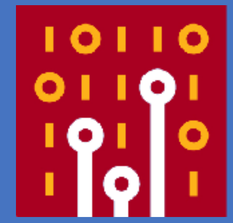
SharkFest '18 US



Wireshark CLI tools and Scripting

June 28th, 2018

http://syn-bit.nl/files/sf18us.zip

Sake Blok

Relational Therapist for Computer Systems

SYN-bit

deep traffic analysis

A little bit about me…

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Application and network troubleshooting

Protocol and packet analysis

Training (Wireshark, TCP, SSL)

www.SYN-bit.nl

Agenda

- Introductions
- Why use CLI tools?
  ... and how?
- Wireshark CLI tools
- Useful shell commands
- Some Scripting Examples
- Q&A

Why use the CLI tools?

- When GUI is not available (shell access)
- Quick and Easy Analysis
- Postprocessing results
  - GUI is powerful & interactive, but fixed functionality
  - CLI combined with other tooling is very flexible
- Automation

CLI not only when GUI is unavailable

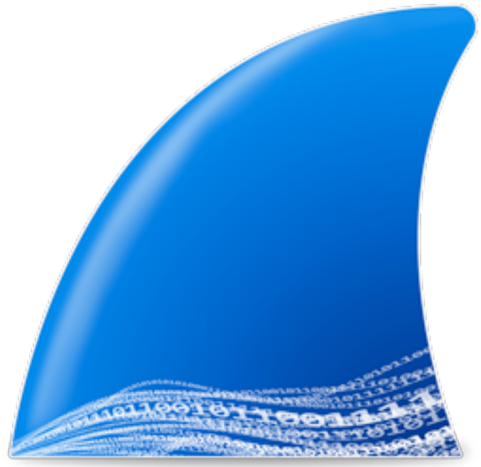
How?

- What information do I need?
  - visualize your output
- What (raw) data sources do I have?
  - Know the output formats of your data sources
- What tools are available?
  - What can they do, browse through manpages for unknown options

Practice, Experiment & be Creative :-)

(some) Wireshark CLI tools

- tshark
- dumpcap
- capinfos
- editcap
- mergecap



tshark (1)

- CLI version of wireshark
- Similar to tcpdump, but statefull / reassembly
  .... and MANY full protocol decodes
- uses dumpcap as capture engine
- standard options: -D, -i, -c, -n, -l, -f, -R, -s, -w, -r
- name resolving (-n)
- time stamps (-t <format>)
- decode as (-d tcp.port==8080,http)
- preferences (-o <pref>:<value>)

tshark (2)

- output formats (-V or -T <format>)
  - default: summary, uses column prefs
  - Verbose (-V), hex dump (-x), protocol selection (-O)
  - PDML (-T pdml)
  - JSON (-T json or -T jsonraw or -T ek)
  - fields (-T fields -E <sep> -e <field1> -e <field2> …)

- statistics (-z …)
  - protocol hierarchy (-qz io,phs)
  - conversations (-qz conv,eth , -qz conv,tcp)
  - i/o statistics (-qz io,stat,10,ip,icmp,udp,tcp)
  - follow stream (-qz follow,tcp,ascii,0)

Demo 1: Explore output formats

- Show normal output (‘tshark -r http.cap’)
- Show full decodes ('tshark -r http.cap -V')
- Show PDML (XML) decodes ('-T pdml’)
- Show JSON decodes ('-T json')

http.pcap

Demo 2: protocol preferences

- Display the contents of file ssl.cap with tshark, do you see http traffic?
- Use '-o ssl.keys_list:192.168.3.3,443,http,key.pem', do you see http traffic now?
- Which version of OpenSSL is used by the webserver (use '-V' and look at the “Server: <xxx>” http header)

ssl.pcap

Demo 3: Saving a selection of packets

- Use tshark with option '-o tcp.desegment_tcp_streams:TRUE' and filter on http
- Now use tshark with option '-o tcp.desegment_tcp_streams:FALSE' and filter on http.
  - How is this output different from the output in 4a?
- Do 3a and 3b again, but now use '-w' to write the output to 3a.cap and 3b.cap respectively. Read 4a.cap and 4b.cap with tshark.
  - Can you explain the difference?

