ACTIVE COUNTERMEASURES

Network Threat Hunter Training

Level 1

Thanks to our sponsors!

Continue Your Training

- Weekly blogs including malware of the day
  https://www.activecountermeasures.com/blog/
- Check out our Webcasts
  https://www.activecountermeasures.com/webcasts/
- Advanced threat hunter training
  https://wildwesthackinfest.com/training/advanced-network-threat-hunting-chris-brenton/
  - ▷ Next open advanced class is the end of March

Before we get started

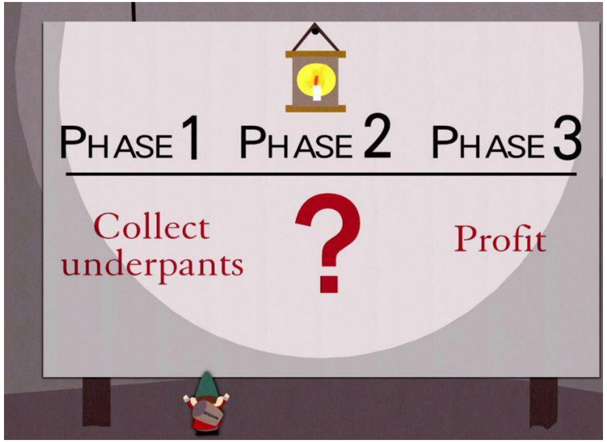
- You'll need the class VM to do the labs
- Login info:
  - Name: thunt
  - Pass: aybab2u
- Or run the install script (currently beta)
- This should have been done before class :-)
- Slides are now available as well

Logistics

- 10 minute break at top of 1st and 3rd hour
- 20 minute break at midpoint
- Use the Discord channel for discussion
  - #acm-webcast-chat channel
- The team is monitoring for your questions

In this webcast

- I'm going to question some industry accepted standard practices
  - Because what we are doing is broken
  - And it's not getting any better
- Please keep an open mind
- Prime cognitive bias fodder



How we (try to) catch the bad guys

- Centralized log collection
- Write "signatures" to identify patterns that may indicate an attack
  - Patterns in the log messages
  - Matches against intel feeds
- Alert on signature matches
- Follow up on alerts

Limitations of system logging

- Syslog was not designed for security
  - Facility 13 is "security/log audit"
  - But rarely used in a general security context
  - More appropriate as a severity level
  - But there is no "security" severity level
- No standard for message context
  - Different platforms log events differently
  - Different applications log events differently
- Decoder ring not included

Limitations of deployment

- Every device and system?
- Are you sure?
- Are you REALLY sure?
  - I have yet to see an environment that can accurately make this claim
  - Even when you log, adversaries can disable this
- **"Fail open" system**
  - Can access Internet without logging and no alert
  - Can you detect disabled logging?

What are signatures?

- Basically RegEx for logs
- Sometimes with pretty graphics
- Match known bad patterns
- Because adversaries have stopped innovating and we now know all of the possible bad patterns they can use
- Oh wait…
- This is the 1990's anti-virus model

Lack of innovation

- Log review to detect attacks is old
  - Older than IDS
  - Older than firewalls
- First SANS logging course early 2000's
- Not much has changed

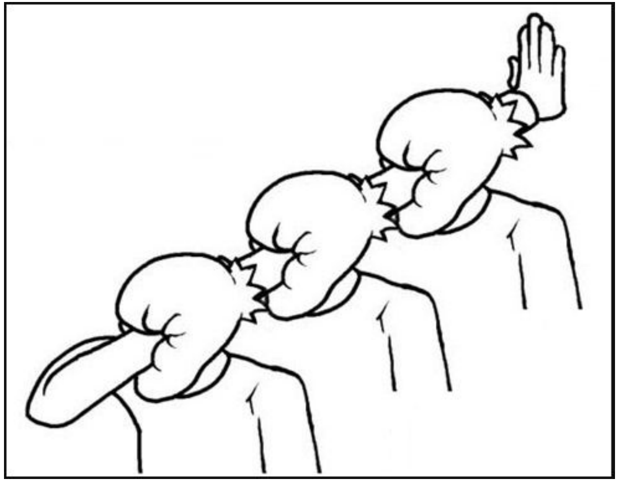
OK to still wear parachute pants?

Is there data showing its broken?

- Out of 1,200 orgs surveyed, 71% breached
  - [451 Group 2018 Global Threat Report]
- Less than 50% of breaches get detected internally
  - [2019 Verizon Breach Report]
- 40% of orgs that think they are threat hunting, are not
  - [SANS 2019 Threat Hunting Survey]
- **On average, 191-197 days to ID a breach & 66-69 days to contain it**
  - [Ponemon Institute 2017 study]
  - [2018 IBM Global Breach Study]

2019 Verizon Breach Report

But we review our SIEM logs!



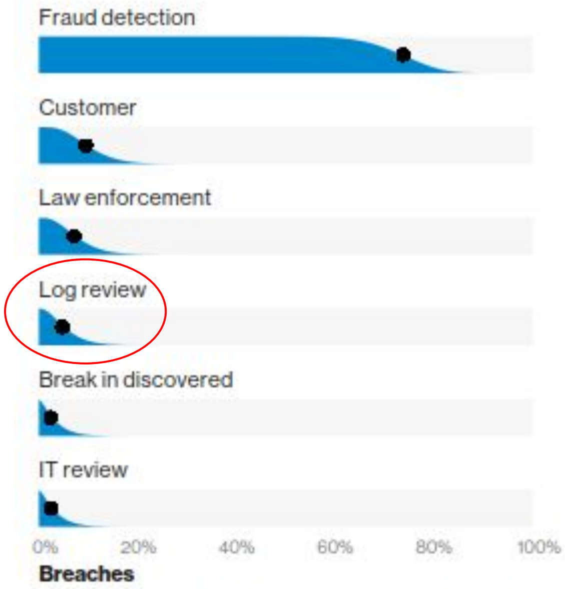


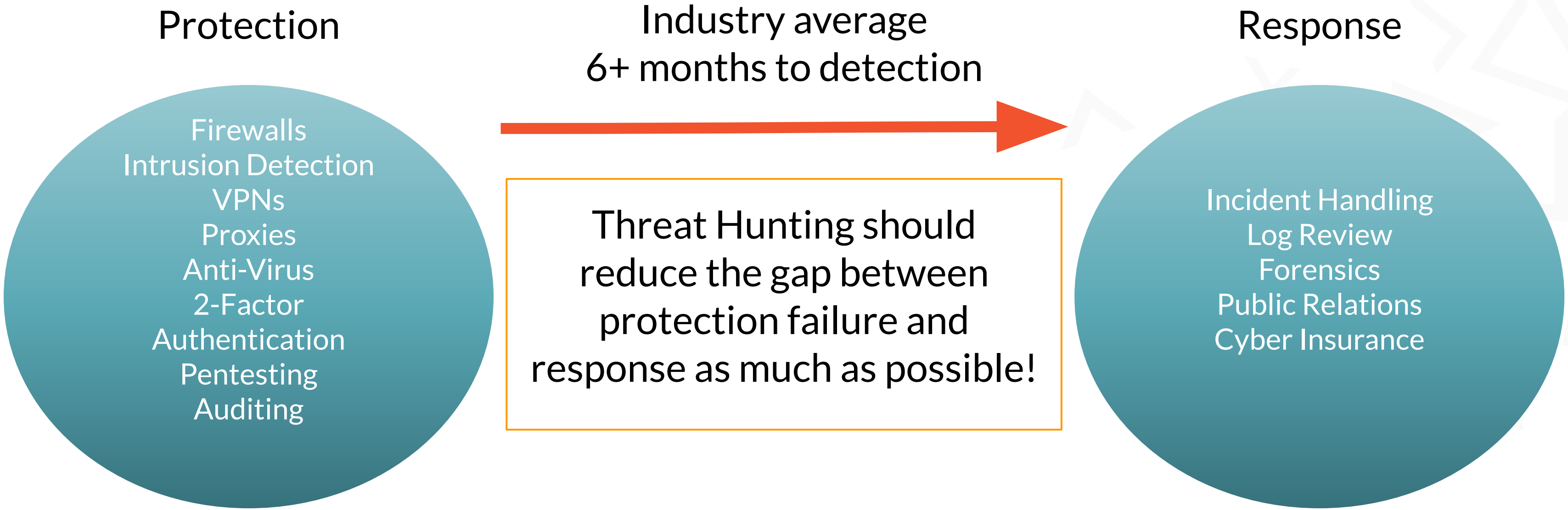
Figure 45. Discovery methods in Accommodation breaches (n=42)

POS devices 100% external detection

So is log review threat hunting?

- Just to review
  - Protocol can't describe security events
  - It's a fail open system
  - We try to pattern match on old attack patterns
  - False positive rates are extremely high
  - It's old technology
- The data says otherwise
- This process is clearly broken
- We need to assess new ideas and improve

The Purpose of Threat Hunting



Protection

Firewalls
Intrusion Detection
VPNs
Proxies
Anti-Virus
2-Factor
Authentication
Pentesting
Auditing

Industry average
6+ months to detection

Threat Hunting should reduce the gap between protection failure and response as much as possible!

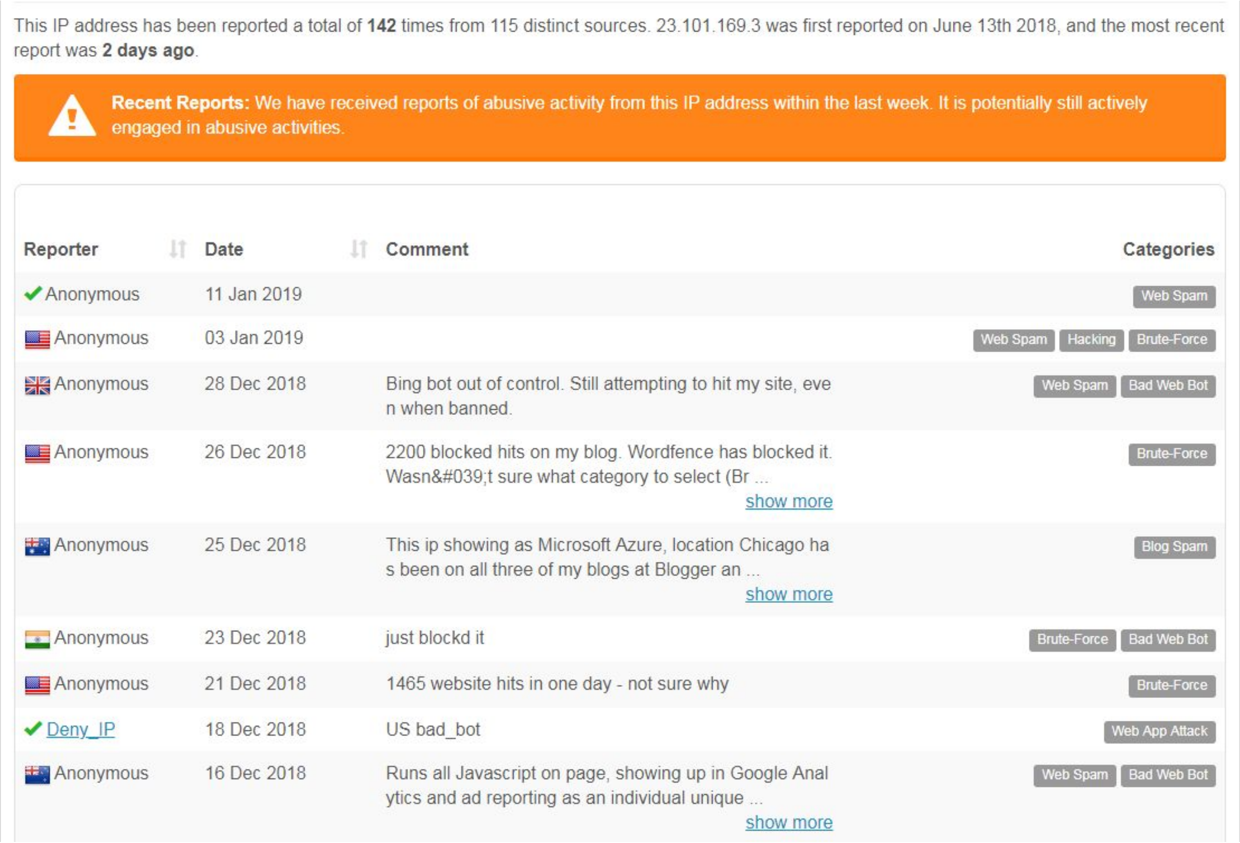
Response

Incident Handling
Log Review
Forensics
Public Relations
Cyber Insurance

I'm good, I use threat intel feeds

- Match on IP because someone said it's bad
- Also based on 1990's AV technology
- Is the data really actionable?
  - Adversaries frequently change IPs and DNS
  - Tend to use shared IP space
  - The accuracy is dependent on the reporter
- A threat intel match does not mean you've prevented an attack

Bing bot - false positive

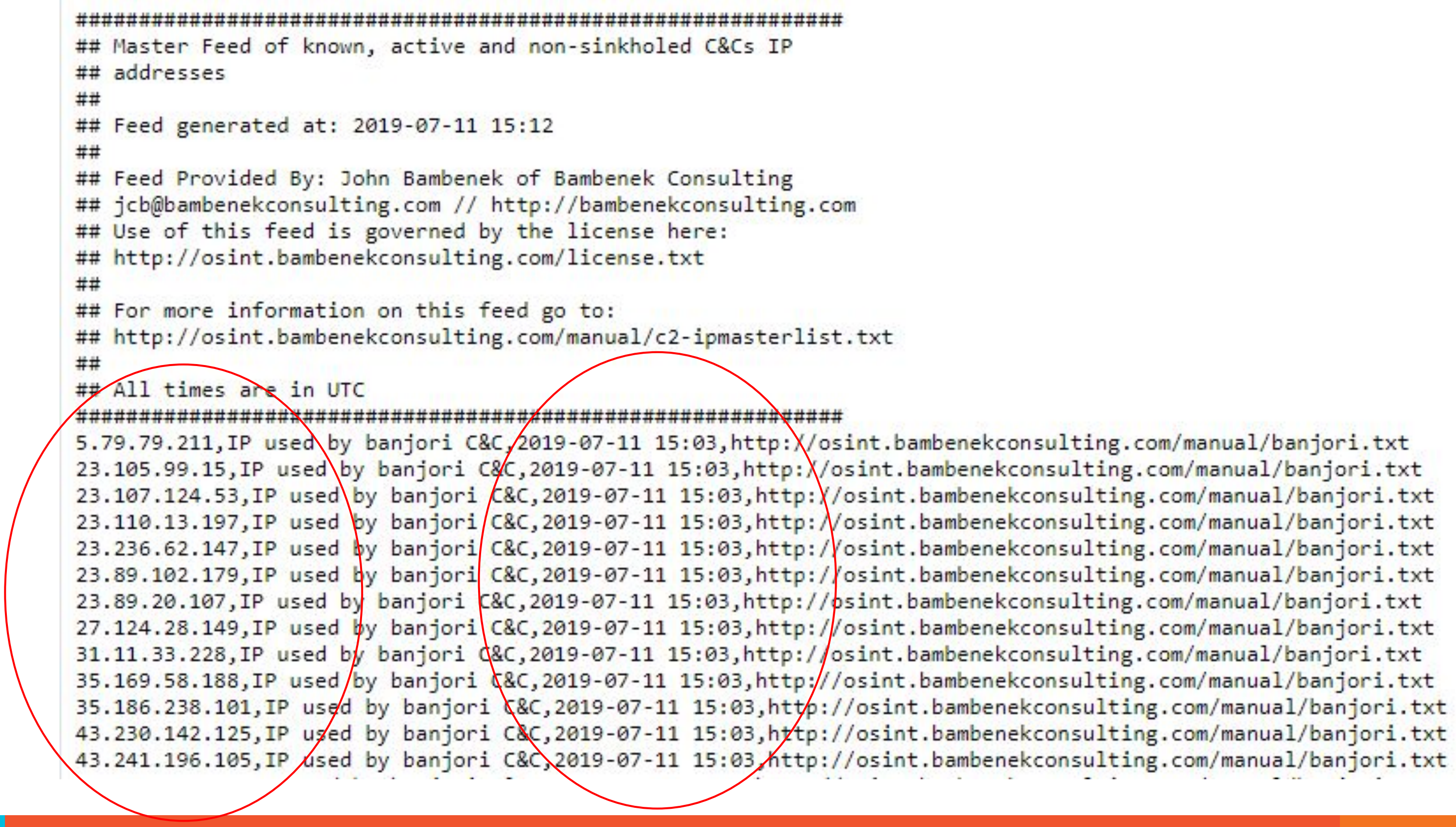


This IP address has been reported a total of **142** times from 115 distinct sources. 23.101.169.3 was first reported on June 13th 2018, and the most recent report was **2 days ago**.

Recent Reports: We have received reports of abusive activity from this IP address within the last week. It is potentially still actively engaged in abusive activities.

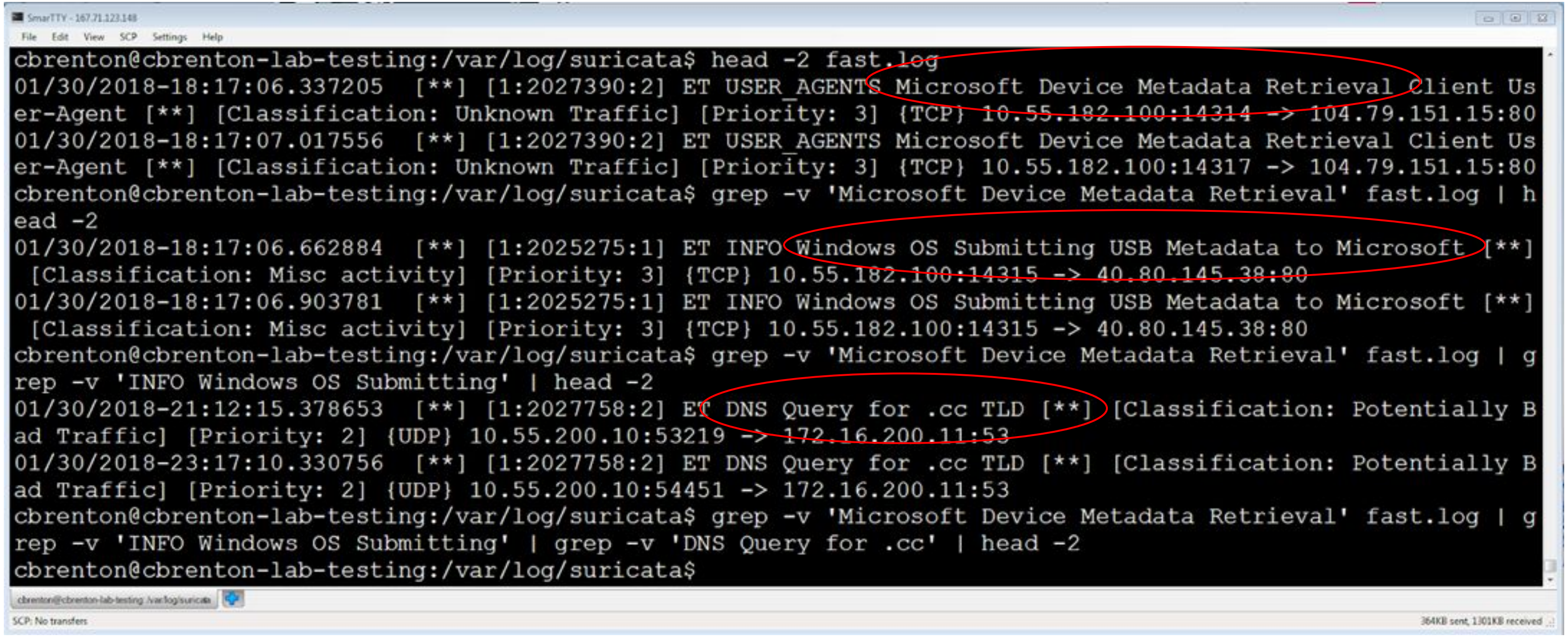
Reporter	Date	Comment	Categories
✓ Anonymous	11 Jan 2019		Web Spam
🇺🇸 Anonymous	03 Jan 2019		Web Spam Hacking Brute-Force
🇬🇧 Anonymous	28 Dec 2018	Bing bot out of control. Still attempting to hit my site, eve n when banned.	Web Spam Bad Web Bot
🇺🇸 Anonymous	26 Dec 2018	2200 blocked hits on my blog. Wordfence has blocked it. Wasn&#039;t sure what category to select (Br ... show more	Brute-Force
🇦🇺 Anonymous	25 Dec 2018	This ip showing as Microsoft Azure, location Chicago ha s been on all three of my blogs at Blogger an ... show more	Blog Spam
🇮🇳 Anonymous	23 Dec 2018	just blockd it	Brute-Force Bad Web Bot
🇺🇸 Anonymous	21 Dec 2018	1465 website hits in one day - not sure why	Brute-Force
✓ Deny_IP	18 Dec 2018	US bad_bot	Web App Attack
🇦🇺 Anonymous	16 Dec 2018	Runs all Javascript on page, showing up in Google Anal ytics and ad reporting as an individual unique ... show more	Web Spam Bad Web Bot

Sample threat feed



```
#############################################################
## Master Feed of known, active and non-sinkholed C&Cs IP
## addresses
##
## Feed generated at: 2019-07-11 15:12
##
## Feed Provided By: John Bambenek of Bambenek Consulting
## jcb@bambenekconsulting.com // http://bambenekconsulting.com
## Use of this feed is governed by the license here:
## http://osint.bambenekconsulting.com/license.txt
##
## For more information on this feed go to:
## http://osint.bambenekconsulting.com/manual/c2-ipmasterlist.txt
##
## All times are in UTC
#############################################################
5.79.79.211,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.105.99.15,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.107.124.53,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.110.13.197,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.236.62.147,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.89.102.179,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
23.89.20.107,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
27.124.28.149,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
31.11.33.228,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
35.169.58.188,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
35.186.238.101,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
43.230.142.125,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
43.241.196.105,IP used by banjori C&C,2019-07-11 15:03,http://osint.bambenekconsulting.com/manual/banjori.txt
```

Can I threat hunt with my NIDS?


SmarTTY - 167.71.123.148
File
Edit
View
SCP
Settings
Help
cbrenton@cbrenton-lab-testing:/var/log/suricata
SCP: No transfers
364KB sent, 1301KB received

```
cbrenton@cbrenton-lab-testing:/var/log/suricata$ head -2 fast.log
01/30/2018-18:17:06.337205  [**] [1:2027390:2] ET USER_AGENTS Microsoft Device Metadata Retrieval Client Us
er-Agent [**] [Classification: Unknown Traffic] [Priority: 3] {TCP} 10.55.182.100:14314 -> 104.79.151.15:80
01/30/2018-18:17:07.017556  [**] [1:2027390:2] ET USER_AGENTS Microsoft Device Metadata Retrieval Client Us
er-Agent [**] [Classification: Unknown Traffic] [Priority: 3] {TCP} 10.55.182.100:14317 -> 104.79.151.15:80
cbrenton@cbrenton-lab-testing:/var/log/suricata$ grep -v 'Microsoft Device Metadata Retrieval' fast.log | h
ead -2
01/30/2018-18:17:06.662884  [**] [1:2025275:1] ET INFO Windows OS Submitting USB Metadata to Microsoft [**]
 [Classification: Misc activity] [Priority: 3] {TCP} 10.55.182.100:14315 -> 40.80.145.38:80
01/30/2018-18:17:06.903781  [**] [1:2025275:1] ET INFO Windows OS Submitting USB Metadata to Microsoft [**]
 [Classification: Misc activity] [Priority: 3] {TCP} 10.55.182.100:14315 -> 40.80.145.38:80
cbrenton@cbrenton-lab-testing:/var/log/suricata$ grep -v 'Microsoft Device Metadata Retrieval' fast.log | g
rep -v 'INFO Windows OS Submitting' | head -2
01/30/2018-21:12:15.378653  [**] [1:2027758:2] ET DNS Query for .cc TLD [**] [Classification: Potentially B
ad Traffic] [Priority: 2] {UDP} 10.55.200.10:53219 -> 172.16.200.11:53
01/30/2018-23:17:10.330756  [**] [1:2027758:2] ET DNS Query for .cc TLD [**] [Classification: Potentially B
ad Traffic] [Priority: 2] {UDP} 10.55.200.10:54451 -> 172.16.200.11:53
cbrenton@cbrenton-lab-testing:/var/log/suricata$ grep -v 'Microsoft Device Metadata Retrieval' fast.log | g
rep -v 'INFO Windows OS Submitting' | grep -v 'DNS Query for .cc' | head -2
cbrenton@cbrenton-lab-testing:/var/log/suricata$
```

But empire and dnscat2 were missed

What Threat Hunting should be

- A proactive validation of all systems connected to the organization's network
- Needs to include all systems
  - Desktops, laptops, cellphones, tablets
  - Servers, network gear, printers
  - IoT, IIoT, any type of Internet "Thing"
- Execute without making assumptions
- Deliverable is a compromise assessment

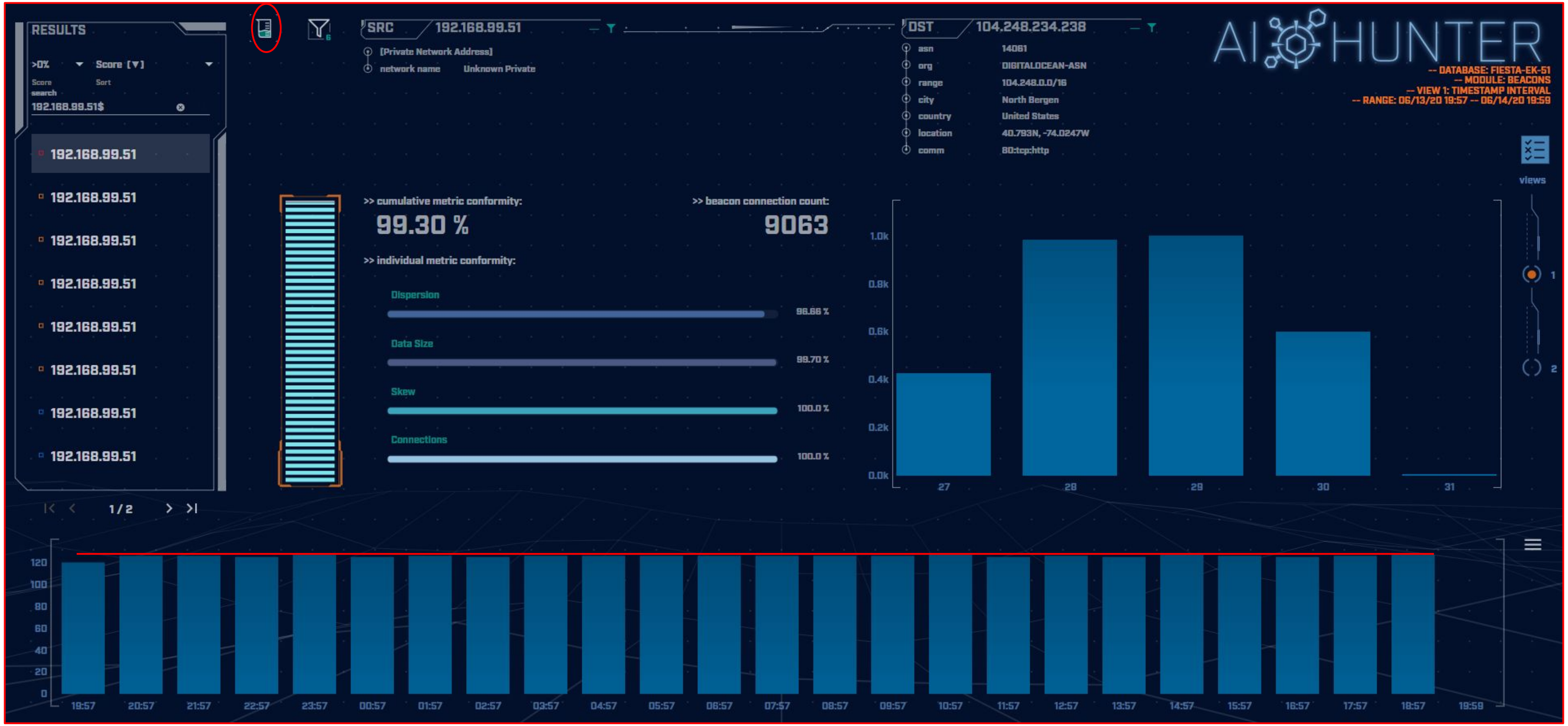
The process of threat hunting

- Review the integrity of every device
  - Desktops, servers, network gear, IoT, IIoT, etc.
- Generate one of 3 dispositions
  - I'm pretty certain the system is safe
  - I'm pretty certain the system is compromised
  - I'm unsure of state so will collect additional info to derive one of the above two results
- Leverage context for host log review

Proposal - Start with the network

- The network is the great equalizer
  - You see everything, regardless of platform
  - High level assessment of the terrain
- You can hide processes but not packets
- Malware is usually controlled
  - Which makes targeting C2 extremely effective
  - Identify compromise when C2 "calls home"
  - Must be frequent enough to be useful
- Wide view so you can target from there

Start on the network



RESULTS

>0% Score [▼]

Score search Sort

192.168.99.51$

192.168.99.51
192.168.99.51
192.168.99.51
192.168.99.51
192.168.99.51
192.168.99.51
192.168.99.51
192.168.99.51

1 / 2

SRC 192.168.99.51

[Private Network Address]

network name Unknown Private

DST 104.248.234.238

asn	14061
org	DIGITALOCEAN-ASN
range	104.248.0.0/16
city	North Bergen
country	United States
location	40.793N, -74.0247W
comm	80:tcp:http

-- DATABASE: FIESTA-EK-51
-- MODULE: BEACONS
-- VIEW 1: TIMESTAMP INTERVAL
-- RANGE: 06/13/20 19:57 -- 06/14/20 19:59

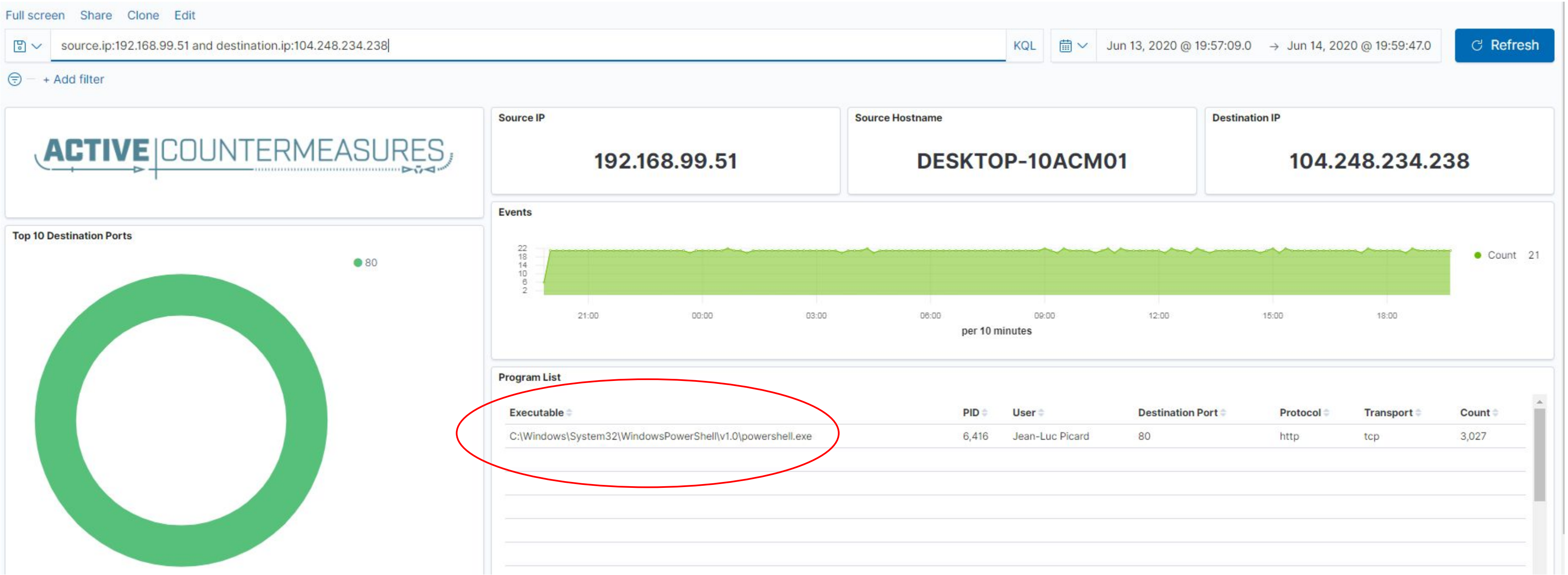
>> cumulative metric conformity:
99.30 %

>> beacon connection count:
9063

>> individual metric conformity:

Dispersion	96.66 %
Data Size	99.70 %
Skew	100.0 %
Connections	100.0 %

THEN pivot to the system logs



source.ip:192.168.99.51 and destination.ip:104.248.234.238

Jun 13, 2020 @ 19:57:09.0 → Jun 14, 2020 @ 19:59:47.0

Source IP: 192.168.99.51

Source Hostname: DESKTOP-10ACM01

Destination IP: 104.248.234.238

Program List

Executable	PID	User	Destination Port	Protocol	Transport	Count
C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	6,416	Jean-Luc Picard	80	http	tcp	3,027

ACTIVE COUNTERMEASURES

C2 Detection Techniques

Where to Start

- Traffic to and from the Internet
  - Monitor internal interface of firewall
- Packet captures or Bro/Zeek data
- Analyze in large time blocks
  - More data = better fidelity
  - Minimum of 12 hours, 24 is ideal
- Analyze communications in pairs
  - For every internal IP, each external IP connected to
  - Ignore internal to internal (high false positive)

Threat hunting process order

- Persistent connection?
  - No = No further action required
  - Yes = Go to next step
- Abnormal protocol behaviour?
- Reputation check of external IP
- Investigation of internal IP
- Disposition
  - Safe = whitelist
  - Compromised = incident handling

Threat score system

- Our job is to disposition IPs
- How do you know when to make a choice?
- A numeric system can help guide you
  - Score of 0 = system is safe
  - Score of 100 = system is compromised
- Score modifiers
  - Major - A clue that strongly indicates integrity state
  - Minor - A clue that peripherally indicates integrity state

Score examples

- Major score modifier
  - Persistency of connection
  - Unexpected protocol on well known port
  - Moving lots of data to a threat intel IP address
- Minor modifier
  - Moving lots of data to a random IP
  - Unique client signature
  - self signed digital certificate
  - EV digital certificate (reduce score)

Does targeting C2 have blind spots?

