Finding a Needle in a PCAP

Flocon 2015

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DM-0001893

Goal

Describe a full packet capture solution that can quickly and efficiently produce requested information.

Show analysis capabilities of YAF, super_mediator, and SiLK.

Demonstrate PCAP features in YAF.

PCAP Challenges

Volume (4Gbps):

- 1 Hour: 1.7TB
- 1 Day: 40.8TB
- 1 Week: 285.6TB
- 1 Month: 1.1PB

Data Stored on Sensors

- Separate from analysis

Indexing:

- Timestamp Files
- BPF Filters
- GUI tools
- Splunk

YAF PCAP Features

Rolling PCAP dump

- Rotates files using time or size.
- Creates meta file with flows contained in each PCAP file.

Index a PCAP File

- Uses flow key hash and start time.

PCAP per flow

- Creates a PCAP file for each flow.
- Use with BPF filters.

Gh0st Rat Investigation

Gh0st

Chinese remote access Trojan

Free source code

Easy to modify

Distinctive Network Signature

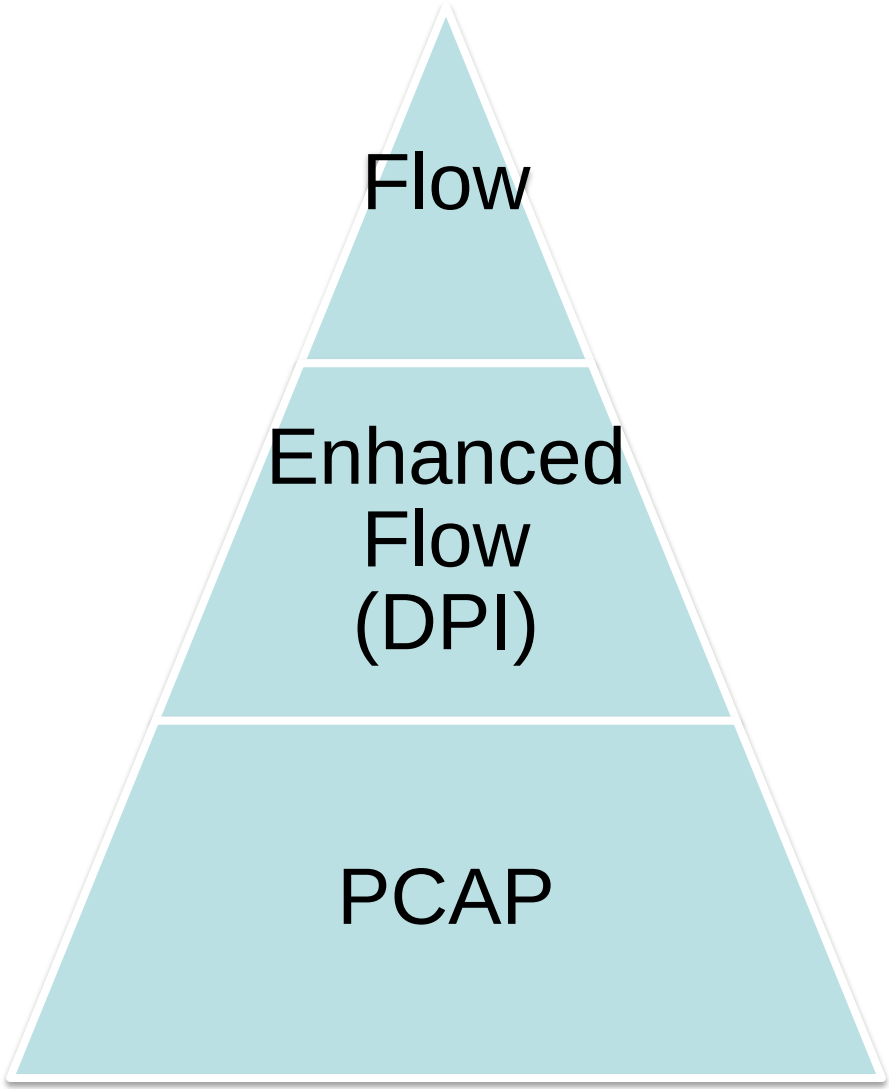
Signature	Compressed Length	Uncompressed Length	ZLIBHDR	Data
Usually 5 BYTES	4 BYTES	4 BYTES	0x789C 2 BYTES	

Method

29,000 (15G) PCAP samples

Use YAF to index and produce flow, DPI

YAF Signatures



Tool setup

src — ssh — 115×25

```
File Edit Options Buffers Tools Sh-Script Help
#! /bin/bash

PCAP_DIR=/storage/pcaps/*

flowcap --sensor-conf=/data/sensor.conf --destination-dir=/data/flow --max-file-size=20m --log-dest=/var/log/flowp\
ack.log

super_mediator -c /data/super_mediator.conf -d

i=0

for file in $PCAP_DIR
do

yaf --in $file --out localhost --ipfix tcp --ipfix-port=6789 --log=/var/log/yaf.log --verbose --applabel --max-pay\
load=1024 --plugin-name=/usr/lib64/yaf/dpacketplugin.la --flow-stats --no-stats --applabel-rules=/data/yafApplabel\
Rules.conf --noerror --pcap-meta-file=/data/pcapmeta/$(basename $file).txt --observation-domain=$i

i=$[$i+1]

done

-UU-:----F1  test.sh        All L1     (Shell-script[bash])----------------------------------------------------
```