http.pcap

Demo 4: tshark statistics

- Create a protocol hierarchy with '-qz io,phs'.
  - Which protocols are present in the file?
- Create a ip conversation list with '-qz conv,ip'
- Create a tcp conversation list with '-qz conv,tcp'
- Create some io statistics with '-qz io,stat,60,ip,tcp,smtp,pop'
- Did the previous commands give you an overview of the contents of mail.cap?

mail.pcap

dumpcap

- used by (wire|t)shark
  ... for privilege separation
- can be used separately
- options similar to tshark
- fast! only network->disk
- stateless! so traces can run forever
- ring buffer feature extremely useful:
  - dumpcap -i 5 -s0 -b filesize:16384 -files:1024 -w ring.cap

capinfos

- display summary of a tracefile
- all info vs specific info
- Or in table form with -T

```
$ capinfos example.cap
File name: example.cap
File type: Wireshark/tcpdump/... - libpcap
File encapsulation: Ethernet
Number of packets: 3973
File size: 1431813 bytes
Data size: 1368221 bytes
Capture duration: 1299.436650 seconds
Start time: Thu Jan 17 11:37:16 2008
End time: Thu Jan 17 11:58:55 2008
Data rate: 1052.93 bytes/s
Data rate: 8423.47 bits/s
Average packet size: 344.38 bytes
```

```
$ capinfos -ae sharkfest-*.cap
File name: example.cap
Start time: Thu Jan 17 11:37:16 2008
End time: Thu Jan 17 11:58:55 2008

File name: sharkfest-2.cap
Start time: Thu Jan 17 11:39:27 2008
End time: Thu Jan 17 12:02:52 2008
```

editcap (1) : select packets

- select frame ranges or time ranges
  - editcap -r example.cap tmp.cap 1-1000 2001-3000
  - editcap -A "2008-01-17 11:40:00" -B "2008-01-17 11:49:59" example.cap tmp.cap
- split file in chunks
  - editcap -c 1000 example.cap tmp.cap
  - editcap -i 60 example.cap tmp.cap
- remove duplicate packets
  - editcap -d example.cap tmp.cap

editcap (2) : change packets

- change snaplen
  - editcap -s 96 example.cap tmp.cap
- change timetamps
  - editcap -t -3600 example.cap tmp.cap
- change link layer type
  - editcap -T user0 example.cap tmp.cap
- change file type
  - editcap -F ngsniffer example.cap tmp.cap

mergecap

- merge packets in multiple files based on their timestamps
  - mergecap -w out.cap in-1.cap in-2.cap
- ... or just append the packets from each file
  - mergecap -a -w out.cap in-1.cap in-2.cap

Demo 5: splitting with editcap

- Execute the command 'editcap -i 60 mail.cap tmp.cap'.
  - How many files are created?
- Use 'capinfos -Tcae tmp*' to display a summary of these new files.
  - Why are the timestamps not exactly 60 seconds apart?
- Remove the 'tmp*' files
- Execute the command 'editcap -c 1000 mail.cap tmp.cap'.
  - How many files are created?
- Use 'capinfos -Tcae tmp*' to display a summary of these new files.

mail.pcap

Demo 5: merging with mergecap

- Use 'mergecap -w mail-new.cap tmp*'.
  - Is the resulting file exactly the same as mail.cap?
    (tip: use 'cmp <file1> <file2>')

tmp*.pcap

Demo 6: editing timestamps

- Adjusting timestamps with editcap
  - Use 'editcap -t <delta>' to create a new tracefile (tmp.cap) where the first packet arrived exactly at 11:39:00 (tip: use '-V -c1' to see the exact timestamp of the first packet). What is your '<delta>'?
  - What is the timestamp of the last packet in the new file? Are all packets adjusted with the same '<delta>'?

