



SharkFest '18 Europe



Wireshark CLI tools and Scripting

<http://syn-bit.nl/files/sf18eu.zip>

Sake Blok

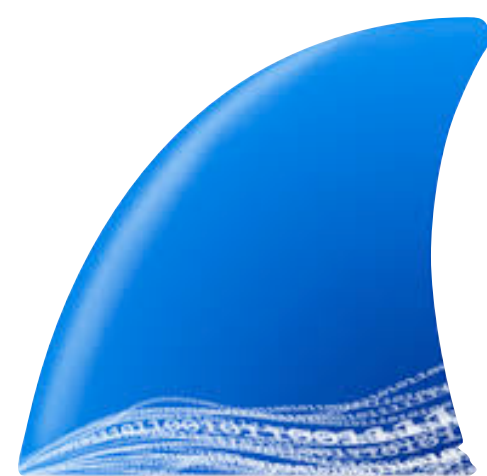
Relational Therapist for Computer Systems



SYN-bit
deep traffic analysis



A little bit about me...



SYN-bit
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deep traffic analysis

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?



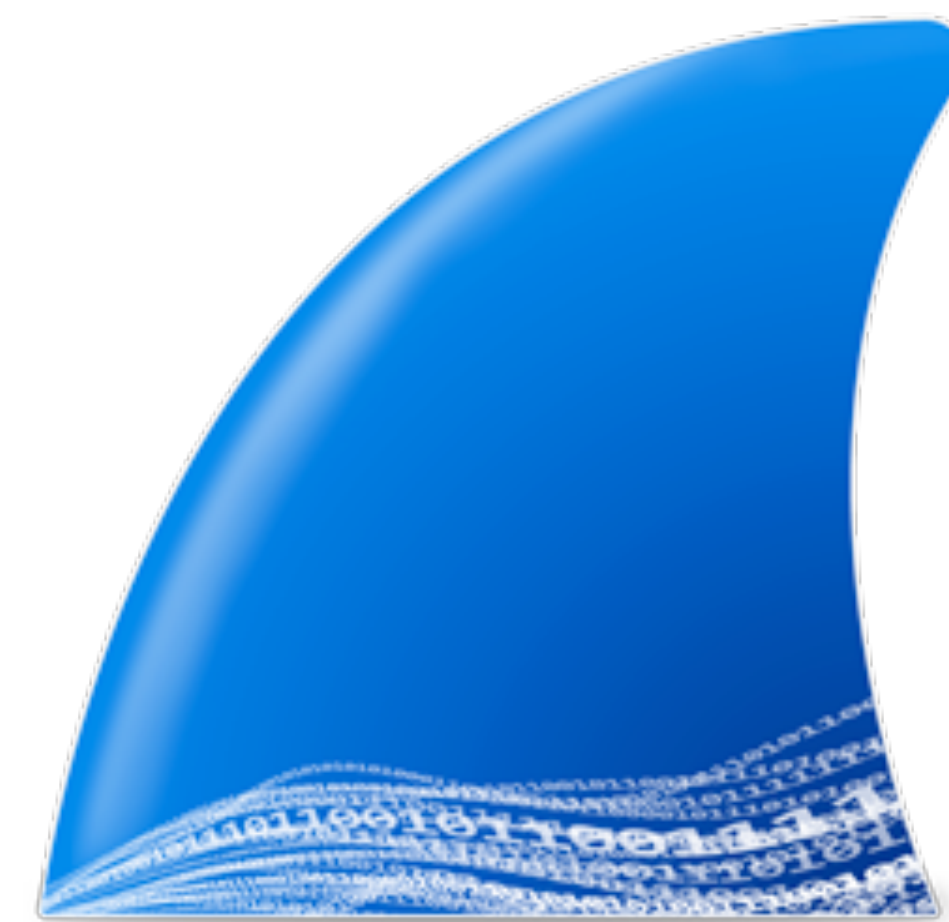
- What information do I need?
 - visualize your output
- What (raw) data sources do I have?
 - Know the output formats of your data sources
- What tools are available?
 - What can they do, browse through manpages for unknown options
- **Practice, Experiment & be Creative :-)**



(some) Wireshark CLI tools



- tshark
- dumpcap
- capinfos
- editcap
- mergecap





tshark (1)



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



tshark (2)