- Attackers motivated by gain
  - Information
  - Control of resources
- Sometimes "gain" does not require C2
  - Just looking to destroy the target
  - Equivalent to dropping a cyber bomb
  - We are talking nation state at this level
- NotPetya
  - Worm with no C2 designed to seek and destroy

Techniques Vs Methodology

- We are going to deep dive on finding C2
- It's important to understand what needs to happen "under the hood"
- Some of these techniques don't scale
  - Manually breaking out connection pairs
  - But that's OK
- Will focus on tools in a later module
- For now, focus on just the techniques

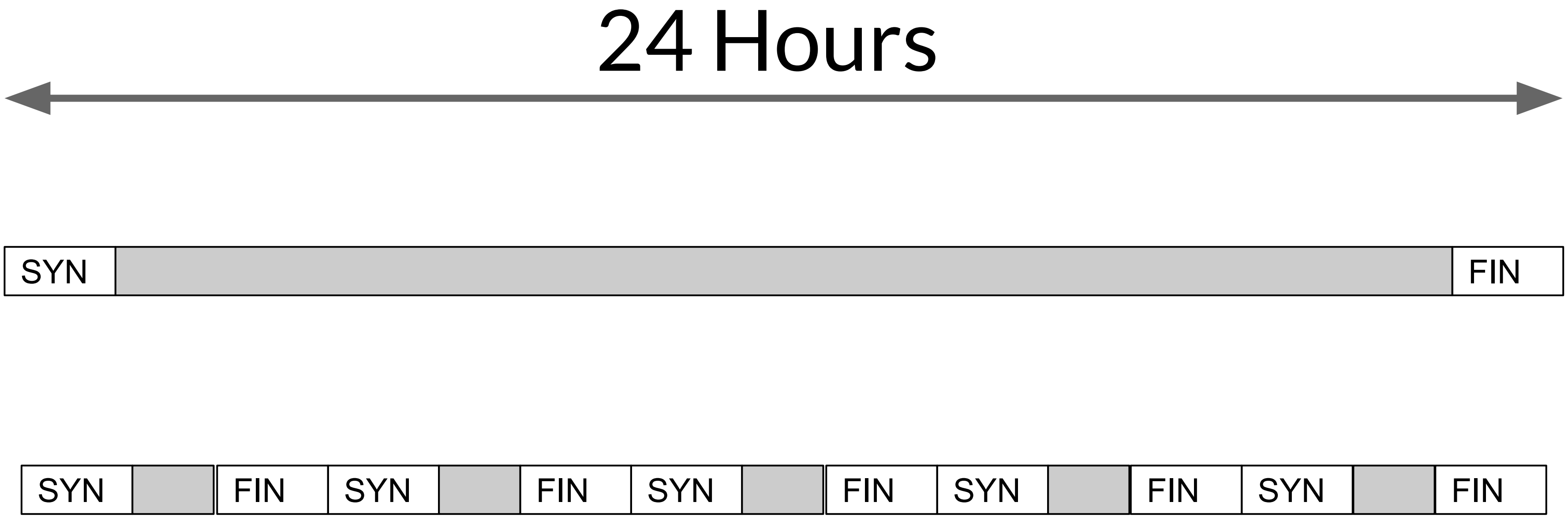
Bad guys Vs. Red Teams

- Bad guys = C2 is part of a business model
- Red team = C2 is why they get paid
- Much harder to detect red team C2 than the real bad guys
  - In the wild, most evil C2 beacons <= 60 seconds
  - Red team on long term contract <= week
- Focus will be on the bad guys

Long connections

- You are looking for:
- Total time for each connection
  - Which ones have gone on the longest?
- Cumulative time for all pair connections
  - Total amount of time the pair has been in contact
- Can be useful to ignore ports or protocols
  - C2 can change channels

Long connection examples

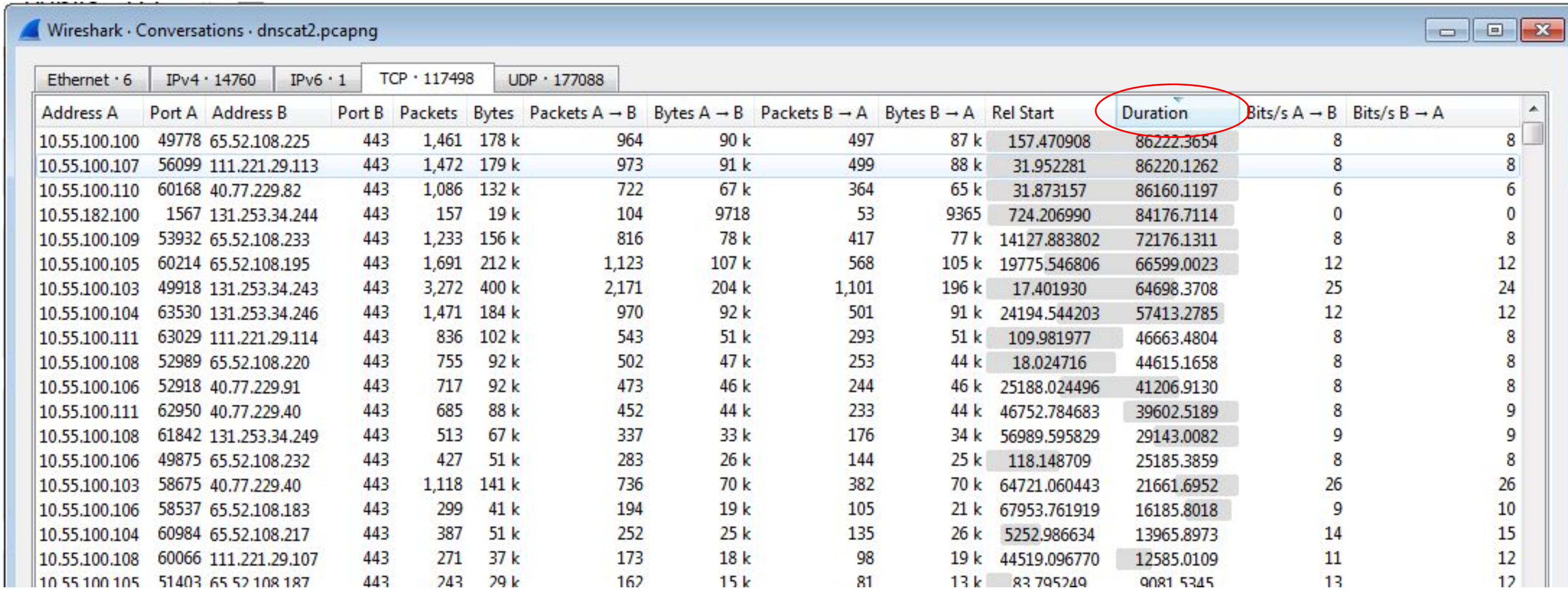


24 Hours

SYN FIN

SYN FIN SYN FIN SYN FIN SYN FIN SYN FIN

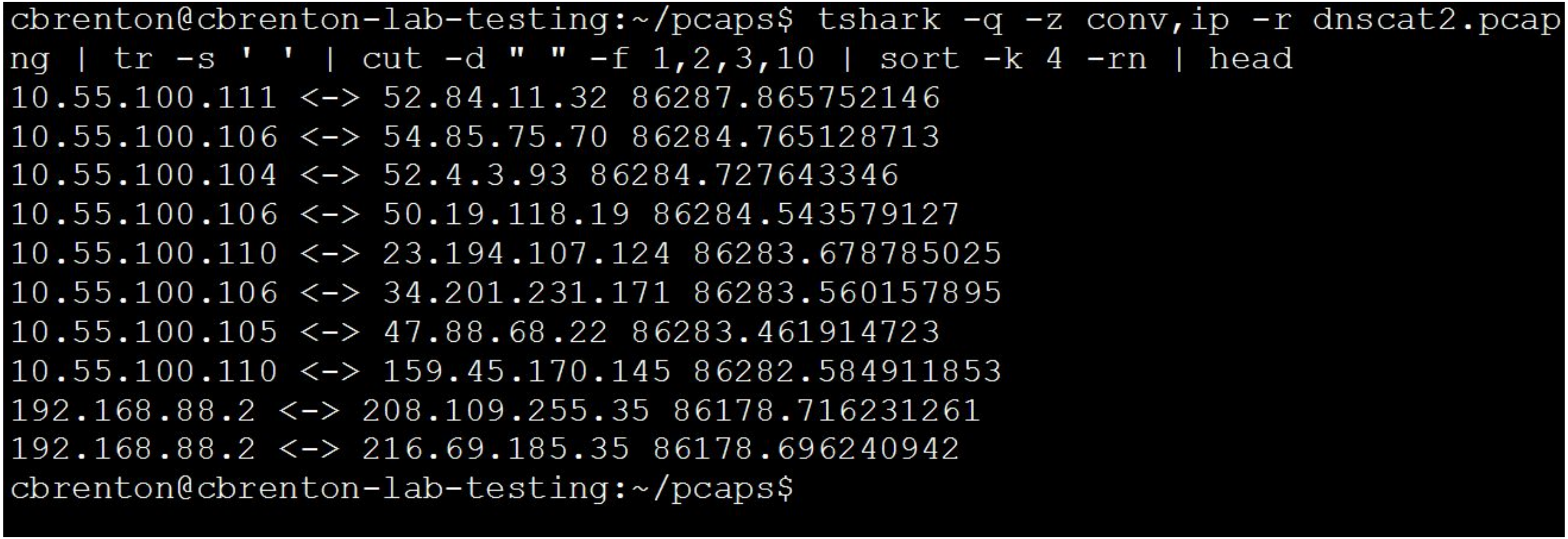
Wireshark-Statistics-Conversations



Address A	Port A	Address B	Port B	Packets	Bytes	Packets A → B	Bytes A → B	Packets B → A	Bytes B → A	Rel Start	Duration	Bits/s A → B	Bits/s B → A
10.55.100.100	49778	65.52.108.225	443	1,461	178 k	964	90 k	497	87 k	157.470908	86222.3654	8	8
10.55.100.107	56099	111.221.29.113	443	1,472	179 k	973	91 k	499	88 k	31.952281	86220.1262	8	8
10.55.100.110	60168	40.77.229.82	443	1,086	132 k	722	67 k	364	65 k	31.873157	86160.1197	6	6
10.55.182.100	1567	131.253.34.244	443	157	19 k	104	9718	53	9365	724.206990	84176.7114	0	0
10.55.100.109	53932	65.52.108.233	443	1,233	156 k	816	78 k	417	77 k	14127.883802	72176.1311	8	8
10.55.100.105	60214	65.52.108.195	443	1,691	212 k	1,123	107 k	568	105 k	19775.546806	66599.0023	12	12
10.55.100.103	49918	131.253.34.243	443	3,272	400 k	2,171	204 k	1,101	196 k	17.401930	64698.3708	25	24
10.55.100.104	63530	131.253.34.246	443	1,471	184 k	970	92 k	501	91 k	24194.544203	57413.2785	12	12
10.55.100.111	63029	111.221.29.114	443	836	102 k	543	51 k	293	51 k	109.981977	46663.4804	8	8
10.55.100.108	52989	65.52.108.220	443	755	92 k	502	47 k	253	44 k	18.024716	44615.1658	8	8
10.55.100.106	52918	40.77.229.91	443	717	92 k	473	46 k	244	46 k	25188.024496	41206.9130	8	8
10.55.100.111	62950	40.77.229.40	443	685	88 k	452	44 k	233	44 k	46752.784683	39602.5189	8	9
10.55.100.108	61842	131.253.34.249	443	513	67 k	337	33 k	176	34 k	56989.595829	29143.0082	9	9
10.55.100.106	49875	65.52.108.232	443	427	51 k	283	26 k	144	25 k	118.148709	25185.3859	8	8
10.55.100.103	58675	40.77.229.40	443	1,118	141 k	736	70 k	382	70 k	64721.060443	21661.6952	26	26
10.55.100.106	58537	65.52.108.183	443	299	41 k	194	19 k	105	21 k	67953.761919	16185.8018	9	10
10.55.100.104	60984	65.52.108.217	443	387	51 k	252	25 k	135	26 k	5252.986634	13965.8973	14	15
10.55.100.108	60066	111.221.29.107	443	271	37 k	173	18 k	98	19 k	44519.096770	12585.0109	11	12
10.55.100.105	51403	65.52.108.187	443	243	29 k	162	15 k	81	13 k	83.795249	9081.5345	13	12

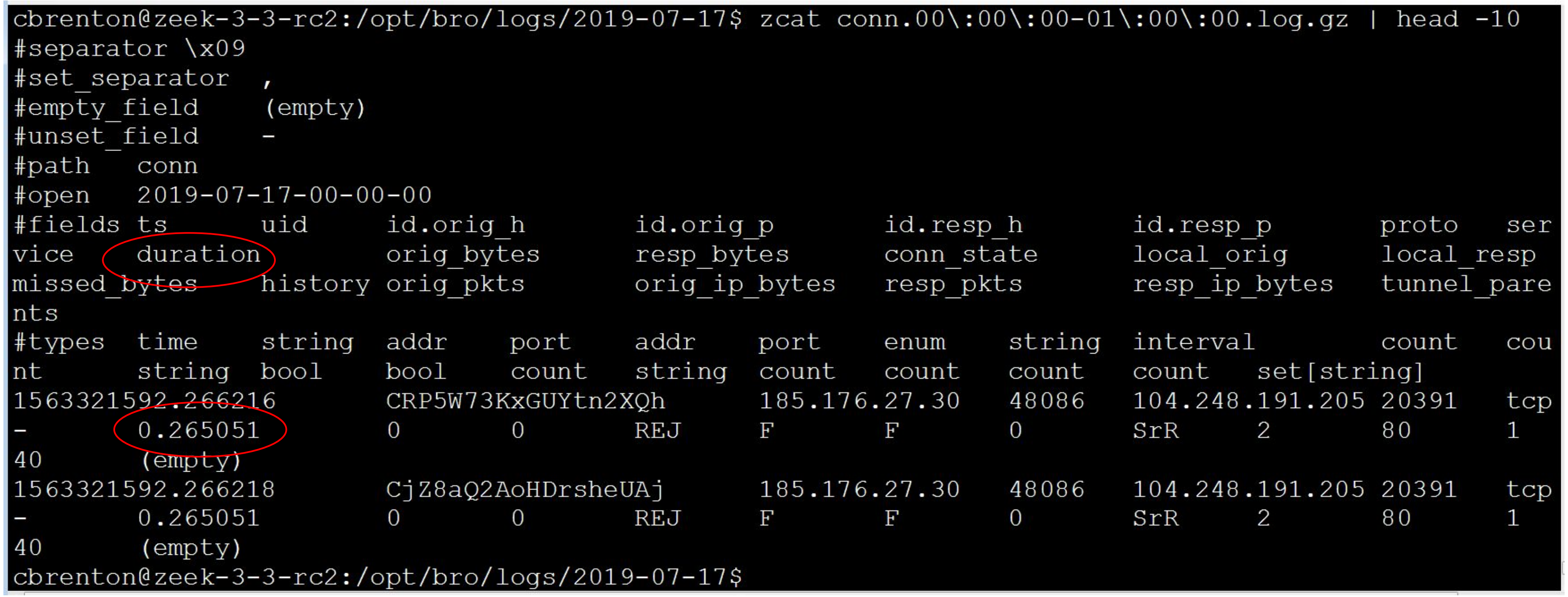
86,400 seconds = 24 hours

The same, but with tshark



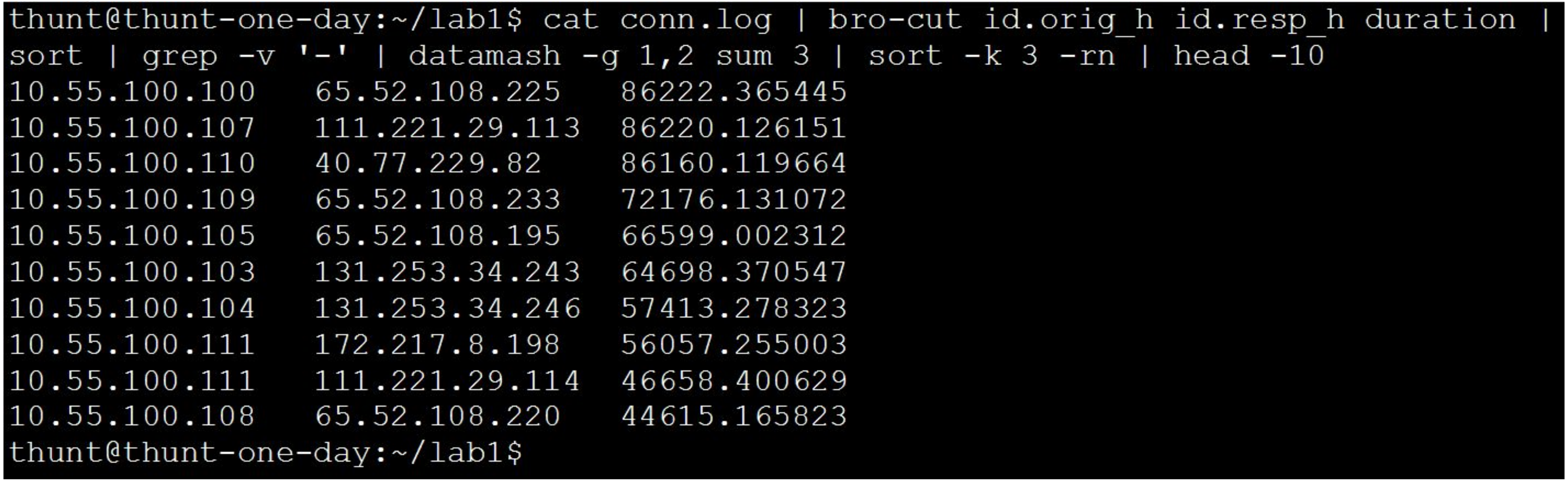
```
cbrenton@cbrenton-lab-testing:~/pcaps$ tshark -q -z conv,ip -r dnscat2.pcap
ng | tr -s ' ' | cut -d " " -f 1,2,3,10 | sort -k 4 -rn | head
10.55.100.111 <-> 52.84.11.32 86287.865752146
10.55.100.106 <-> 54.85.75.70 86284.765128713
10.55.100.104 <-> 52.4.3.93 86284.727643346
10.55.100.106 <-> 50.19.118.19 86284.543579127
10.55.100.110 <-> 23.194.107.124 86283.678785025
10.55.100.106 <-> 34.201.231.171 86283.560157895
10.55.100.105 <-> 47.88.68.22 86283.461914723
10.55.100.110 <-> 159.45.170.145 86282.584911853
192.168.88.2 <-> 208.109.255.35 86178.716231261
192.168.88.2 <-> 216.69.185.35 86178.696240942
cbrenton@cbrenton-lab-testing:~/pcaps$
```

Connection timing from Bro/Zeek



```
cbrenton@zeek-3-3-rc2:/opt/bro/logs/2019-07-17$ zcat conn.00\:00\:00-01\:00\:00.log.gz | head -10
#separator \x09
#set_separator  ,
#empty_field    (empty)
#unset_field    -
#path   conn
#open   2019-07-17-00-00-00
#fields ts      uid     id.orig_h       id.orig_p       id.resp_h       id.resp_p       proto   ser
vice    duration        orig_bytes      resp_bytes      conn_state      local_orig      local_resp
missed_bytes    history orig_pkts       orig_ip_bytes   resp_pkts       resp_ip_bytes   tunnel_pare
nts
#types  time    string  addr    port    addr    port    enum    string  interval        count   cou
nt      string  bool    bool    count   string  count   count   count   count   set[string]
1563321592.266216       CRP5W73KxGUYtn2XQh      185.176.27.30   48086   104.248.191.205 20391   tcp
-       0.265051        0       0       REJ     F       F       0       SrR     2       80      1
40      (empty)
1563321592.266218       CjZ8aQ2AoHDrsheUAj      185.176.27.30   48086   104.248.191.205 20391   tcp
-       0.265051        0       0       REJ     F       F       0       SrR     2       80      1
40      (empty)
cbrenton@zeek-3-3-rc2:/opt/bro/logs/2019-07-17$
```

Cumulative talk time with Zeek



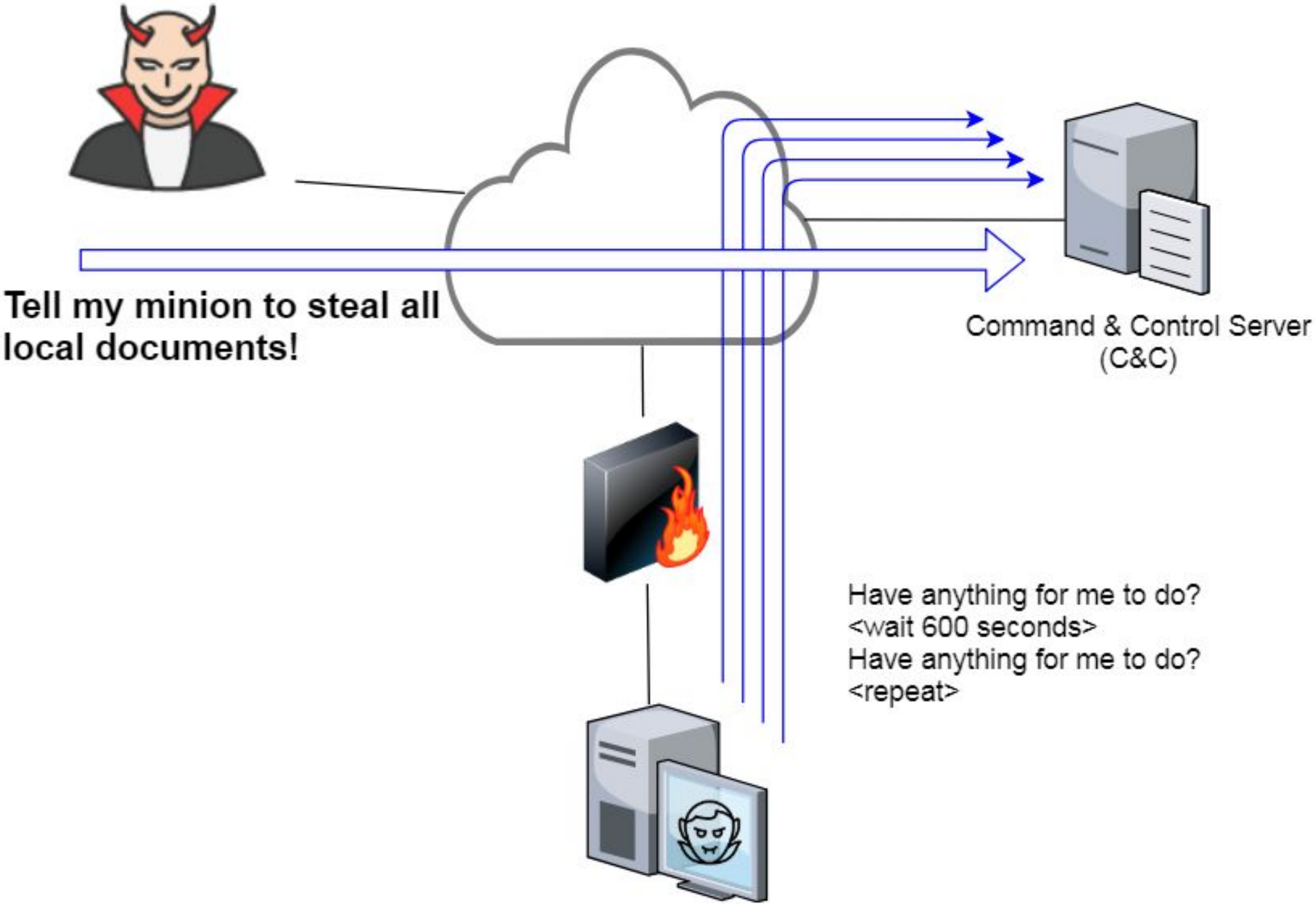
```
thunt@thunt-one-day:~/lab1$ cat conn.log | bro-cut id.orig_h id.resp_h duration |
sort | grep -v '-' | datamash -g 1,2 sum 3 | sort -k 3 -rn | head -10
10.55.100.100   65.52.108.225   86222.365445
10.55.100.107   111.221.29.113  86220.126151
10.55.100.110   40.77.229.82    86160.119664
10.55.100.109   65.52.108.233   72176.131072
10.55.100.105   65.52.108.195   66599.002312
10.55.100.103   131.253.34.243  64698.370547
10.55.100.104   131.253.34.246  57413.278323
10.55.100.111   172.217.8.198   56057.255003
10.55.100.111   111.221.29.114  46658.400629
10.55.100.108   65.52.108.220   44615.165823
thunt@thunt-one-day:~/lab1$
```

What about firewalls?

- Surprisingly hard to get this info
- "Timing" tends to be TTL, not duration
- BSD
  - pftop - output connection age in seconds
- Junos
  - show security flow session extensive node all
  - Duration in seconds

Beacons

- Same rules - internal to external
- Can be more challenging than long conns
- Looking for persistent outbound signal
    - Is there consistency in timing?
    - Is there consistency in session size?



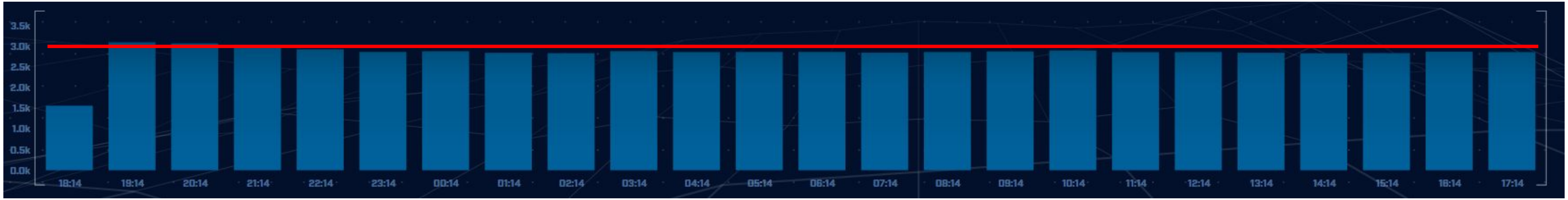
Tell my minion to steal all local documents!

Command & Control Server (C&C)

Have anything for me to do?
<wait 600 seconds>
Have anything for me to do?
<repeat>

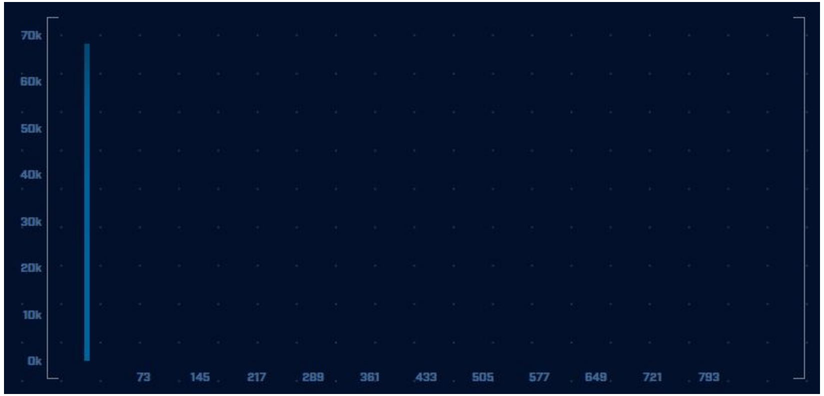
A beacon timing example

Flat line = beacon!