mail.pcap

Getting Help

- Use “<command> -h” for options
  - ... check once-in-a-while for new features
- Read the man-pages for in-depth guidance
  - see: http://www.wireshark.org/docs/man-pages/

Useful shell commands

- bash internals:
  |, >, for … do … done, `<command>`
- cut
- sort
- uniq
- tr
- sed
- awk
- q
- scripting (sh/perl/python/…)

| , > , for ... do ... done

- Command piping with '|'
  - ls -1t | head
- Output redirection with '>'
  - ls -1t | head > 10-newest-files.txt
- Looping with for … do … done
  - for word in 'one' 'two' 'three'; do echo $word; done

`<command>` , variable assignments

- Command evaluation with backtics (``)
  - for file in `ls -1t | head`
    do
      echo $file
      head -1 $file
      echo ""
    done > firstlines.txt

- Variable assignments
  - backupfile=`echo ${file}.bak`

cut

- By character position (-c <range>)
  - cut -c1-10 /etc/passwd
- By field (-f<index> [-d '<delimiter>']
  - cut -d ':' -f1 /etc/passwd

sort

- General alphabetic sort (no option)
  - sort names.txt
- Reverse sorting (-r)
  - sort -r names.txt
- Numerical (-n)
  - sort -n numbers.txt
- Or combined:
  - du -ks * | sort -rn | head

uniq

- De-duplication (no option)
  - sort names.txt | uniq
- Show only 'doubles' (-d)
  - sort names.txt | uniq -d
- Count occurrences (-c)
  - sort names.txt | uniq -c

tr

- Translate a character(set)
  - echo "one two" | tr " " "_"
  - echo "code 217" | tr "[0-9]" "[A-J]"
  - echo "What is a house?" | tr "aeiou" "eioua"

- Delete a character(set)
  - echo "no more spaces" | tr -d " "
  - echo "no more vowels" | tr -d "aeiou"
  - cat dosfile.txt | tr –d "\015" > unixfile.txt

sed

- Stream editor
- Very powerful ‘editing language’

- Some simple examples:
  - deleting text:
    sed -e 's/<deleteme>//'
  - replacing text:
    sed -e 's/<replaceme>/<withthis>/'
  - extracting text:
    sed -e 's/^.*\(<keepme>\).*\(<andme>\).*$/\1 \2/‘

awk

- Pattern scanning and processing language
- Also a very powerful language

- Some examples:
  - netstat -an | \
    awk '$1~"tcp" {print $4}' | \
    sort | uniq –c

  - … | awk '{printf("%stcp.port==%s",sep,$1);sep="||"}'

q

- Perform SQL queries on text files

- An example:

```
netstat -an | \
q 'SELECT c6, count(*) FROM - WHERE c1 LIKE "%tcp%" GROUP BY c6'
```

scripting

- parsing output when command piping is not enough
- automate execution of tshark/dumpcap/mergecap etc
- use your own favorite language (sh/perl/python/etc)

do anything you want :-)

Some Cases

- Using command piping
  - Counting http response codes
  - Top 10 URL's
  - All TCP sessions which contain session-cookie XXXX

- Using scripting
  - All sessions for user XXXX (shell script)

example.pcap

Case 1: Counting http response codes (1)

- Problem
  - I need an overview of http response codes
- Output
  - table with http response codes & counts
- Input
  - Capture file with http traffic

Case 1: Counting http response codes (2)

- Steps to take
  - print only http response code
  - count
  - make (sorted) table

Case 1: Counting http response codes (3)

- Command:
  - tshark -r example.cap -R http.response
    -T fields -e http.response.code |\
    sort | uniq -c

- New tricks learned:
  - -T fields -e <field>
  - | sort | uniq -c

Case 2: Top 10 requested URL's (1)

- Problem
  - I need a list of all URL’s that have been visited
- Output
  - Sorted list with requested URL’s and count
- Input
  - Capture file with http traffic

Case 2: Top 10 requested URL's (2)

