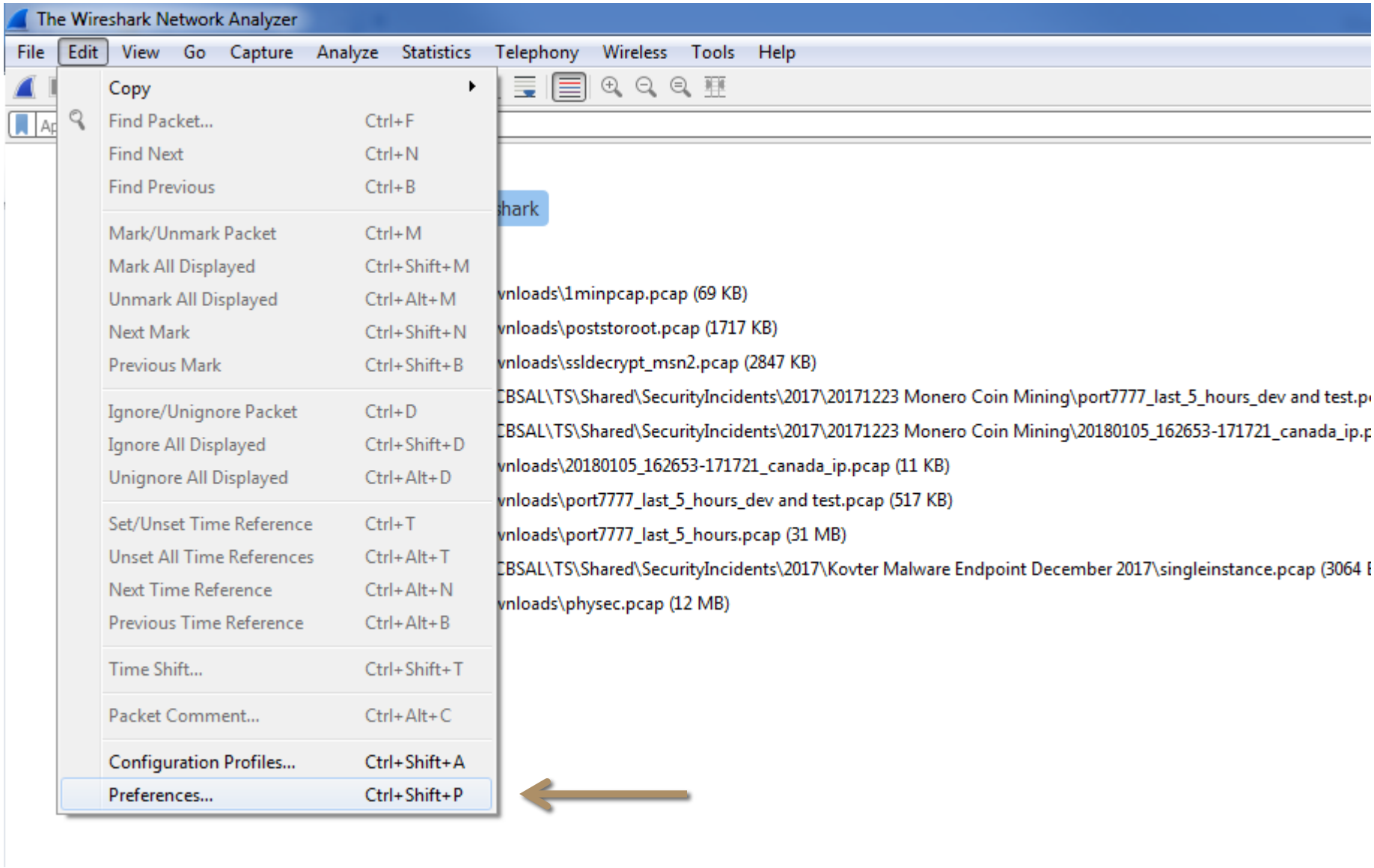
Learn more onl


System Properties
Computer Name
Hardware
Advanced
System Protection
Remote
Environment Variables
User variables for b19059
Variable
Value
SSLKEYLOGFILE
C:\Users\t93181\Documents\sslkeylog.log
TEMP
%USERPROFILE%\AppData\Local\Temp
TMP
%USERPROFILE%\AppData\Local\Temp
New...
Edit...
Delete
System variables
Variable
Value
APPV_SERVER
EDMAPPV1
ComSpec
C:\WINDOWS\system32\cmd.exe
FP_NO_HOST_C...
NO
NUMBER_OF_P...
4
New...
Edit...
Delete
OK
Cancel
Edit User Variable
Variable name:
SSLKEYLOGFILE
Variable value:
C:\Users\t93181\Documents\sslkeylog.log
OK
Cancel
Support Information
Change settings

Sample of SSLKEYLOGFILE

```
1  CLIENT_RANDOM 20e9087ed53a3f43ceb066982ef12b8d8f684db3492824aee777b41ef917b263
   8fcd43e8bf8e72ba2f06d30de185f7c0d2d9354bb6cf6dc4645ec638a0637e258187e179e2219a60c95efc6a1f207b01
2  CLIENT_RANDOM 61d1a5b96364592e4cd6b44ec712280a9d9f565c7b99f2237edd5f5853f44b18
   9af68e8fd550db589e5207fdf242fb4a0247242161eb46eae689e4203eb1fb339246d13322971a33fc3499b2669a8649
3  CLIENT_RANDOM 744c3e16b2f313b4bc3f48b5bd5da8ffbf0c489e3828169c3d891ac21f47382f
   8107987a95537a21c08854bcfa95c70217056a78cecaad09bc390d2f3689056eaecc74a10a2114c6bcdb523fa9e57866
4  CLIENT_RANDOM 7f07adb94bd7474565fd8d522102884a906eab62a276f3ca6f0576d441c08d73
   6afbdb8f8f4572a9ba2952b9b98c9aa9f43cd1f7ef8cada2193be9cc0db5cc332eddf4eed1fab6c3ae742ce6cf58ee9c
5  CLIENT_RANDOM 0c85fff6023fd3cd9f5cf9411fce39b50d1a82121a6b6013ec80b071b76ad76d
   ba6e15e8fb76b85db833462466560aca5615d8ac9065b6b58c9a9776fd0b2a9afab11c92fe35e247a834c6685801c9c4
6  CLIENT_RANDOM fc4c078e24d117a9a385bcf9cd3bf1a020fe2ec16f8437f050f647b6aba813ea
   19dda96cbc69af66b274e3f35996f8b8202bba3c2162e7661d3629ba14fc14b295c56937bfa2e8f34e695b7e5d13b572
7  CLIENT_RANDOM f384298938d11203c63b57b81b3ce40bec747420a1a8e806e288132c87ab7d72
   f56c0cd978c84ab52dd1abd1d1bc08a1c5b087d91b9b62d23f14fd2c9a54f7f585cc5efa79a0e6016e559e3d1816efb1
8  CLIENT_RANDOM 4a22976c20e96985e30fcfed689689cde5b8fd6614a8129ed960db8b161c0eee
   01b755494d5968d7df21a0dd414330e3bba7288758d6e1a15a6232807de2e33bf4902783f032ddbc4a3756b8c9af64b4
9  CLIENT_RANDOM 637ca76852d0abcd07878457ea40d4d6b5d3b582cc1014a36b4e0e9c3096a112
   94912e8414b013ec2258b2149ad9faf88795fbe2c70f4ba1864e0c929b242012e7edef060859a2b8b2d0aa13860e5828
10 CLIENT_RANDOM cd53d416e196d3e614079b5814ee9016ba27b7620d8a43e95a475ecd4f61eb5d
   f1234b14acd510dfe52d372f7810381bedf3fa7cfaa7fdf3efc94e9eee1c74901db3c19551cf108c173b57757725fda1
11 CLIENT_RANDOM fede8e8011ae6649b95be639221c811937f0c3f75736740363f5e6e8eb9c59cd
   1ad318c98d2fe633453f1841429d80c1e189cdbbf33304e43af182e4554678d8617f690b555ab731121d745d48240250
12 CLIENT_RANDOM 3a79b55ca2ff09893695bafd234b435af0ad5027f884ecf293b87e804282ef90
   1ad318c98d2fe633453f1841429d80c1e189cdbbf33304e43af182e4554678d8617f690b555ab731121d745d48240250
13 CLIENT_RANDOM d768cf502aa03fe351a16675d5b988150e53496569a5c81c1eeab62eac33dd9c
   c253890505623cea25274dbb537e449751c8bb06bc03e318183823946157796c5436e862a58765999653a525637fc014
14 CLIENT_RANDOM f1c4c03de992b98f7e06a14ef5665d94047f1922c8e56c95e1b1384e4969e906
   94912e8414b013ec2258b2149ad9faf88795fbe2c70f4ba1864e0c929b242012e7edef060859a2b8b2d0aa13860e5828
15 CLIENT_RANDOM 78a296a5daf7eb385222edde61fe5da9ba00c99ea8f28f87df562b767c62a57f
   d0bb014a6eadbe562667b8af726976f6dd721f4f808d60169af5b1ac23c121c0c181d9b363b6488bd9c30eeacc4dade4
16 CLIENT_RANDOM 7ad4b2714a8266729b44a2f3d594d232a46d81aaf7d5d99b06ae043eabf11a31
   92514b2c70a1177e77bc9851af91576296e65eecb9ce255c84a031aee8e56f5a593f0b63ad8709b9a4cbb1f05ff30731
17 CLIENT_RANDOM 372f3a32a6dec0e2bfbc09a64c25c91b93bc7e7493e4013e8633c14a6a390fb1
```