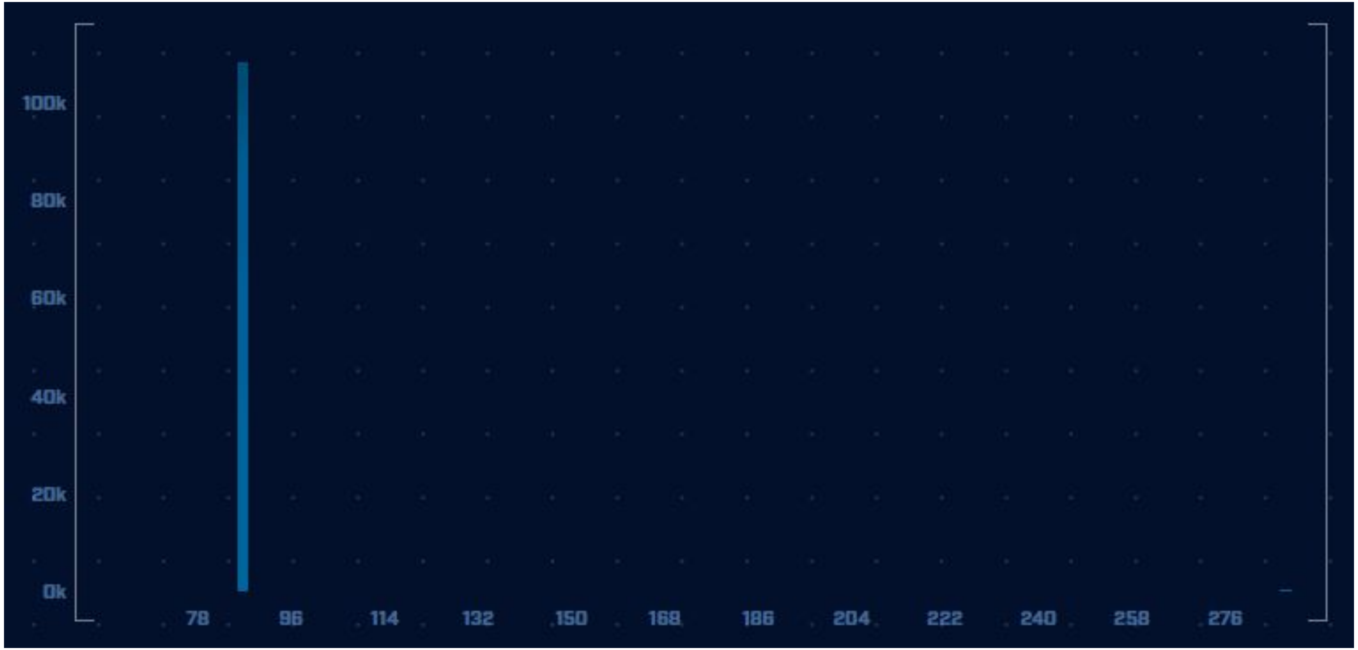


Connections per hour

Dispersion of connection deltas



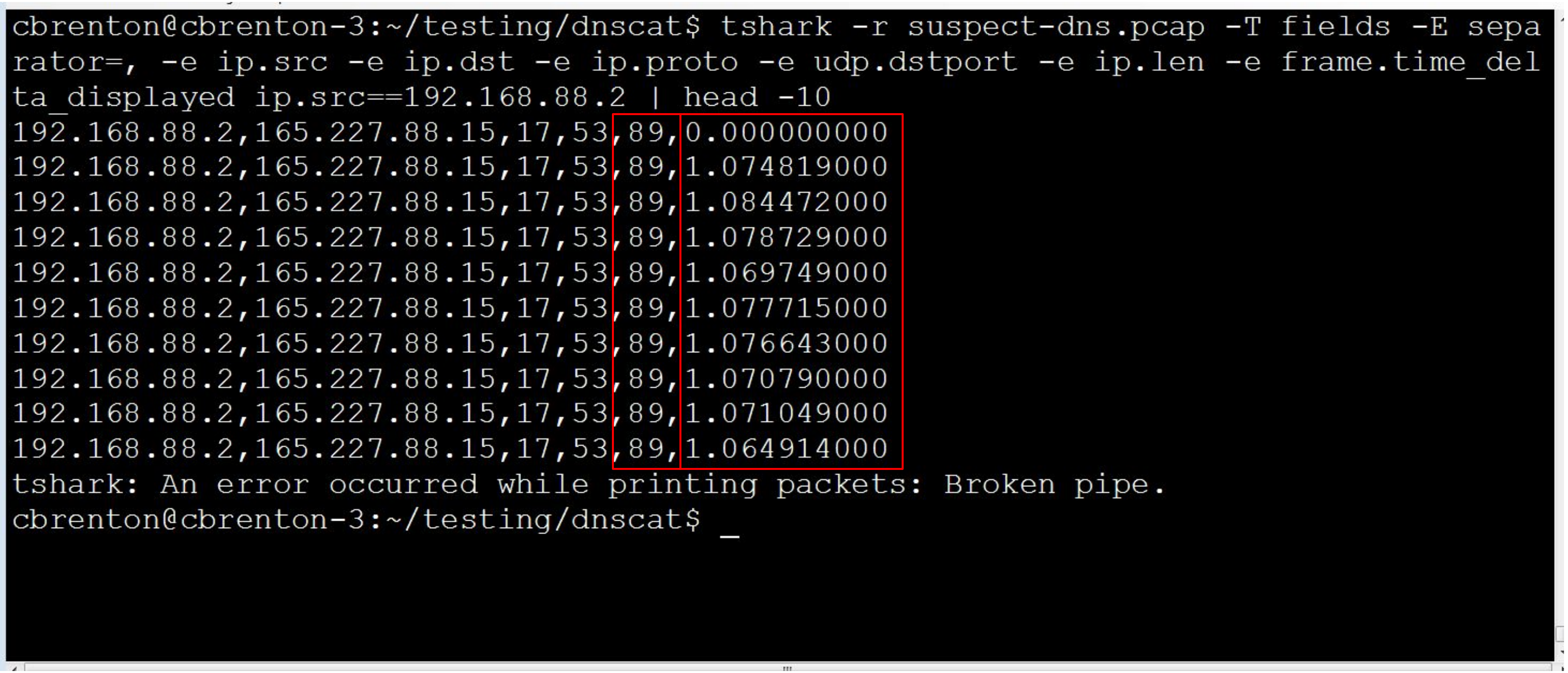
Beacon session size example



Heartbeat
(check in, nothing to do)

Activation

Tshark timing & size



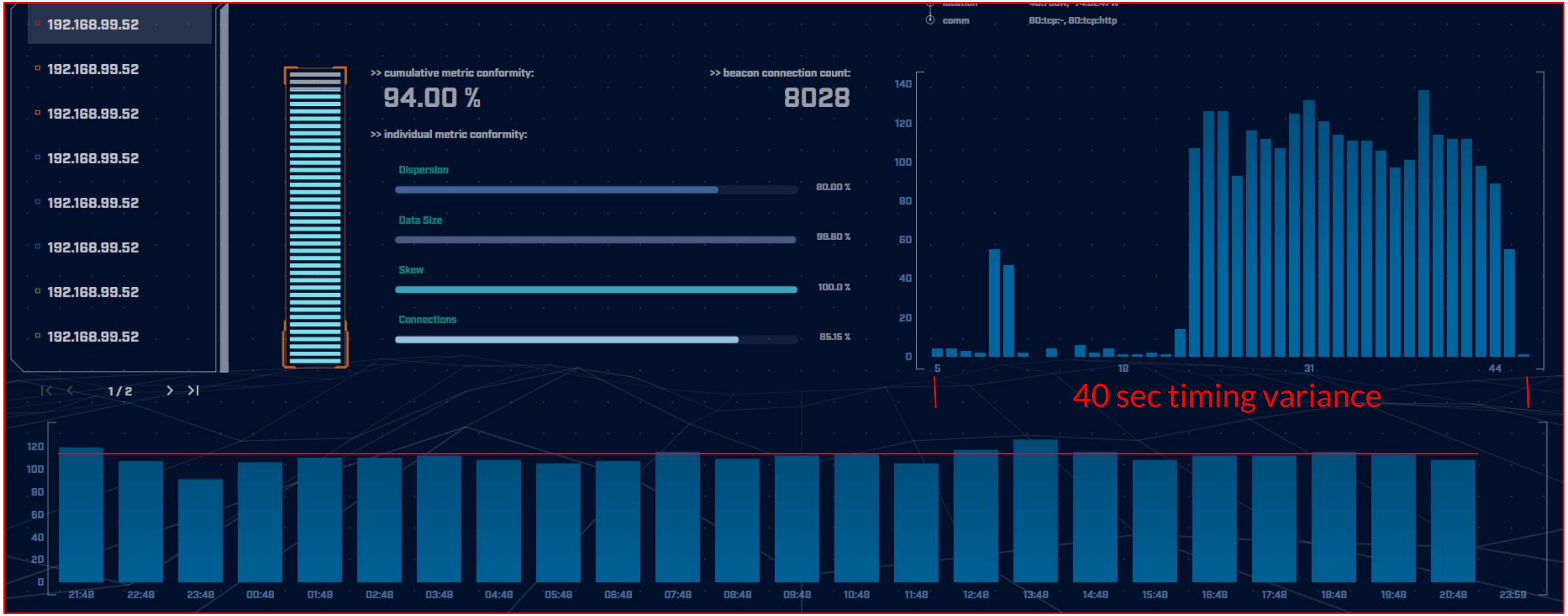
```
cbrenton@cbrenton-3:~/testing/dnscat$ tshark -r suspect-dns.pcap -T fields -E sepa
rator=, -e ip.src -e ip.dst -e ip.proto -e udp.dstport -e ip.len -e frame.time_del
ta_displayed ip.src==192.168.88.2 | head -10
192.168.88.2,165.227.88.15,17,53,89,0.000000000
192.168.88.2,165.227.88.15,17,53,89,1.074819000
192.168.88.2,165.227.88.15,17,53,89,1.084472000
192.168.88.2,165.227.88.15,17,53,89,1.078729000
192.168.88.2,165.227.88.15,17,53,89,1.069749000
192.168.88.2,165.227.88.15,17,53,89,1.077715000
192.168.88.2,165.227.88.15,17,53,89,1.076643000
192.168.88.2,165.227.88.15,17,53,89,1.070790000
192.168.88.2,165.227.88.15,17,53,89,1.071049000
192.168.88.2,165.227.88.15,17,53,89,1.064914000
tshark: An error occurred while printing packets: Broken pipe.
cbrenton@cbrenton-3:~/testing/dnscat$ _
```

Stats are per packet, not per session!

Beacon jitter

- The introduction of variance into timing
- Designed to make signal harder to detect
  - Defeat detection based on K-Means clustering
- Cobalt Strike:
  - bsleep($1, 60, 50);
    - For all beacon IDs ($1)
    - Sleep 60 seconds
    - Jitter timing +/- 50%
- This become a challenge statistically
- Easier to detect in "time buckets"

A jitter example



comm 80:tcp:-, 80:tcp:http

192.168.99.52
192.168.99.52
192.168.99.52
192.168.99.52
192.168.99.52
192.168.99.52
192.168.99.52
192.168.99.52

1 / 2

>> cumulative metric conformity:

94.00 %

>> beacon connection count:

8028

>> individual metric conformity:

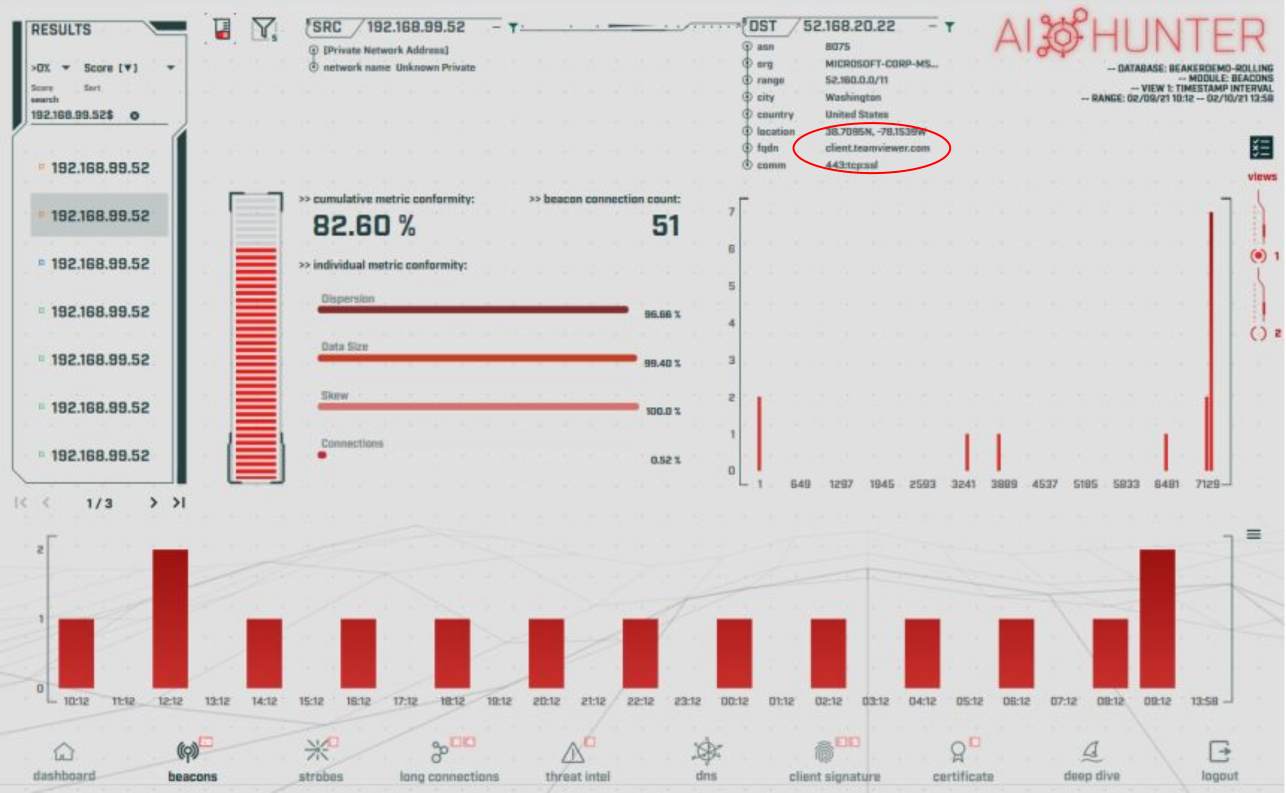
Dispersion	80.00 %
Data Size	99.60 %
Skew	100.0 %
Connections	85.15 %

40 sec timing variance

Working around jitter

- Easier to detect when normalized out over long periods of time
  - Average the time deltas for each hour
  - Plot over 24 hours
- Should make a beacon even more suspect
  - False positives don't obscure their beacon timing
  - High probability of being evil

Is there a business need?



RESULTS

>0% Score search

Score [▼] Sort

192.168.99.52$

- 192.168.99.52
- 192.168.99.52
- 192.168.99.52
- 192.168.99.52
- 192.168.99.52
- 192.168.99.52
- 192.168.99.52

1 / 3

SRC 192.168.99.52

[Private Network Address]

network name Unknown Private

DST 52.168.20.22

asn	8075
org	MICROSOFT-CORP-MS...
range	52.160.0.0/11
city	Washington
country	United States
location	38.7095N, -78.1539W
fqdn	client.teamviewer.com
comm	443:tcp:ssl

-- DATABASE: BEAKERDEMO-ROLLING
-- MODULE: BEACONS
-- VIEW 1: TIMESTAMP INTERVAL
-- RANGE: 02/09/21 10:12 -- 02/10/21 13:58

>> cumulative metric conformity:
82.60 %

>> beacon connection count:
51

>> individual metric conformity:

Dispersion	96.66 %
Data Size	99.40 %
Skew	100.0 %
Connections	0.52 %

Potential false positives

- Long connections
  - BGP
  - Chat programs
  - Dynamic web pages (weather)
- Beacons
  - NTP
  - Internal DNS forwarder to external DNS resolvers
  - Chat programs
  - Security software
- Whitelist to remove from future hunts

ACTIVE COUNTERMEASURES

C2 Detection Techniques
Part 2

Minor modifiers for review

- Protocol compliance
- External IP address
- Internal IP address

Unexpected app or port usage

- There should be a business need for all outbound protocols
- Research non-standard or unknown ports
  - TCP/5222 (Chrome remote desktop)
  - TCP/5800 & 590X (VNC)
  - TCP/502 (Modbus)

Unknown app on standard port

- C2 wants to tunnel out of environment
  - Pick a port likely to be permitted outbound
  - Does not always worry about protocol compliance
- Check standard ports for unexpected apps
  - Indication of tunneling
- Different than app on non-standard port
  - This is sometimes done as "a feature"
  - Example: SSH listening on TCP/2222

Bro/Zeek decodes many apps

- Detect over 50 applications
  - HTTP, DNS, SIP, MYSQL, RDP, NTLM, etc. etc.
- Fairly easy to add new ones
  - Example: HL7 if you are in healthcare
- Checks all analyzers for each port
- Does not assume WKP = application

Bro/Zeek example

```
$ cat conn.log | bro-cut  id.orig_h id.resp_h id.resp_p proto
service orig_ip_bytes resp_ip_bytes

183.131.82.99    104.248.191.205  22      tcp   ssh   1923    0
112.85.42.229    104.248.191.205  22      tcp   -     344     0
104.248.191.205  67.207.67.3      53      udp   dns   42      126
81.22.45.150     104.248.191.205  7180    tcp   -     80      40
110.49.40.4      104.248.191.205  445     tcp   -     52      40
81.22.45.150     104.248.191.205  7404    tcp   -     80      40
```

Unexpected protocol use

- Attackers may bend but not break rules
- This can result in:
  - Full protocol compliance
  - Abnormal behaviour
- Need to understand "normal"
  - For the protocol
  - For your environment

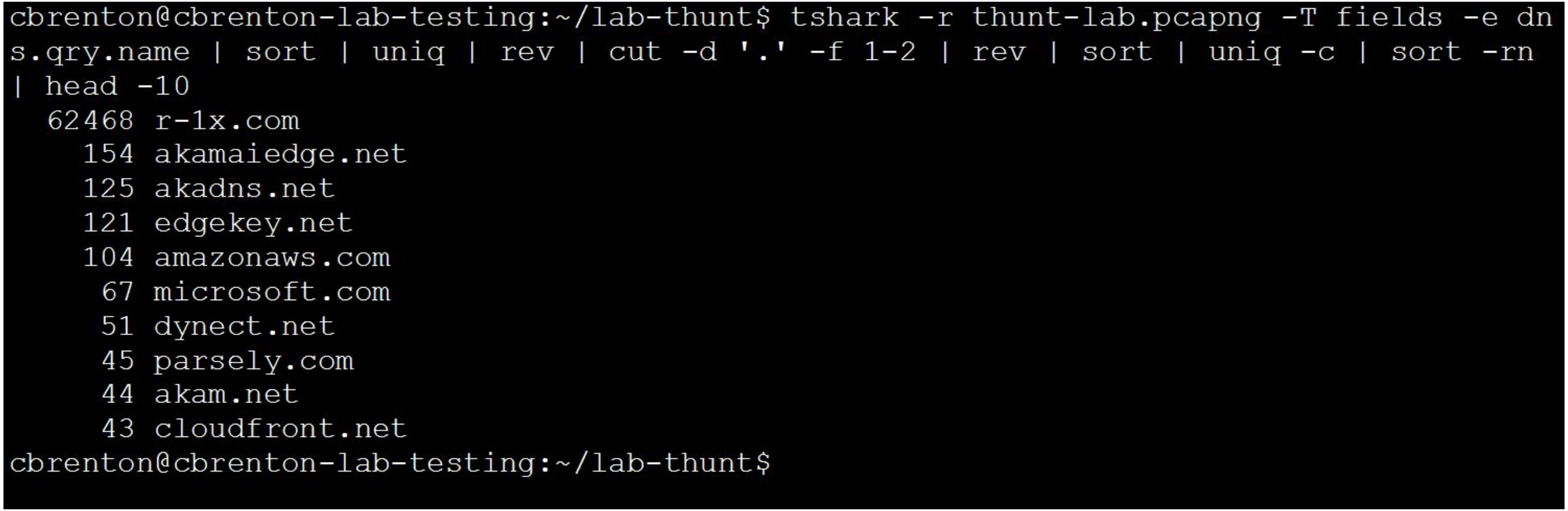
Example: Too many FQDNs

- How many FQDNs do domains expose?
  - Most is < 10
  - Recognizable Internet based vendors 200 - 600
    - Microsoft
    - Akamai
    - Google
    - Amazon
- Greater than 1,000 is suspicious
- Could be an indication of C2 traffic

Detecting C2 over DNS

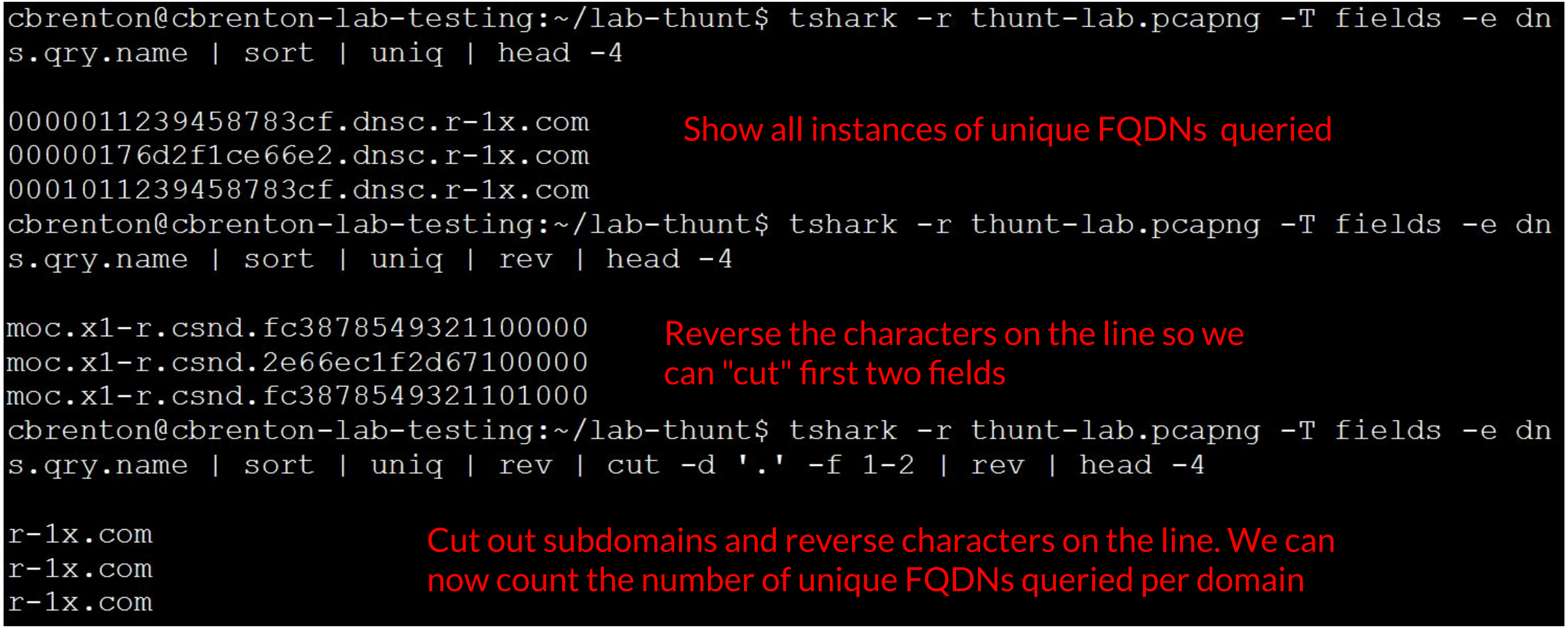
- Capture all DNS traffic
  - Capture tool of your choice
  - Longer the capture time, the better
- Filter so it's DNS traffic only
- Extract to text so we can sort and count
- Review total FQDNs per domain

Counting FQDNs per domain



```
cbrenton@cbrenton-lab-testing:~/lab-thunt$ tshark -r thunt-lab.pcapng -T fields -e dn
s.qry.name | sort | uniq | rev | cut -d '.' -f 1-2 | rev | sort | uniq -c | sort -rn
| head -10
  62468 r-1x.com
    154 akamaiedge.net
    125 akadns.net
    121 edgekey.net
    104 amazonaws.com
     67 microsoft.com
     51 dynect.net
     45 parsely.com
     44 akam.net
     43 cloudfront.net
cbrenton@cbrenton-lab-testing:~/lab-thunt$
```

Breaking it down



```
cbrenton@cbrenton-lab-testing:~/lab-thunt$ tshark -r thunt-lab.pcapng -T fields -e dn
s.qry.name | sort | uniq | head -4

00000112394587 83cf.dnsc.r-1x.com
00000176d2f1ce66e2.dnsc.r-1x.com
00010112394587 83cf.dnsc.r-1x.com
cbrenton@cbrenton-lab-testing:~/lab-thunt$ tshark -r thunt-lab.pcapng -T fields -e dn
s.qry.name | sort | uniq | rev | head -4

moc.x1-r.csnd.fc387854932110000 0
moc.x1-r.csnd.2e66ec1f2d67100000
moc.x1-r.csnd.fc38785493211010 00
cbrenton@cbrenton-lab-testing:~/lab-thunt$ tshark -r thunt-lab.pcapng -T fields -e dn
s.qry.name | sort | uniq | rev | cut -d '.' -f 1-2 | rev | head -4

r-1x.com
r-1x.com
r-1x.com
```

Show all instances of unique FQDNs queried

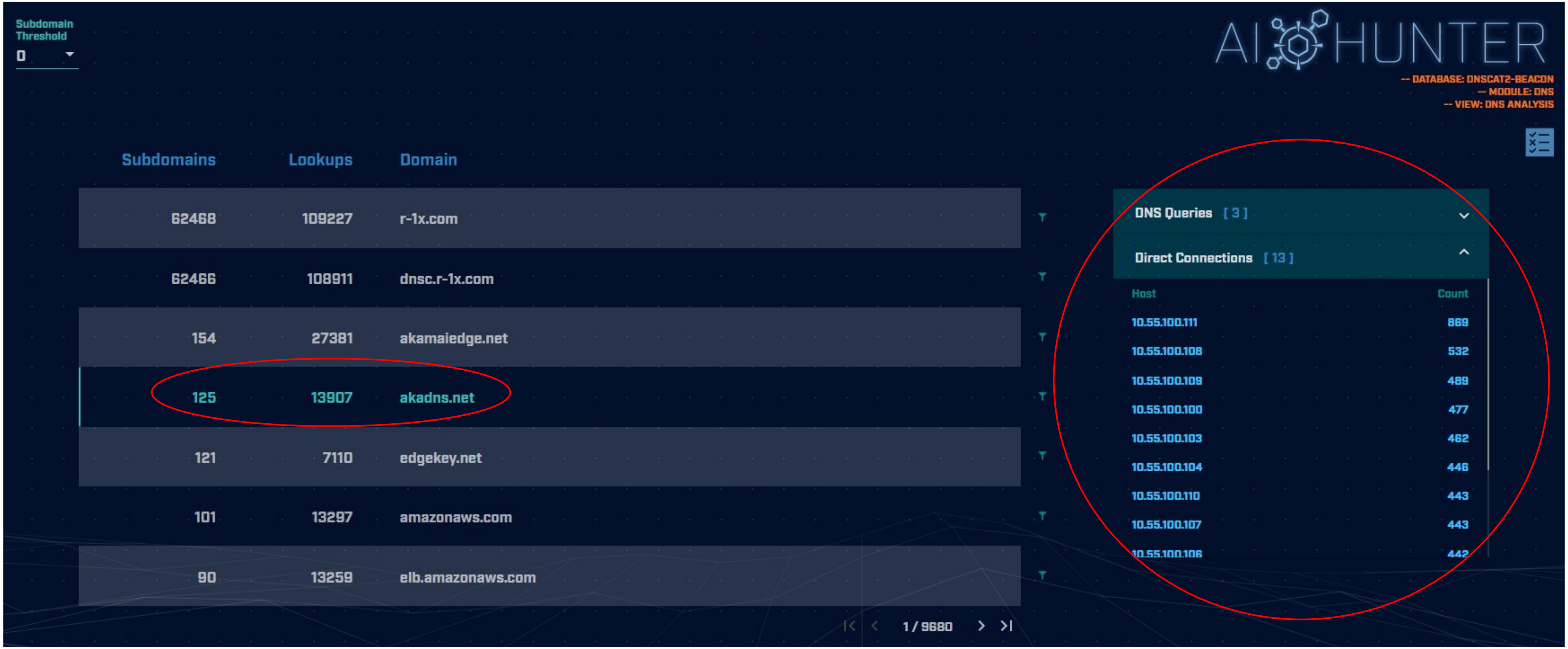
Reverse the characters on the line so we can "cut" first two fields

Cut out subdomains and reverse characters on the line. We can now count the number of unique FQDNs queried per domain

Bonus checks on DNS

- Check domains with a lot of FQDNs
- Get a list of the IPs returned
- Compare against traffic patterns
    - Are internal hosts visiting this domain?
    - Is it just your name servers?
- Unique trait of C2 over DNS
    - Lots or FQDN queries
    - But no one ever connects to these systems

Normal DNS query patten



Subdomain Threshold
0

-- DATABASE: DNSCAT2-BEACON
-- MODULE: DNS
-- VIEW: DNS ANALYSIS

Subdomains	Lookups	Domain
62468	109227	r-1x.com
62466	108911	dnsc.r-1x.com
154	27381	akamaiedge.net
125	13907	akadns.net
121	7110	edgekey.net
101	13297	amazonaws.com
90	13259	elb.amazonaws.com