Initial Results

```
(5)      $ rwstats --fields=29 --xargs=destroy-flow/silkfiles.txt --top --count 9
INPUT: 379068 Records for 10 Bins and 379068 Total Records
OUTPUT: Top 9 Bins by Records
appli|   Records|  %Records|   cumul_%|
    0|    260316| 68.672639| 68.672639|
   80|     43263| 11.412992| 80.085631|
  139|     38170| 10.069433| 90.155065|
  137|     20324|  5.361571| 95.516636|
   53|     16675|  4.398947| 99.915582|
  119|       240|  0.063313| 99.978896|
 3306|        68|  0.017939| 99.996834|
 1080|         6|  0.001583| 99.998417|
  194|         4|  0.001055| 99.999472|
```

YAF Signatures

Norman ASA 2012 Report identifies 85 Gh0st variants

```
9999 signature ^Gh0st
9998 signature ^LURK0
9997 signature ^7hero
9996 signature ^Adobe
9995 signature ^B1X6Z
9994 signature ^BEILa
9993 signature ^ByShe
9992 signature ^FKJP3
9991 signature ^FLYNN
9990 signature ^FWAPR
9989 signature ^FWKJG
9988 signature ^GWRAT
9987 signature ^GOLDt
9986 signature ^HEART
9985 signature ^HTTPS
9984 signature ^HXWAN
9983 signature ^Heart
9982 signature ^IM007
9981 signature ^ITore
9980 signature ^KOBBX
9979 signature ^KrisR
9978 signature ^LUCKK
9977 signature ^LYRAT
9976 signature ^Level
9975 signature ^Lover
9974 signature ^Lyyyy
9973 signature ^MFYB
9972 signature ^MoZhe
9971 signature ^MyRat
9970 signature ^OXXMM
9969 signature ^PCRat
9968 signature ^QWPOT
9967 signature ^Spidern
9966 signature ^Tyjhu
9965 signature ^URATU
9964 signature ^W0LFKO
9963 signature ^Wangz
9962 signature ^Winds
9961 signature ^World
9960 signature ^X6RAT
9959 signature ^XDAPR
9958 signature ^Xjjhj
9957 signature ^ag0ft
9956 signature ^attac
9955 signature ^cb1st
9954 signature ^https
9953 signature ^whmhl
9952 signature ^xhjyk
9951 signature ^00000
```

download01.**norman**.no/documents/Themanyfacesof**Gh0st**Rat.pdf

Results with YAF Signatures

```
(25) _____$ rwstats --fields=29 --xargs=destroy-flow/silkfiles.txt --top --count=50
INPUT: 379068 Records for 31 Bins and 379068 Total Records
OUTPUT: Top 50 Bins by Records
appli|   Records|  %Records|   cumul_%|
    0|    138766| 36.607152| 36.607152|
 9969|     52080| 13.738960| 50.346112|
   80|     43263| 11.412992| 61.759104|
  139|     38170| 10.069433| 71.828537|
 9999|     32076|  8.461806| 80.290344|
 9989|     27998|  7.386010| 87.676354|
  137|     20324|  5.361571| 93.037925|
   53|     16675|  4.398947| 97.436871|
 9962|      2638|  0.695917| 98.132789|
 9991|      2140|  0.564543| 98.697331|
 9955|       950|  0.250615| 98.947946|
 9965|       860|  0.226872| 99.174818|
 9960|       724|  0.190995| 99.365813|
 9971|       384|  0.101301| 99.467114|
 9974|       378|  0.099718| 99.566832|
 9954|       348|  0.091804| 99.658636|
 9942|       344|  0.090749| 99.749385|
 9967|       182|  0.048012| 99.797398|
 9952|       172|  0.045374| 99.842772|
  119|       160|  0.042209| 99.884981|
 9916|       128|  0.033767| 99.918748|
 3306|        68|  0.017939| 99.936687|
 9938|        64|  0.016884| 99.953570|
 9944|        62|  0.016356| 99.969926|
 9945|        60|  0.015828| 99.985755|
 9950|        28|  0.007387| 99.993141|
 9927|        12|  0.003166| 99.996307|
 1080|         6|  0.001583| 99.997890|
  194|         4|  0.001055| 99.998945|
 9919|         2|  0.000528| 99.999472|
 9979|         2|  0.000528|100.000000|
```