The Wireshark Network Analyzer
File
Edit
View
Go
Capture
Analyze
Statistics
Telephony
Wireless
Tools
Help
Copy
Find Packet... Ctrl+F
Find Next Ctrl+N
Find Previous Ctrl+B
Mark/Unmark Packet Ctrl+M
Mark All Displayed Ctrl+Shift+M
Unmark All Displayed Ctrl+Alt+M
Next Mark Ctrl+Shift+N
Previous Mark Ctrl+Shift+B
Ignore/Unignore Packet Ctrl+D
Ignore All Displayed Ctrl+Shift+D
Unignore All Displayed Ctrl+Alt+D
Set/Unset Time Reference Ctrl+T
Unset All Time References Ctrl+Alt+T
Next Time Reference Ctrl+Alt+N
Previous Time Reference Ctrl+Alt+B
Time Shift... Ctrl+Shift+T
Packet Comment... Ctrl+Alt+C
Configuration Profiles... Ctrl+Shift+A
Preferences... Ctrl+Shift+P
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vnloads\ssldecrypt_msn2.pcap (2847 KB)
vnloads\20180105_162653-171721_canada_ip.pcap (11 KB)
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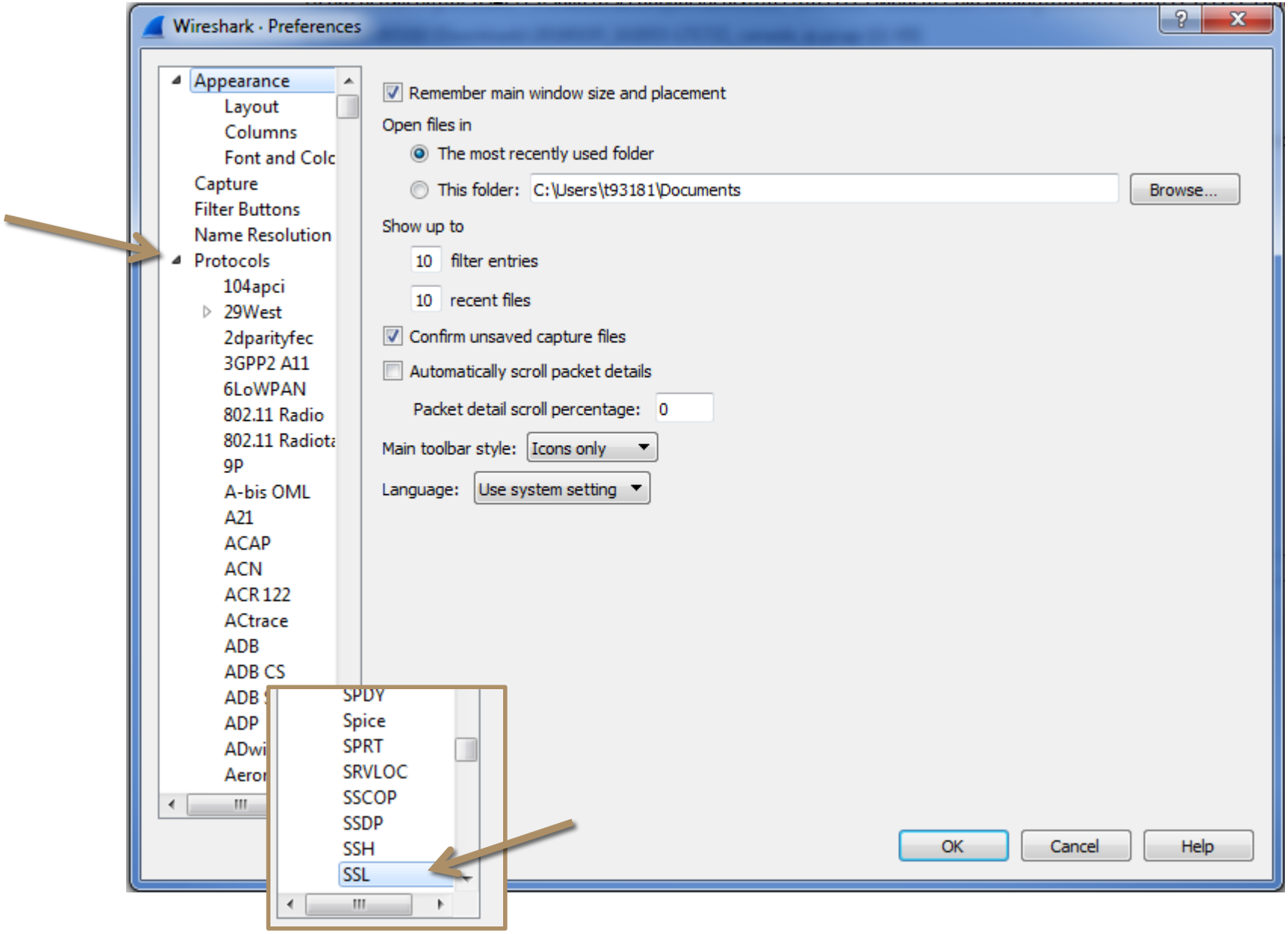
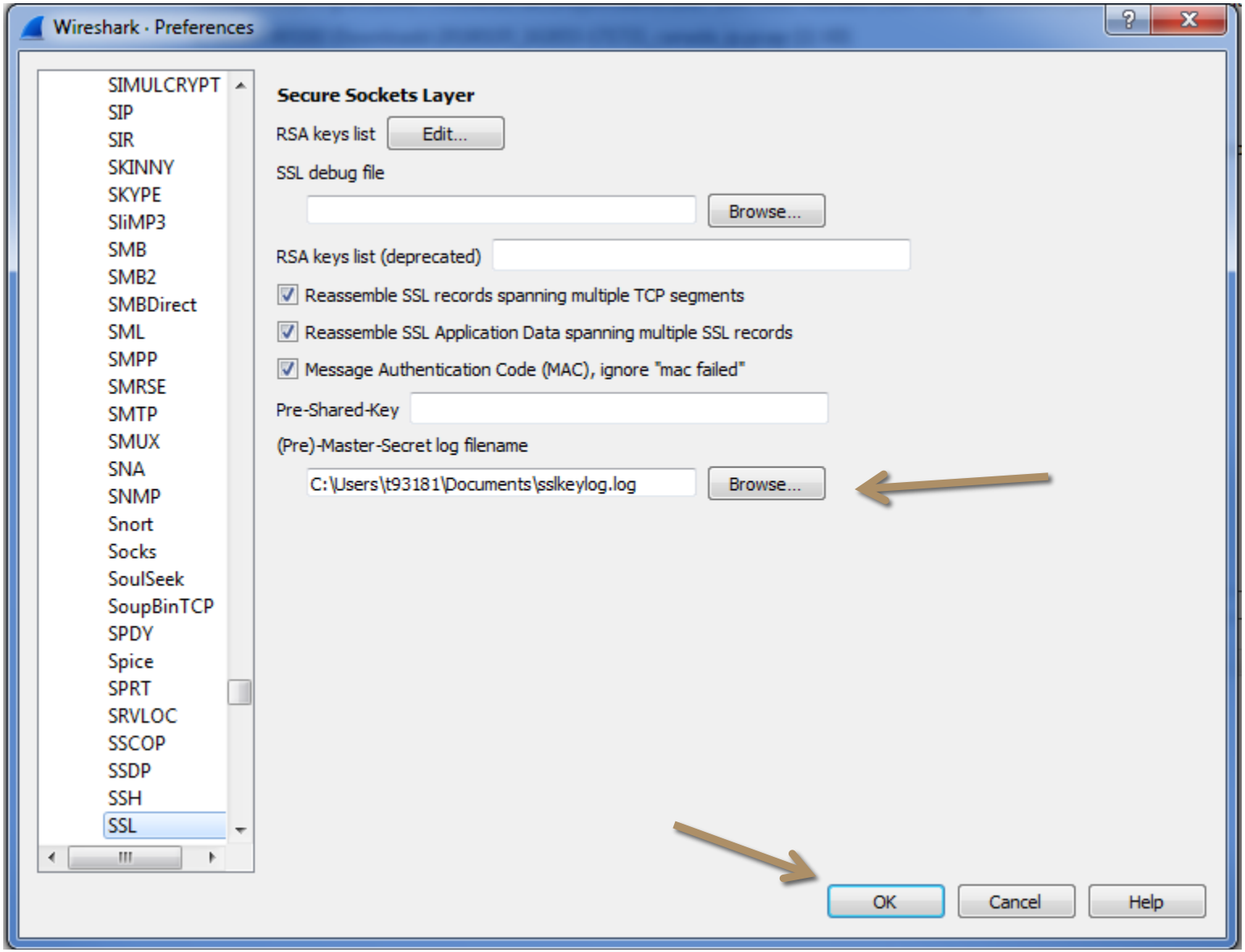