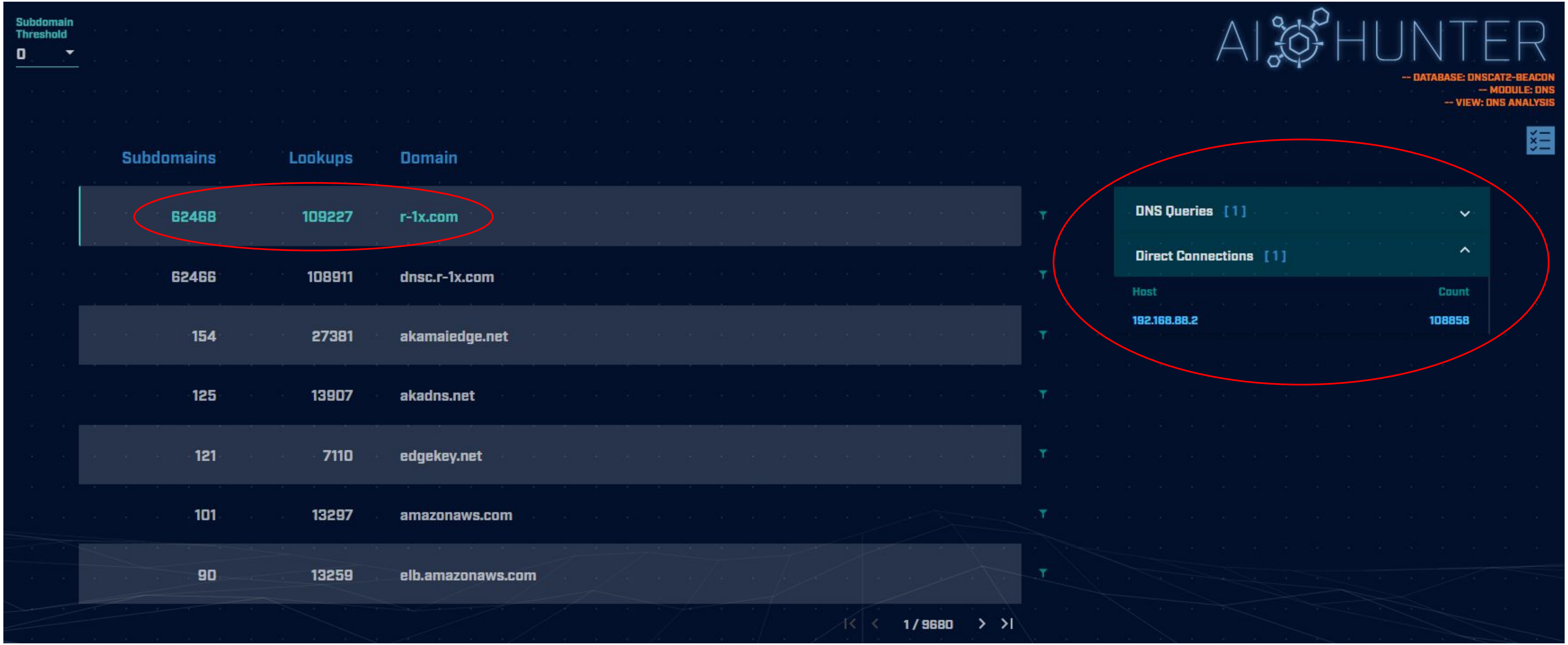
1 / 9680

DNS Queries [3]

Direct Connections [13]

Host	Count
10.55.100.111	869
10.55.100.108	532
10.55.100.109	489
10.55.100.100	477
10.55.100.103	462
10.55.100.104	446
10.55.100.110	443
10.55.100.107	443
10.55.100.106	442

Things that make you go "hummm"



Subdomain Threshold

0

AI HUNTER

-- DATABASE: DNSCAT2-BEACON
-- MODULE: DNS
-- VIEW: DNS ANALYSIS

Subdomains	Lookups	Domain
62468	109227	r-1x.com
62466	108911	dnsc.r-1x.com
154	27381	akamaiedge.net
125	13907	akadns.net
121	7110	edgekey.net
101	13297	amazonaws.com
90	13259	elb.amazonaws.com

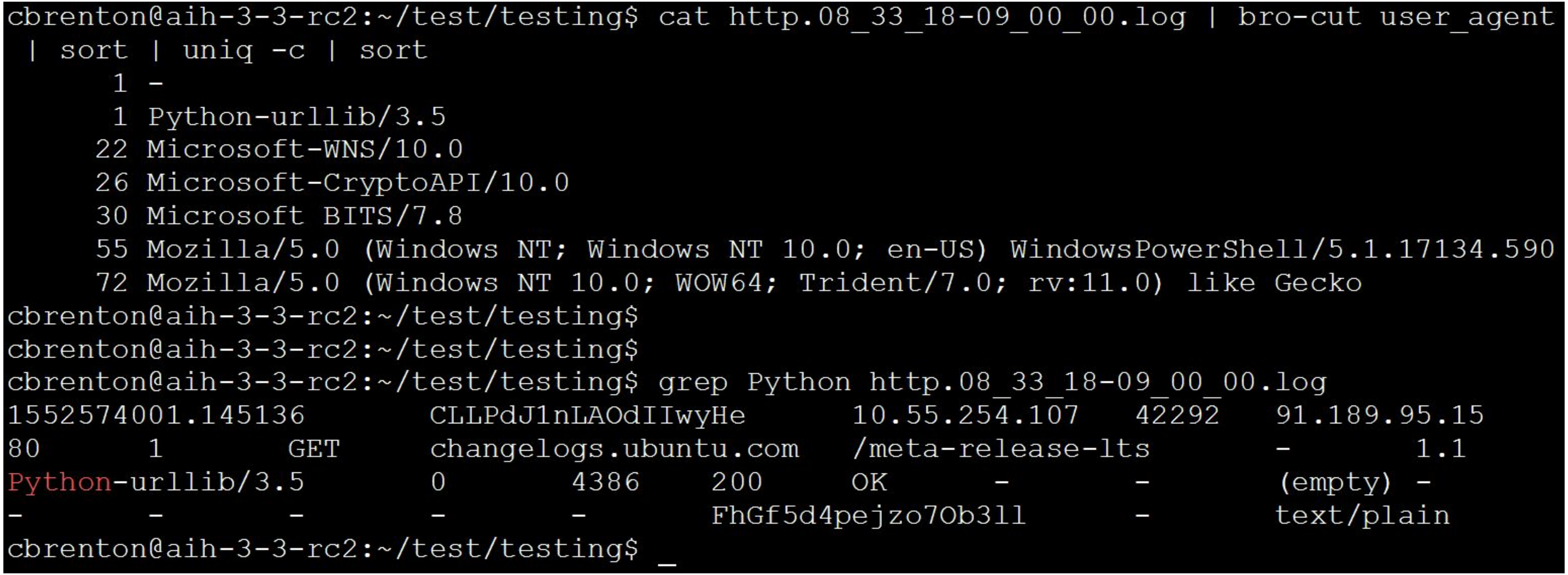
1 / 9680

DNS Queries [1]

Direct Connections [1]

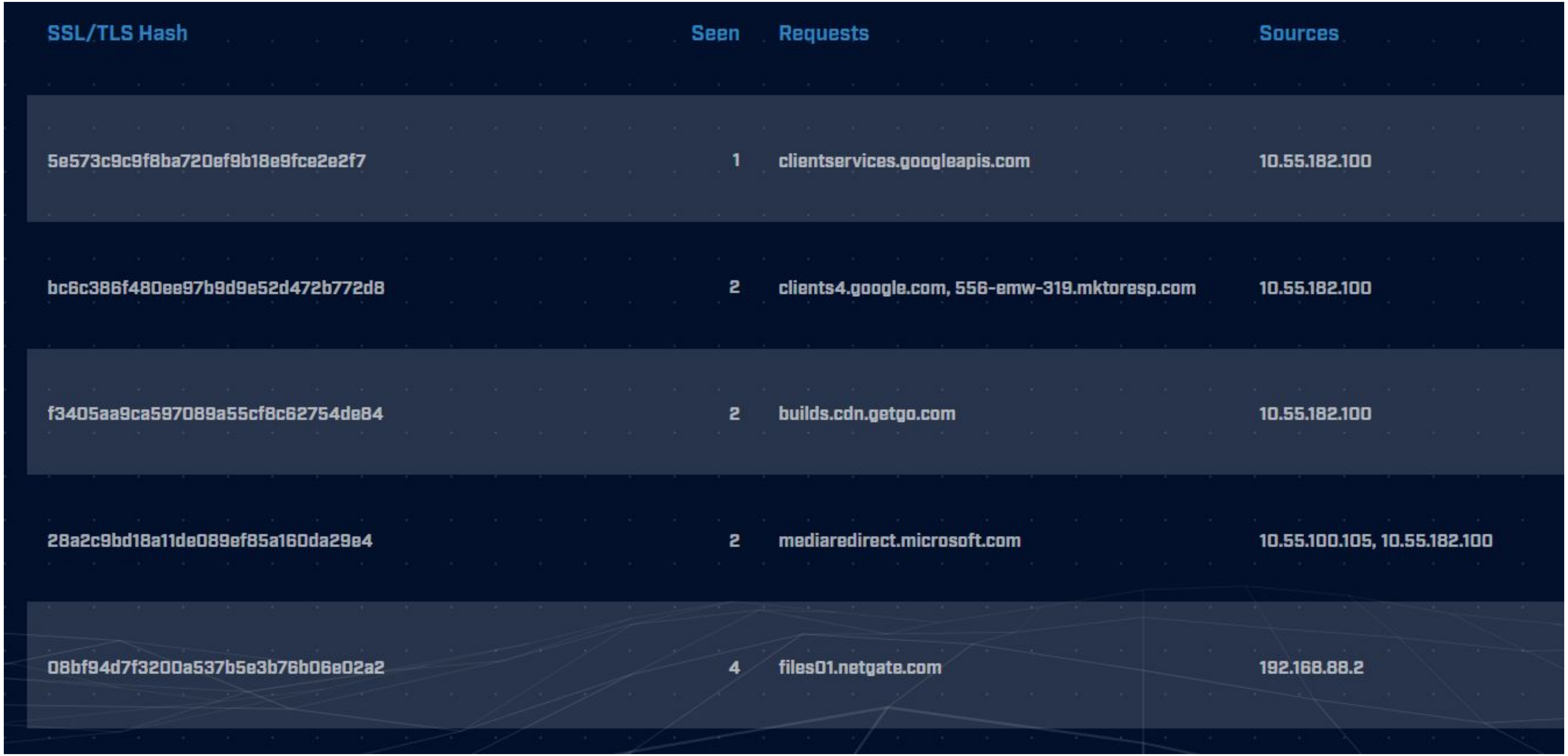
Host	Count
192.168.88.2	108858

Look for unique HTTP user agents



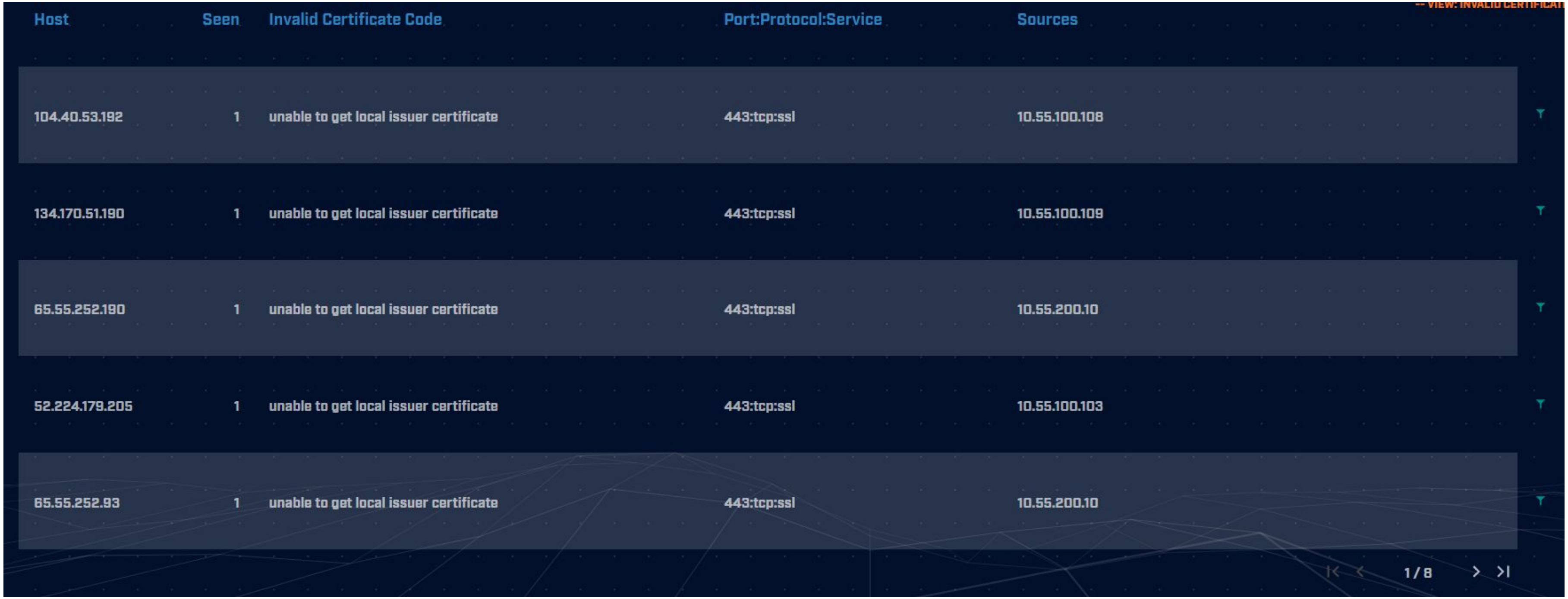
```
cbrenton@aih-3-3-rc2:~/test/testing$ cat http.08_33_18-09_00_00.log | bro-cut user_agent
 | sort | uniq -c | sort
      1 -
      1 Python-urllib/3.5
     22 Microsoft-WNS/10.0
     26 Microsoft-CryptoAPI/10.0
     30 Microsoft BITS/7.8
     55 Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US) WindowsPowerShell/5.1.17134.590
     72 Mozilla/5.0 (Windows NT 10.0; WOW64; Trident/7.0; rv:11.0) like Gecko
cbrenton@aih-3-3-rc2:~/test/testing$
cbrenton@aih-3-3-rc2:~/test/testing$
cbrenton@aih-3-3-rc2:~/test/testing$ grep Python http.08_33_18-09_00_00.log
1552574001.145136       CLLPdJ1nLAOdIIwyHe      10.55.254.107   42292   91.189.95.15
80      1       GET     changelogs.ubuntu.com   /meta-release-lts       -       1.1
Python-urllib/3.5       0       4386    200     OK      -       -       (empty) -
-       -       -       -       -       FhGf5d4pejzo7Ob3ll      -       text/plain
cbrenton@aih-3-3-rc2:~/test/testing$ _
```

Unique SSL Client Hello: Zeek + JA3



SSL/TLS Hash	Seen	Requests	Sources
5e573c9c9f8ba720ef9b18e9fce2e2f7	1	clientservices.googleapis.com	10.55.182.100
bc6c386f480ee97b9d9e52d472b772d8	2	clients4.google.com, 556-emw-319.mktoresp.com	10.55.182.100
f3405aa9ca597089a55cf8c62754de84	2	builds.cdn.getgo.com	10.55.182.100
28a2c9bd18a11de089ef85a160da29e4	2	mediaredirect.microsoft.com	10.55.100.105, 10.55.182.100
08bf94d7f3200a537b5e3b76b06e02a2	4	files01.netgate.com	192.168.88.2

Invalid certificate check



-- VIEW: INVALID CERTIFICAT

Host	Seen	Invalid Certificate Code	Port:Protocol:Service	Sources
104.40.53.192	1	unable to get local issuer certificate	443:tcp:ssl	10.55.100.108
134.170.51.190	1	unable to get local issuer certificate	443:tcp:ssl	10.55.100.109
65.55.252.190	1	unable to get local issuer certificate	443:tcp:ssl	10.55.200.10
52.224.179.205	1	unable to get local issuer certificate	443:tcp:ssl	10.55.100.103
65.55.252.93	1	unable to get local issuer certificate	443:tcp:ssl	10.55.200.10

Extended Validation (EV) certs are more trusted and can assign negative threat points

Check destination IP address

- Start simple
  - Who manages ASN?
  - Geolocation info?
  - IP delegation
  - PTR records
- Do you recognize the target organization?
  - Business partner or field office
  - Current vendor (active status)
- Other internal IP's connecting?

Check threat intel on target IP

- Need to understand:
  - When was the record first created?
  - Why was the record created?

https://www.abuseipdb.com/check/<ip address>
https://apility.io/search/<IP address>
https://dnslytics.com/ip/<IP address>
https://transparencyreport.google.com/safe-browsing/search?url=<IP, FQDN or URL>

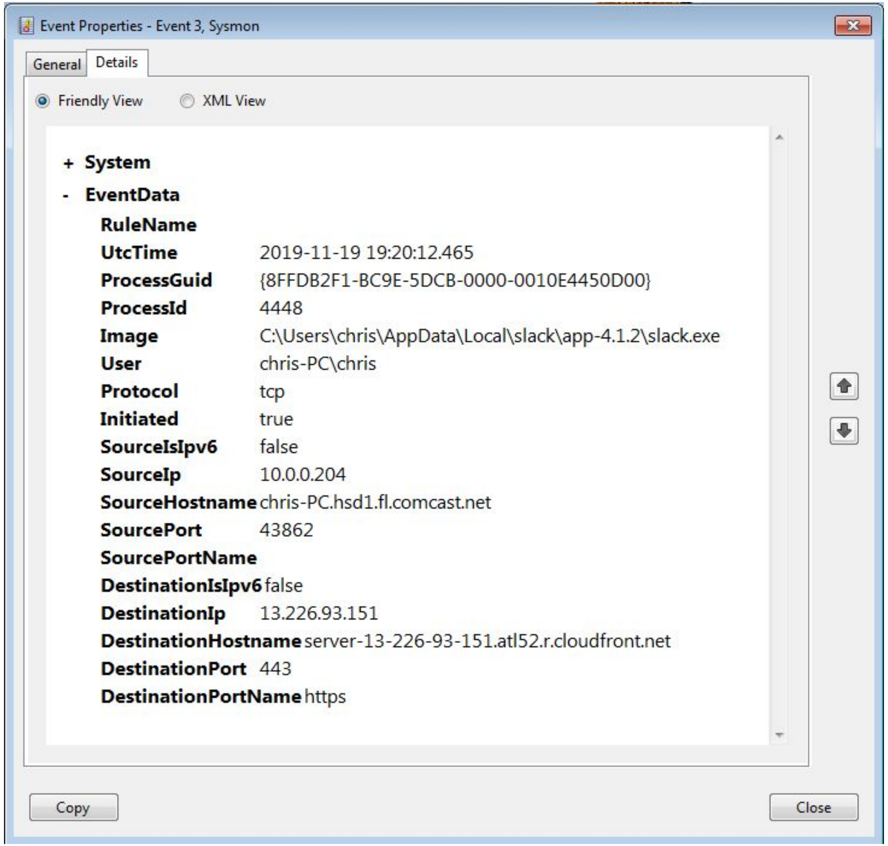
Internal system

- Info available varies greatly between orgs
- Inventory management systems
- Security tools like Carbon Black
- OS projects like BeaKer
- Internal security scans
- DHCP logs
- Login events
- Passive fingerprinting

Leverage internal host logging

- Network shows suspicious traffic patterns
- Use this data to pivot to host logs
- Filter your logs based on:
  - Suspect internal host
  - Timeframe being analyzed
- Anything stand out as unique or odd?

Sysmon Event ID Type 3's



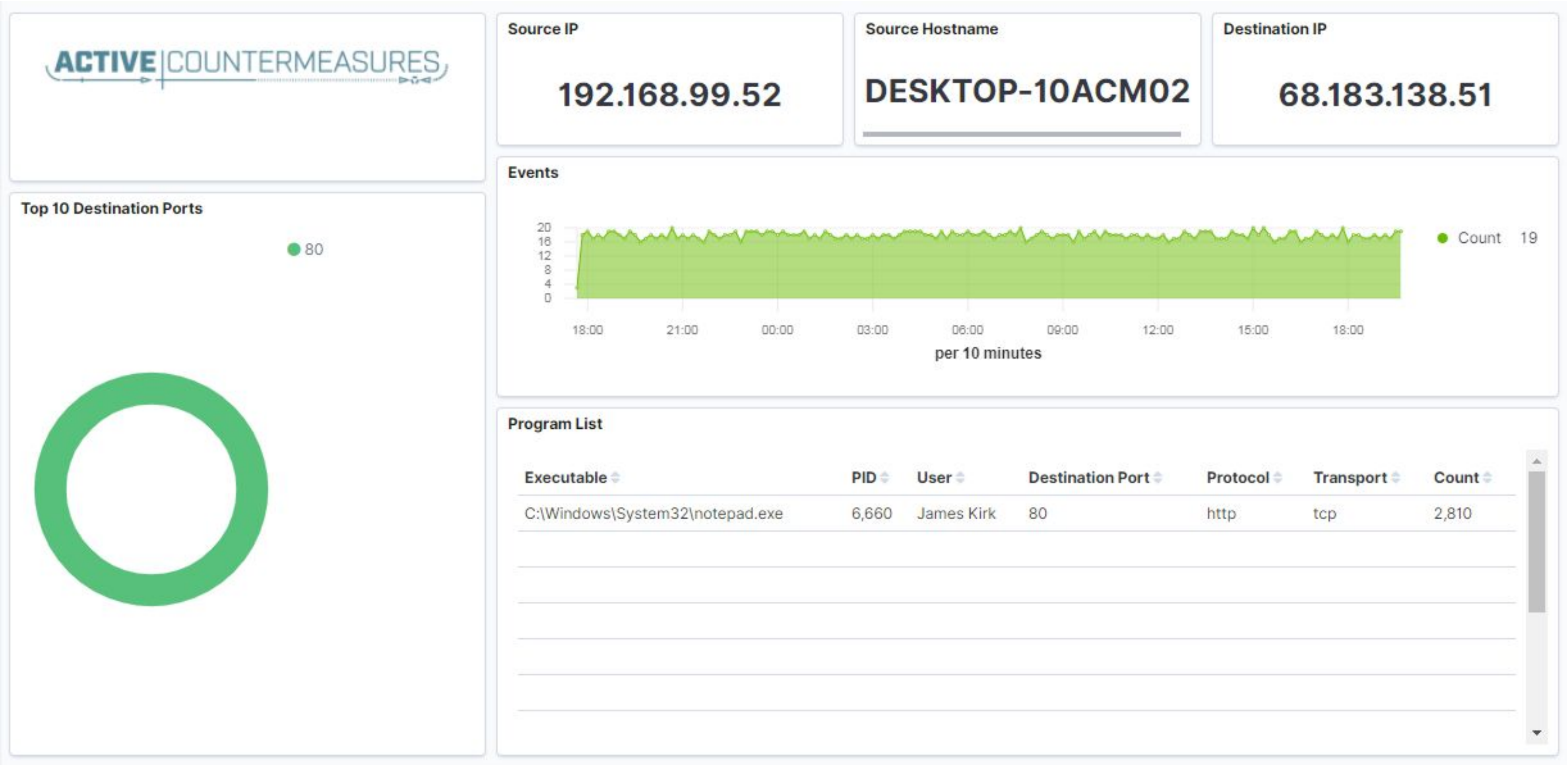
+ System

- EventData

RuleName	
UtcTime	2019-11-19 19:20:12.465
ProcessGuid	{8FFDB2F1-BC9E-5DCB-0000-0010E4450D00}
ProcessId	4448
Image	C:\Users\chris\AppData\Local\slack\app-4.1.2\slack.exe
User	chris-PC\chris
Protocol	tcp
Initiated	true
SourceIsIpv6	false
SourceIp	10.0.0.204
SourceHostname	chris-PC.hsd1.fl.comcast.net
SourcePort	43862
SourcePortName	
DestinationIsIpv6	false
DestinationIp	13.226.93.151
DestinationHostname	server-13-226-93-151.atl52.r.cloudfront.net
DestinationPort	443
DestinationPortName	https

Map outbound connections to the applications that created them.

Sysmon Type 3 + BeaKer



Source IP

192.168.99.52

Source Hostname

DESKTOP-10ACM02

Destination IP

68.183.138.51

Events

Top 10 Destination Ports

Program List

Executable	PID	User	Destination Port	Protocol	Transport	Count
C:\Windows\System32\notepad.exe	6,660	James Kirk	80	http	tcp	2,810

But I have no system logs!

- Might be a good time to start collecting them
- Full packet captures from system
- Apply additional network tools to collect more data

What next?

- Assign points to connection persistence
  - How certain are you that it's automated?
- Assign points to the protocol review
- Assign points to the endpoint research
- Remember negative points are OK
- Add the score, how certain are you?
  - Safe = add to whitelist
  - Scary = Trigger incident response
  - Still unsure = Collect more data

ACTIVE COUNTERMEASURES

C2 Detection Tools

tcpdump

- What's it good for?
  - Lightweight packet capturing tool
  - Cross platform support (windump on Windows)
- When to use it
  - Audit trail of all traffic
  - Can also filter to see only specific traffic
  - Can be fully automated
- Where to get it

https://www.tcpdump.org/

Tcpdump example

- Debian/Ubuntu
  - Place the following in /etc/rc.local
- Red Hat/CentOS, Fedora
  - Place the following in /etc/rc.d/rc.local
- Grabs all traffic and rotates every 60 min
  - Date/time stamped and compressed

```
#Place _above_ any "exit" line
mkdir -p /opt/pcaps
screen -S capture -t capture -d -m bash -c "tcpdump -ieth0 -G
3600 -w '/opt/pcaps/`hostname -s`.%Y%m%d%H%M%S.pcap' -z bzip2"
```

tshark

- What's it good for?
  - Extracting interesting fields from packet captures
  - Multiple passes to focus on different attributes
  - Combine with text manipulation tools
  - Can be automated
- When to use it
  - Both major and minor attributes
- Where to get it

https://www.wireshark.org/

Tshark example - DNS queries

```
$ tshark -r thunt-lab.pcapng -T fields -e dns.qry.name
udp.port==53 | head -10

6dde0175375169c68f.dnsc.r-1x.com
6dde0175375169c68f.dnsc.r-1x.com
0b320175375169c68f.dnsc.r-1x.com
0b320175375169c68f.dnsc.r-1x.com
344b0175375169c68f.dnsc.r-1x.com
344b0175375169c68f.dnsc.r-1x.com
0f370175375169c68f.dnsc.r-1x.com
0f370175375169c68f.dnsc.r-1x.com
251e0175375169c68f.dnsc.r-1x.com
251e0175375169c68f.dnsc.r-1x.com
```

Tshark example - user agents

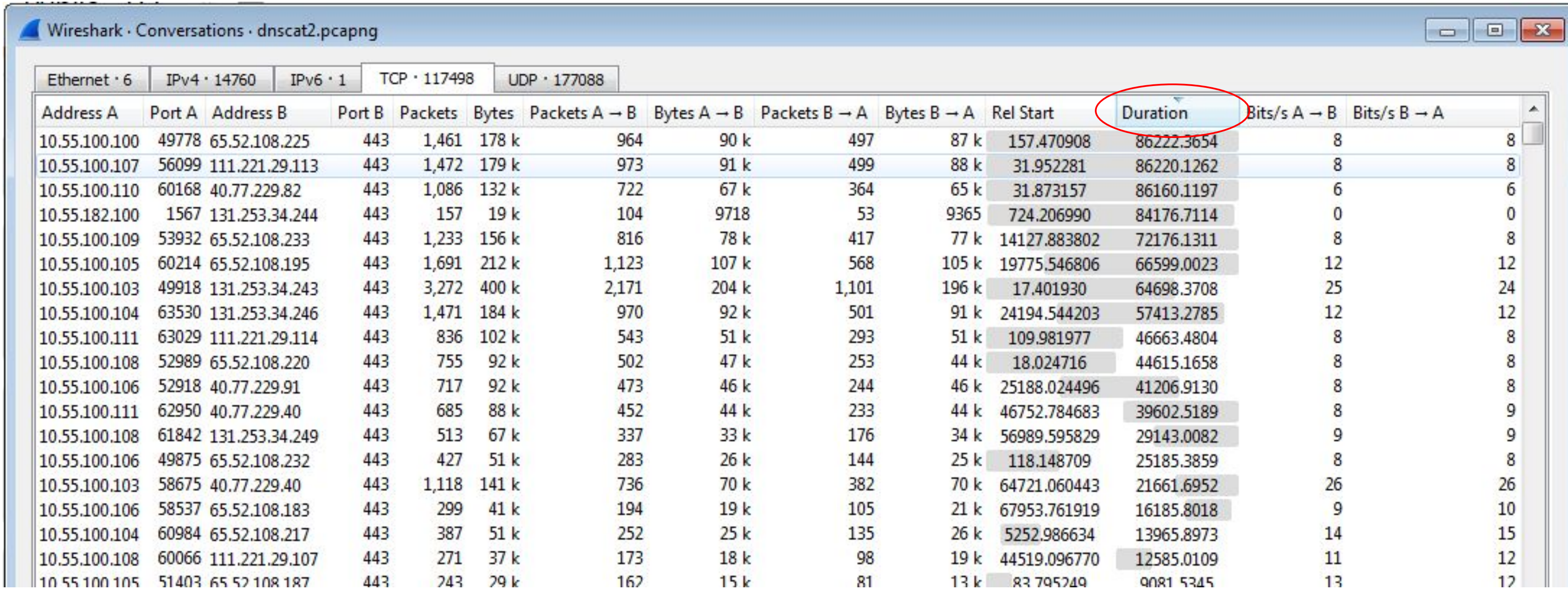
```
$ tshark -r sample.pcap -T fields -e http.user_agent tcp.
dstport==80 | sort | uniq -c | sort -n | head -10
      2 Microsoft Office/16.0
      2 Valve/Steam HTTP Client 1.0 (client;windows;10;1551832902)
      3 Valve/Steam HTTP Client 1.0
     11 Microsoft BITS/7.5
     11 Windows-Update-Agent
     12 Microsoft-CryptoAPI/6.1
    104 PCU
```