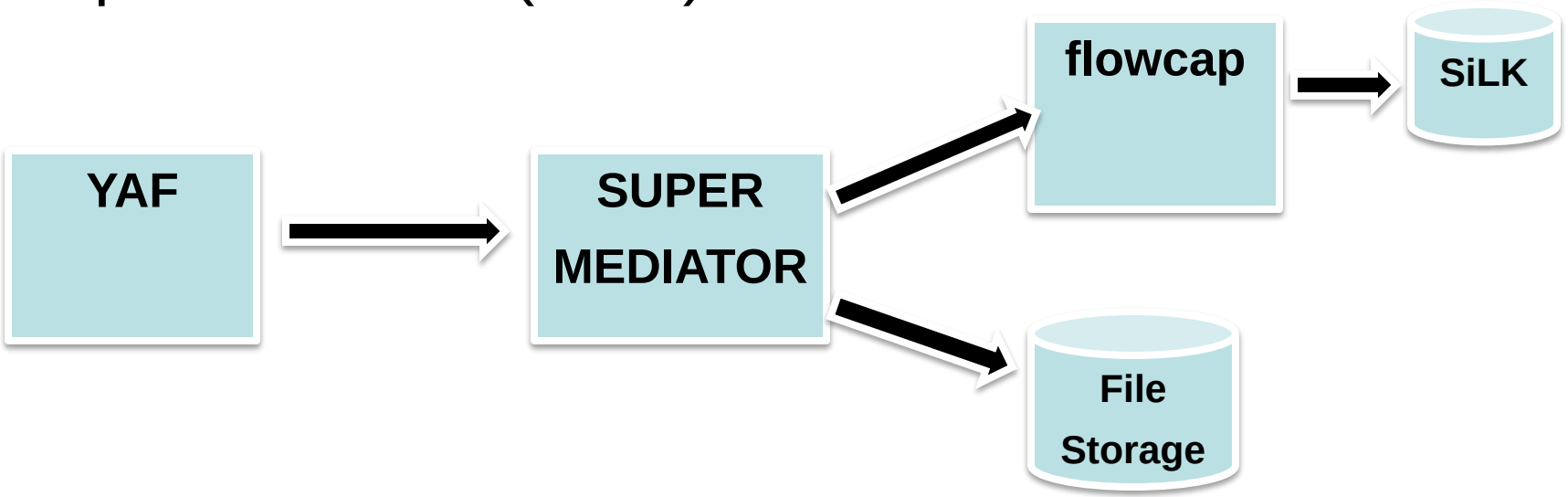
Super_mediator

A very configurable IPFIX mediator

Collects every IPFIX information element YAF can export

Multiple exporters

Multiple collectors (v.1.0)



Super_mediator configuration

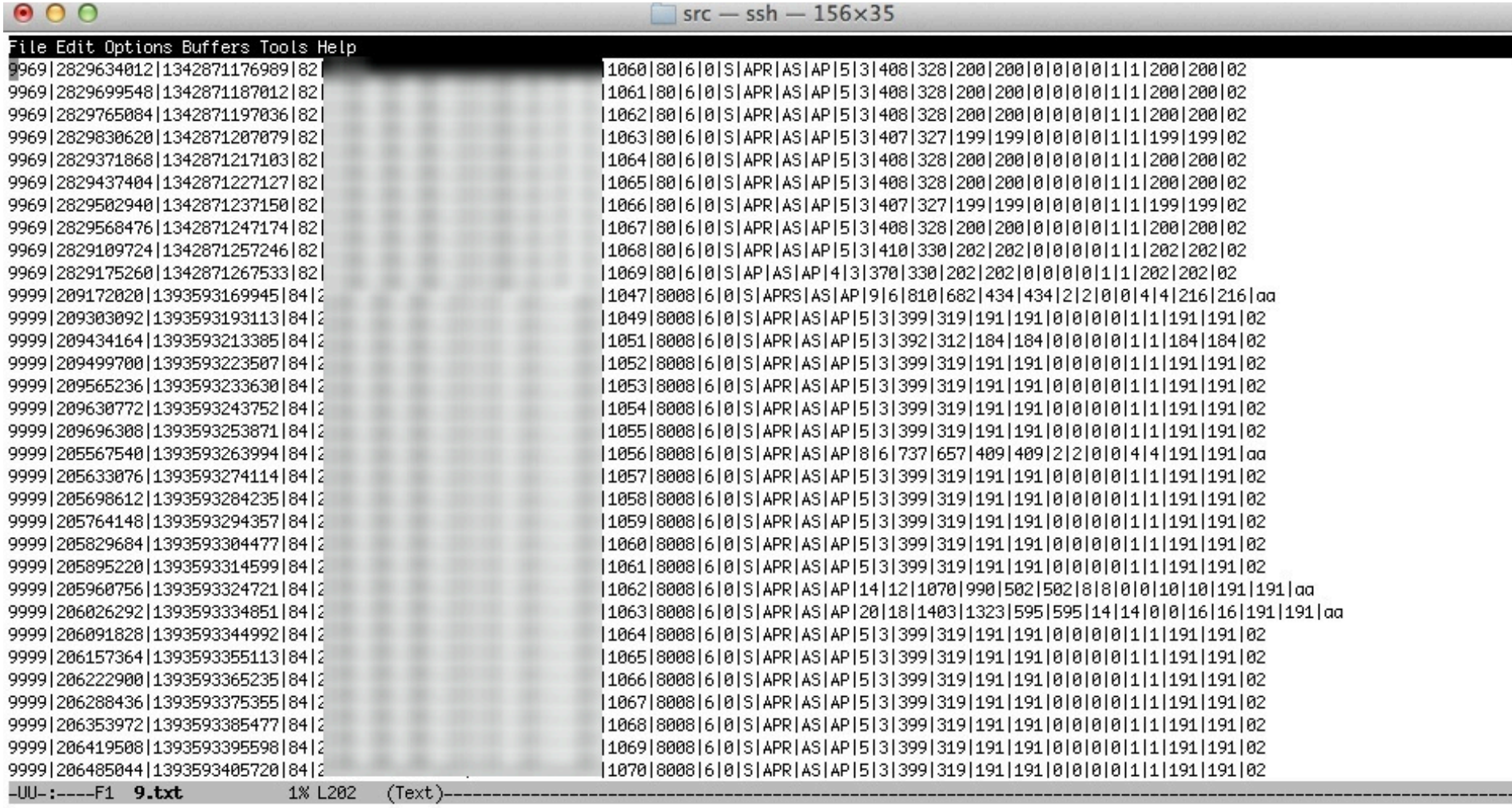
Listing application label first allowed for quick binning by variant.