- Steps
  - Print http.host and http.request.uri
  - Strip everything after “?”
  - Combine host + uri and format into normal URL
  - count url’s
  - make top 10

Case 2: Top 10 requested URL's (3)

- Command:
  - tshark -r example.cap -R http.request \
    -T fields -e http.host -e http.request.uri |\
    sed -e 's/?.*$//' |\
    sed -e 's#^\(.*\)\t\(.*\)$#http://\1\2#' |\
    sort | uniq -c | sort -rn | head

- New tricks learned:
  - remove unnecessary info : sed -e 's/?.*$//'
  - transform : sed -e 's#^\(.*\)\t\(.*\)$#http://\1\2#'
  - top10 : | sort | uniq -c | sort -rn | head

Case 2: Top 10 requested URL's (3)

- Command:
  - tshark -r example.cap -R http.request \
    -T fields -e http.host -e http.request.uri |\
    sed -e 's/?.*$//' |\
    sed -e 's#^\(.*\)\t\(.*\)$#http://\1\2#' |\
    sort | uniq -c | sort -rn | head

http.request.full_uri

- New tricks learned:
  - remove unnecessary info : sed -e 's/?.*$//'
  - transform : sed -e 's#^\(.*\)\t\(.*\)$#http://\1\2#'
  - top10 : | sort | uniq -c | sort -rn | head

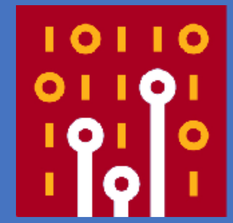
Case 3: All sessions with cookie XXXX (1)

- Problem
  - I know in which “session” a problem exists, but I need all data from that session to work it out
- Output
  - New capture file with whole tcp sessions that contain cookie PHPSESSID=c0bb9d04cebbc765bc9bc366f663fcaf
- Input
  - Capture file with http traffic

Case 3: All sessions with cookie XXXX (2)

- Steps
  - select packets that contain the cookie
  - print the tcp stream numbers
  - create new filter based on the stream numbers
  - use filter to extract tcp sessions
  - save packets to a new capture file

Case 3: All sessions with cookie XXXX (3)



- Command:
  - tshark -r example.cap -w cookie.cap \
    -R `tshark -r example.cap -T fields -e tcp.stream
    -R "http.request and http.cookie contains \
    "PHPSESSID=c0bb9d04cebbc765bc9bc366f663fcaf\"" |\
    awk '{printf("%stcp.stream==%s",sep,1);sep="||"}' `

- New tricks learned:
  - tshark -R `<other command that generated filter>`
  - awk '{printf("%stcp.stream==%s",sep,$1);sep="||"}'

Case 4: All sessions for user XXXX (1)

- Problem
  - A particular user has multiple sessions and I need to see all sessions from that user
- Output
  - New capture file with all data for user xxxx
- Input
  - Capture file with http data

Case 4: All sessions for user XXXX (2)

- Steps
  - print all session cookies for user XXXX
  - create new capture file per session cookie (see example 3)
  - merge files to new output file

Case 4: All sessions for user XXXX (3)

```
#!/bin/bash

file=$1
user=$2

for cookie in `tshark -r $file -R "http.request and http contains $user" \
                              -T fields -e http.cookie | cut -d ' ' -f2`
do
   tmpfile="tmp_`echo $cookie | cut -d '=' -f 2`.cap"
   echo "Processing session cookie $cookie to $tmpfile"

   tshark -r $file -w $tmpfile -R `tshark -r $file -T fields -e tcp.stream \
      -R "http.request and http.cookie contains \"$cookie\"" | \
      awk '{printf("%stcp.stream==%s",sep,$1);sep="||"}'`
done

mergecap -w $user.cap tmp_*.cap
rm tmp_*.cap
```

Case 4: All sessions for user XXXX (4)

- New tricks learned:
  - for … do … done
  - <var>=`echo … | …`
  - cut -d <FS> -f <x>
  - mergecap -w <outfile> <infile1> <infile2> …

Case 5: show metrics per URI (1)