Wireshark

- What's it good for?
  - Packet analysis with guardrails
  - Stream level summaries
- When to use it
  - As part of a manual analysis
  - When steps cannot be automated
- Where to get it

https://www.wireshark.org/

Wireshark-Statistics-Conversations



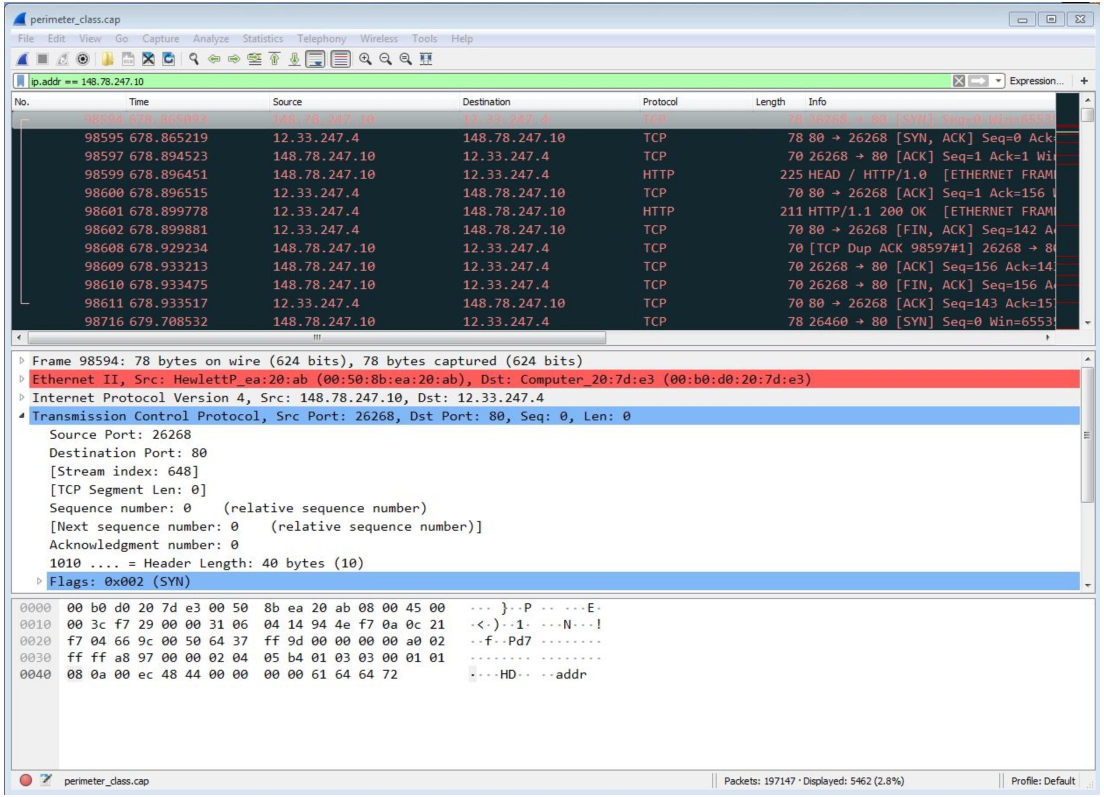
Wireshark · Conversations · dnscat2.pcapng

Ethernet · 6 | IPv4 · 14760 | IPv6 · 1 | TCP · 117498 | UDP · 177088

Address A	Port A	Address B	Port B	Packets	Bytes	Packets A → B	Bytes A → B	Packets B → A	Bytes B → A	Rel Start	Duration	Bits/s A → B	Bits/s B → A
10.55.100.100	49778	65.52.108.225	443	1,461	178 k	964	90 k	497	87 k	157.470908	86222.3654	8	8
10.55.100.107	56099	111.221.29.113	443	1,472	179 k	973	91 k	499	88 k	31.952281	86220.1262	8	8
10.55.100.110	60168	40.77.229.82	443	1,086	132 k	722	67 k	364	65 k	31.873157	86160.1197	6	6
10.55.182.100	1567	131.253.34.244	443	157	19 k	104	9718	53	9365	724.206990	84176.7114	0	0
10.55.100.109	53932	65.52.108.233	443	1,233	156 k	816	78 k	417	77 k	14127.883802	72176.1311	8	8
10.55.100.105	60214	65.52.108.195	443	1,691	212 k	1,123	107 k	568	105 k	19775.546806	66599.0023	12	12
10.55.100.103	49918	131.253.34.243	443	3,272	400 k	2,171	204 k	1,101	196 k	17.401930	64698.3708	25	24
10.55.100.104	63530	131.253.34.246	443	1,471	184 k	970	92 k	501	91 k	24194.544203	57413.2785	12	12
10.55.100.111	63029	111.221.29.114	443	836	102 k	543	51 k	293	51 k	109.981977	46663.4804	8	8
10.55.100.108	52989	65.52.108.220	443	755	92 k	502	47 k	253	44 k	18.024716	44615.1658	8	8
10.55.100.106	52918	40.77.229.91	443	717	92 k	473	46 k	244	46 k	25188.024496	41206.9130	8	8
10.55.100.111	62950	40.77.229.40	443	685	88 k	452	44 k	233	44 k	46752.784683	39602.5189	8	9
10.55.100.108	61842	131.253.34.249	443	513	67 k	337	33 k	176	34 k	56989.595829	29143.0082	9	9
10.55.100.106	49875	65.52.108.232	443	427	51 k	283	26 k	144	25 k	118.148709	25185.3859	8	8
10.55.100.103	58675	40.77.229.40	443	1,118	141 k	736	70 k	382	70 k	64721.060443	21661.6952	26	26
10.55.100.106	58537	65.52.108.183	443	299	41 k	194	19 k	105	21 k	67953.761919	16185.8018	9	10
10.55.100.104	60984	65.52.108.217	443	387	51 k	252	25 k	135	26 k	5252.986634	13965.8973	14	15
10.55.100.108	60066	111.221.29.107	443	271	37 k	173	18 k	98	19 k	44519.096770	12585.0109	11	12
10.55.100.105	51403	65.52.108.187	443	243	29 k	162	15 k	81	13 k	83.795249	9081.5345	13	12

86,400 seconds = 24 hours

Useful when I have a target


perimeter_class.cap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Expression…

```
ip.addr == 148.78.247.10
```

```
No.    Time        Source         Destination    Protocol  Length Info
98594 678.865093  148.78.247.10  12.33.247.4    TCP       78 26268 → 80 [SYN] Seq=0 Win=6553
98595 678.865219  12.33.247.4    148.78.247.10  TCP       78 80 → 26268 [SYN, ACK] Seq=0 Ack
98597 678.894523  148.78.247.10  12.33.247.4    TCP       70 26268 → 80 [ACK] Seq=1 Ack=1 Wi
98599 678.896451  148.78.247.10  12.33.247.4    HTTP     225 HEAD / HTTP/1.0  [ETHERNET FRAM
98600 678.896515  12.33.247.4    148.78.247.10  TCP       70 80 → 26268 [ACK] Seq=1 Ack=156 
98601 678.899778  12.33.247.4    148.78.247.10  HTTP     211 HTTP/1.1 200 OK  [ETHERNET FRAM
98602 678.899881  12.33.247.4    148.78.247.10  TCP       70 80 → 26268 [FIN, ACK] Seq=142 A
98608 678.929234  148.78.247.10  12.33.247.4    TCP       70 [TCP Dup ACK 98597#1] 26268 → 8
98609 678.933213  148.78.247.10  12.33.247.4    TCP       70 26268 → 80 [ACK] Seq=156 Ack=14
98610 678.933475  148.78.247.10  12.33.247.4    TCP       70 26268 → 80 [FIN, ACK] Seq=156 A
98611 678.933517  12.33.247.4    148.78.247.10  TCP       70 80 → 26268 [ACK] Seq=143 Ack=15
98716 679.708532  148.78.247.10  12.33.247.4    TCP       78 26460 → 80 [SYN] Seq=0 Win=6553
```

```
▷ Frame 98594: 78 bytes on wire (624 bits), 78 bytes captured (624 bits)
▷ Ethernet II, Src: HewlettP_ea:20:ab (00:50:8b:ea:20:ab), Dst: Computer_20:7d:e3 (00:b0:d0:20:7d:e3)
▷ Internet Protocol Version 4, Src: 148.78.247.10, Dst: 12.33.247.4
◢ Transmission Control Protocol, Src Port: 26268, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 26268
    Destination Port: 80
    [Stream index: 648]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    [Next sequence number: 0    (relative sequence number)]
    Acknowledgment number: 0
    1010 .... = Header Length: 40 bytes (10)
  ▷ Flags: 0x002 (SYN)
```

```
0000  00 b0 d0 20 7d e3 00 50  8b ea 20 ab 08 00 45 00   ···}··P·· ···E·
0010  00 3c f7 29 00 00 31 06  04 14 94 4e f7 0a 0c 21   ·<·)··1· ···N···!
0020  f7 04 66 9c 00 50 64 37  ff 9d 00 00 00 00 a0 02   ··f··Pd7 ········
0030  ff ff a8 97 00 00 02 04  05 b4 01 03 03 00 01 01   ········ ········
0040  08 0a 00 ec 48 44 00 00  00 00 61 64 64 72         ····HD·· ··addr
```

perimeter_class.cap | Packets: 197147 · Displayed: 5462 (2.8%) | Profile: Default

Bro/Zeek

- What's it good for?
  - Near real time analysis
  - More storage friendly than pcaps
- When to use it
  - When you need to scale
  - When you know what attributes to review
- Where to get it

https://www.zeek.org/

```
sudo apt -y install zeek zeek-aux
```

Gets you zeek-cut tools

Bro/Zeek example

```
$ cat conn.log | zeek-cut  id.orig_h id.resp_h id.resp_p
proto service orig_ip_bytes resp_ip_bytes

183.131.82.99    104.248.191.205  22      tcp  ssh  1923   0
112.85.42.229    104.248.191.205  22      tcp  -    344    0
104.248.191.205  67.207.67.3      53      udp  dns  42     126
81.22.45.150     104.248.191.205  7180    tcp  -    80     40
110.49.40.4      104.248.191.205  445     tcp  -    52     40
81.22.45.150     104.248.191.205  7404    tcp  -    80     40
```

Bro/Zeek example - cert check

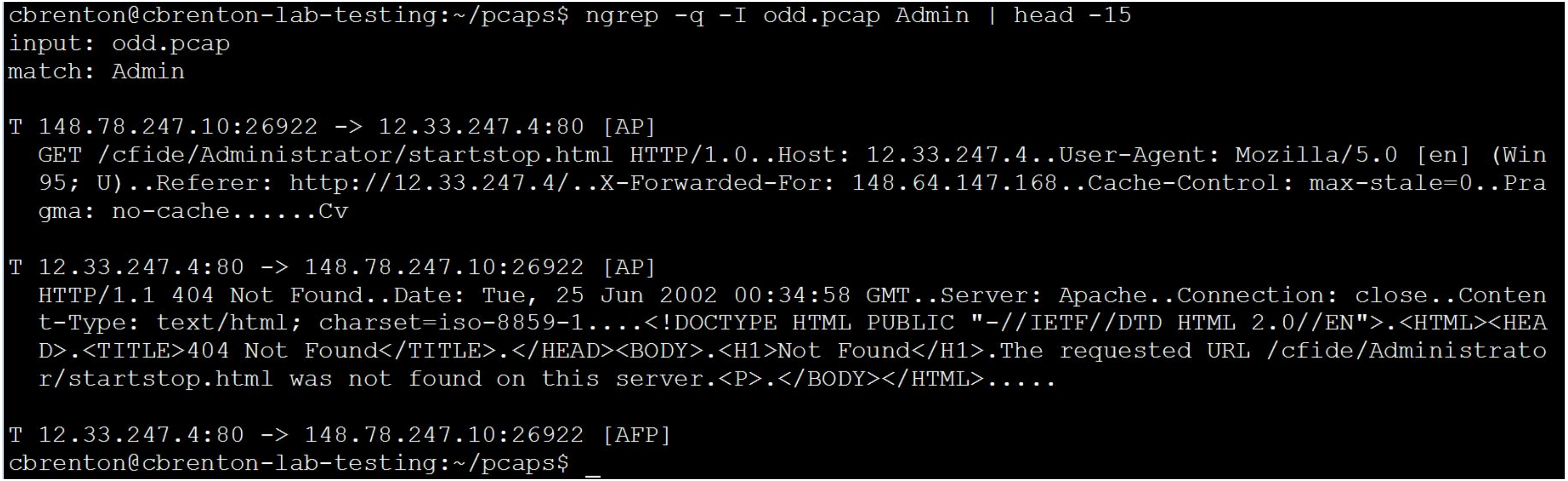
```
$ cat ssl* | zeek-cut id.orig_h id.resp_h id.resp_p
validation_status | grep 'self signed' | sort | uniq
122.228.10.51   192.168.88.2    9943    self signed certificate in
certificate chain
24.111.1.134    192.168.88.2    9943    self signed certificate in
certificate chain
71.6.167.142    192.168.88.2    9943    self signed certificate in
certificate chain
```

ngrep

- Pattern match on passing packets
- Like "grep" for network traffic
- Useful for quick checks
  - NIDS with signature better choice for long term
- Useful switches
  - "-q" = Don't print "#" for non-matches
  - "-I" = Read a pcap file

https://github.com/jpr5/ngrep
sudo apt install ngrep

Ngrep example



```
cbrenton@cbrenton-lab-testing:~/pcaps$ ngrep -q -I odd.pcap Admin | head -15
input: odd.pcap
match: Admin

T 148.78.247.10:26922 -> 12.33.247.4:80 [AP]
  GET /cfide/Administrator/startstop.html HTTP/1.0..Host: 12.33.247.4..User-Agent: Mozilla/5.0 [en] (Win
  95; U)..Referer: http://12.33.247.4/..X-Forwarded-For: 148.64.147.168..Cache-Control: max-stale=0..Pra
  gma: no-cache......Cv

T 12.33.247.4:80 -> 148.78.247.10:26922 [AP]
  HTTP/1.1 404 Not Found..Date: Tue, 25 Jun 2002 00:34:58 GMT..Server: Apache..Connection: close..Conten
  t-Type: text/html; charset=iso-8859-1....<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">.<HTML><HEA
  D>.<TITLE>404 Not Found</TITLE>.</HEAD><BODY>.<H1>Not Found</H1>.The requested URL /cfide/Administrato
  r/startstop.html was not found on this server.<P>.</BODY></HTML>.....

T 12.33.247.4:80 -> 148.78.247.10:26922 [AFP]
cbrenton@cbrenton-lab-testing:~/pcaps$ _
```

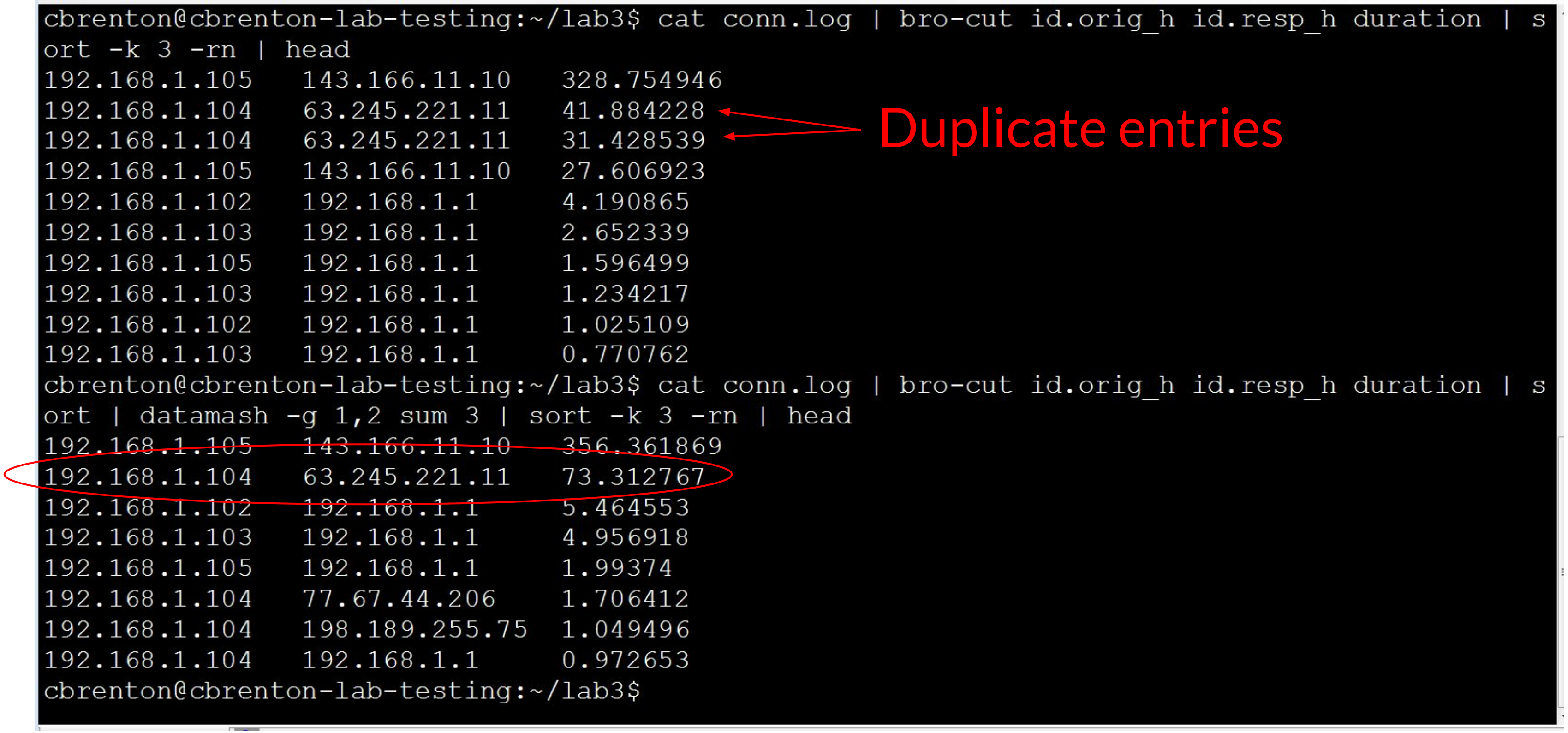
Datamash

- What's it good for?
  - Similar to the R-base tools, but more extensive
  - Performing simple calculation on data
- When to use it
  - Performing calculations on multiple lines
  - Statistical analysis
- Where to get it

https://www.gnu.org/software/datamash/

```
sudo apt install datamash
```

Datamash example



```
cbrenton@cbrenton-lab-testing:~/lab3$ cat conn.log | bro-cut id.orig_h id.resp_h duration | s
ort -k 3 -rn | head
192.168.1.105   143.166.11.10   328.754946
192.168.1.104   63.245.221.11   41.884228
192.168.1.104   63.245.221.11   31.428539
192.168.1.105   143.166.11.10   27.606923
192.168.1.102   192.168.1.1     4.190865
192.168.1.103   192.168.1.1     2.652339
192.168.1.105   192.168.1.1     1.596499
192.168.1.103   192.168.1.1     1.234217
192.168.1.102   192.168.1.1     1.025109
192.168.1.103   192.168.1.1     0.770762
cbrenton@cbrenton-lab-testing:~/lab3$ cat conn.log | bro-cut id.orig_h id.resp_h duration | s
ort | datamash -g 1,2 sum 3 | sort -k 3 -rn | head
192.168.1.105   143.166.11.10   356.361869
192.168.1.104   63.245.221.11   73.312767
192.168.1.102   192.168.1.1     5.464553
192.168.1.103   192.168.1.1     4.956918
192.168.1.105   192.168.1.1     1.99374
192.168.1.104   77.67.44.206    1.706412
192.168.1.104   198.189.255.75  1.049496
192.168.1.104   192.168.1.1     0.972653
cbrenton@cbrenton-lab-testing:~/lab3$
```

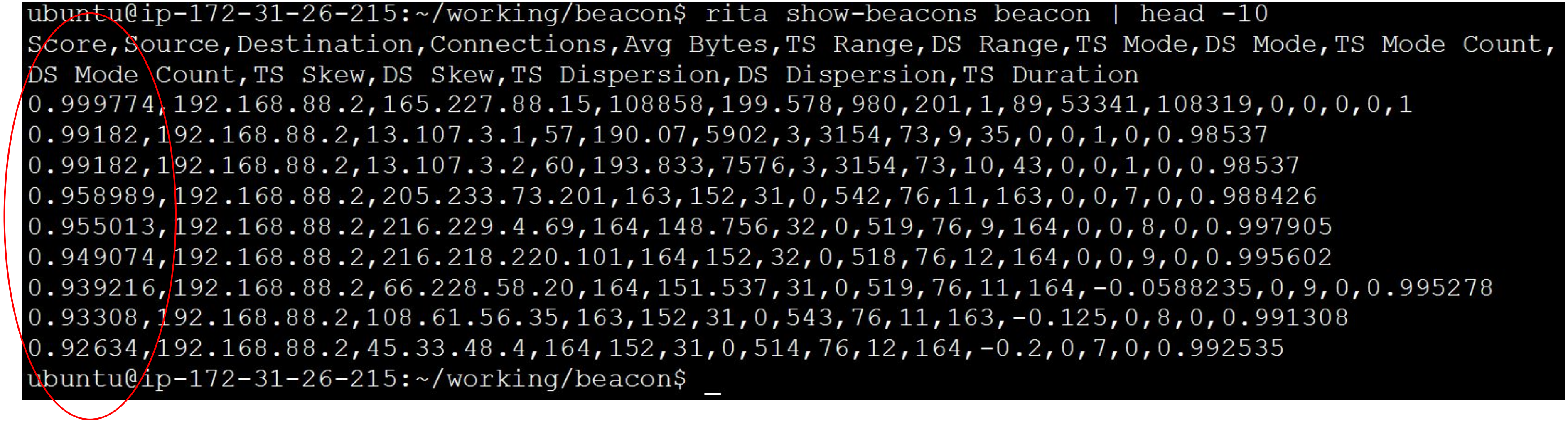
Duplicate entries

RITA

- What's it good for?
    - Beacon & long conn at scale
    - Some secondary attributes
- When to use it
    - Can better organize Bro/Zeek data
    - Good when you are comfortable scripting
    - Will scale but can be time consuming
- Where to get it

https://github.com/activecm/rita

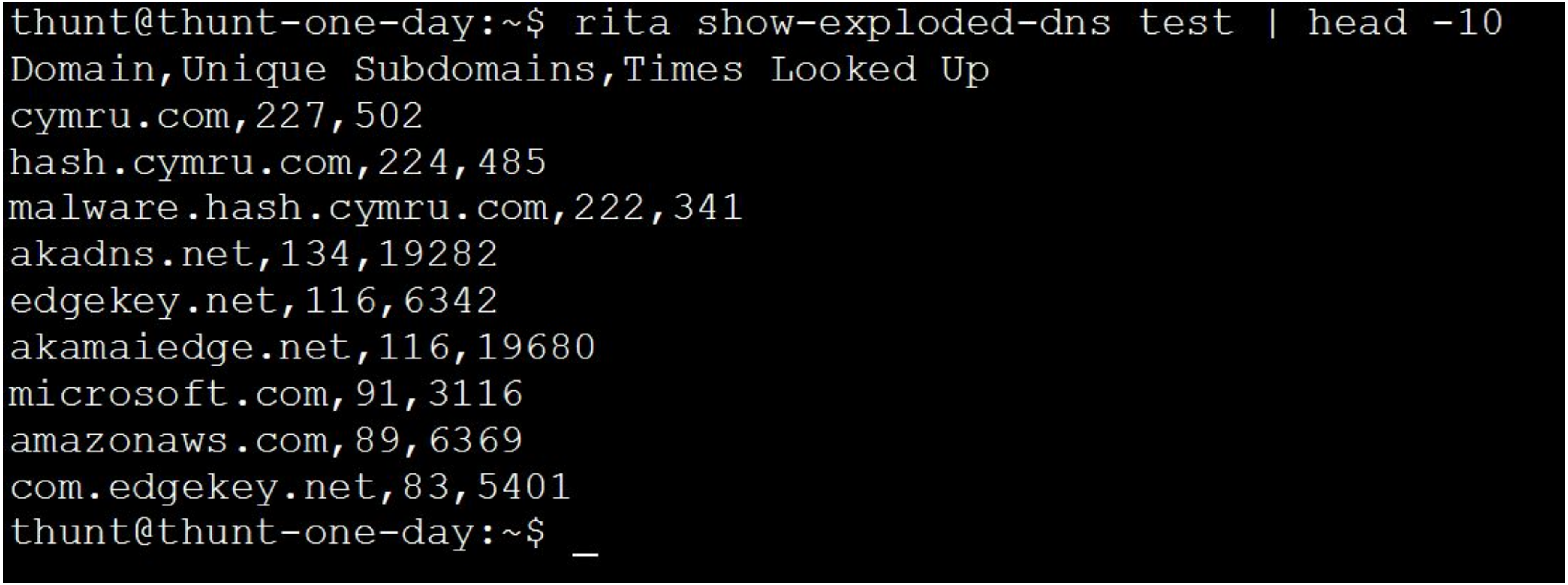
RITA example - beacons



```
ubuntu@ip-172-31-26-215:~/working/beacon$ rita show-beacons beacon | head -10
Score,Source,Destination,Connections,Avg Bytes,TS Range,DS Range,TS Mode,DS Mode,TS Mode Count,
DS Mode Count,TS Skew,DS Skew,TS Dispersion,DS Dispersion,TS Duration
0.999774,192.168.88.2,165.227.88.15,108858,199.578,980,201,1,89,53341,108319,0,0,0,0,1
0.99182,192.168.88.2,13.107.3.1,57,190.07,5902,3,3154,73,9,35,0,0,1,0,0.98537
0.99182,192.168.88.2,13.107.3.2,60,193.833,7576,3,3154,73,10,43,0,0,1,0,0.98537
0.958989,192.168.88.2,205.233.73.201,163,152,31,0,542,76,11,163,0,0,7,0,0.988426
0.955013,192.168.88.2,216.229.4.69,164,148.756,32,0,519,76,9,164,0,0,8,0,0.997905
0.949074,192.168.88.2,216.218.220.101,164,152,32,0,518,76,12,164,0,0,9,0,0.995602
0.939216,192.168.88.2,66.228.58.20,164,151.537,31,0,519,76,11,164,-0.0588235,0,9,0,0.995278
0.93308,192.168.88.2,108.61.56.35,163,152,31,0,543,76,11,163,-0.125,0,8,0,0.991308
0.92634,192.168.88.2,45.33.48.4,164,152,31,0,514,76,12,164,-0.2,0,7,0,0.992535
ubuntu@ip-172-31-26-215:~/working/beacon$ _
```

Scale is 0 - 1 with 1.0 being a perfect beacon score

RITA example - C2 over DNS



```
thunt@thunt-one-day:~$ rita show-exploded-dns test | head -10
Domain,Unique Subdomains,Times Looked Up
cymru.com,227,502
hash.cymru.com,224,485
malware.hash.cymru.com,222,341
akadns.net,134,19282
edgekey.net,116,6342
akamaiedge.net,116,19680
microsoft.com,91,3116
amazonaws.com,89,6369
com.edgekey.net,83,5401
thunt@thunt-one-day:~$ _
```

Passer

```
TC,172.1.199.23,TCP_43,open,
TC,172.16.199.23,TCP_55443,open,
UC,172.16.199.23,UDP_626,open,serialnumberd/clientscanner likely nmap
scan Warnings:scan
UC,172.16.199.23,UDP_1194,open,openvpn/client Warnings:tunnel
UC,172.16.199.23,UDP_3386,open,udp3386/client
UC,172.16.199.23,UDP_5632,open,pcanywherestat/clientscanner
Warnings:scan
UC,172.16.199.23,UDP_64738,open,shodan_host/clientscanner abcdefgh
Unlisted host Warnings:scan
DN,2001:db8:1001:0000:0000:0000:0000:0015,AAAA,ns3.markmonitor.com.,
DN,fe80:0000:0000:0000:189f:545b:7d4c:eeb8,PTR,Apple
TV._device-info._tcp.local.,model=J105aA
```

Majestic Top 1 Million

- List of busiest sites on the Internet
- Busiest sites less likely to be evil
  - But not a guarantee
  - Absolutely a minor modifier

http://downloads.majesticseo.com/majestic_million.csv

Open source threat feeds

- What's it good for?
  - Identifying reputation of external IPs
  - Can assist with attribution
  - Need to qualify any matches
    - How old is the entry?
    - Why was it flagged?
    - Is it within dynamic space?
- When to use it
  - Minor modifier only

Threat feeds

Spamhaus & DShield
http://rules.emergingthreats.net/fwrules/emerging-Block-IPs.txt

Known C2 servers
http://osint.bambenekconsulting.com/feeds/c2-ipmasterlist.txt

Consolidation of multiple feeds
https://raw.githubusercontent.com/stamparm/ipsum/master/ipsum.txt

ISC top reported sites
https://isc.sans.edu/feeds/suspiciousdomains_High.txt

ACTIVE COUNTERMEASURES

C2 Labs

What We Will Cover

- This section is mostly hands on labs
- Implement what you have learned
- Lab format:
  - Given a problem
    - Use earlier content to help solve
  - Given hints
    - If you don't know where to start, try the hints
  - Given the exact commands
  - Solution
    - Complete walk through of the solution

Reminder

- All lab files are on the VM
  - No network access needed
- Login info
  - Name = thunt
  - Password = aybab2u
- Labs are in /home/thunt/lab*

Find long connections

- Files located in /home/thunt/lab1
- Provided with pcap and Zeek log files
- Identify
    - Top 10 longest connections between private and legal IP addresses (internal to external)
    - Top 10 cumulative communication time between private and legal IP addresses (internal to external)

Find long conns - Hints

- Long connections is a relative term. You need to know the length of time being audited.
- Pcaps don't store connection duration
- Zeek stores duration in conn.log
- Zeek-cut extracts fields from Zeek logs
- Datamash is useful for adding values

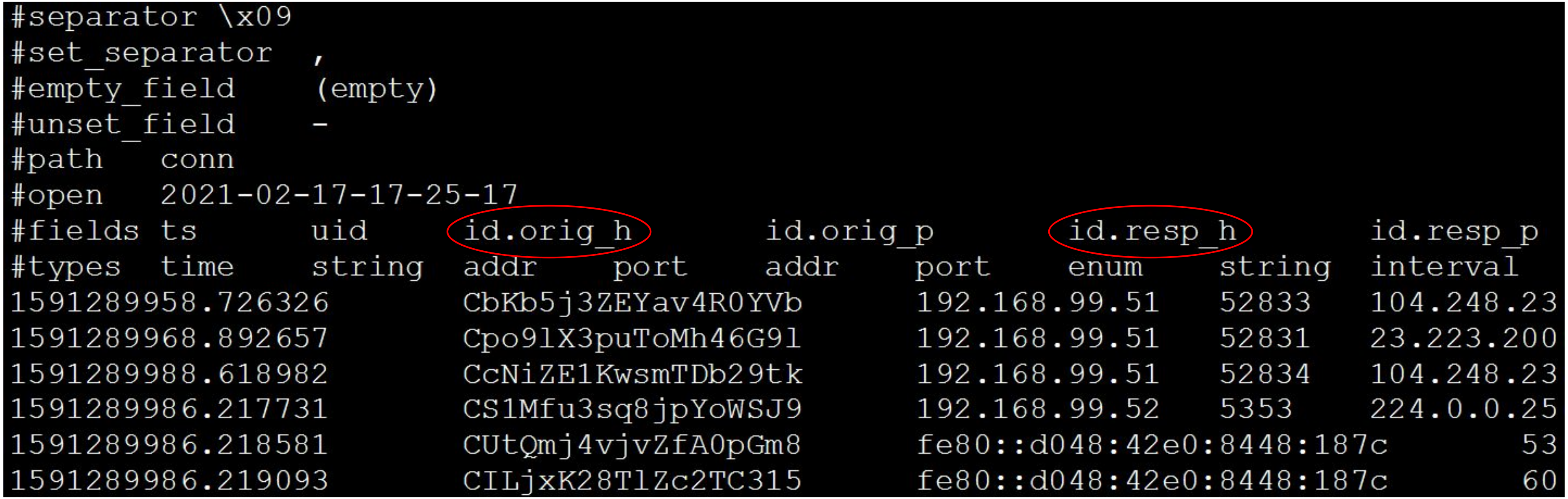
Useful commands to try

```
capinfos -aeu <pcap file>

cat conn.log | zeek-cut id.orig_h
id.resp_h duration | sort -k 3 -rn | head

cat conn.log | zeek-cut id.orig_h
id.resp_h duration | sort | grep -v -e
'^$' | grep -v '-' | datamash -g 1,2 sum 3
| sort -k 3 -rn | head
```