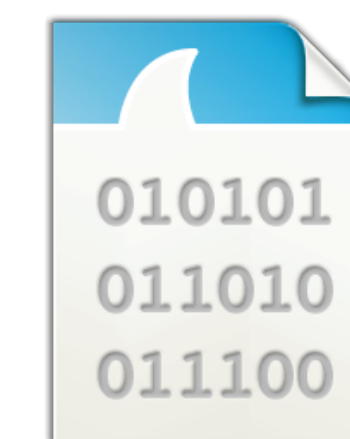
- output formats (-V or -T <format>)
 - default: summary, uses column prefs
 - Verbose (-V), hex dump (-x), protocol selection (-O)
 - PDML (-T pdml)
 - JSON (-T json or -T jsonraw or -T ek)
 - fields (-T fields -E <sep> -e <field1> -e <field2> ...)
- statistics (-z ...)
 - protocol hierarchy (-qz io,phs)
 - 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.pcap`)
- Show full decodes (`tshark -r http.pcap -V`)
- Show PDML (XML) decodes (`-T pdml`)
- Show JSON decodes (`-T json`)



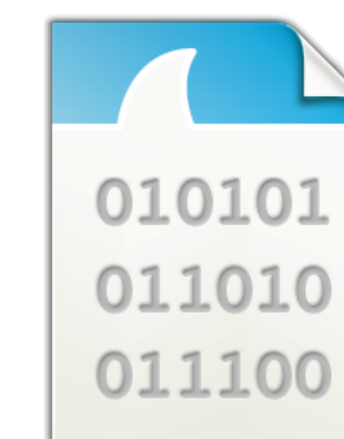
http.pcap



Demo 2: protocol preferences



- Display the contents of file `ssl.pcap` 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)



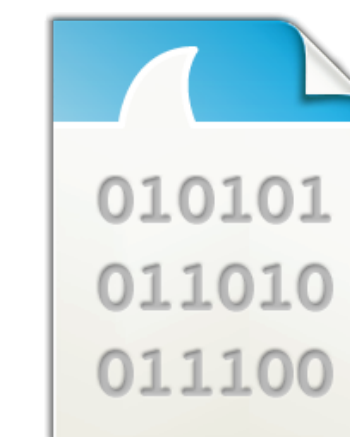
ssl.pcap



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 previous output?
- Execute the same commands again, but now use '-w' to write the output to 3a.pcap and 3b.pcap respectively.
- Read 3a.pcap and 3b.pcap with tshark.
 - Can you explain the difference?



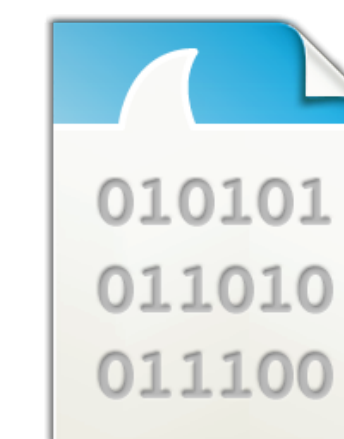
http.pcap



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.pcap?



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 16gb-ring.pcap`



capinfos



- display summary of a tracefile
- all info vs specific info

```
$ capinfos -ae example.pcap http.pcap
File name:          example.pcap
First packet time: 2008-01-17 11:37:16.280071
Last packet time:  2008-01-17 11:58:55.716721

File name:          http.pcap
First packet time: 2008-01-17 11:43:09.216077
Last packet time:  2008-01-17 11:43:09.263399
$
```

- Or in table form with -T

```
$ capinfos -Tae example.pcap http.pcap mail.pcap
File name  Start time  End time
example.pcap 2008-01-17 11:37:16.280071 2008-01-17 11:58:55.716721
http.pcap   2008-01-17 11:43:09.216077 2008-01-17 11:43:09.263399
$
```

```
$ capinfos example.pcap
File name:          example.pcap
File type:          Wireshark/tcpdump/... - pcap
File encapsulation: Ethernet
File timestamp precision: microseconds (6)
Packet size limit:  file hdr: 65535 bytes
Number of packets:  2357
File size:          921 kB
Data size:          884 kB
Capture duration:   1299.436650 seconds
First packet time: 2008-01-17 11:37:16.280071
Last packet time:  2008-01-17 11:58:55.716721
Data byte rate:     680 bytes/s
Data bit rate:      5443 bits/s
Average packet size: 375.13 bytes
Average packet rate: 1 packets/s
SHA256:             3527ce3d6297cf8d735f25092811b4f1...
RIPEMD160:          3628f17b67b2d4c1e54fa31c9a438831...
SHA1:               54373b7b0536621beeca2cffa2179647...
Strict time order:  True
Number of interfaces in file: 1
Interface #0 info:
                   Encapsulation = Ethernet (1 - ether)
                   Capture length = 65535
                   Time precision = microseconds (6)
                   Time ticks per second = 1000000
                   Number of stat entries = 0
                   Number of packets = 2357
$
```