Super_mediator Results:

- 227,833 Total Bi-flows
- 60,816 Bi-flows Gh0st
- 86,053 Unidentified

Application
Hash
Stimems
Domain
Sip
Dip
Sport
Dport
Protocol
vlanint
Iflags
Uflags
Riflags
Ruflags
Pkts,
Rpkts
Bytes
Rbytes
Databytes
Rdatabytes
Smallpkts
Rsmallpkts
Largepkts
Rlargepkts
Nonemptypkts
Rnonemptypkts
Maxsize
Rmaxsize
Firsteight

Finding a Pattern



Analysis Part 1

Remove unwanted flows from unidentified flows:

- Remove flows with source/destination port 138,139.
- Remove flows with initialTCPFlags = ‘R’
- Remove flows with dataByteCount = 0

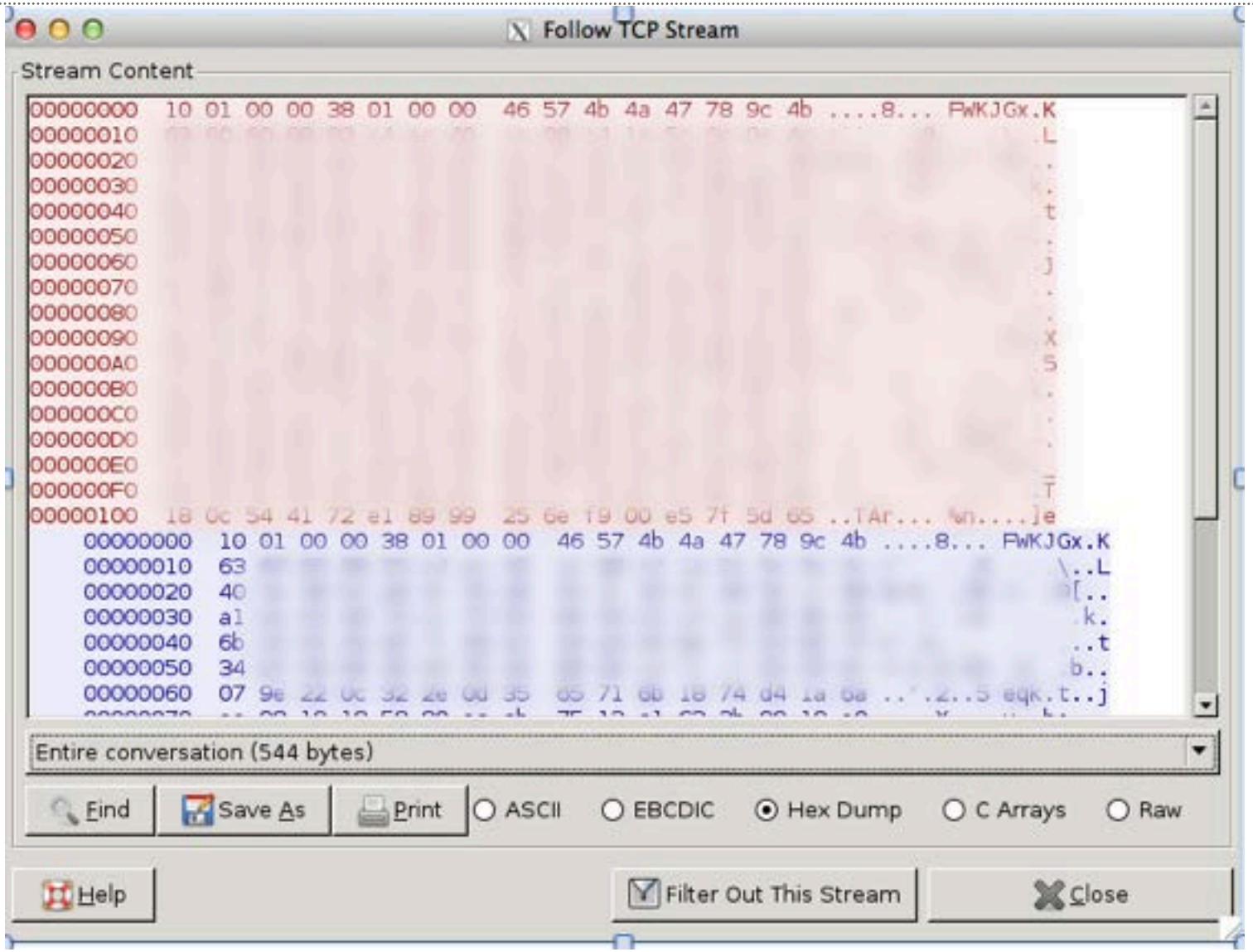
Find flows with pattern:

- No more than 1 small packet (forward), 0 reverse
- Non-empty packets = 1 or 2 (forward), 1 reverse
- maxPacketSize = reverseMaxPacketSize
- firstEightPacketDirection = 0x02

Results:

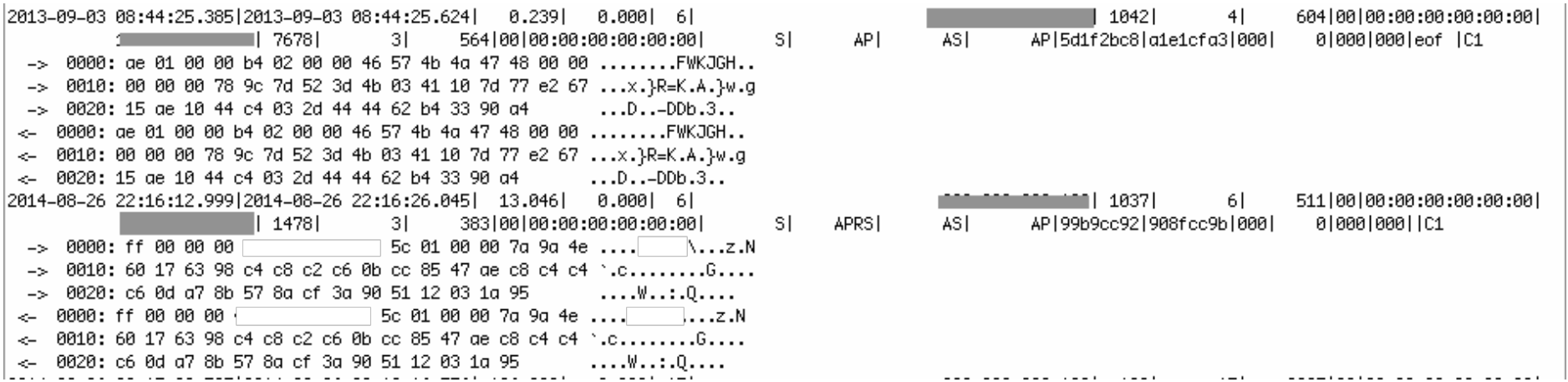
- 44,468 bi-flows removed
- 37,500 bi-flows with pattern
- 4,085 bi-flows did not follow pattern

Finding Gh0st Variants and Signatures



Analysis Part 2

Run unidentified PCAP files through YAF again and export first 100 bytes of payload



Results

Identified several signature variants of Gh0st

Found 55 new Gh0st variants

Created YAF Application Label for Gh0st

- Correctly identifies 97% of Gh0st traffic.