Long conns - Answers

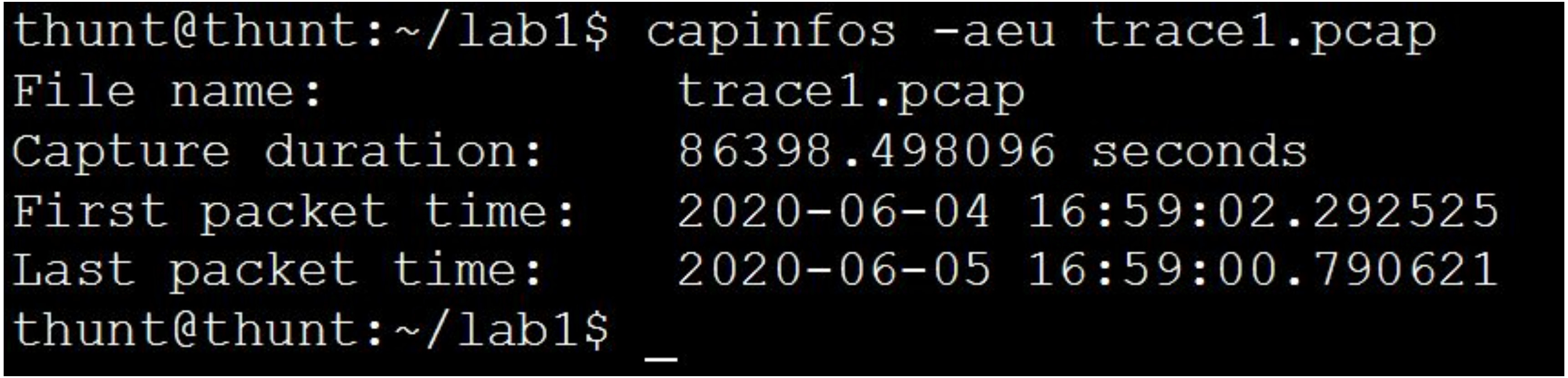
- Need to ID how long the pcap captured
- Use Zeek conn.log to easily get duration
- Need to extract:
  - Source IP
  - Destination IP
  - Duration of each connection
- Need to be able to:
  - Add up connection time between IP's
  - Present longest results first

less -S conn.log



```
#separator \x09
#set_separator  ,
#empty_field    (empty)
#unset_field    -
#path   conn
#open   2021-02-17-17-25-17
#fields ts      uid     id.orig_h       id.orig_p       id.resp_h       id.resp_p
#types  time    string  addr    port    addr    port    enum    string  interval
1591289958.726326       CbKb5j3ZEYav4R0YVb      192.168.99.51   52833   104.248.23
1591289968.892657       Cpo9lX3puToMh46G9l      192.168.99.51   52831   23.223.200
1591289988.618982       CcNiZE1KwsmTDb29tk      192.168.99.51   52834   104.248.23
1591289986.217731       CS1Mfu3sq8jpYoWSJ9      192.168.99.52   5353    224.0.0.25
1591289986.218581       CUtQmj4vjvZfA0pGm8      fe80::d048:42e0:8448:187c       53
1591289986.219093       CILjxK28TlZc2TC315      fe80::d048:42e0:8448:187c       60
```

Identify time window being audited



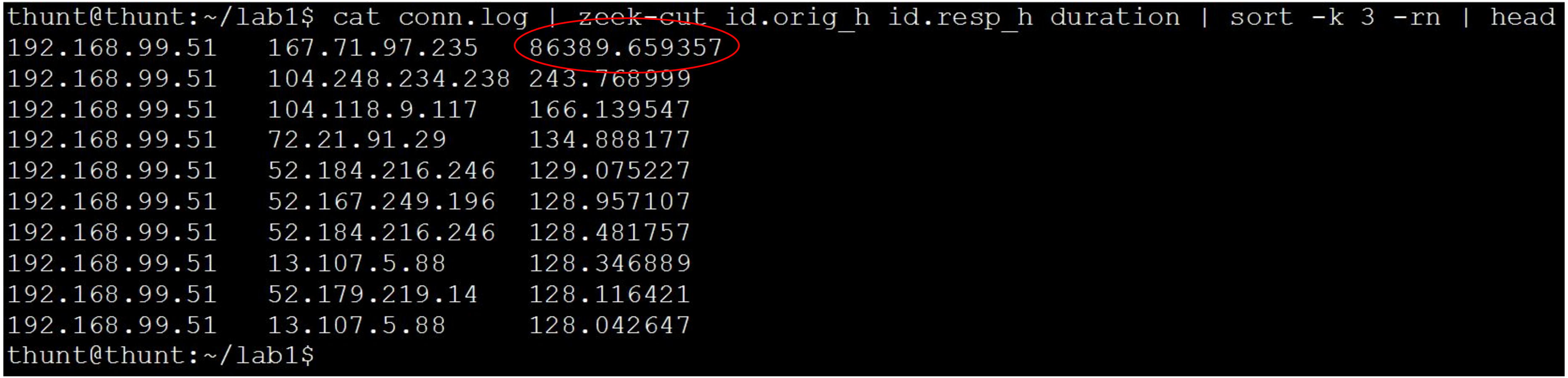
```
thunt@thunt:~/lab1$ capinfos -aeu trace1.pcap
File name:           trace1.pcap
Capture duration:    86398.498096 seconds
First packet time:   2020-06-04 16:59:02.292525
Last packet time:    2020-06-05 16:59:00.790621
thunt@thunt:~/lab1$ _
```

24 hours = 86,400 seconds

Plan B for files too large for capinfos:

```
tcpdump -tttt -n -r <filename> | awk 'NR==1; END{print}'
```

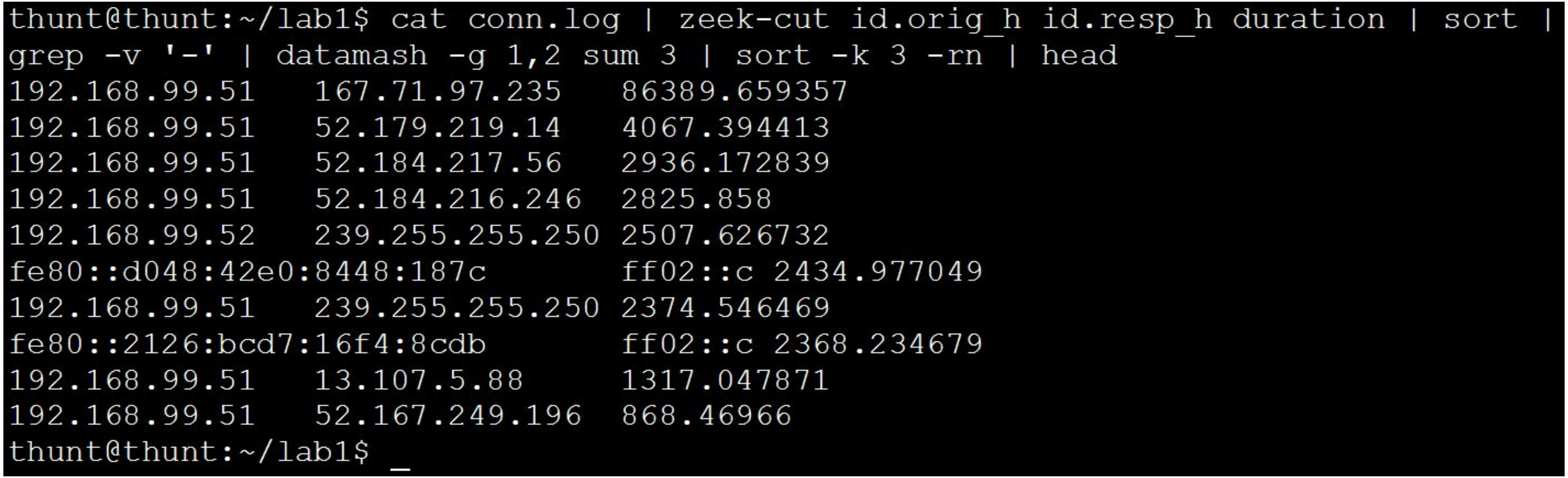
Longest unique connections



```
thunt@thunt:~/lab1$ cat conn.log | zeek-cut id.orig_h id.resp_h duration | sort -k 3 -rn | head
192.168.99.51   167.71.97.235   86389.659357
192.168.99.51   104.248.234.238 243.768999
192.168.99.51   104.118.9.117   166.139547
192.168.99.51   72.21.91.29     134.888177
192.168.99.51   52.184.216.246  129.075227
192.168.99.51   52.167.249.196  128.957107
192.168.99.51   52.184.216.246  128.481757
192.168.99.51   13.107.5.88     128.346889
192.168.99.51   52.179.219.14   128.116421
192.168.99.51   13.107.5.88     128.042647
thunt@thunt:~/lab1$
```

Duration is just short of the full 86,398 second capture time

Longest talk time



```
thunt@thunt:~/lab1$ cat conn.log | zeek-cut id.orig_h id.resp_h duration | sort |
grep -v '-' | datamash -g 1,2 sum 3 | sort -k 3 -rn | head
192.168.99.51   167.71.97.235   86389.659357
192.168.99.51   52.179.219.14   4067.394413
192.168.99.51   52.184.217.56   2936.172839
192.168.99.51   52.184.216.246  2825.858
192.168.99.52   239.255.255.250 2507.626732
fe80::d048:42e0:8448:187c       ff02::c 2434.977049
192.168.99.51   239.255.255.250 2374.546469
fe80::2126:bcd7:16f4:8cdb       ff02::c 2368.234679
192.168.99.51   13.107.5.88     1317.047871
192.168.99.51   52.167.249.196  868.46966
thunt@thunt:~/lab1$ _
```

Note the first entry is still the same, but all others are new.
IPv6 addresses have shifted info to the right.

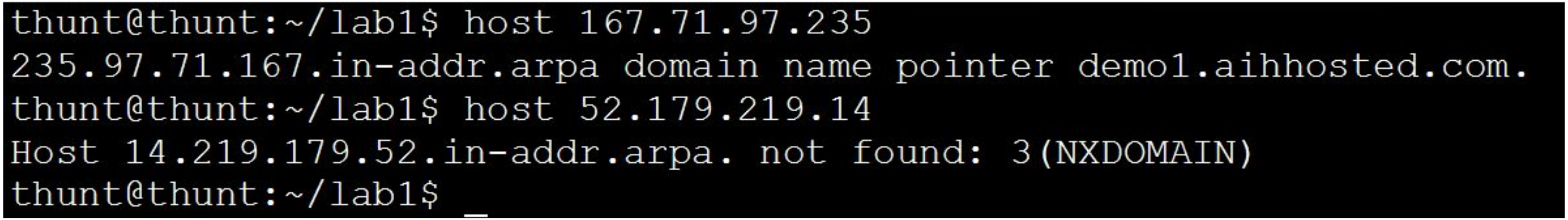
Investigate the longest talkers

- Let's investigate the external IP of the two longest session
    - 167.71.97.235
    - 52.179.219.14
- We'll use two common research methods
    - "host" command
    - AbuseIPDB
        - https://www.threatcrowd.org/
    - ThreatCrowd
        - https://www.threatcrowd.org/

Investigate - hints

- You were given the two IP addresses to research
- The "host" command is run from the command line
- Use a browser to connect to the two research Websites and enter each IP

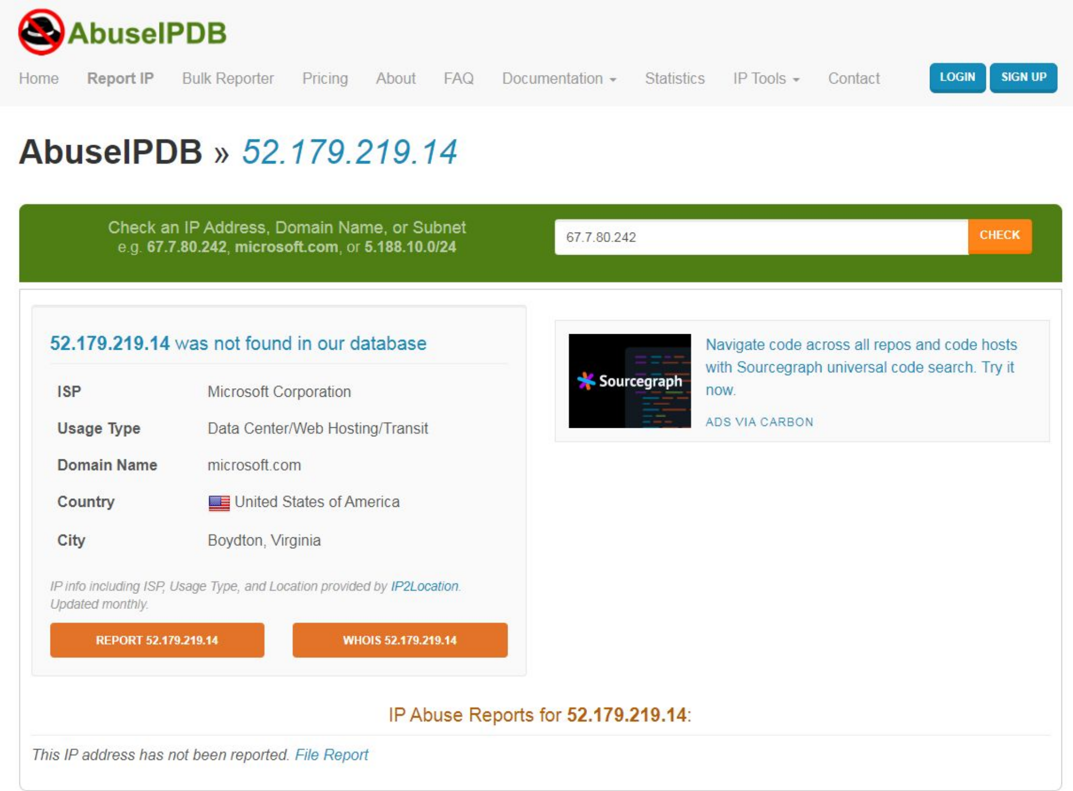
One out of two is not bad



```
thunt@thunt:~/lab1$ host 167.71.97.235
235.97.71.167.in-addr.arpa domain name pointer demo1.aihhosted.com.
thunt@thunt:~/lab1$ host 52.179.219.14
Host 14.219.179.52.in-addr.arpa. not found: 3(NXDOMAIN)
thunt@thunt:~/lab1$ _
```

Is there a business need for this connection?

AbuseIPDB data on 2nd IP



AbuseIPDB » *52.179.219.14*

Check an IP Address, Domain Name, or Subnet
e.g. **67.7.80.242**, **microsoft.com**, or **5.188.10.0/24**

67.7.80.242

52.179.219.14 was not found in our database

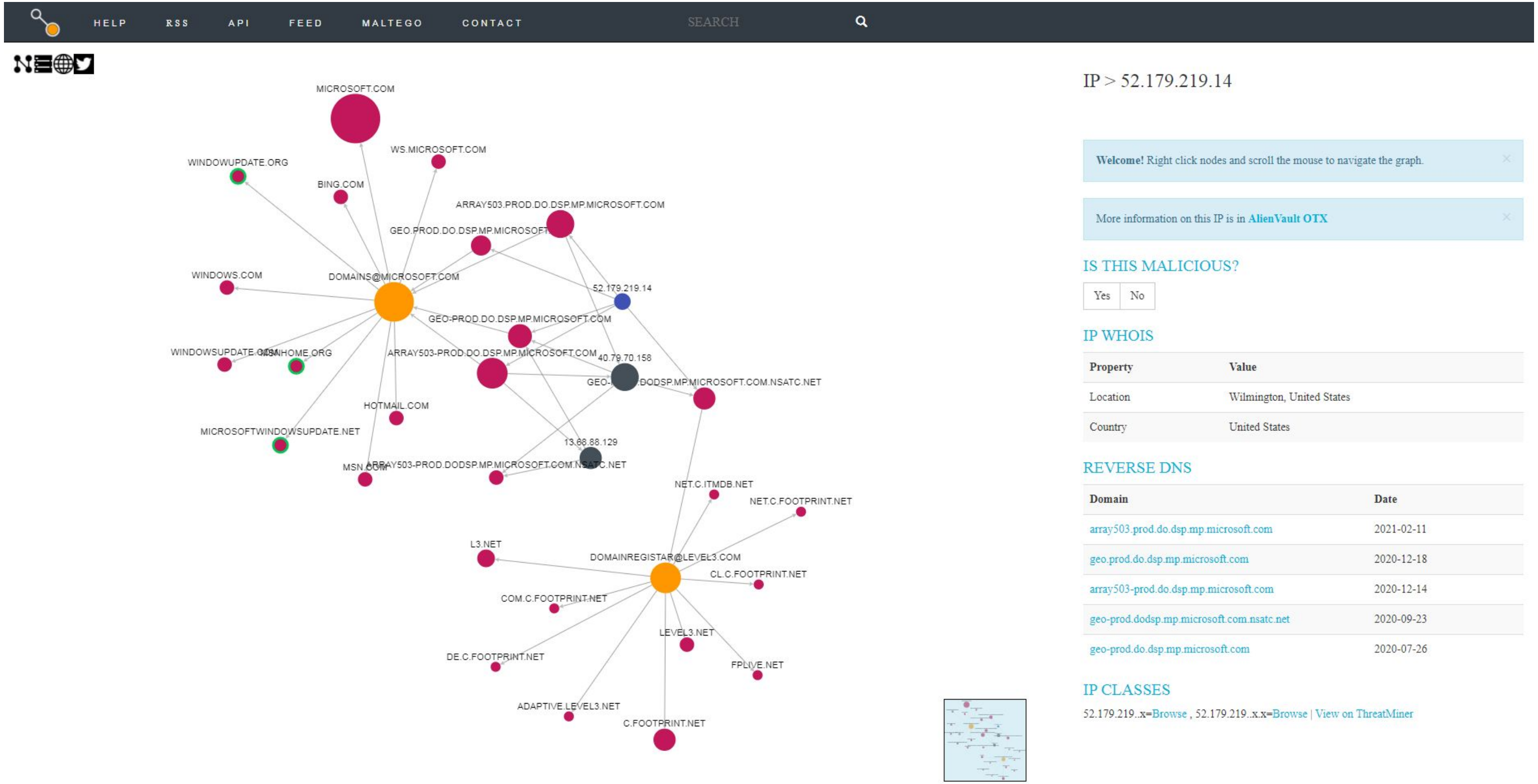
ISP	Microsoft Corporation
Usage Type	Data Center/Web Hosting/Transit
Domain Name	microsoft.com
Country	United States of America
City	Boydton, Virginia

IP info including ISP, Usage Type, and Location provided by IP2Location. Updated monthly.

IP Abuse Reports for **52.179.219.14**:

This IP address has not been reported. File Report

ThreatCrowd data on 2nd IP



IP > 52.179.219.14

Welcome! Right click nodes and scroll the mouse to navigate the graph. ×

More information on this IP is in **AlienVault OTX** ×

IS THIS MALICIOUS?

Yes No

IP WHOIS

Property	Value
Location	Wilmington, United States
Country	United States

REVERSE DNS

Domain	Date
array503.prod.do.dsp.mp.microsoft.com	2021-02-11
geo.prod.do.dsp.mp.microsoft.com	2020-12-18
array503-prod.do.dsp.mp.microsoft.com	2020-12-14
geo-prod.dodsp.mp.microsoft.com.nsatc.net	2020-09-23
geo-prod.do.dsp.mp.microsoft.com	2020-07-26

IP CLASSES

52.179.219..x=Browse , 52.179.219..x.x=Browse | View on ThreatMiner

Answers

- Longest connection appears to be business partner related
- Second longest is is used in keeping Windows 10 updated
- Neither appear to be malware related
- Is there a business need for this?
  - If no, hunt down app and kill it
  - If yes, whitelist to remove from future hunts

Find beacons by session size

- Use the same data files as last lab
- Identify which internal IP's are connecting to individual external IP's most frequently
- Focus on IP pairs that create thousands of connections per days
  - Beacons can have smaller quantities, but we need to start somewhere
- Is there consistency in session size?
  - Possible beacon?

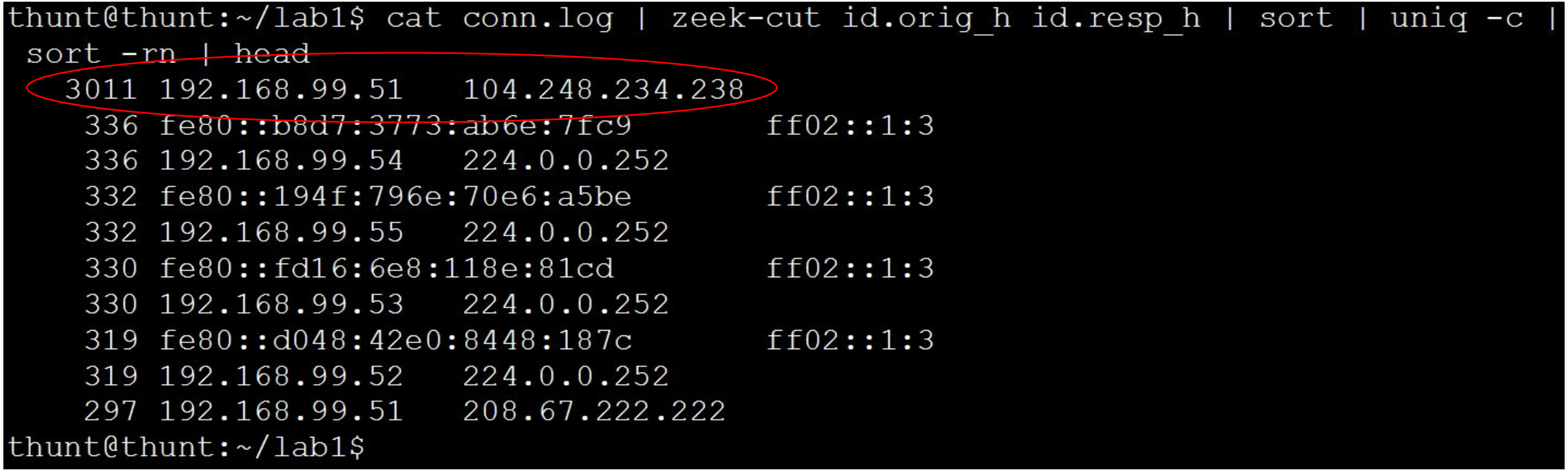
Find beacons - hints

- You need to be able to clearly identify:
  - Number of unique connections over 24 hours
    - Not the number of packets
  - The amount of payload data transferred
- Pick targets - Who has most connections?
- Zeek displays both bytes sent and received
  - Focus on bytes sent
  - orig_bytes

Useful commands to try

```
cat conn.log | zeek-cut id.orig_h id.resp_h | sort
| uniq -c | sort -rn | head

cat conn.log | zeek-cut id.orig_h id.resp_h
orig_bytes | grep 192.168.99.51 | grep
104.248.234.238 | sort | uniq -c | sort -rn | head
```

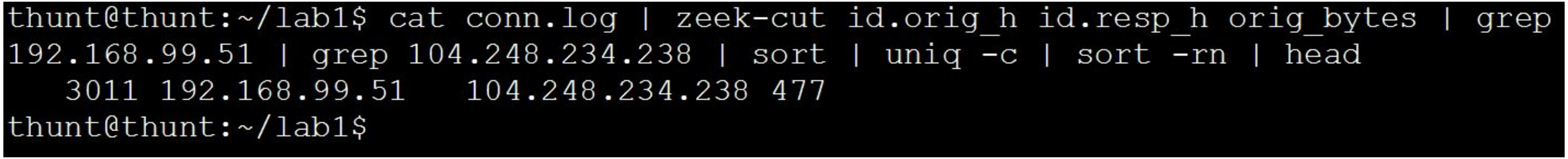
Answers - most connections



```
thunt@thunt:~/lab1$ cat conn.log | zeek-cut id.orig_h id.resp_h | sort | uniq -c |
 sort -rn | head
   3011 192.168.99.51   104.248.234.238
    336 fe80::b8d7:3773:ab6e:7fc9       ff02::1:3
    336 192.168.99.54   224.0.0.252
    332 fe80::194f:796e:70e6:a5be       ff02::1:3
    332 192.168.99.55   224.0.0.252
    330 fe80::fd16:6e8:118e:81cd        ff02::1:3
    330 192.168.99.53   224.0.0.252
    319 fe80::d048:42e0:8448:187c       ff02::1:3
    319 192.168.99.52   224.0.0.252
    297 192.168.99.51   208.67.222.222
thunt@thunt:~/lab1$
```

The first looks potentially suspicious (no time analysis)
The rest are just local multicast traffic

Session size analysis



```
thunt@thunt:~/lab1$ cat conn.log | zeek-cut id.orig_h id.resp_h orig_bytes | grep
192.168.99.51 | grep 104.248.234.238 | sort | uniq -c | sort -rn | head
   3011 192.168.99.51   104.248.234.238 477
thunt@thunt:~/lab1$
```

Every session resulted in 477 bytes sent to external host
This could indicate a beacon that was not activated over the 24 hours

Payload analysis with ngrep

- We found a suspicious IP pair
  - 192.168.99.51 to 104.248.234.238
- Let's analyze the payloads in these sessions
- Multiple tools can help here
  - But ngrep easily focuses on payload
- Use "host" parameter to focus in on the above IPs

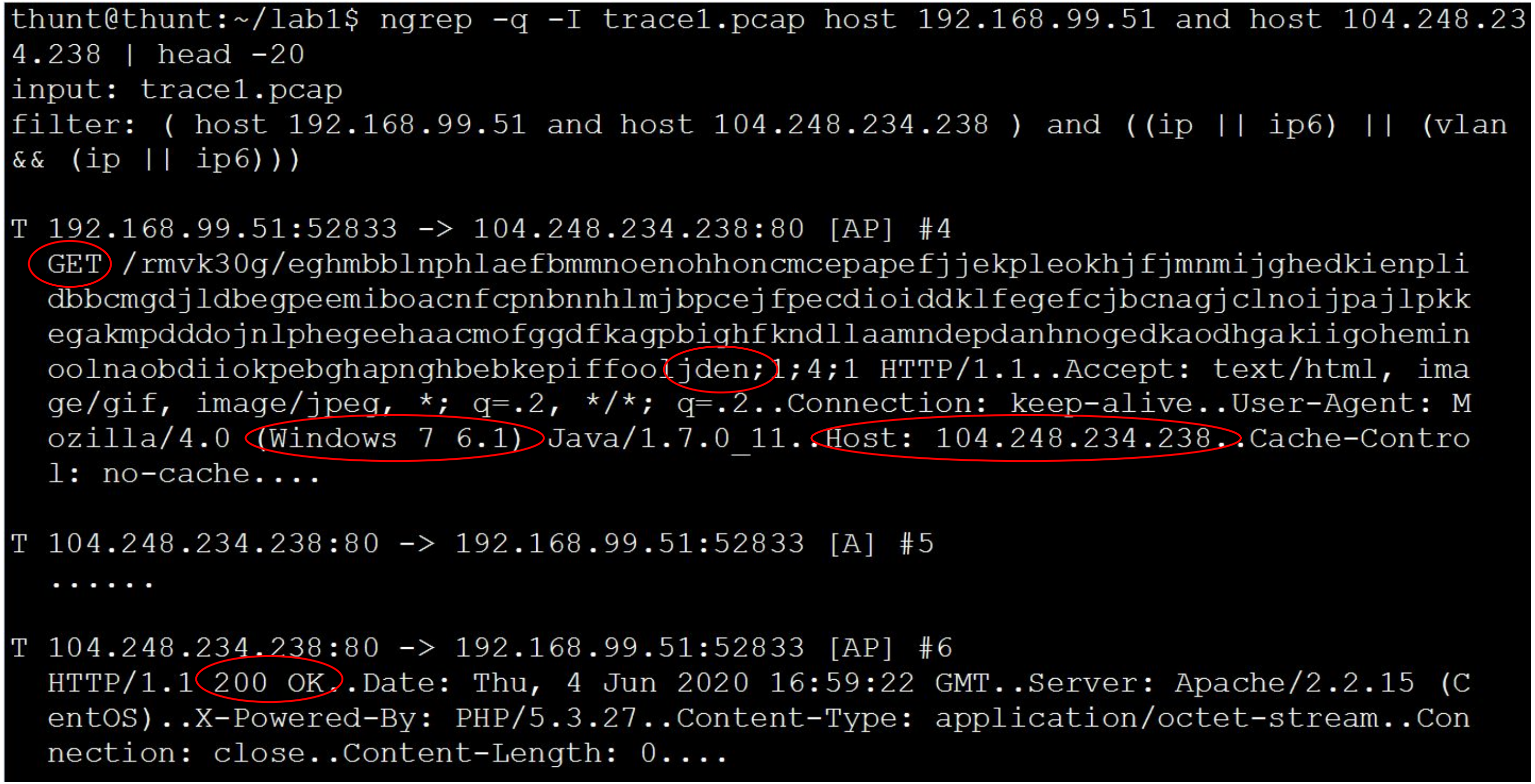
Payload analysis - hints

- Ngrep is normally used to search for patterns within the payload of all packets
- You can use BP filters to:
  - Focus on specific IP addresses
  - Focus on specific ports
  - "host" focuses on specific IP addresses
- Helpful switches
  - "-q" = Don't print "#" for packets that don't match
  - "-I" (capital letter i) = Read from pcap file

Useful commands to try

```
ngrep -q -I trace1.pcap host 192.168.99.51 and host
104.248.234.238 | less
```

Things that make you go "humm"



```
thunt@thunt:~/lab1$ ngrep -q -I trace1.pcap host 192.168.99.51 and host 104.248.23
4.238 | head -20
input: trace1.pcap
filter: ( host 192.168.99.51 and host 104.248.234.238 ) and ((ip || ip6) || (vlan
&& (ip || ip6)))

T 192.168.99.51:52833 -> 104.248.234.238:80 [AP] #4
  GET /rmvk30g/eghmbblnphlaefbmmnoenohhoncmcepapefjjekpleokhjfjmnmijghedkienpli
  dbbcmgdjldbegpeemiboacnfcpnbnnhlmjbpcejfpecdioiddklfegefcjbcnagjclnoijpajlpkk
  egakmpdddojnlphegeehaacmofggdfkagpbighfkndllaamndepdanhnogedkaodhgakiigohemin
  oolnaobdiiokpebghapnghbebkepiffooljden;1;4;1 HTTP/1.1..Accept: text/html, ima
  ge/gif, image/jpeg, *; q=.2, */*; q=.2..Connection: keep-alive..User-Agent: M
  ozilla/4.0 (Windows 7 6.1) Java/1.7.0_11..Host: 104.248.234.238..Cache-Contro
  l: no-cache....

T 104.248.234.238:80 -> 192.168.99.51:52833 [A] #5
  ......

T 104.248.234.238:80 -> 192.168.99.51:52833 [AP] #6
  HTTP/1.1 200 OK..Date: Thu, 4 Jun 2020 16:59:22 GMT..Server: Apache/2.2.15 (C
  entOS)..X-Powered-By: PHP/5.3.27..Content-Type: application/octet-stream..Con
  nection: close..Content-Length: 0....
```

What data are we sending?