editcap (1) : select packets



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



editcap (2) : change packets



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



merg pcap



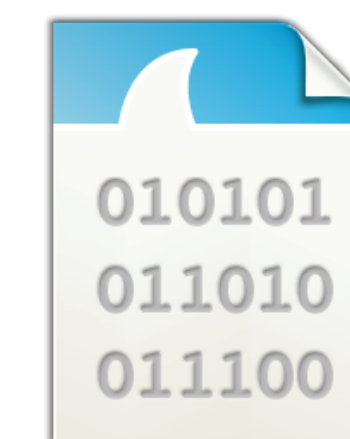
- merge packets in multiple files based on their timestamps
 - `merg pcap -w out.pcap in-1.pcap in-2.pcap`
- ... or just append the packets from each file
 - `merg pcap -a -w out.pcap in-1.pcap in-2.pcap`



Demo 5: splitting with editcap



- Execute the command `'editcap -i 60 mail.pcap tmp.pcap'`.
 - 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.pcap tmp.pcap'`.
 - How many files are created?
- Use `'capinfos -Tcae tmp*'` to display a summary of these new files.



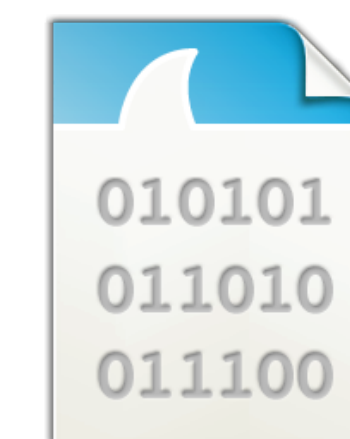
mail.pcap



Demo 5: merging with mergecap



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



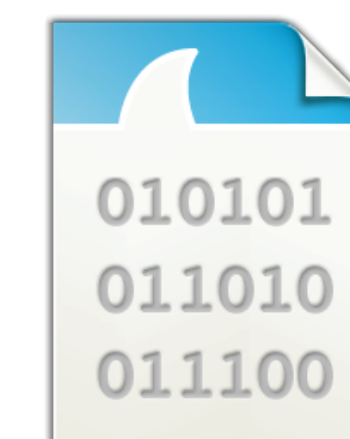
tmp*.pcap



Demo 6: editing timestamps



- Adjusting timestamps with editcap
 - Use 'editcap -t <delta>' to create a new tracefile (tmp.pcap) 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/>



Command line piping



- Linux, MacOS, Unices
 - Use bash (or other command shell)
- Windows
 - use Cygwin
 - use “Linux Bash Shell” (Windows 10)
 - use powershell commands
(see Graham’s presentation from Sharkfest ’17 Europe)



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 -lt | head
- Output redirection with '>'
 - ls -lt | 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 backticks (``)

- for file in `ls -lt | 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



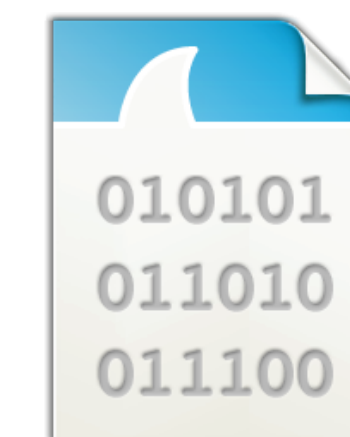
- parsing output when command piping is not enough
- automate execution of tshark/dumpcap/mergecap etc
- use your own favorite language
(sh/perl/python/etc)
- **do anything you want :-)**



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.pcap -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.pcap -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.pcap -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.pcap -w cookie.pcap \
-R `tshark -r example.pcap -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`.pcap"
    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

mergcap -w $user.pcap tmp_*.pcap
rm tmp_*.pcap
```




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.pcap -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 6 (continued)



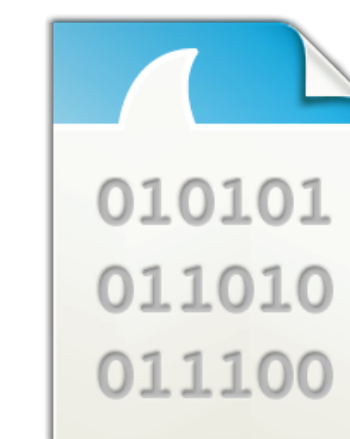
- Now use the output of the previous command between backticks to create the new file:
`tshark -r mail.pcap -w sake-test2.pcap -R `<previous command>``
- Use `'tshark -r sake-test2.pcap -R pop.request.command==USER'` to verify that the new file only contains sessions of user sake-test2. Did we succeed? 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.pcap
- 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 7 (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
```



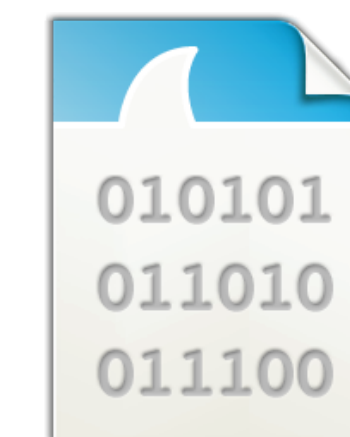
Challenge!