Wireshark · Preferences
Appearance
Layout
Columns
Font and Colc
Capture
Filter Buttons
Name Resolution
Protocols
104apci
29West
2dparityfec
3GPP2 A11
6LoWPAN
802.11 Radio
802.11 Radiota
9P
A-bis OML
A21
ACAP
ACN
ACR 122
ACtrace
ADB
ADB CS
ADB
ADP
ADwi
Aeror
SPDY
Spice
SPRT
SRVLOC
SSCOP
SSDP
SSH
SSL
Remember main window size and placement
Open files in
The most recently used folder
This folder: C:\Users\t93181\Documents
Browse...
Show up to
10 filter entries
10 recent files
Confirm unsaved capture files
Automatically scroll packet details
Packet detail scroll percentage: 0
Main toolbar style: Icons only
Language: Use system setting
OK
Cancel
Help


Wireshark · Preferences
SIMULCRYPT
SIP
SIR
SKINNY
SKYPE
SliMP3
SMB
SMB2
SMBDirect
SML
SMPP
SMRSE
SMTP
SMUX
SNA
SNMP
Snort
Socks
SoulSeek
SoupBinTCP
SPDY
Spice
SPRT
SRVLOC
SSCOP
SSDP
SSH
SSL
Secure Sockets Layer
RSA keys list
Edit...
SSL debug file
Browse...
RSA keys list (deprecated)
Reassemble SSL records spanning multiple TCP segments
Reassemble SSL Application Data spanning multiple SSL records
Message Authentication Code (MAC), ignore "mac failed"
Pre-Shared-Key
(Pre)-Master-Secret log filename
C:\Users\t93181\Documents\sslkeylog.log
Browse...
OK
Cancel
Help

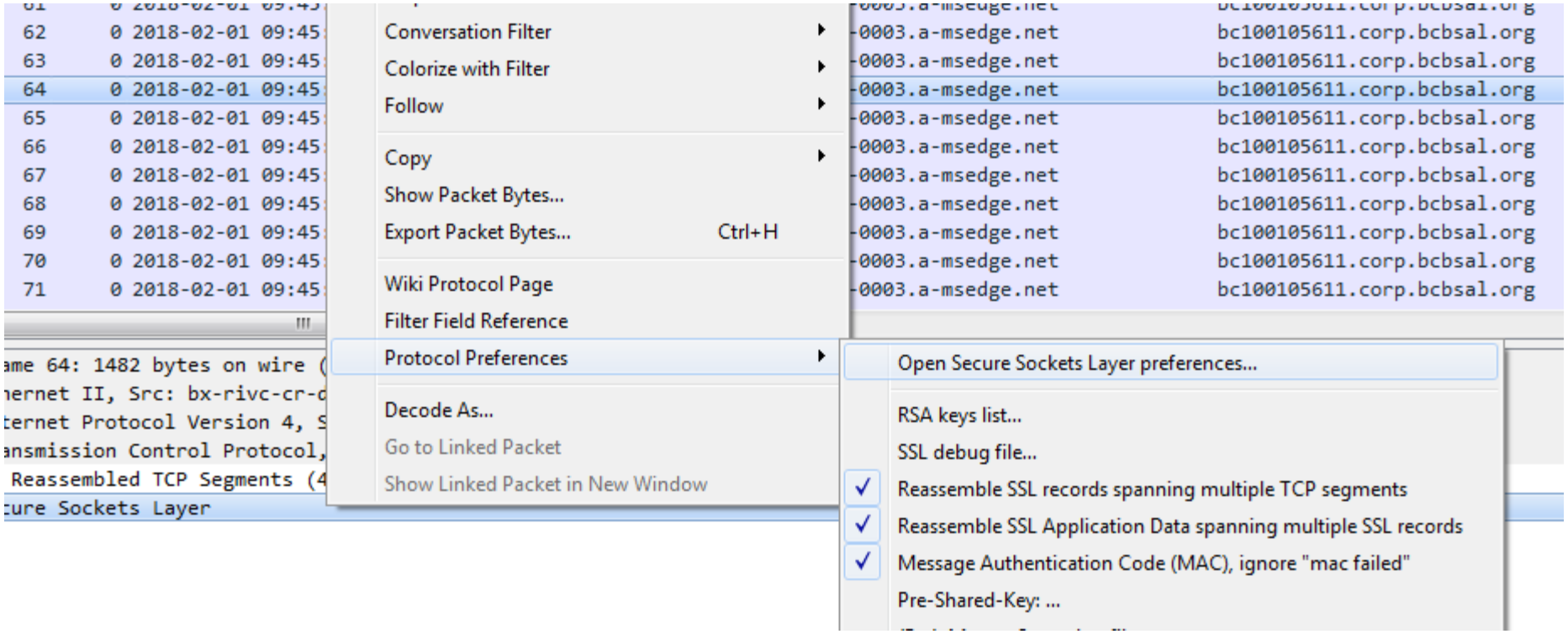
Next steps

- Open Chrome or IE. Sorry, this doesn't work in Firefox.
- Start capturing data in Wireshark.
  - Capture filters samples: https://wiki.wireshark.org/CaptureFilters
- Browse to a webpage then immediately stop the capture.
- Internal-External filter
  - ((ip.src==10.0.0.0/8 && !ip.dst==10.0.0.0/8 && !ip.dst==224.0.0.0/8 && !ip.dst==255.255.255.255/32) or (!ip.src==10.0.0.0/8 && !ip.src==224.0.0.0/8 && !ip.src==255.255.255.255/32 && ip.dst==10.0.0.0/8)) && !tcp.analysis.flags

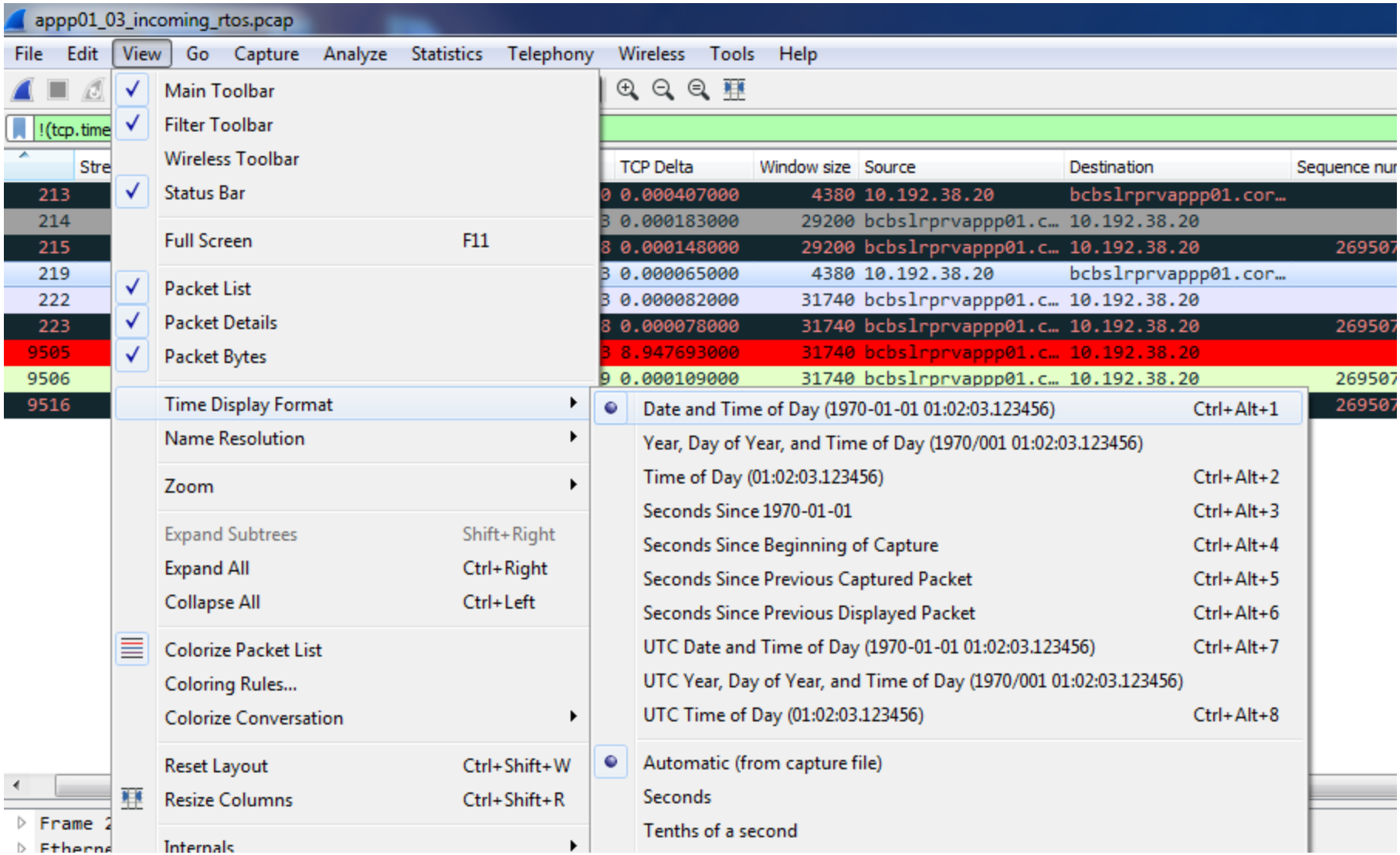
  - This filter blocks multicast traffic, broadcast traffic, TCP analysis packets, and any RFC1918 private IPs in the 10.0.0.0 Class A network from talking to other IPs in the same private network.
  - If you use 192.168.0.0/16 or 172.16.0.0/12 instead, just replace 10.0.0.0/8 in the filter.