- Is this the only URI we send to this host?
- We could eyeball it, but...
- Zeek stores this type of data
  - It's in the http.log file
- Let's use this log to identify all of the URI's requested from this external host

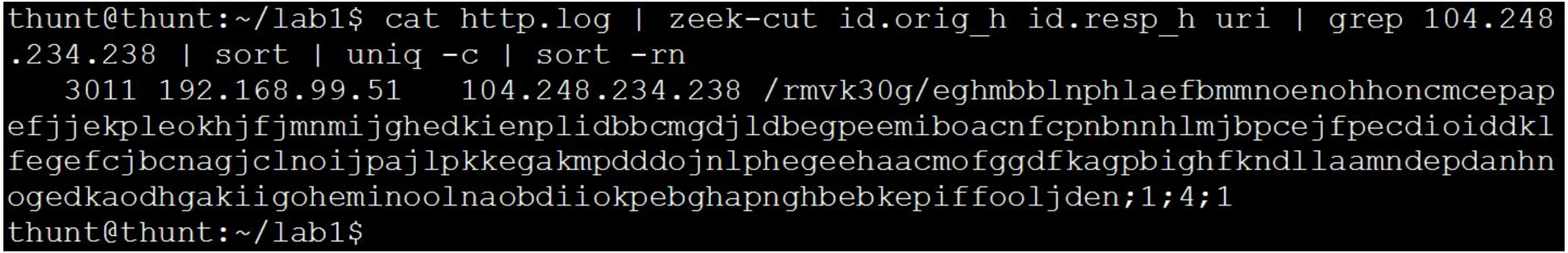
URI request - hints

- Zeek-cut is your friend
- We should extract
  - Source IP
  - Destination IP
  - The "uri" string
- Grep can focus on the traffic we care about
- Remember the threat hunter's mantra
  - sort | uniq | sort

Useful commands to try

```
cat http.log | zeek-cut id.orig_h id.resp_h uri |
grep 104.248.234.238 | sort | uniq -c | sort -rn
```

Single minded request



```
thunt@thunt:~/lab1$ cat http.log | zeek-cut id.orig_h id.resp_h uri | grep 104.248
.234.238 | sort | uniq -c | sort -rn
   3011 192.168.99.51   104.248.234.238 /rmvk30g/eghmbblnphlaefbmmnoenohhoncmcepap
efjjekpleokhjfjmnmijghedkienplidbbcmgdjldbegpeemiboacnfcpnbnnhlmjbpcejfpecdioiddkl
fegefcjbcnagjclnoijpajlpkkegakmpdddojnlphegeehaacmofggdfkagpbighfkndllaamndepdanhn
ogedkaodhgakiigoheminoolnaobdiiokpebghapnghbebkepiffooljden;1;4;1
thunt@thunt:~/lab1$
```

Answers

- 3,011 connections to external host
- Always sending the same odd "GET" request
- HTTP header data looks forged
- This really looks like a C2 channel
- Google search for "rmvk30g"
  - Looks like Fiesta EK malware

https://www.malware-traffic-analysis.net/2014/04/05/index.html

Look for C2 over DNS

- Move to the "lab2" directory
- Check to see if C2 over DNS is in play
- Consider any domain with more than 1,000 FQDNs in it suspect
  - Not interested in total quantity of queries
  - Interest in quantities of unique FQDNs

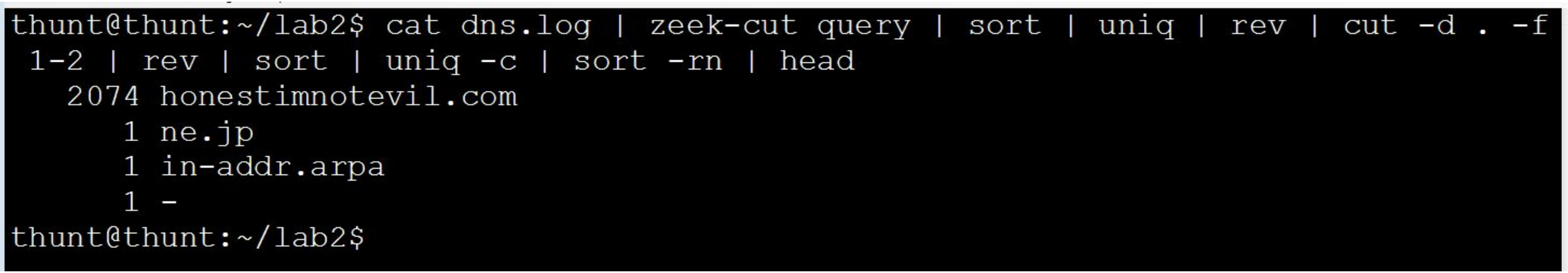
C2 over DNS - hints

- Zeek has a log file just for DNS traffic
- "query" field shows what was looked up
- Need a way to count hosts within a domain
- Some helpful text manipulation tools
  - sort = Pull together matching lines
  - uniq = Remove repeat entries
  - rev = Reverse the characters on a line
  - cut = Remove a section of characters on a line

Useful commands to try

```
cat dns.log | zeek-cut query | sort | uniq |
rev | cut -d . -f 1-2 | rev | sort | uniq -c |
sort -rn | head
```

C2 over DNS - Zeek



```
thunt@thunt:~/lab2$ cat dns.log | zeek-cut query | sort | uniq | rev | cut -d . -f
 1-2 | rev | sort | uniq -c | sort -rn | head
   2074 honestimnotevil.com
      1 ne.jp
      1 in-addr.arpa
      1 -
thunt@thunt:~/lab2$
```

That first entry looks pretty odd

Answers

- We looked up 2,074 FQDNs within honestimnoteveil.com
- This extremely high for a domain we do not recognize
- Could very well indicate C2 over DNS

Query types used by C2

- Many C2 over DNS tools use TXT record types to create channel
- This is why many orgs focus on this type
  - Leverage NIDs signatures
- Is that true for this C2 channel?
- Lab time!
  - Identify what record types were used

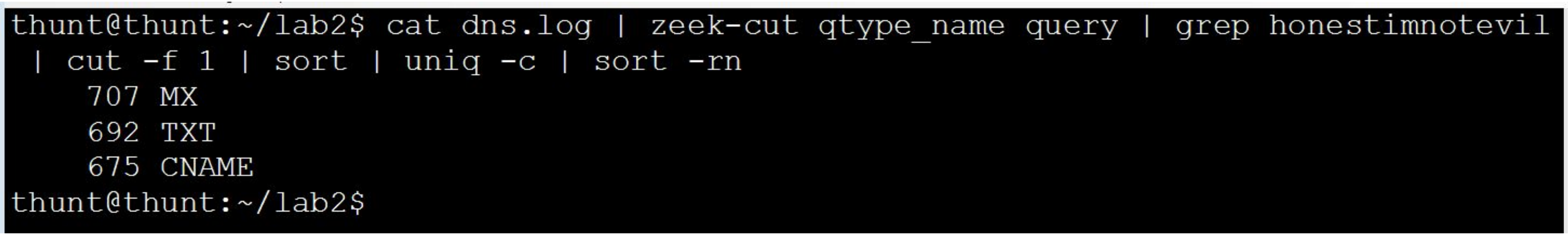
Hints - C2 over DNS record types

- Will need to extract "qtype_name" and "query" for each record
- We only care about "honestimnotevil" records
- Once these are extracted, we can "cut" out the query types and use our mantra to summarize

Useful commands to try

```
cat dns.log | zeek-cut qtype_name query | grep
honestimnotevil | cut -f 1 | sort | uniq -c |
sort -rn
```

A mix of query types



```
thunt@thunt:~/lab2$ cat dns.log | zeek-cut qtype_name query | grep honestimnotevil
 | cut -f 1 | sort | uniq -c | sort -rn
    707 MX
    692 TXT
    675 CNAME
thunt@thunt:~/lab2$
```

707 + 692 + 675 = 2,074 (same as number of FQDNs found in first lab

Answers

- Three different query types were used
  - Fairly even spread of quantities
- May be done to reduce the number of records for a specific type
- While TXT was used, may not be needed
- We can't just look for TXT records and hope to always catch C2

Next lab

- Move to the "lab3" directory
- Check for long connections and beacons
- Investigate any suspect external IP's
- Do you see anything of concern?

Hints

- Repeat what we did with "lab1"
  - Look for long connections
  - Look for cumulative communication time
  - Look for beacons
- Us "up arrow" key to scroll through previous commands to find what you used earlier
- You've got this! :-)

Useful commands to try

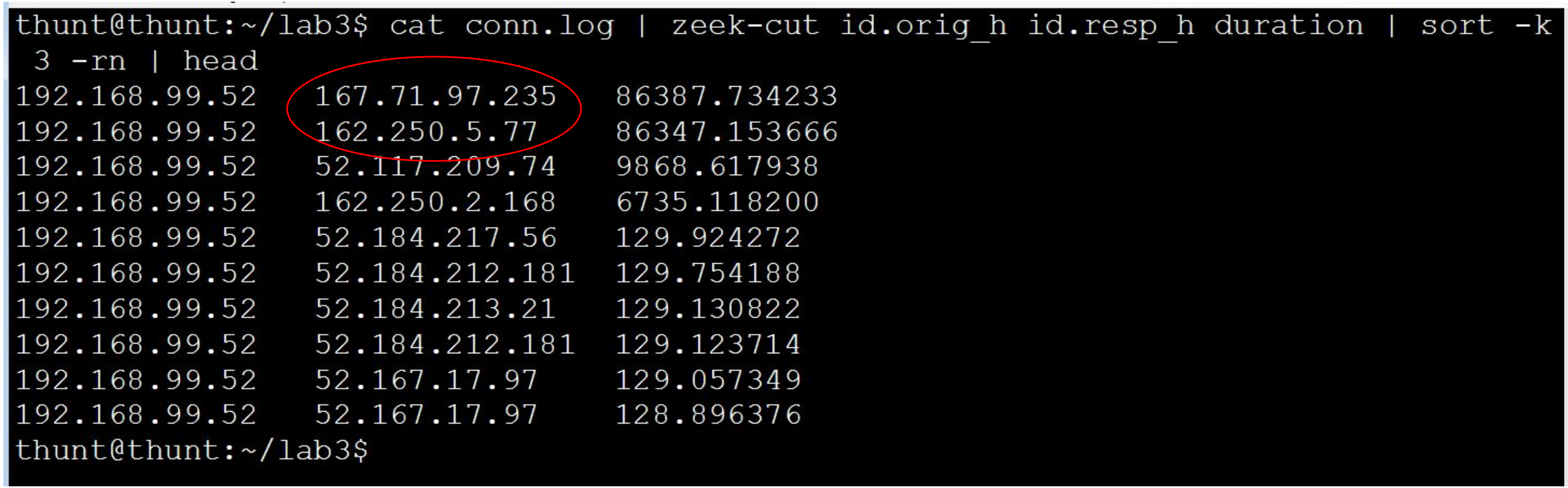
```
cat conn.log | zeek-cut id.orig_h id.resp_h
duration | sort -k 3 -rn | head
```

```
cat conn.log | zeek-cut id.orig_h id.resp_h
duration | sort | grep -v -e '^$' | grep -v '-'
| datamash -g 1,2 sum 3 | sort -k 3 -rn | head
```

```
cat conn.log | zeek-cut id.orig_h id.resp_h |
sort | uniq -c | sort -rn | head
```

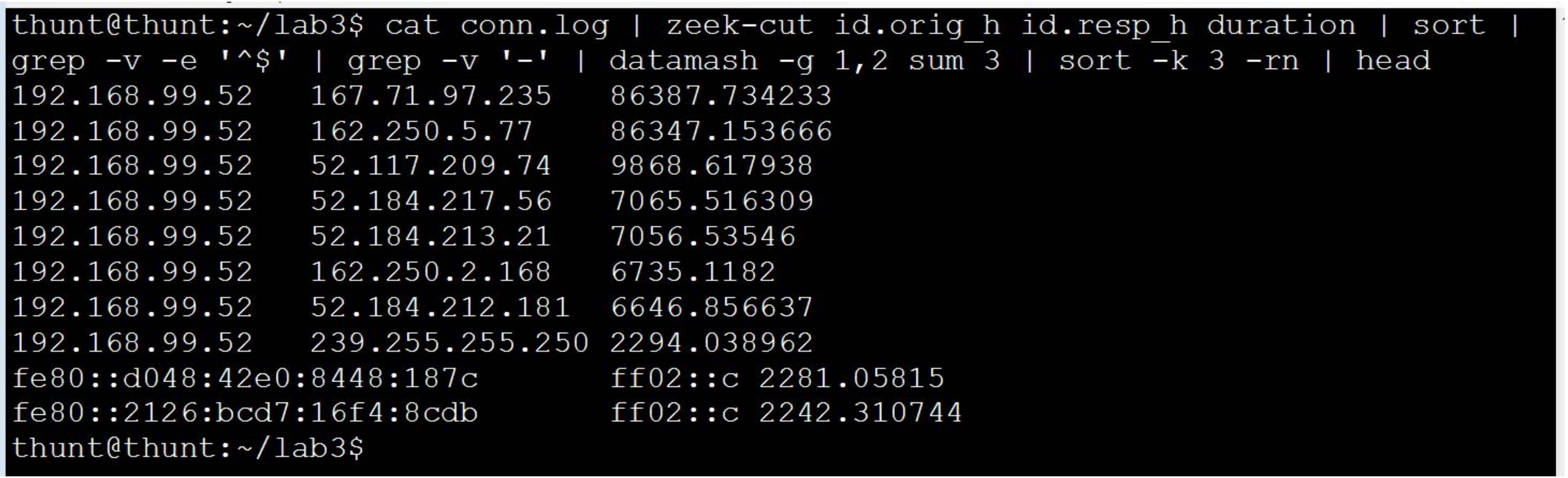
```
host <IP address to investigate>
```

Answers - Long connections



```
thunt@thunt:~/lab3$ cat conn.log | zeek-cut id.orig_h id.resp_h duration | sort -k
 3 -rn | head
192.168.99.52   167.71.97.235   86387.734233
192.168.99.52   162.250.5.77    86347.153666
192.168.99.52   52.117.209.74   9868.617938
192.168.99.52   162.250.2.168   6735.118200
192.168.99.52   52.184.217.56   129.924272
192.168.99.52   52.184.212.181  129.754188
192.168.99.52   52.184.213.21   129.130822
192.168.99.52   52.184.212.181  129.123714
192.168.99.52   52.167.17.97    129.057349
192.168.99.52   52.167.17.97    128.896376
thunt@thunt:~/lab3$
```

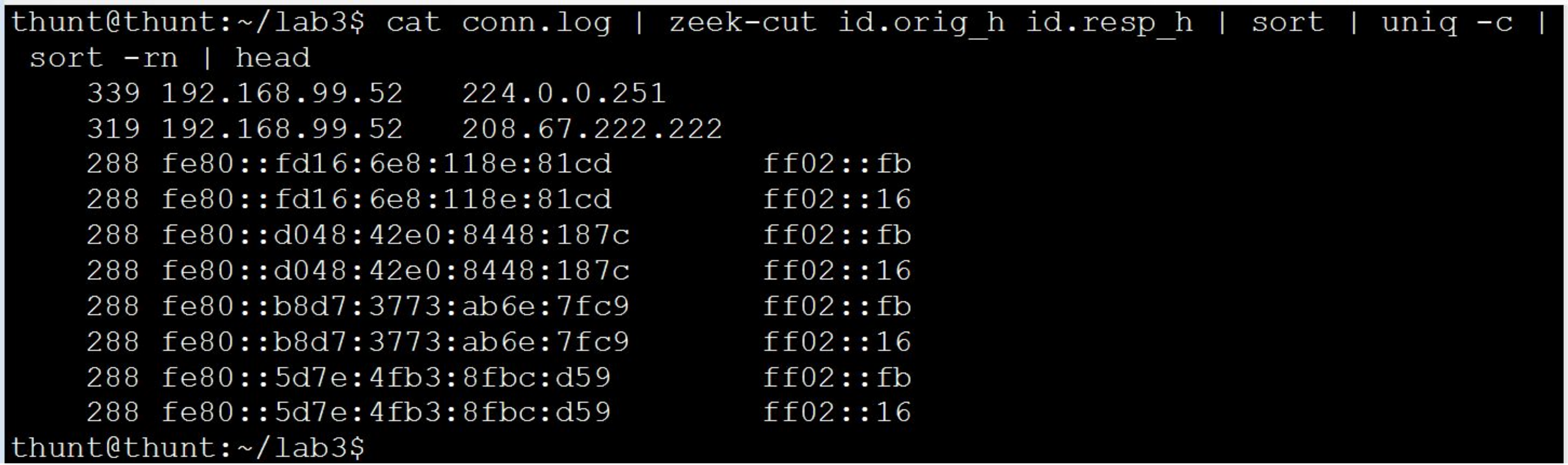
Answers - Cumulative comm time



```
thunt@thunt:~/lab3$ cat conn.log | zeek-cut id.orig_h id.resp_h duration | sort |
grep -v -e '^$' | grep -v '-' | datamash -g 1,2 sum 3 | sort -k 3 -rn | head
192.168.99.52   167.71.97.235   86387.734233
192.168.99.52   162.250.5.77    86347.153666
192.168.99.52   52.117.209.74   9868.617938
192.168.99.52   52.184.217.56   7065.516309
192.168.99.52   52.184.213.21   7056.53546
192.168.99.52   162.250.2.168   6735.1182
192.168.99.52   52.184.212.181  6646.856637
192.168.99.52   239.255.255.250 2294.038962
fe80::d048:42e0:8448:187c       ff02::c 2281.05815
fe80::2126:bcd7:16f4:8cdb       ff02::c 2242.310744
thunt@thunt:~/lab3$
```

Same two top IPs

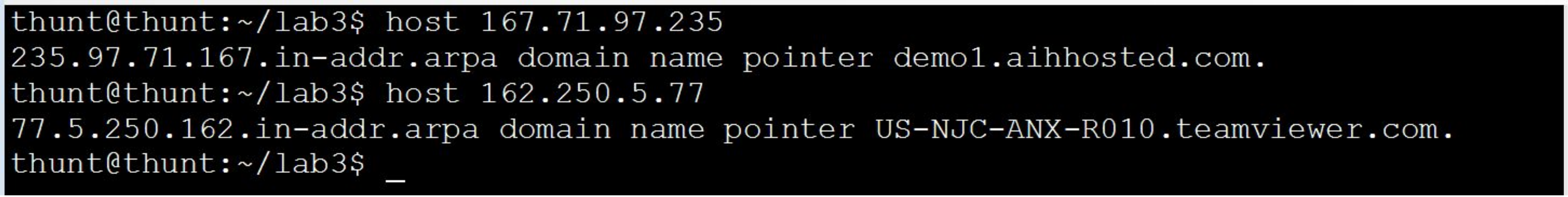
Answers - Beacons



```
thunt@thunt:~/lab3$ cat conn.log | zeek-cut id.orig_h id.resp_h | sort | uniq -c |
 sort -rn | head
    339 192.168.99.52   224.0.0.251
    319 192.168.99.52   208.67.222.222
    288 fe80::fd16:6e8:118e:81cd        ff02::fb
    288 fe80::fd16:6e8:118e:81cd        ff02::16
    288 fe80::d048:42e0:8448:187c       ff02::fb
    288 fe80::d048:42e0:8448:187c       ff02::16
    288 fe80::b8d7:3773:ab6e:7fc9       ff02::fb
    288 fe80::b8d7:3773:ab6e:7fc9       ff02::16
    288 fe80::5d7e:4fb3:8fbc:d59        ff02::fb
    288 fe80::5d7e:4fb3:8fbc:d59        ff02::16
thunt@thunt:~/lab3$
```

Nothing of note

Answers - Investigate IPs



```
thunt@thunt:~/lab3$ host 167.71.97.235
235.97.71.167.in-addr.arpa domain name pointer demo1.aihhosted.com.
thunt@thunt:~/lab3$ host 162.250.5.77
77.5.250.162.in-addr.arpa domain name pointer US-NJC-ANX-R010.teamviewer.com.
thunt@thunt:~/lab3$ _
```

Business need?

Answers - Final

- Two long connections found
- Unlikely (but not impossible) we have any beacons
- For the two long connections
  - First was discussed earlier (business partner)
  - The second is TeamViewer
- Is there a business need to run TeamViewer on this system?

Repeat the labs with RITA

- Let's see if RITA makes this easier
- Zeek logs already imported into RITA
- Dataset names match directory names
  - Lab1, lab2, lab3
- Repeat analysis for each
- Note: RITA scores beacons, investigate 0.8 or higher scores
- Type "rita" to get a list of commands

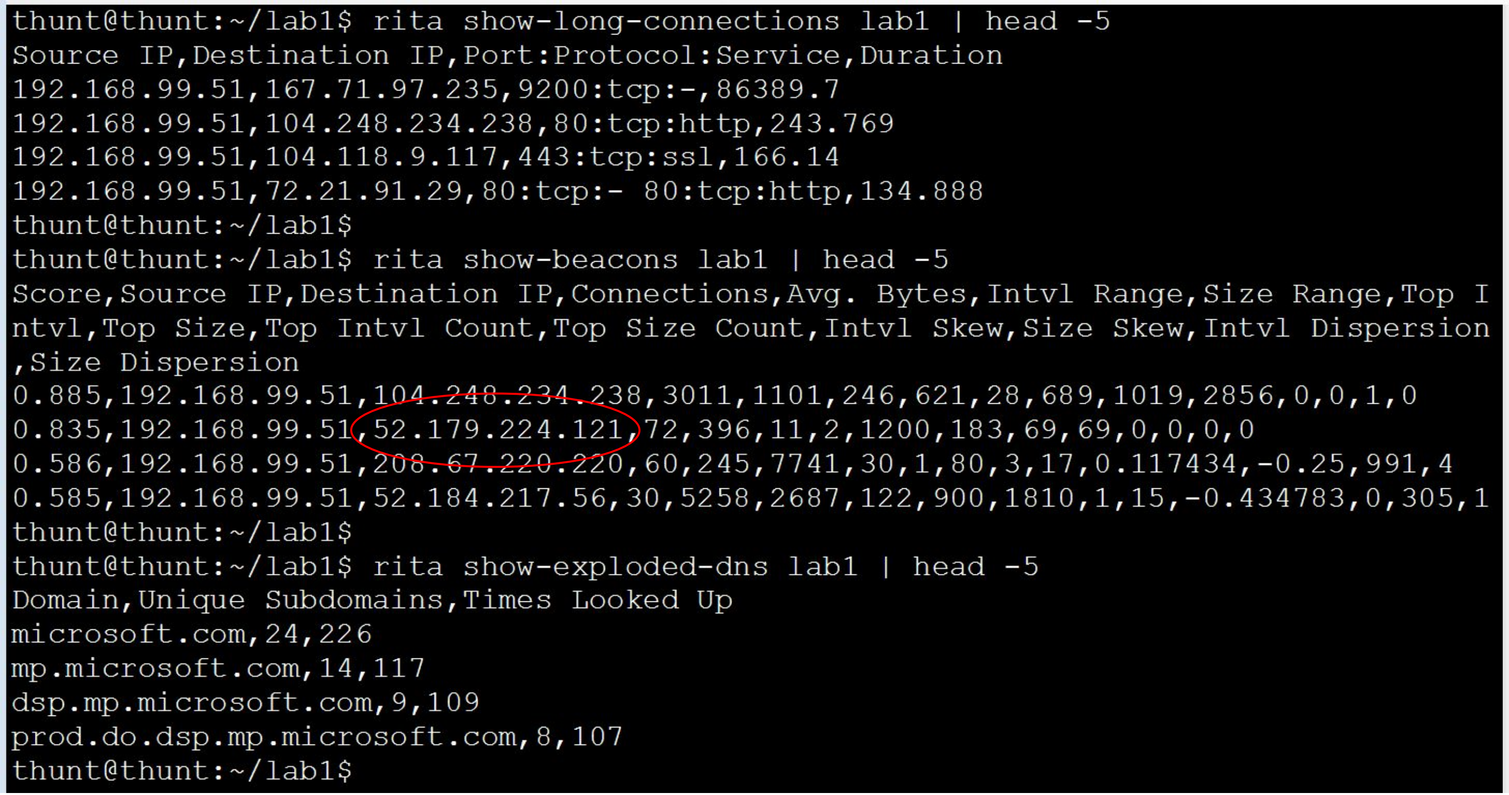
Hints

- List current databases
  - rita list or rita show-databases
- Look for long connections
  - rita show-long-connections <database name>
- Look for beacons
  - rita show-beacons <database name>
- Look for C2 over DNS
  - rita show-exploded-dns <database name>

Useful commands to try

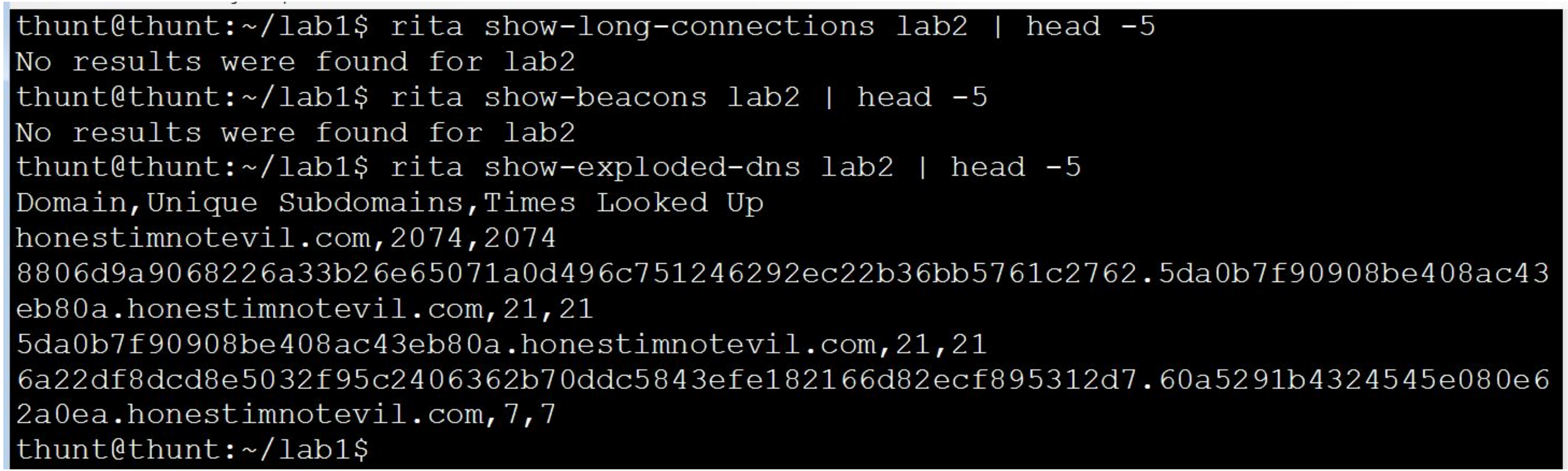
```
rita show-databases
rita show-long-connections lab1 | head

rita show-long-connections lab1 | cut -d ,
-f 1,2,4 | sort | datamash -H -t , -g 1,2
sum 3 | sort -t , -k 3 -rn | head

rita show-beacons lab1 | head

rita show-exploded-dns lab1 | head
```