- Problem
  - Create an overview of min, avg and max response times per URI
- Output
  - Overview with "uri, count,min,avg,max"
- Input
  - Capture file with http data

Case 5: show metrics per URI (2)

- Steps
  - create a text file with all requests
  - create a text file with all responses
  - use q to 'join' the files and calculate the statistics

Case 5: show metrics per URI (3)

- Command:
  - tshark -r example.pcap -Y http.request -T fields -E separator=' ' \
    -e frame.number -e http.request.uri | sed -e 's/\?.*$//' > req

  - tshark -r example.pcap -Y http.response -T fields -E separator=' ' \
    -e http.request_in -e http.response.code -e http.time > resp

  - q 'SELECT REQ.c2, count(*), min(RESP.c3), avg(RESP.c3), max (RESP.c3)
    FROM req AS REQ
    JOIN resp AS RESP
    ON REQ.c1=RESP.c1
    GROUP BY REQ.c2'

Case 5: show metrics per URI (4)

- New tricks learned:
  - use q to combine multiple outputs with JOIN

Case 6: Automatic save for one user

- Create a new trace file for a specific pop user that contains only his pop sessions.
- First get an idea of a typical POP session, use :
  - tshark -r mail.cap -R 'tcp.port==64315 and tcp.len>0'
- Use the following steps to create a list of tcp ports used by user 'sake-test2':
  - Use the filter ' pop.request.parameter=="sake-test2" ' to only show sessions of user sake-test2
  - Add '-T fields -e tcp.stream' to the command to just show the tcp streams.
  - Add | awk '{printf("%stcp.stream==%s",sep,$1);sep="||"}' to

mail.pcap

Case 5 (continued)

- Now use the output of the previous command between backticks to create the new file:
  tshark -r mail.cap -w sake-test2.cap -R `<previous command>`
- Use 'tshark -r sake-test2.cap -R pop.request.command==USER' to verify that the new file only contains sessions of user sake-test2. Did we succeed? What went wrong? How can we fix it?

Case 7: Automatic save for every user

- Creating a separate trace file for each pop user automatically.
  - Delete the file sake-test2.cap
- Create a list of users with the following steps:
  - Use a filter to only select the packets where the pop command was “USER” and use '-T fields' to only print the username.
  - Use '| sort | uniq' to create a list of unique usernames

mail.pcap

Case 6 (continued)

- Loop through the list of usernames and create the file per user with:

```
for user in `<command from case XX>`
do
  echo $user
  <command from case XX with $user as variable>
done
```

Challenge!

- Create a shell script [or a one-liner ;-)] that produces the following output:

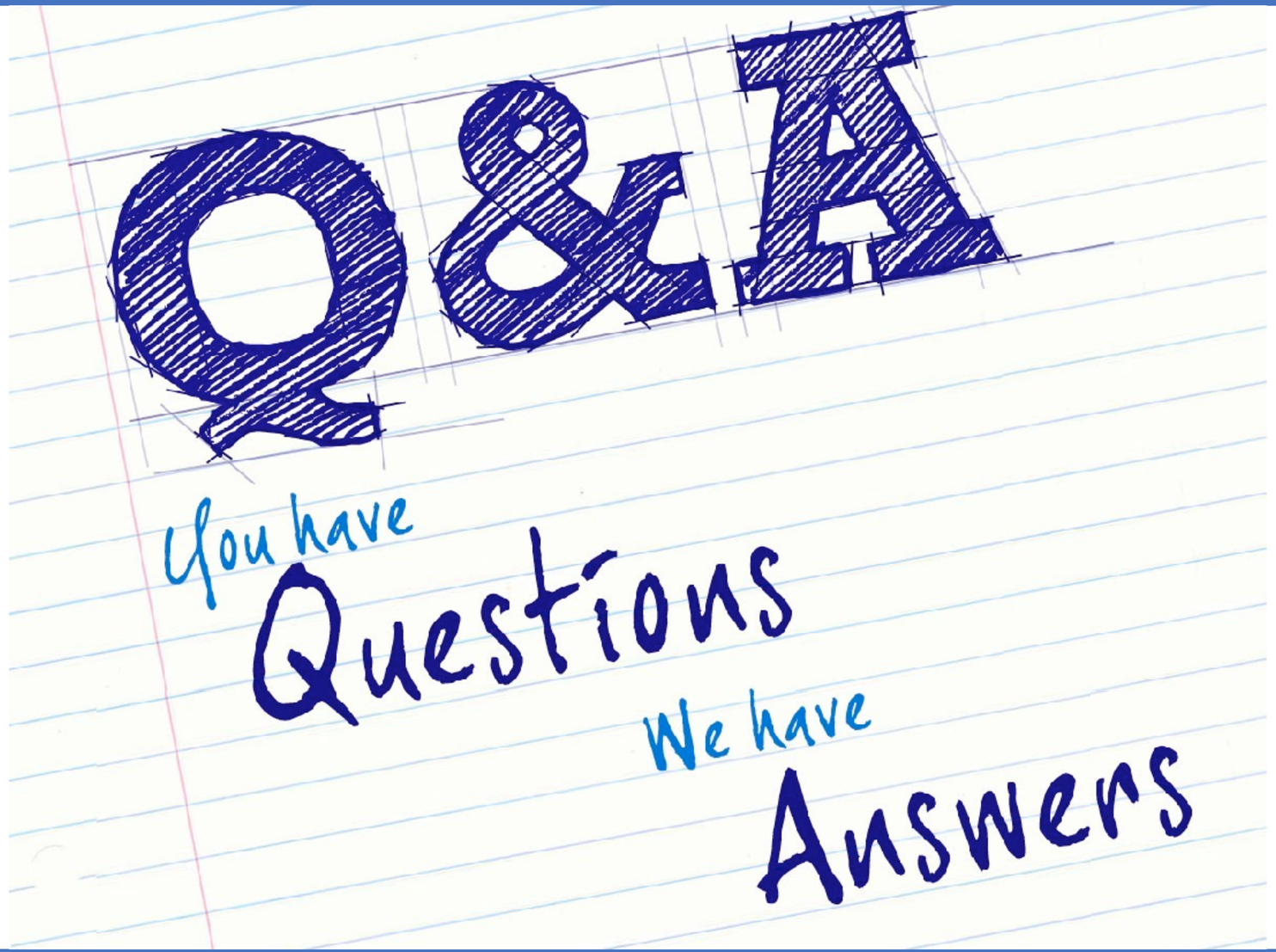
```
Mail check times for : sake-test1
11:39:43 : 1 message (2833 octets)
11:40:00 : 0 messages (0 octets)
11:42:33 : 7 messages (25958 octets)
11:45:04 : 6 messages (21538 octets)
11:47:37 : 5 messages (17480 octets)
11:50:09 : 8 messages (32297 octets)
11:52:40 : 5 messages (17017 octets)
11:55:13 : 6 messages (21075 octets)
11:57:46 : 6 messages (20859 octets)
12:00:28 : 7 messages (25416 octets)
12:02:49 : 1 message (3677 octets)

Mail check times for : sake-test2
11:39:44 : 5 messages (14512 octets)
11:40:01 : 6 messages (16811 octets)
11:42:34 : 5 messages (17568 octets)
11:45:05 : 4 messages (8551 octets)
11:47:38 : 6 messages (16337 octets)
11:50:10 : 2 messages (5396 octets)
11:52:42 : 7 messages (20601 octets)
11:55:14 : 5 messages (12089 octets)
11:57:46 : 4 messages (14463 octets)
12:00:22 : 5 messages (15016 octets)
12:02:50 : 4 messages (14805 octets)
```

mail.pcap

Summary

- Wireshark comes with powerful CLI tools (tshark, dumpcap, capinfos, editcap, mergecap)
- tshark+scripting can complement GUI
- use little building blocks and combine them

Questions?



FIN/ACK, ACK, FIN/ACK, ACK

Still questions?

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