Next steps

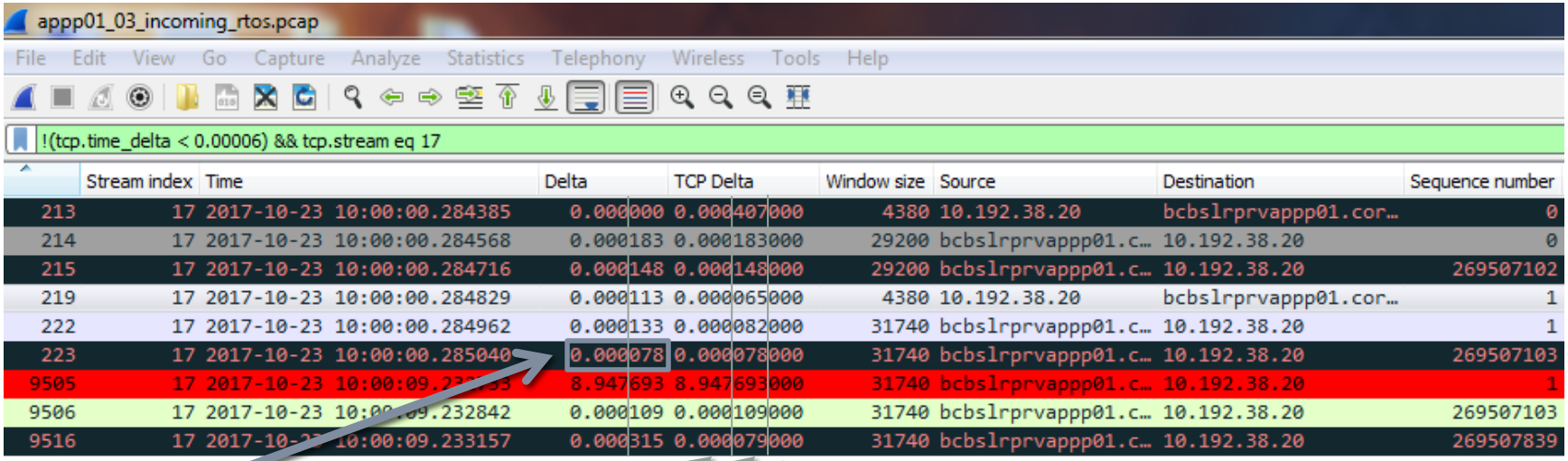
- Ensure the following SSL reassembly settings are enabled:



Configuring time display format



Communicating Timestamps




```
0.000078  seconds =
   0.078     milliseconds
      78     microseconds
   78000     nanoseconds
```

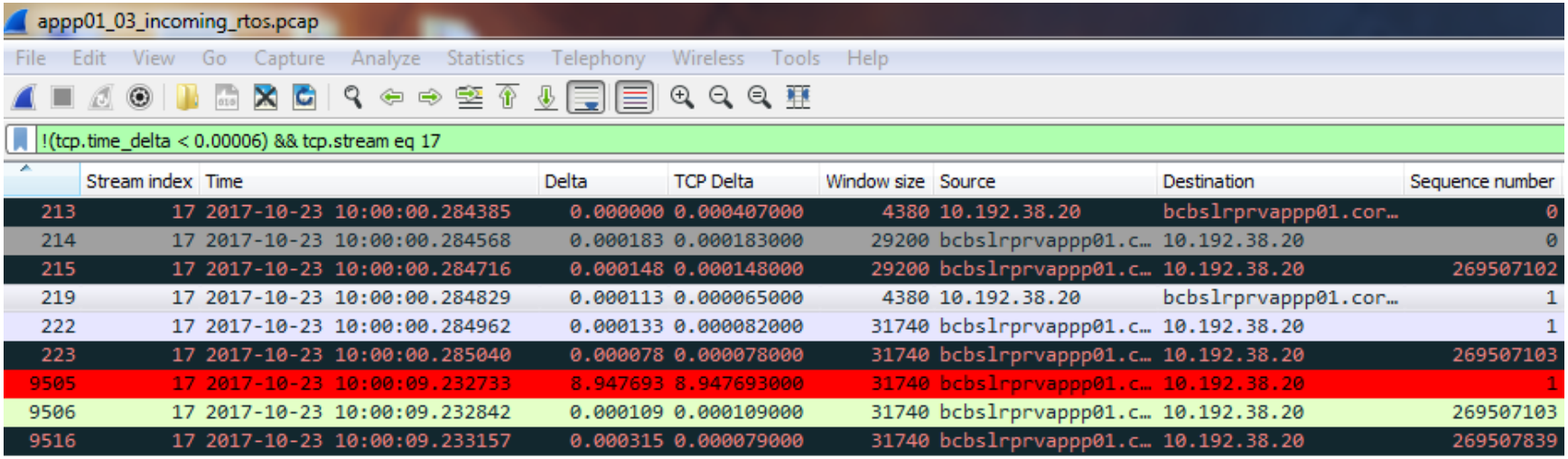
TCP Deltas

tcp.stream eq 17

No.	Stream index	Time	Delta	TCP Delta	Window size	Source	Destination
212	17	2017-10-23 10:00:00.283978	0.000000	0.000000000	4380	10.192.38.20	bcbslrprvappp01.cor…
213	17	2017-10-23 10:00:00.284385	0.000407	0.000407000	4380	10.192.38.20	bcbslrprvappp01.cor…
214	17	2017-10-23 10:00:00.284568	0.000183	0.000183000	29200	bcbslrprvappp01.c…	10.192.38.20
215	17	2017-10-23 10:00:00.284716	0.000148	0.000148000	29200	bcbslrprvappp01.c…	10.192.38.20
216	17	2017-10-23 10:00:00.284734	0.000018	0.000018000	4380	10.192.38.20	bcbslrprvappp01.cor…
217	17	2017-10-23 10:00:00.284763	0.000029	0.000029000	4380	10.192.38.20	bcbslrprvappp01.cor…
218	17	2017-10-23 10:00:00.284764	0.000001	0.000001000	4380	10.192.38.20	bcbslrprvappp01.cor…
219	17	2017-10-23 10:00:00.284829	0.000065	0.000065000	4380	10.192.38.20	bcbslrprvappp01.cor…
220	17	2017-10-23 10:00:00.284879	0.000050	0.000050000	4380	10.192.38.20	bcbslrprvappp01.cor…
221	17	2017-10-23 10:00:00.284880	0.000001	0.000001000	4380	10.192.38.20	bcbslrprvappp01.cor…
222	17	2017-10-23 10:00:00.284962	0.000082	0.000082000	31740	bcbslrprvappp01.c…	10.192.38.20
223	17	2017-10-23 10:00:00.285040	0.000078	0.000078000	31740	bcbslrprvappp01.c…	10.192.38.20
9505	17	2017-10-23 10:00:09.232733	8.947693	8.947693000	31740	bcbslrprvappp01.c…	10.192.38.20
9506	17	2017-10-23 10:00:09.232842	0.000109	0.000109000	31740	bcbslrprvappp01.c…	10.192.38.20
9507	17	2017-10-23 10:00:09.232858	0.000016	0.000016000	31740	bcbslrprvappp01.c…	10.192.38.20
9508	17	2017-10-23 10:00:09.232905	0.000047	0.000047000	5115	10.192.38.20	bcbslrprvappp01.cor…
9509	17	2017-10-23 10:00:09.232906	0.000001	0.000001000	5115	10.192.38.20	bcbslrprvappp01.cor…
9510	17	2017-10-23 10:00:09.232932	0.000026	0.000026000	31740	bcbslrprvappp01.c…	10.192.38.20
9511	17	2017-10-23 10:00:09.232985	0.000053	0.000053000	5115	10.192.38.20	bcbslrprvappp01.cor…
9512	17	2017-10-23 10:00:09.232998	0.000013	0.000013000	5115	10.192.38.20	bcbslrprvappp01.cor…
9513	17	2017-10-23 10:00:09.233006	0.000008	0.000008000	5115	10.192.38.20	bcbslrprvappp01.cor…
9514	17	2017-10-23 10:00:09.233046	0.000040	0.000040000	5115	10.192.38.20	bcbslrprvappp01.cor…