Answers - Lab1



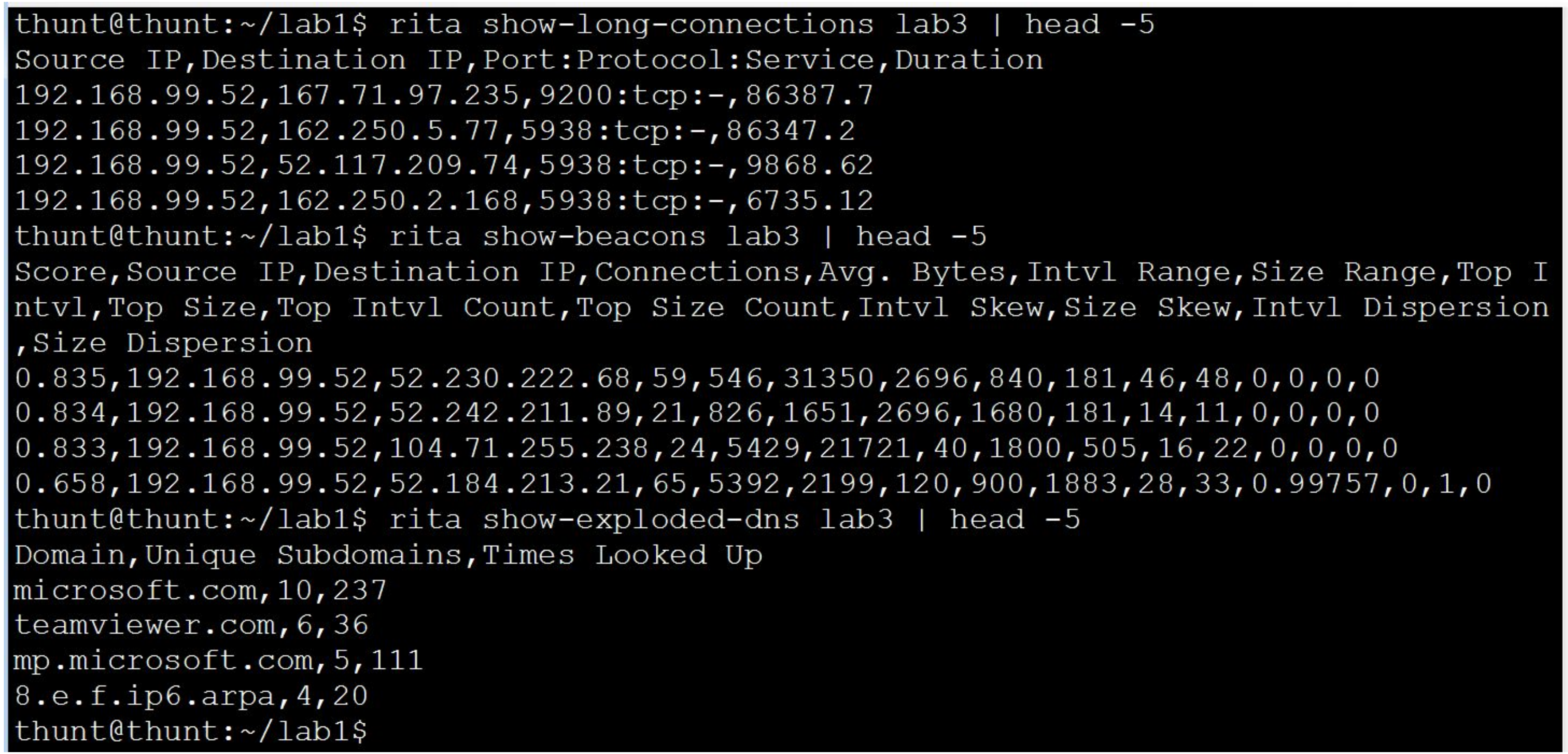
```
thunt@thunt:~/lab1$ rita show-long-connections lab1 | head -5
Source IP,Destination IP,Port:Protocol:Service,Duration
192.168.99.51,167.71.97.235,9200:tcp:-,86389.7
192.168.99.51,104.248.234.238,80:tcp:http,243.769
192.168.99.51,104.118.9.117,443:tcp:ssl,166.14
192.168.99.51,72.21.91.29,80:tcp:- 80:tcp:http,134.888
thunt@thunt:~/lab1$
thunt@thunt:~/lab1$ rita show-beacons lab1 | head -5
Score,Source IP,Destination IP,Connections,Avg. Bytes,Intvl Range,Size Range,Top I
ntvl,Top Size,Top Intvl Count,Top Size Count,Intvl Skew,Size Skew,Intvl Dispersion
,Size Dispersion
0.885,192.168.99.51,104.248.234.238,3011,1101,246,621,28,689,1019,2856,0,0,1,0
0.835,192.168.99.51,52.179.224.121,72,396,11,2,1200,183,69,69,0,0,0,0
0.586,192.168.99.51,208.67.220.220,60,245,7741,30,1,80,3,17,0.117434,-0.25,991,4
0.585,192.168.99.51,52.184.217.56,30,5258,2687,122,900,1810,1,15,-0.434783,0,305,1
thunt@thunt:~/lab1$
thunt@thunt:~/lab1$ rita show-exploded-dns lab1 | head -5
Domain,Unique Subdomains,Times Looked Up
microsoft.com,24,226
mp.microsoft.com,14,117
dsp.mp.microsoft.com,9,109
prod.do.dsp.mp.microsoft.com,8,107
thunt@thunt:~/lab1$
```

Answers - Lab2



```
thunt@thunt:~/lab1$ rita show-long-connections lab2 | head -5
No results were found for lab2
thunt@thunt:~/lab1$ rita show-beacons lab2 | head -5
No results were found for lab2
thunt@thunt:~/lab1$ rita show-exploded-dns lab2 | head -5
Domain,Unique Subdomains,Times Looked Up
honestimnotevil.com,2074,2074
8806d9a9068226a33b26e65071a0d496c751246292ec22b36bb5761c2762.5da0b7f90908be408ac43
eb80a.honestimnotevil.com,21,21
5da0b7f90908be408ac43eb80a.honestimnotevil.com,21,21
6a22df8dcd8e5032f95c2406362b70ddc5843efe182166d82ecf895312d7.60a5291b4324545e080e6
2a0ea.honestimnotevil.com,7,7
thunt@thunt:~/lab1$
```

Answers - Lab3



```
thunt@thunt:~/lab1$ rita show-long-connections lab3 | head -5
Source IP,Destination IP,Port:Protocol:Service,Duration
192.168.99.52,167.71.97.235,9200:tcp:-,86387.7
192.168.99.52,162.250.5.77,5938:tcp:-,86347.2
192.168.99.52,52.117.209.74,5938:tcp:-,9868.62
192.168.99.52,162.250.2.168,5938:tcp:-,6735.12
thunt@thunt:~/lab1$ rita show-beacons lab3 | head -5
Score,Source IP,Destination IP,Connections,Avg. Bytes,Intvl Range,Size Range,Top I
ntvl,Top Size,Top Intvl Count,Top Size Count,Intvl Skew,Size Skew,Intvl Dispersion
,Size Dispersion
0.835,192.168.99.52,52.230.222.68,59,546,31350,2696,840,181,46,48,0,0,0,0
0.834,192.168.99.52,52.242.211.89,21,826,1651,2696,1680,181,14,11,0,0,0,0
0.833,192.168.99.52,104.71.255.238,24,5429,21721,40,1800,505,16,22,0,0,0,0
0.658,192.168.99.52,52.184.213.21,65,5392,2199,120,900,1883,28,33,0.99757,0,1,0
thunt@thunt:~/lab1$ rita show-exploded-dns lab3 | head -5
Domain,Unique Subdomains,Times Looked Up
microsoft.com,10,237
teamviewer.com,6,36
mp.microsoft.com,5,111
8.e.f.ip6.arpa,4,20
thunt@thunt:~/lab1$
```

Answers - Final

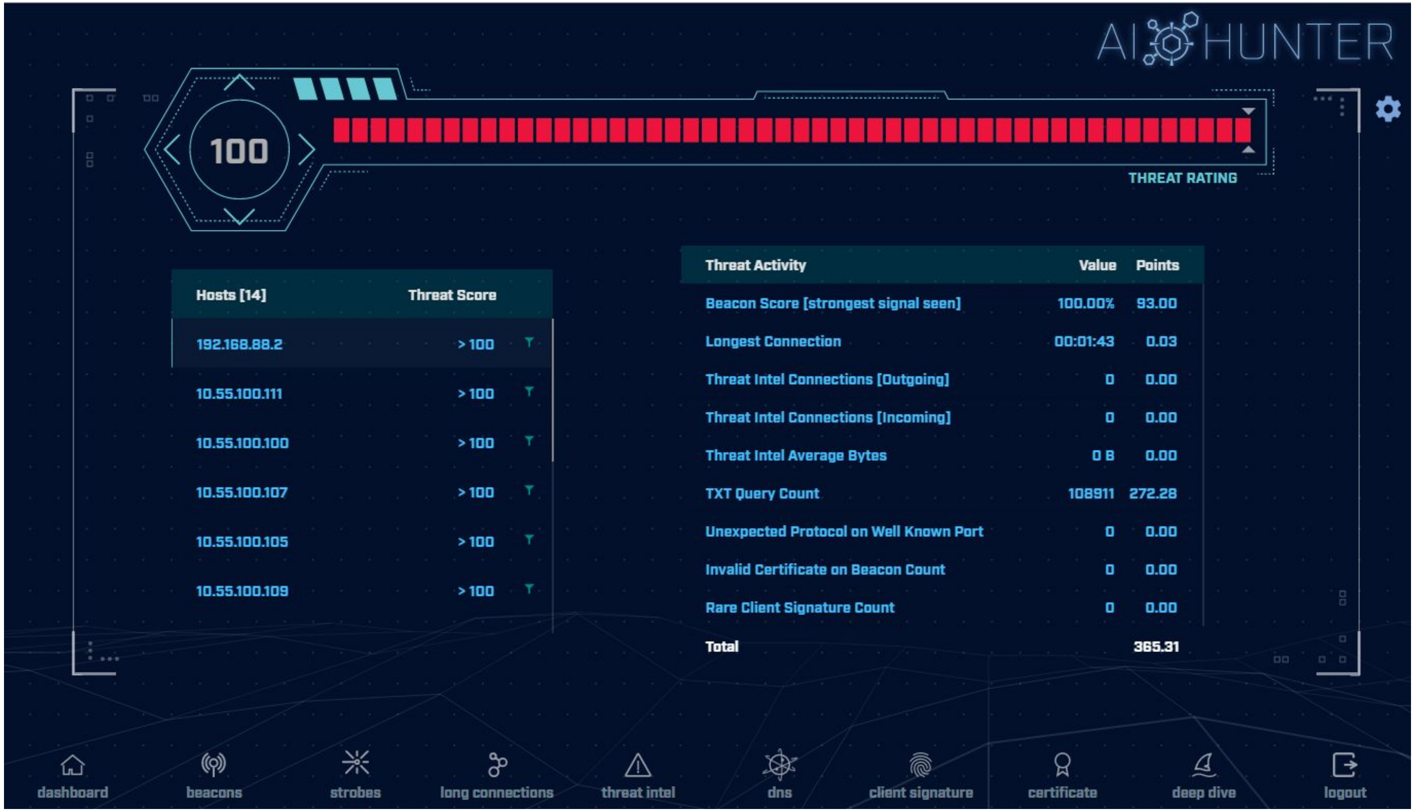
- RITA provides a consistent interface for identifying C2
- Screens pull in additional helpful info
- Even very slow beacons can be detected
- Investigation can be scripted
- Open source, so anyone can use it for free

Next steps

- Do we feel confident in flagging anything we have seen as requiring incident handling?
- Are there any connections that need more research?
  - What should this research be?
  - Do we need to involve any other teams?
  - If we need more data collection, for how long?

Quick demo

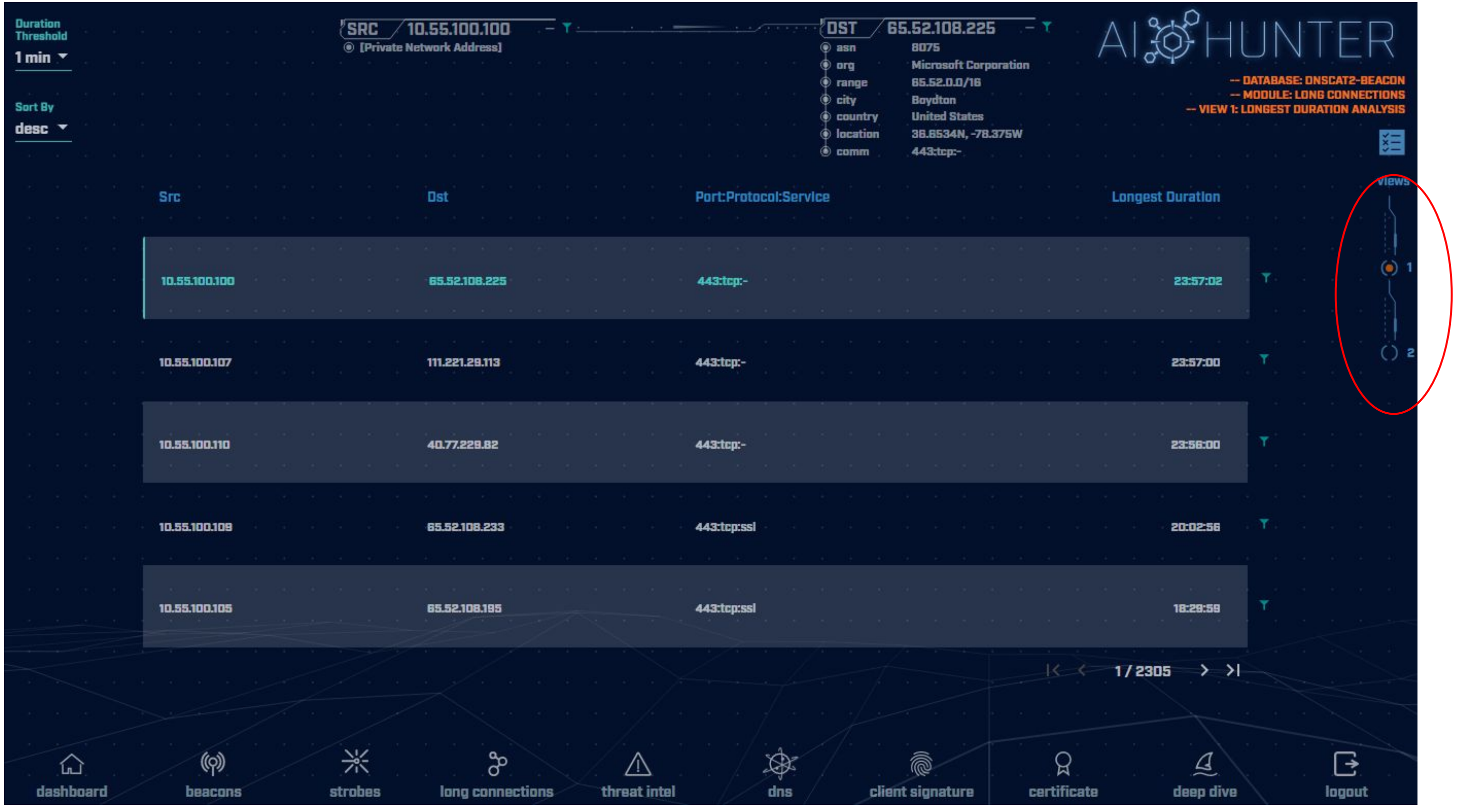
- Similar data, seen through AI-Hunter
- Inexpensive commercial solution
- Automates much of the hunting process



Hosts [14]	Threat Score
192.168.88.2	> 100
10.55.100.111	> 100
10.55.100.100	> 100
10.55.100.107	> 100
10.55.100.105	> 100
10.55.100.109	> 100

Threat Activity	Value	Points
Beacon Score [strongest signal seen]	100.00%	93.00
Longest Connection	00:01:43	0.03
Threat Intel Connections [Outgoing]	0	0.00
Threat Intel Connections [Incoming]	0	0.00
Threat Intel Average Bytes	0 B	0.00
TXT Query Count	108911	272.28
Unexpected Protocol on Well Known Port	0	0.00
Invalid Certificate on Beacon Count	0	0.00
Rare Client Signature Count	0	0.00
Total		365.31

24 active hunts of 24-hours of data every single day
Top results scored, alerts sent to SIEM



Duration Threshold: 1 min

Sort By: desc

SRC 10.55.100.100
[Private Network Address]

DST 65.52.108.225

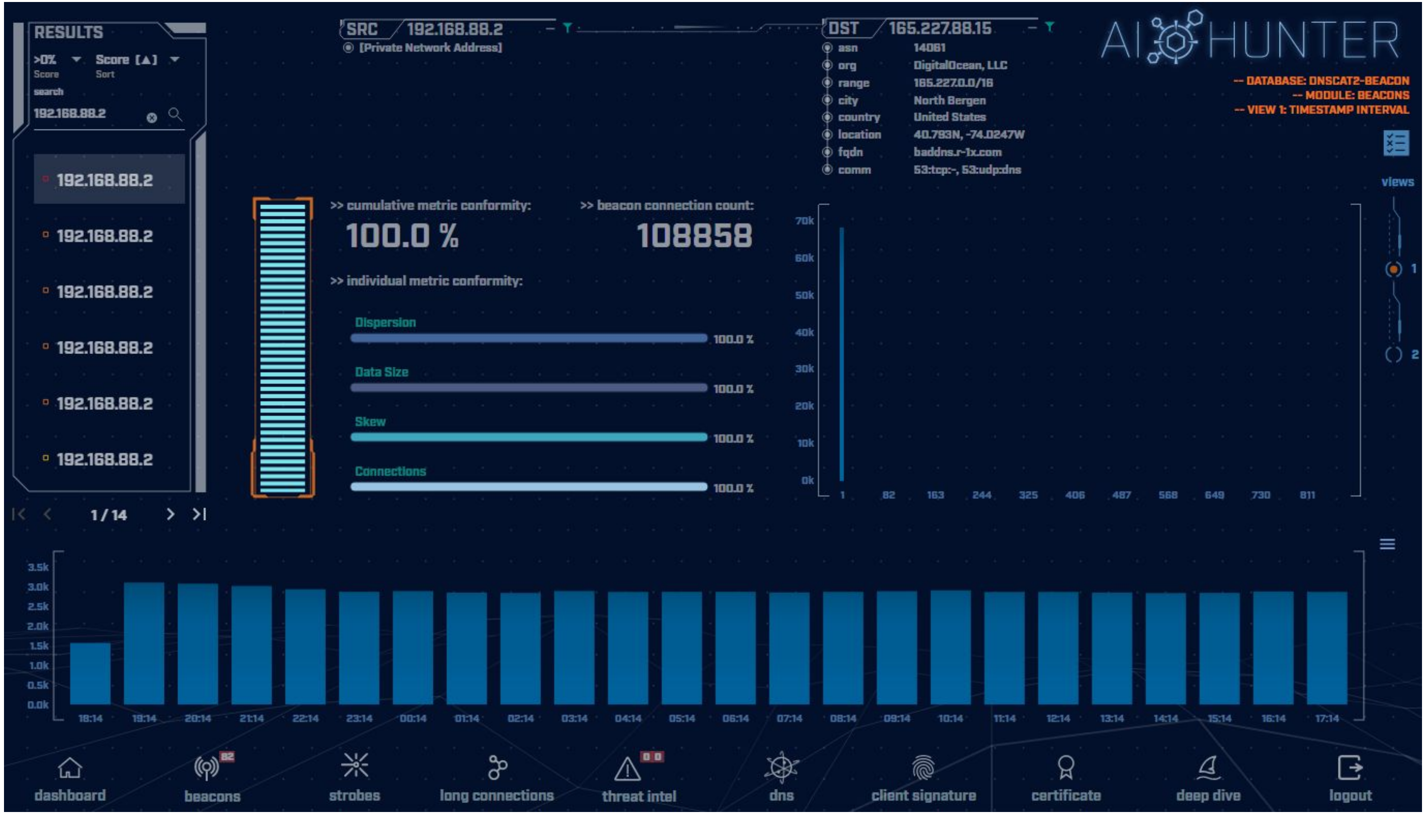
asn	8075
org	Microsoft Corporation
range	65.52.0.0/16
city	Boydton
country	United States
location	36.6534N, -78.375W
comm	443:tcp:-

-- DATABASE: DNSCAT2-BEACON
-- MODULE: LONG CONNECTIONS
-- VIEW 1: LONGEST DURATION ANALYSIS

Src	Dst	Port:Protocol:Service	Longest Duration
10.55.100.100	65.52.108.225	443:tcp:-	23:57:02
10.55.100.107	111.221.29.113	443:tcp:-	23:57:00
10.55.100.110	40.77.229.82	443:tcp:-	23:56:00
10.55.100.109	65.52.108.233	443:tcp:ssl	20:02:56
10.55.100.105	65.52.108.195	443:tcp:ssl	18:29:59

1 / 2305

Long connections with lots of intel
View both individual and cumulative



RESULTS

>0% Score — Score [▲] Sort

search: 192.168.88.2

192.168.88.2
192.168.88.2
192.168.88.2
192.168.88.2
192.168.88.2
192.168.88.2

1 / 14

SRC 192.168.88.2
[Private Network Address]

DST 165.227.88.15

asn	14061
org	DigitalOcean, LLC
range	165.227.0.0/16
city	North Bergen
country	United States
location	40.793N, -74.0247W
fqdn	baddns.r-1x.com
comm	53:tcp:-, 53:udp:dns

-- DATABASE: DNSCAT2-BEACON
-- MODULE: BEACONS
-- VIEW 1: TIMESTAMP INTERVAL

>> cumulative metric conformity: 100.0 %

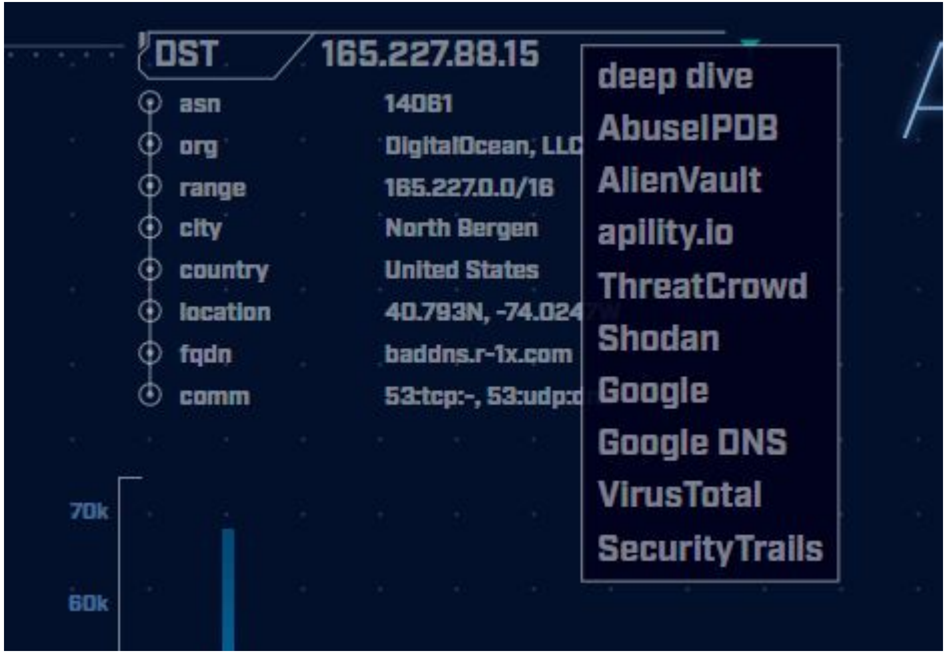
>> beacon connection count: 108858

>> individual metric conformity:

Dispersion	100.0 %
Data Size	100.0 %
Skew	100.0 %
Connections	100.0 %

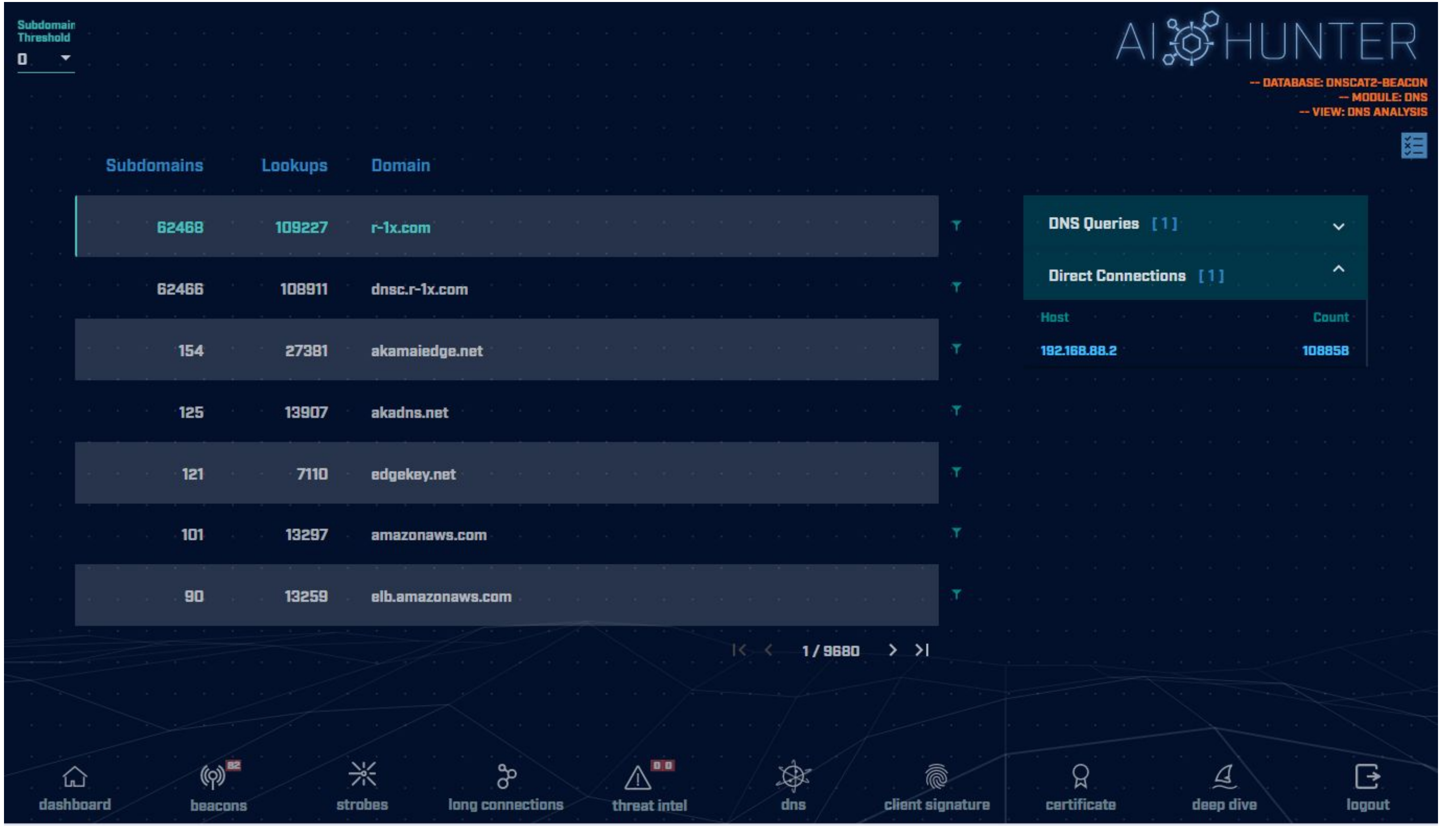
Clear beacon analysis
By both timing and session size

Resources to dig deeper



DST 165.227.88.15

asn	14061
org	DigitalOcean, LLC
range	165.227.0.0/16
city	North Bergen
country	United States
location	40.793N, -74.024
fqdn	baddns.r-1x.com
comm	53:tcp:-, 53:udp:



Subdomain Threshold
0

-- DATABASE: DNSCAT2-BEACON
-- MODULE: DNS
-- VIEW: DNS ANALYSIS

Subdomains	Lookups	Domain
62468	109227	r-1x.com
62466	108911	dnsc.r-1x.com
154	27381	akamaiedge.net
125	13907	akadns.net
121	7110	edgekey.net
101	13297	amazonaws.com
90	13259	elb.amazonaws.com

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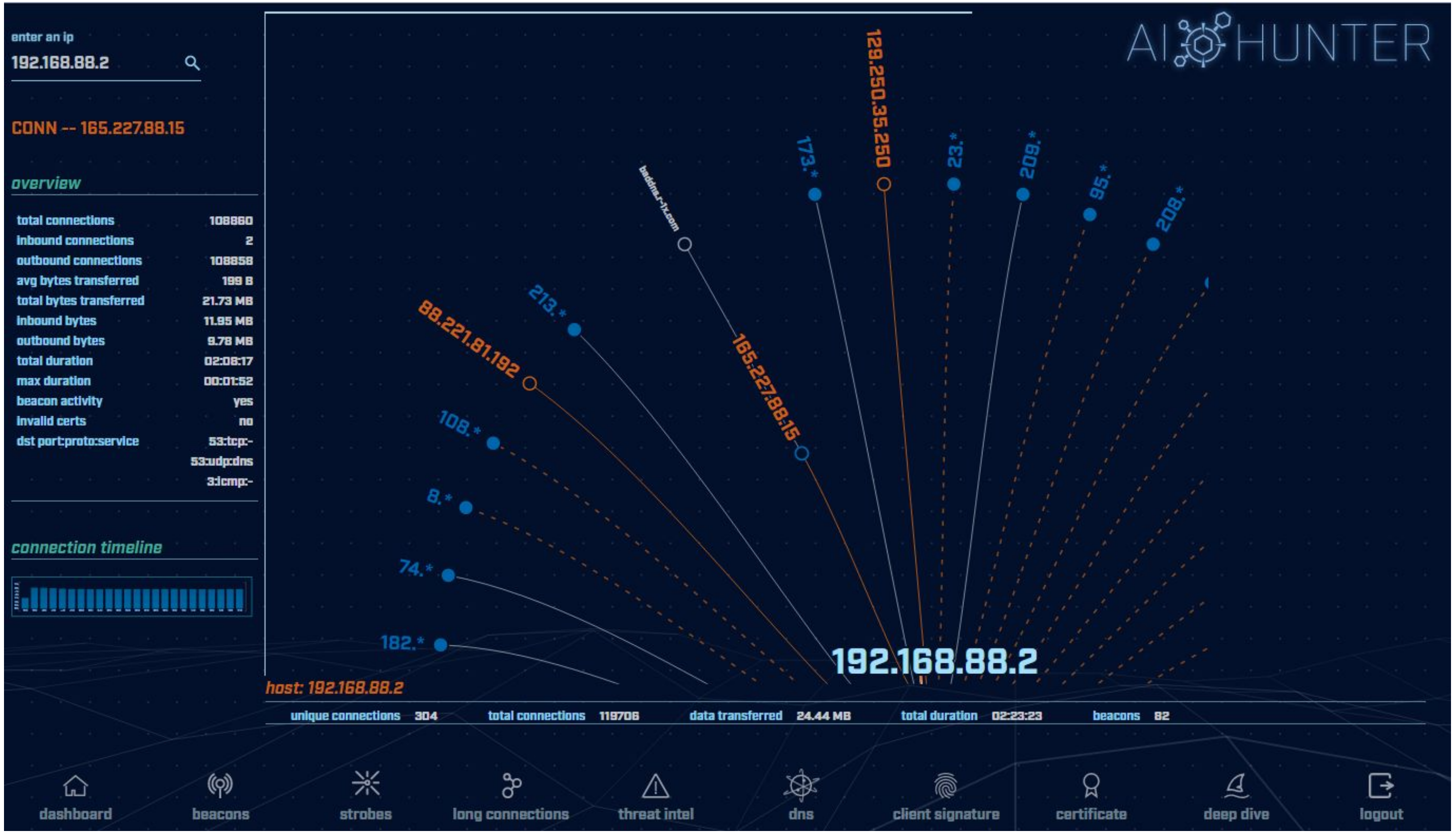
DNS Queries [1]

Direct Connections [1]

Host	Count
192.168.88.2	108858

C2 over DNS analysis



enter an ip

192.168.88.2

CONN -- 165.227.88.15

overview

total connections	108860
inbound connections	2
outbound connections	108858
avg bytes transferred	199 B
total bytes transferred	21.73 MB
inbound bytes	11.95 MB
outbound bytes	9.78 MB
total duration	02:08:17
max duration	00:01:52
beacon activity	yes
invalid certs	no
dst port:proto:service	53:tcp:- 53:udp:dns 3:icmp:-

connection timeline

host: 192.168.88.2

unique connections 304 total connections 119706 data transferred 24.44 MB total duration 02:23:23 beacons 82

Deep dive analysis

Wrap Up

- Thanks for attending!
- Very special thank you to the folks behind the scenes
- Content feedback?
  - Please email: chris@activecountermeasures.com