Searching for Gh0st in DEFCON CTF PCAP

DEFCON CTF PCAP Data

Goal: Test new Gh0st application label

Defcon CTF PCAP Data

- 409 GB
- Separated by team and day

src — ssh — 1

```
(18)        $ /usr/bin/rwstats --fields=29 --xargs=silk/silk
INPUT: 82586983 Records for 27 Bins and 82586983 Total Recor
OUTPUT: Top 50 Bins by Records
appli|   Records|  %Records|   cumul_%|
    0|  47893534| 57.991626| 57.991626|
   53|  19315635| 23.388232| 81.379857|
   80|   7272364|  8.805702| 90.185560|
  143|   4206068|  5.092895| 95.278454|
  443|   3340463|  4.044781| 99.323236|
  427|    504523|  0.610899| 99.934135|
   67|     20009|  0.024228| 99.958363|
   22|     10450|  0.012653| 99.971016|
   21|      7420|  0.008984| 99.980000|
  137|      5423|  0.006566| 99.986567|
 5004|      3783|  0.004581| 99.991148|
  194|      3122|  0.003780| 99.994928|
 6881|      1988|  0.002407| 99.997335|
  139|       642|  0.000777| 99.998112|
  119|       360|  0.000436| 99.998548|
  554|       290|  0.000351| 99.998899|
  161|       247|  0.000299| 99.999198|
  389|       153|  0.000185| 99.999384|
 5222|       125|  0.000151| 99.999535|
 5060|       114|  0.000138| 99.999673|
   69|       114|  0.000138| 99.999811|
  902|        48|  0.000048| 99.999860|
 9997|        38|  0.000046| 99.999906|
 5190|        38|  0.000046| 99.999952|
   25|        28|  0.000034| 99.999985|
  110|         8|  0.000010| 99.999995|
 5900|         4|  0.000005|100.000000|
```

Investigating “Gh0st” in DEFCON

src — ssh — 158×61

```
(23)      $ /usr/bin/rwfilter --application=9997 --pass-dest=stdout --xargs=silk/silkfiles.txt | /usr/bin/rwsilk2ipfix | /analysis/ecoff/bin/getFlowKeyHash
          sIP|           dIP|sPort|dPort|pro| vlan|      hash|              ms
   10.5.19.104|     10.5.18.2|53388| 8888|  6|    0|3498853266|      1407517727292
     10.5.18.2|    10.5.19.104| 8888|53388|  6|    0| 582529446|      1407517727292
   10.5.19.111|      10.5.1.2|52646| 8888|  6|    0|3450228885|      1407526153262
      10.5.1.2|    10.5.19.111| 8888|52646|  6|    0| 582533003|      1407526153262
      10.5.1.2|     10.5.18.2|53388| 8888|  6|    0|3498856952|      1407517727292
     10.5.18.2|      10.5.1.2| 8888|53388|  6|    0| 582525900|      1407517727292
      10.5.1.2|    10.5.11.111|59014|47989|  6|    0|3867595096|      1407622961660
   10.5.11.111|      10.5.1.2|47989|59014|  6|    0|3145043115|      1407622961660
      10.5.6.2|    10.5.11.113|59503|   80|  6|    0|3899616611|      1407623040275
   10.5.11.113|      10.5.6.2|   80|59503|  6|    0|   5277020|      1407623040275
      10.5.6.2|    10.5.11.117|59541| 9001|  6|    0|3902098974|      1407623048722
   10.5.11.117|      10.5.6.2| 9001|59541|  6|    0| 589923746|      1407623048722
     10.5.13.2|    10.5.11.113|59578|  443|  6|    0|3904530312|      1407623055575
   10.5.11.113|     10.5.13.2|  443|59578|  6|    0|  29068937|      1407623055575
      10.5.9.2|    10.5.11.113|59587| 2293|  6|    0|3905120966|      1407623058137
   10.5.11.113|      10.5.9.2| 2293|59587|  6|    0| 150309616|      1407623058137
     10.5.12.2|    10.5.11.117|59699| 8888|  6|    0|3912451471|      1407623093677
   10.5.11.117|     10.5.12.2| 8888|59699|  6|    0| 582520324|      1407623093677
      10.5.3.2|    10.5.11.120|59746|  143|  6|    0|3915540661|      1407623114721
   10.5.11.120|      10.5.3.2|  143|59746|  6|    0|   9404760|      1407623114721
      10.5.2.2|      10.5.9.2|57432| 8888|  6|    0|3763882488|      1407523627665
      10.5.9.2|      10.5.2.2| 8888|57432|  6|    0| 582519576|      1407523627665
   10.5.14.107|    10.5.11.111|59014|47989|  6|    0|3867598385|      1407622961660
   10.5.11.111|    10.5.14.107|47989|59014|  6|    0|3145040834|      1407622961660
   10.5.14.107|    10.5.11.113|59503|   80|  6|    0|3899614474|      1407623040275
   10.5.11.113|    10.5.14.107|   80|59503|  6|    0|   5279029|      1407623040275
   10.5.14.107|    10.5.11.117|59541| 9001|  6|    0|3902097015|      1407623048722
   10.5.11.117|    10.5.14.107| 9001|59541|  6|    0| 589925835|      1407623048722
   10.5.14.107|    10.5.11.113|59578|  443|  6|    0|3904529633|      1407623055575
   10.5.11.113|    10.5.14.107|  443|59578|  6|    0|  29068768|      1407623055575
   10.5.14.107|    10.5.11.113|59587| 2293|  6|    0|3905121711|      1407623058137
   10.5.11.113|    10.5.14.107| 2293|59587|  6|    0| 150310297|      1407623058137
   10.5.14.107|    10.5.11.117|59699| 8888|  6|    0|3912452070|      1407623093677
   10.5.11.117|    10.5.14.107| 8888|59699|  6|    0| 582519917|      1407623093677
   10.5.14.107|    10.5.11.120|59746|  143|  6|    0|3915539932|      1407623114721
   10.5.11.120|    10.5.14.107|  143|59746|  6|    0|   9407537|      1407623114721
     10.5.14.2|      10.5.1.2|52646| 8888|  6|    0|3450228216|      1407526153262
      10.5.1.2|     10.5.14.2| 8888|52646|  6|    0| 582525670|      1407526153262
```