- Delta column = time difference between two consecutive packets in a capture.
- TCP Delta column = time difference between two consecutive packets **in the same TCP stream.**

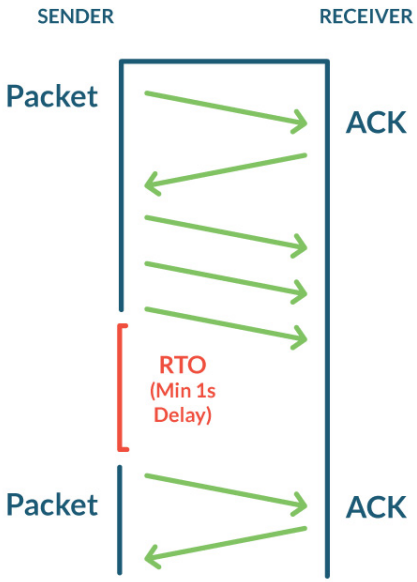
TCP Deltas



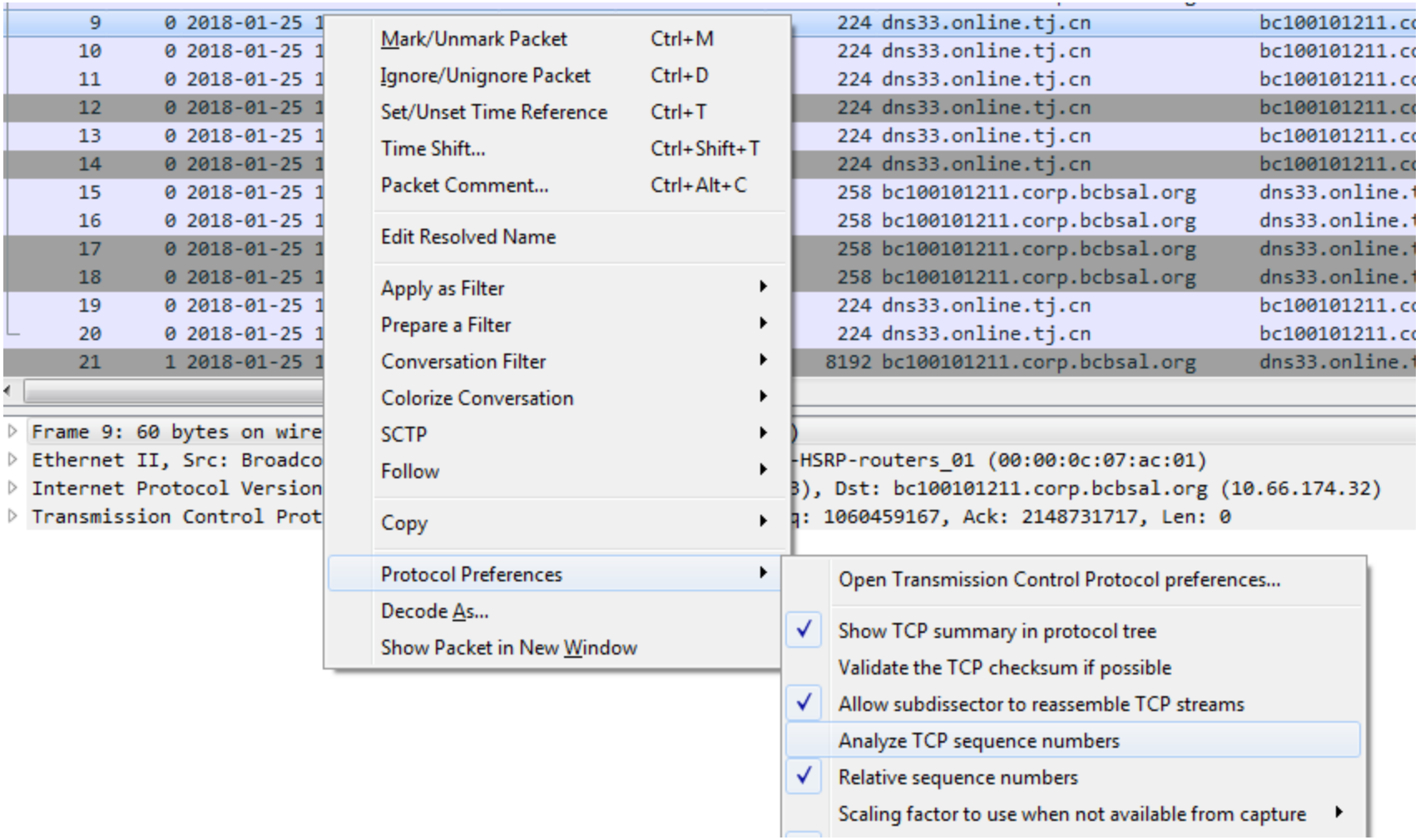
	Stream index	Time	Delta	TCP Delta	Window size	Source	Destination	Sequence number
213	17	2017-10-23 10:00:00.284385	0.000000	0.000407000	4380	10.192.38.20	bcbslrprvappp01.cor…	0
214	17	2017-10-23 10:00:00.284568	0.000183	0.000183000	29200	bcbslrprvappp01.c…	10.192.38.20	0
215	17	2017-10-23 10:00:00.284716	0.000148	0.000148000	29200	bcbslrprvappp01.c…	10.192.38.20	269507102
219	17	2017-10-23 10:00:00.284829	0.000113	0.000065000	4380	10.192.38.20	bcbslrprvappp01.cor…	1
222	17	2017-10-23 10:00:00.284962	0.000133	0.000082000	31740	bcbslrprvappp01.c…	10.192.38.20	1
223	17	2017-10-23 10:00:00.285040	0.000078	0.000078000	31740	bcbslrprvappp01.c…	10.192.38.20	269507103
9505	17	2017-10-23 10:00:09.232733	8.947693	8.947693000	31740	bcbslrprvappp01.c…	10.192.38.20	1
9506	17	2017-10-23 10:00:09.232842	0.000109	0.000109000	31740	bcbslrprvappp01.c…	10.192.38.20	269507103
9516	17	2017-10-23 10:00:09.233157	0.000315	0.000079000	31740	bcbslrprvappp01.c…	10.192.38.20	269507839

RTOs (Retransmission Timeouts)

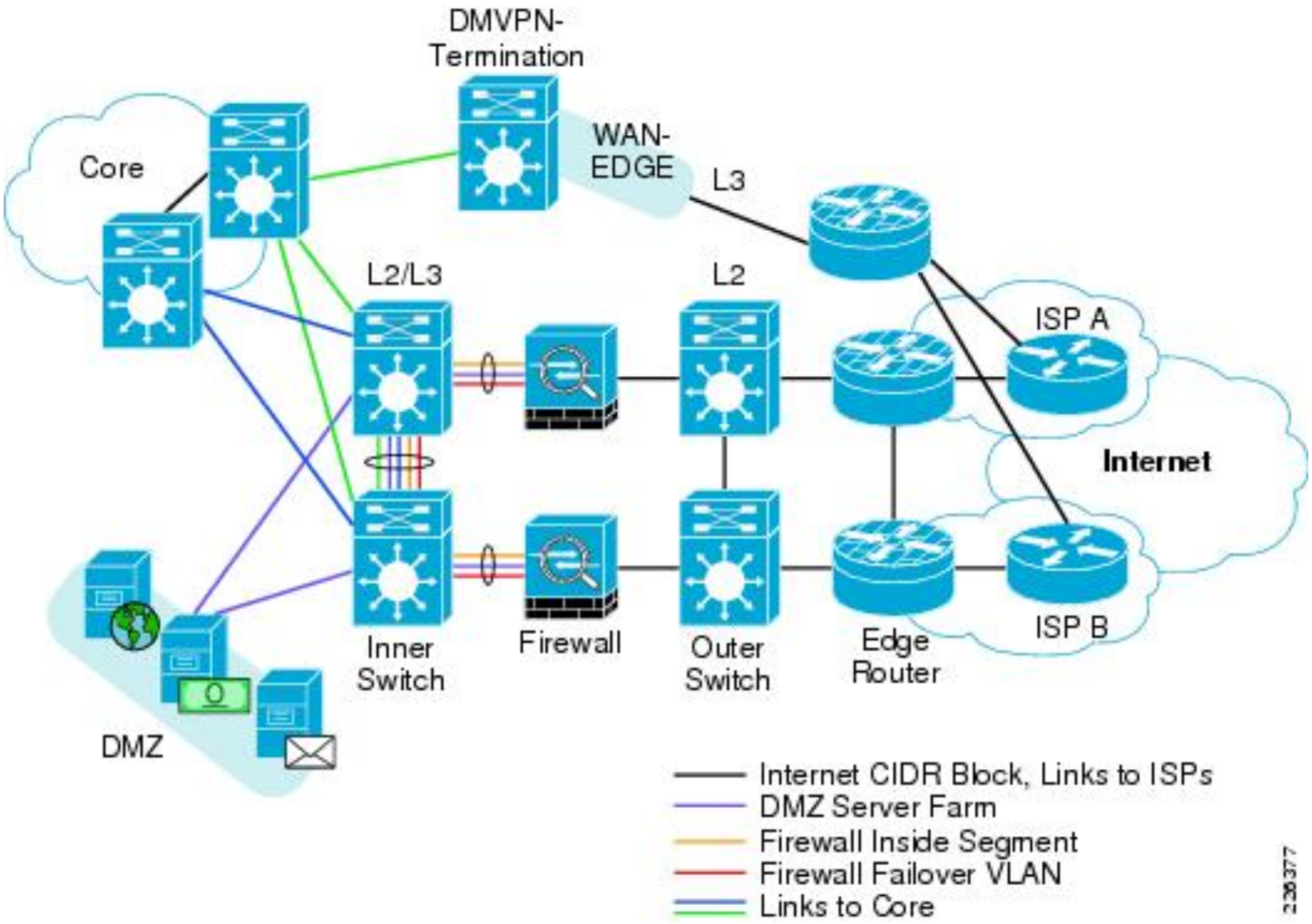
- TCP retransmissions are common
- Retransmission Timeouts are entirely different.
- Wireshark filter to track these down:
  - tcp.analysis.rto **> 1**