- 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

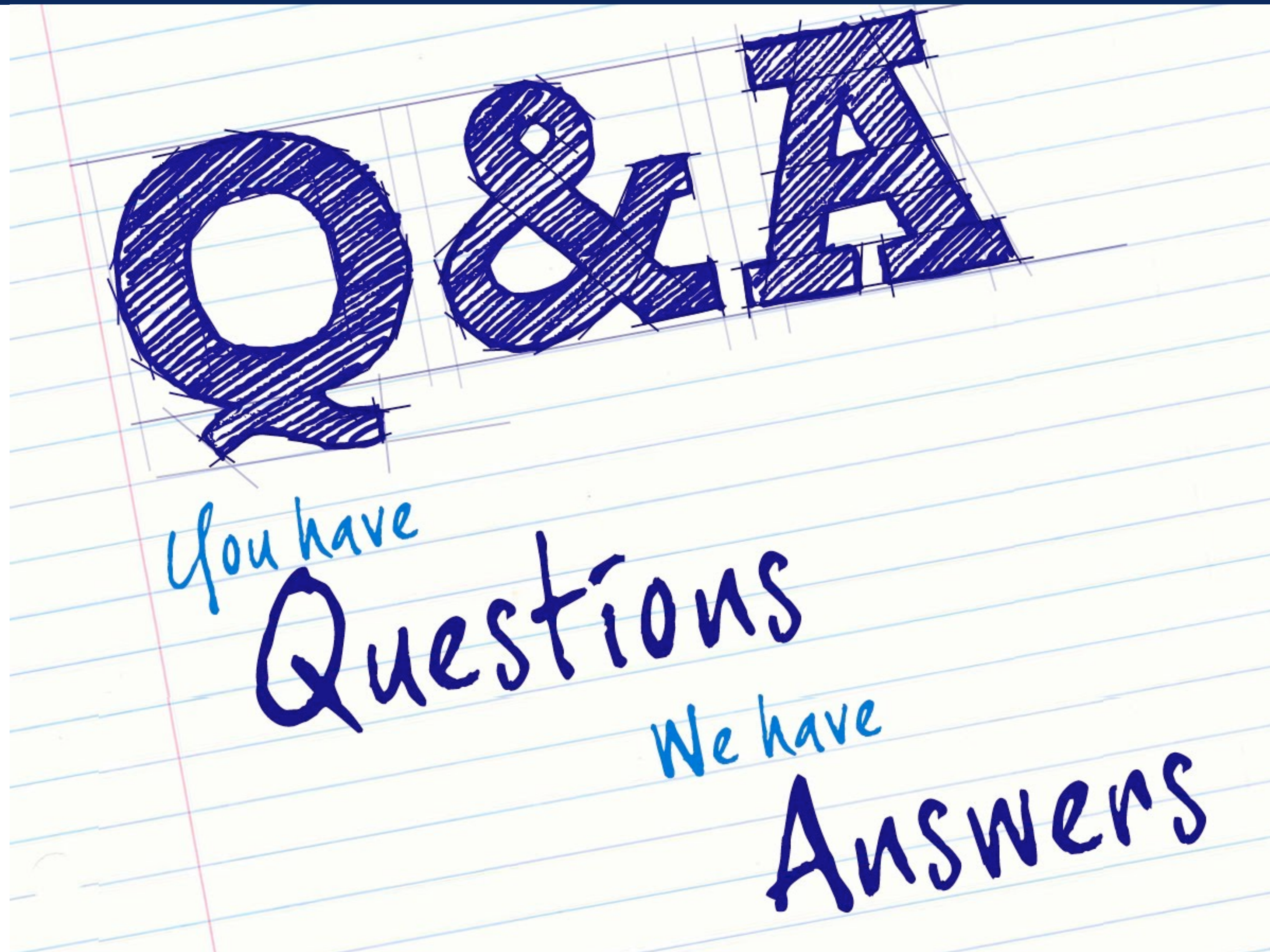


- Wireshark comes with powerful CLI tools (tshark, dumpcap, capinfos, editcap, mergecap)
- tshark+scripting can complement GUI
- use little building blocks and combine them





Questions?





FIN/ACK, ACK, FIN/ACK, ACK



Still questions?
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SYN-bit
deep traffic analysis