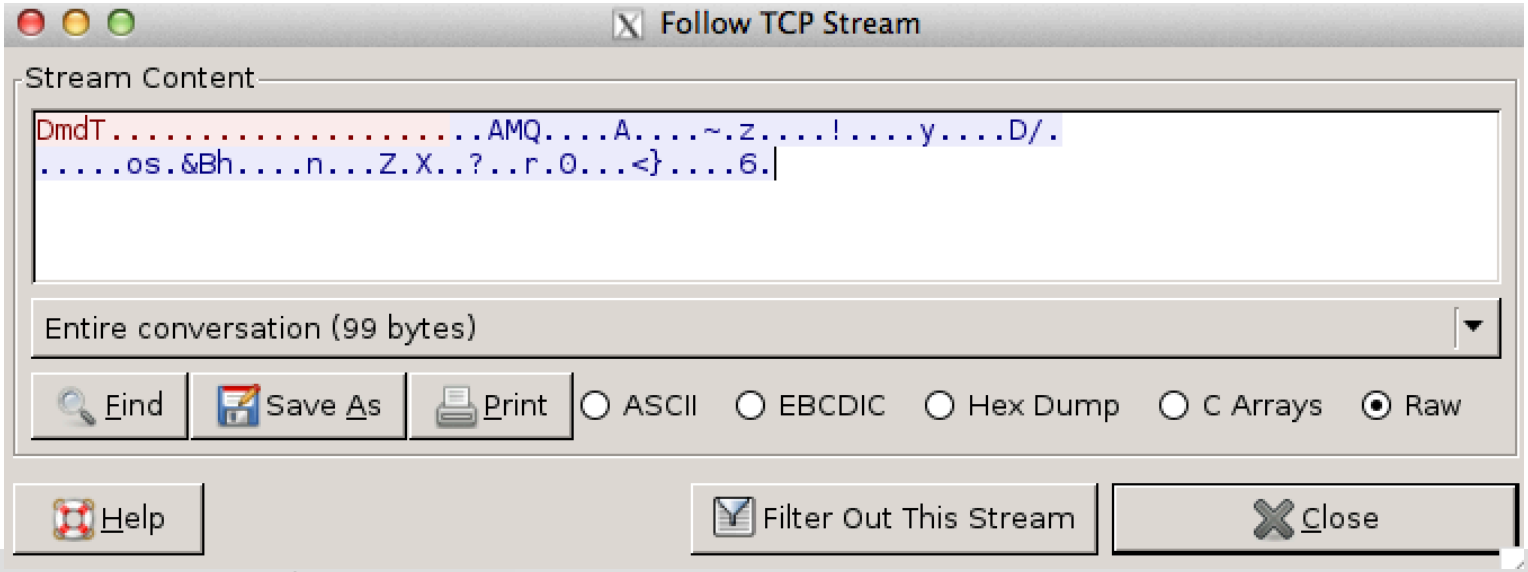
YafMeta2Pcap

Input:

- Large PCAP file or list of PCAP files
- PCAP meta file created by YAF
- Flow key hash and start time

Output

- PCAP file with desired flow



DEFCON Analysis

Used YAF signatures to determine other flows with “DmdT” and “eliza”