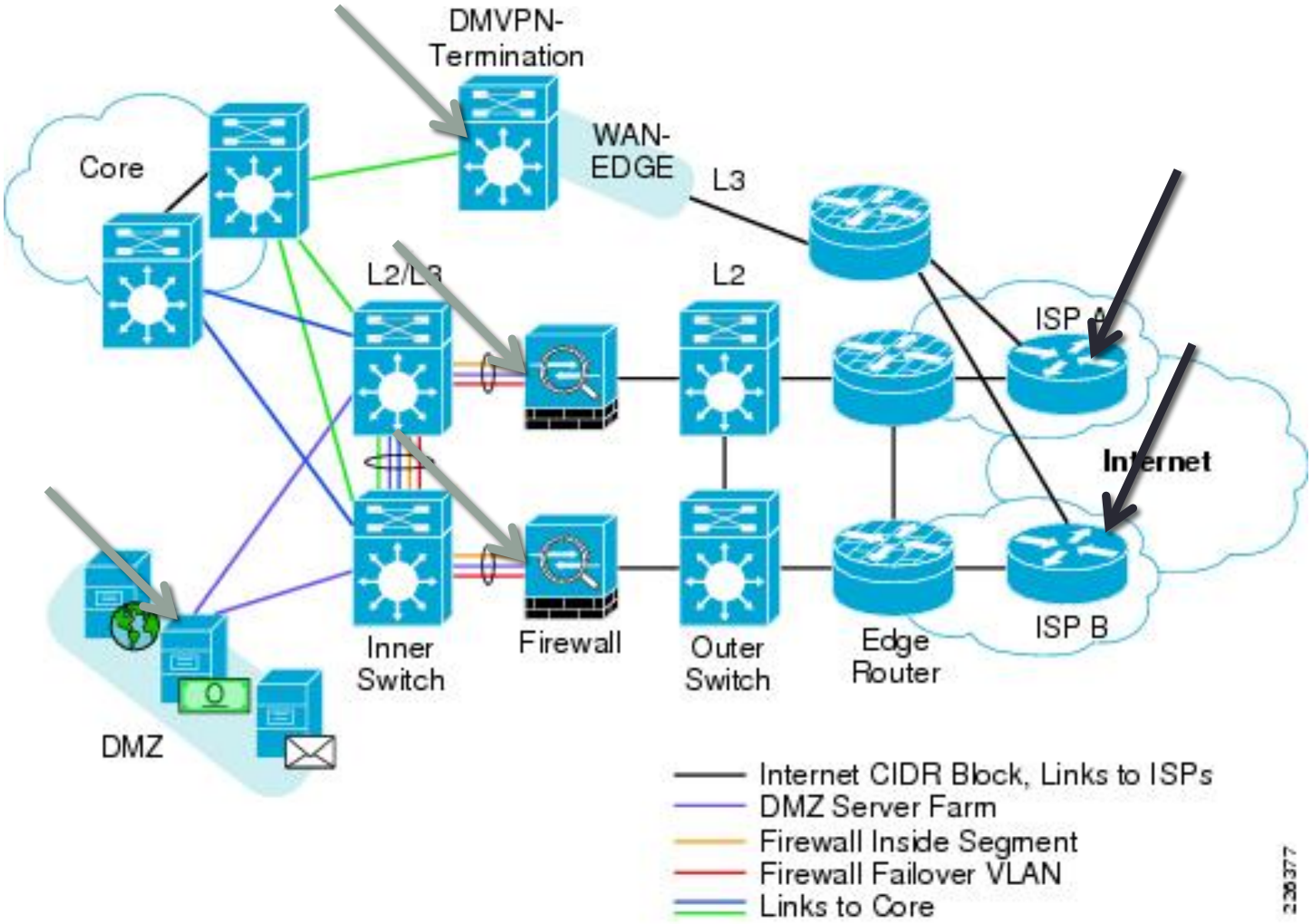
Analyzing TCP Sequence Numbers



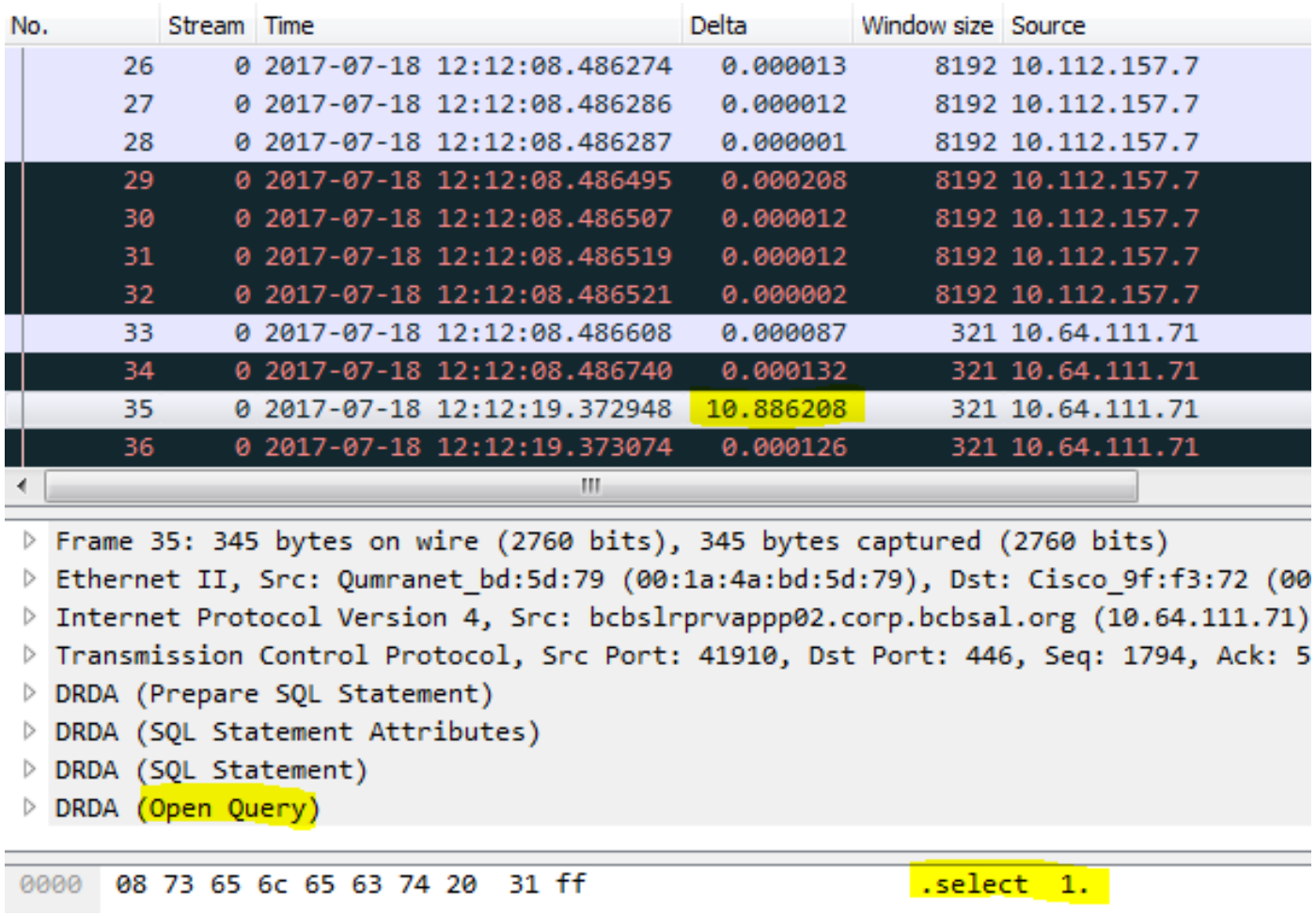
Real-world Delay Example



Real-world Delay Example



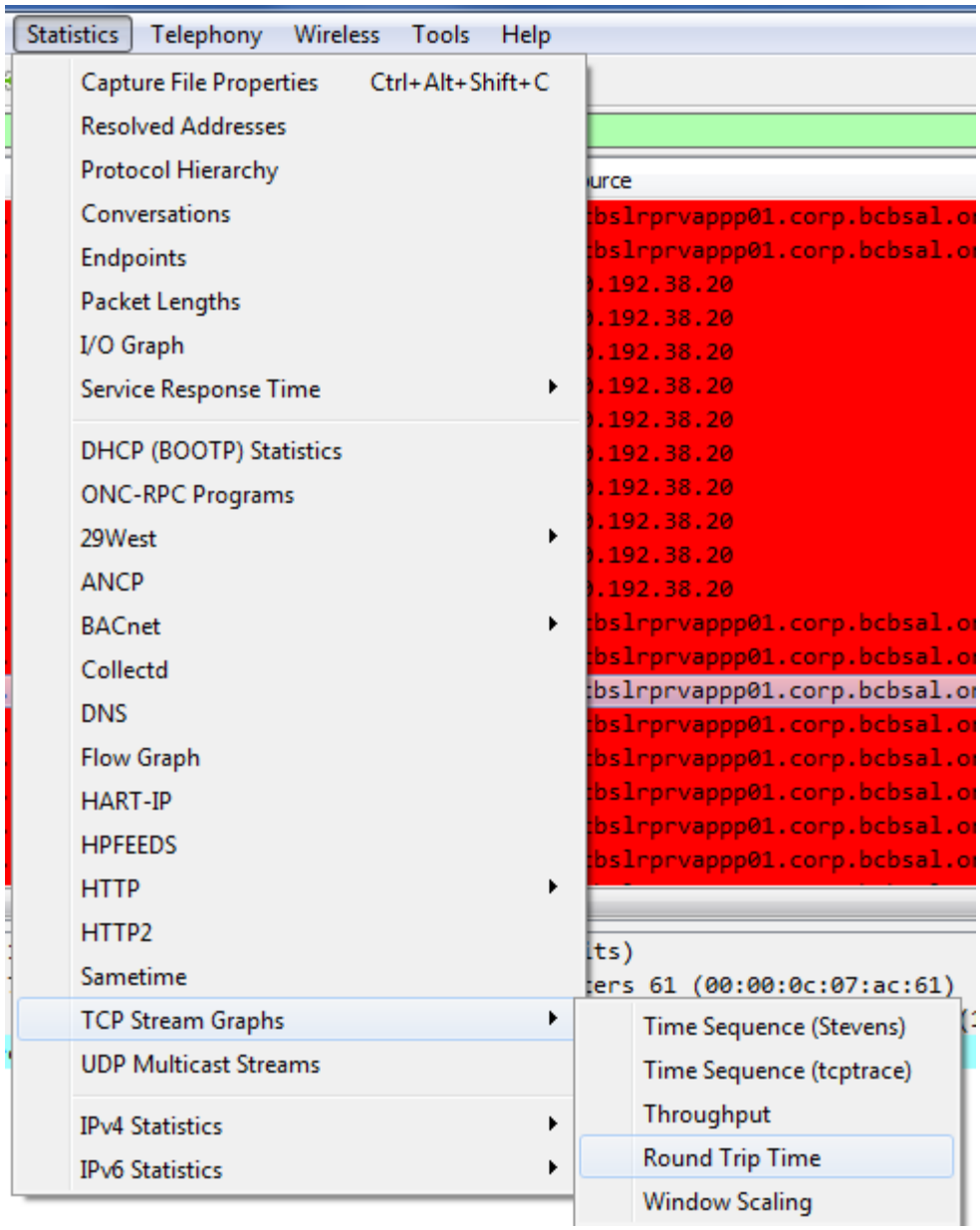
Real-world Delay Example

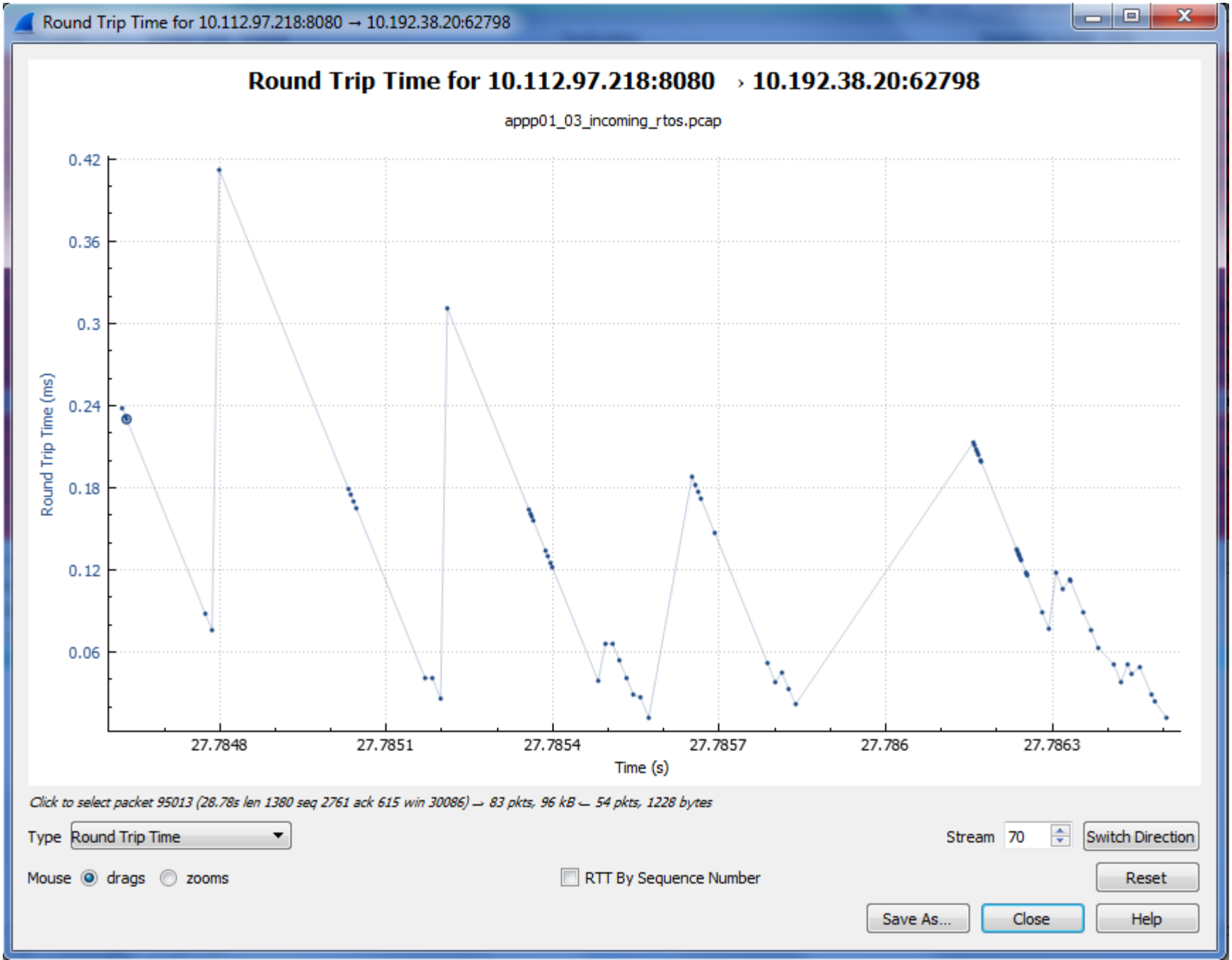


No.	Stream	Time	Delta	Window size	Source
26	0	2017-07-18 12:12:08.486274	0.000013	8192	10.112.157.7
27	0	2017-07-18 12:12:08.486286	0.000012	8192	10.112.157.7
28	0	2017-07-18 12:12:08.486287	0.000001	8192	10.112.157.7
29	0	2017-07-18 12:12:08.486495	0.000208	8192	10.112.157.7
30	0	2017-07-18 12:12:08.486507	0.000012	8192	10.112.157.7
31	0	2017-07-18 12:12:08.486519	0.000012	8192	10.112.157.7
32	0	2017-07-18 12:12:08.486521	0.000002	8192	10.112.157.7
33	0	2017-07-18 12:12:08.486608	0.000087	321	10.64.111.71
34	0	2017-07-18 12:12:08.486740	0.000132	321	10.64.111.71
35	0	2017-07-18 12:12:19.372948	10.886208	321	10.64.111.71
36	0	2017-07-18 12:12:19.373074	0.000126	321	10.64.111.71

```
▷ Frame 35: 345 bytes on wire (2760 bits), 345 bytes captured (2760 bits)
▷ Ethernet II, Src: Qumranet_bd:5d:79 (00:1a:4a:bd:5d:79), Dst: Cisco_9f:f3:72 (00
▷ Internet Protocol Version 4, Src: bcbslrprvappp02.corp.bcbsal.org (10.64.111.71)
▷ Transmission Control Protocol, Src Port: 41910, Dst Port: 446, Seq: 1794, Ack: 5
▷ DRDA (Prepare SQL Statement)
▷ DRDA (SQL Statement Attributes)
▷ DRDA (SQL Statement)
▷ DRDA (Open Query)
```

```
0000  08 73 65 6c 65 63 74 20  31 ff                    .select  1.
```


Statistics
Telephony
Wireless
Tools
Help
Capture File Properties Ctrl+Alt+Shift+C
Resolved Addresses
Protocol Hierarchy
Conversations
Endpoints
Packet Lengths
I/O Graph
Service Response Time
DHCP (BOOTP) Statistics
ONC-RPC Programs
29West
ANCP
BACnet
Collectd
DNS
Flow Graph
HART-IP
HPFEEDS
HTTP
HTTP2
Sametime
TCP Stream Graphs
UDP Multicast Streams
IPv4 Statistics
IPv6 Statistics
Time Sequence (Stevens)
Time Sequence (tcptrace)
Throughput
Round Trip Time
Window Scaling


Round Trip Time for 10.112.97.218:8080 → 10.192.38.20:62798
Round Trip Time for 10.112.97.218:8080 › 10.192.38.20:62798
appp01_03_incoming_rtos.pcap
0.42
0.36
0.3
0.24
0.18
0.12
0.06
Round Trip Time (ms)
27.7848
27.7851
27.7854
27.7857
27.786
27.7863
Time (s)
Click to select packet 95013 (28.78s len 1380 seq 2761 ack 615 win 30086) → 83 pkts, 96 kB ← 54 pkts, 1228 bytes
Type
Round Trip Time
Stream
70
Switch Direction
Mouse
drags
zooms
RTT By Sequence Number
Reset
Save As...
Close
Help

Real-world Delay Example

TCP Delta	Window	Source	Destination	Sequence numbe	Info
0.001358000	229	bcbslrprvappp02…	db2vipa.bcbsal.…	1	EXCSAT | ACCSEC
0.000022000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	1	EXCSATRD | ACCSECRD
0.000003000	237	bcbslrprvappp02…	db2vipa.bcbsal.…	246	SECCHK | ACCRDB
0.000156000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	163	SECCHKRM | ACCRDBRM
0.000923000	245	bcbslrprvappp02…	db2vipa.bcbsal.…	513	PRPSQLSTT | SQLATTR | SQLSTT | DSCSQLSTT | OPNQRY
0.000012000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	3292	SQLDARD | SQLDARD | OPNQRYRM | QRYDSC
0.000001000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	4740	QRYDTA | ENDQRYRM | SQLCARD | ENDUOWRM | SQLCARD
10.886208000	321	bcbslrprvappp02…	db2vipa.bcbsal.…	1794	PRPSQLSTT | SQLATTR | SQLSTT | OPNQRY
0.000301000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	5222	SQLDARD | OPNQFLRM | SQLCARD
0.000292000	343	bcbslrprvappp02…	db2vipa.bcbsal.…	2073	RDBCMM
0.000044000	8192	db2vipa.bcbsal.…	bcbslrprvappp02…	5521	ENDUOWRM | SQLCARD

Database → App Server (before delay)

```
Internet Protocol Version 4, Src: db2vipa.bcbsal.org (10.112.157.7),
Transmission Control Protocol, Src Port: 446, Dst Port: 41910, Seq:
[2 Reassembled TCP Segments (932 bytes): #27(634), #28(298)]
DRDA (Query Answer Set Data)
DRDA (End of Query)
DRDA (SQL Communications Area Reply Data)
DRDA (End Unit of Work Condition)
DRDA (SQL Communications Area Reply Data)
```

App Server → Database (after delay)

```
Internet Protocol Version 4, Src: bcbslrprvappp02.
Transmission Control Protocol, Src Port: 41910, Ds
DRDA (Prepare SQL Statement)
DRDA (SQL Statement Attributes)
DRDA (SQL Statement)
DRDA (Open Query)
```

```
DRDA (Open Query)

0000  08 73 65 6c 65 63 74 20  31 ff                    .select  1.
```

Columns

- No.
  - Packet number
- Stream
  - TCP stream
- Time
- Delta
  - Time between previous packet and selected packet
- **TCP Delta**
  - Time between previous packet **in the current TCP stream** and the selected packet
- Window Size
  - TCP window size. Useful for determining IP stack congestion. Pairs nicely with my TCP window filter I'll show you in a minute.

Columns

- Source (IP, resolved)
- Destination (IP, resolved)
- Sequence number
- Info
  - Displays a brief synopsis of the packet. Some data is interpreted by Wireshark
- RTO Time
- Length
  - Packet length on the wire
- Protocol
- Checksum Status: validates TCP packet based on checksum
- UDP Checksum Status
- Source MAC (resolved)
- Destination MAC (resolved)

Columns

- Transaction ID (only pertains to DHCP)

UDPChecl	TTL	Source MAC	Destination MAC	Transaction ID
Good	253	bx-450r-vd2_Fa1	HewlettP_c2:a1:5c	0x09868088

- TCP Segment Length
- Fragment Count
  - Look for MTU issues
- DNS Qry

MAC Address Resolution

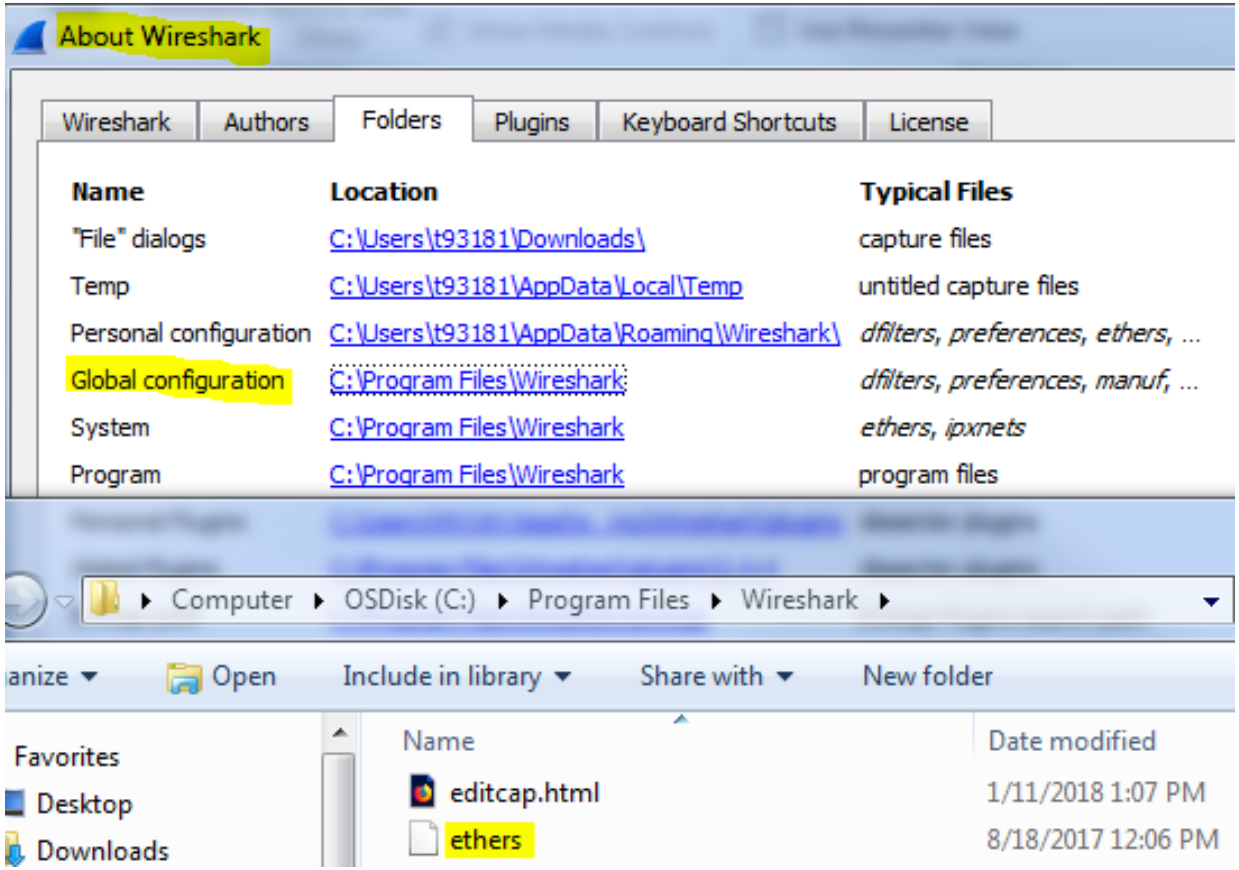
- MAC Address Resolution
  - Know exactly what leg of your network (and even src/dst interfaces) each packet is sourced from
  - Instead of this:

Address
a8:9d:21:68:60:00,7c:0e:ce:03:20:c0

  - you'll see something like this:

Source MAC	Destination MAC
bx-rivc-cr-g45-rt-cor12_Te1/1	bx-rivc-cr-d54-rt-cd36_Te1/1

MAC Address Resolution



Download the profile!

- https://github.com/bc-thomas/shark
- Questions?