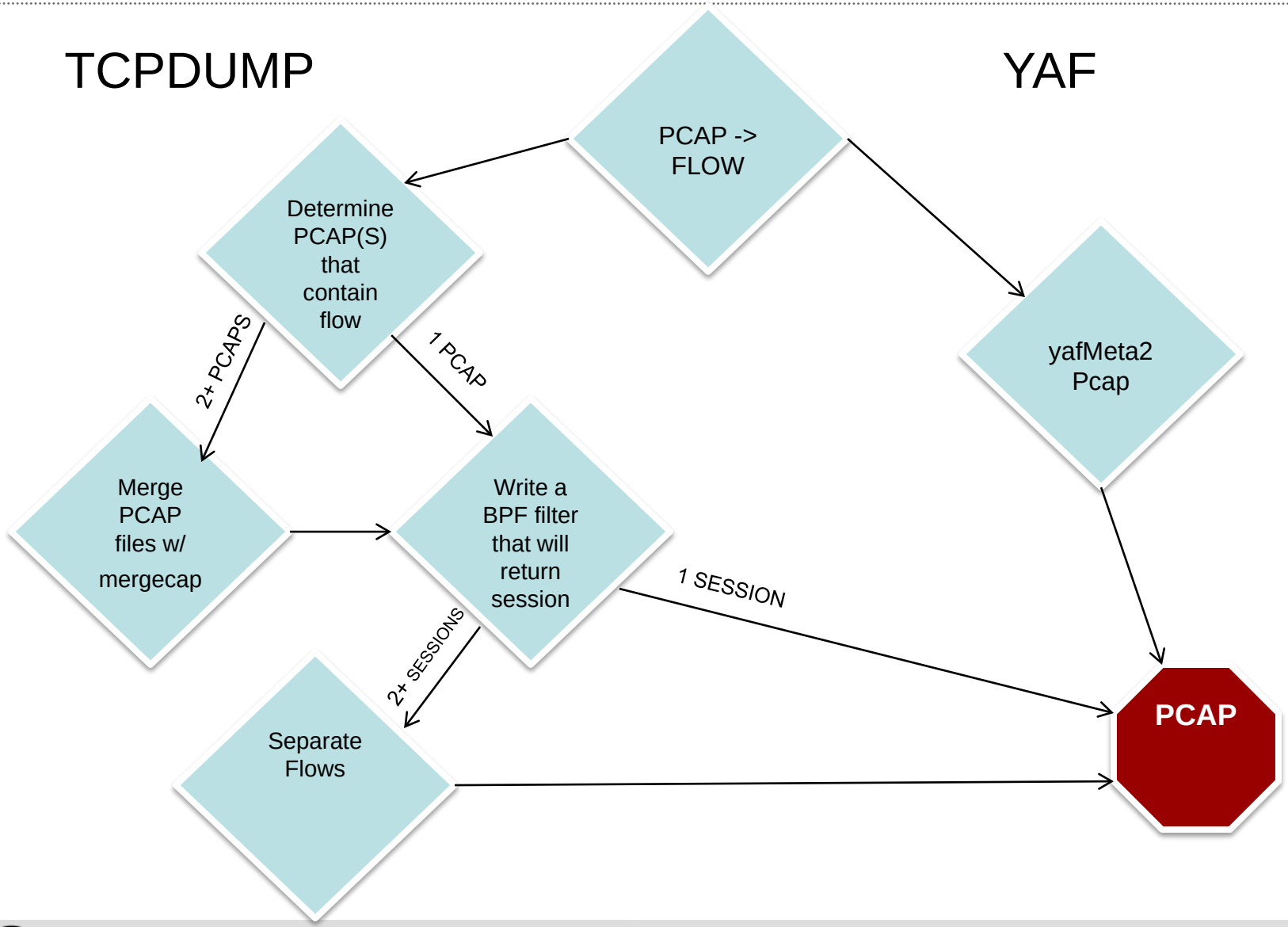
“eliza” was a text-based space economy simulator challenge at CTF

80% of DmdT traffic went to last place team.

INPUT: 82586983 Records for 29 Bins and 82586983 Total Records
OUTPUT: Top 30 Bins by Records

appli	Records	%Records	cumul_%
0	40149632	48.614964	48.614964
53	19515391	23.388178	72.003142
6666	7757938	9.393657	81.396800
80	7255528	8.785317	90.182116
143	4206068	5.092895	95.275011
443	3340449	4.044765	99.319775
427	504523	0.610899	99.930674
67	20009	0.024228	99.954902
22	10450	0.012653	99.967555
21	7420	0.008984	99.976540
137	5423	0.006566	99.983106
5004	3783	0.004581	99.987687
119	3206	0.003882	99.991569
194	3122	0.003780	99.995349
6881	1988	0.002407	99.997756
139	628	0.000760	99.998517
554	276	0.000334	99.998851
161	247	0.000299	99.999150
389	139	0.000168	99.999318
5223	125	0.000151	99.999470
8888	118	0.000143	99.999613
3060	100	0.000121	99.999734
69	100	0.000121	99.999855
902	40	0.000048	99.999903
5190	38	0.000046	99.999949
25	28	0.000034	99.999983
110	8	0.000010	99.999993
5900	4	0.000005	99.999998
3306	2	0.000002	100.000000

Method Comparison



Questions?

CERT NetSA tools website:

tools.netsa.cert.org

Contact:

ecoff@cert.org

netsa-tools-discuss@cert.org

netsa-help@cert.org

Presentation Abstract

Finding a needle in a PCAP

It can be difficult to find what we are looking for in a large PCAP repository, even when we know what to look for and where to look. When traffic captures start to enter multi-gigabyte sizes, the number of tools that can even begin processing these files is limited. SiLK and other flow analysis tools provide the tools for quickly narrowing down the search area but when ground truth is required, we are often back to square one when searching for a particular packet or flow in large traffic captures. This presentation will describe the available features in YAF for indexing large PCAP files with flow. We will provide relevant examples of common analysis techniques with various tools from the CERT NetSA Security Suite and how to perform complementary PCAP analysis with YAF. This presentation will also touch on deploying a tiered approach to network monitoring storage and ways to maximize storage without compromising network analysis.