CHIRON TRAINING

TCPReplay, Rinse, Repeat

BSides Seattle 2017

CYBER PROTECTION PROFESSIONAL™ (CPP)™

OVERVIEW

TCPReplay, Rinse, Repeat

Building a network baseline, one segment at a time.

About Me

Matt Domko

- Beard Enthusiast
- 33% Pacific Northwesterner(sp?)
- Former:
  - Parachutist
  - Enterprise Admin
  - “Cyber Network Defender”
- Instructor at Chiron Technology Services
- Cyber Patriot Mentor
- @hashtagcyber on most platforms

First, a few apologies…

I’m sorry to say:

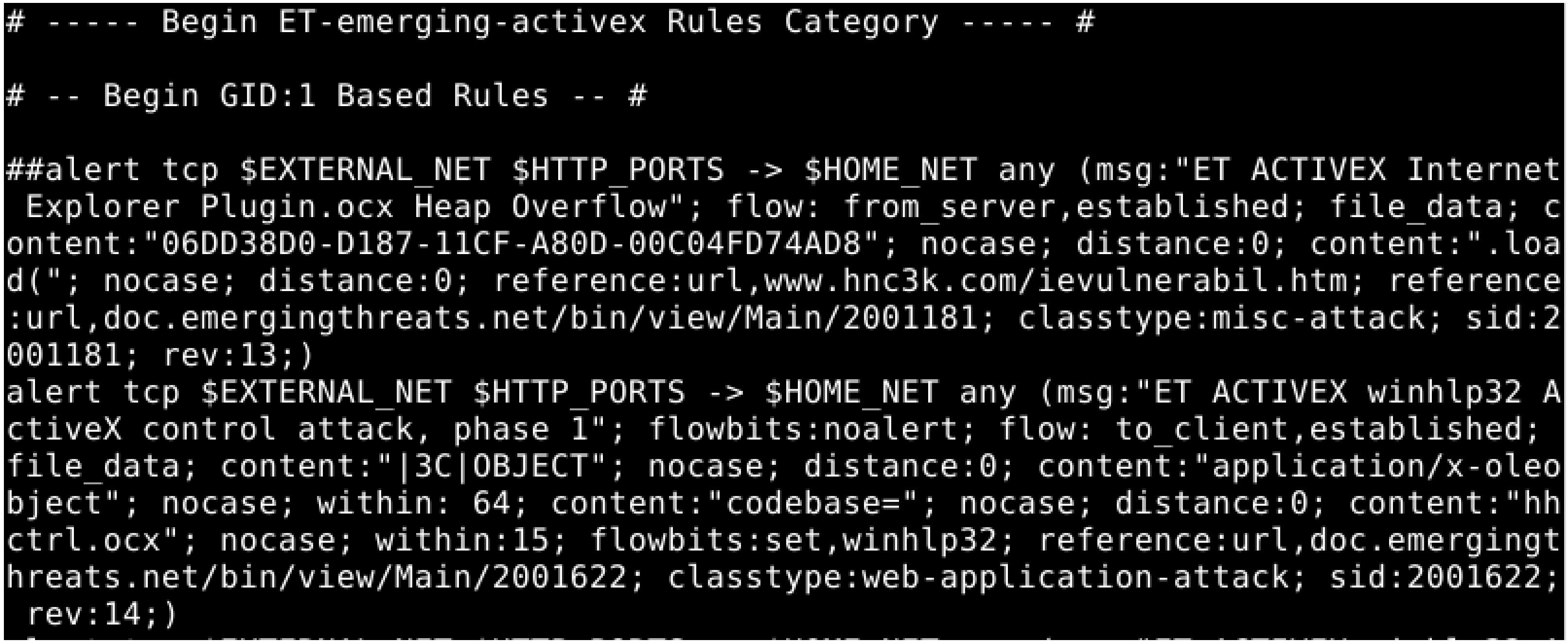
- We won’t use SNORT at all (more on that later)
- This is not a red team talk ☹
- My wife made me shave my beard 2 weeks ago ☹ ☹
- There’s only one cat picture in this deck ☹ ☹ ☹

I’m happy to remind you that:

- Building a network baseline can be easy
- It doesn’t require weeks of pcap analysis or scraping host configs
- And it’s all thanks to those wonderful developers at Bro

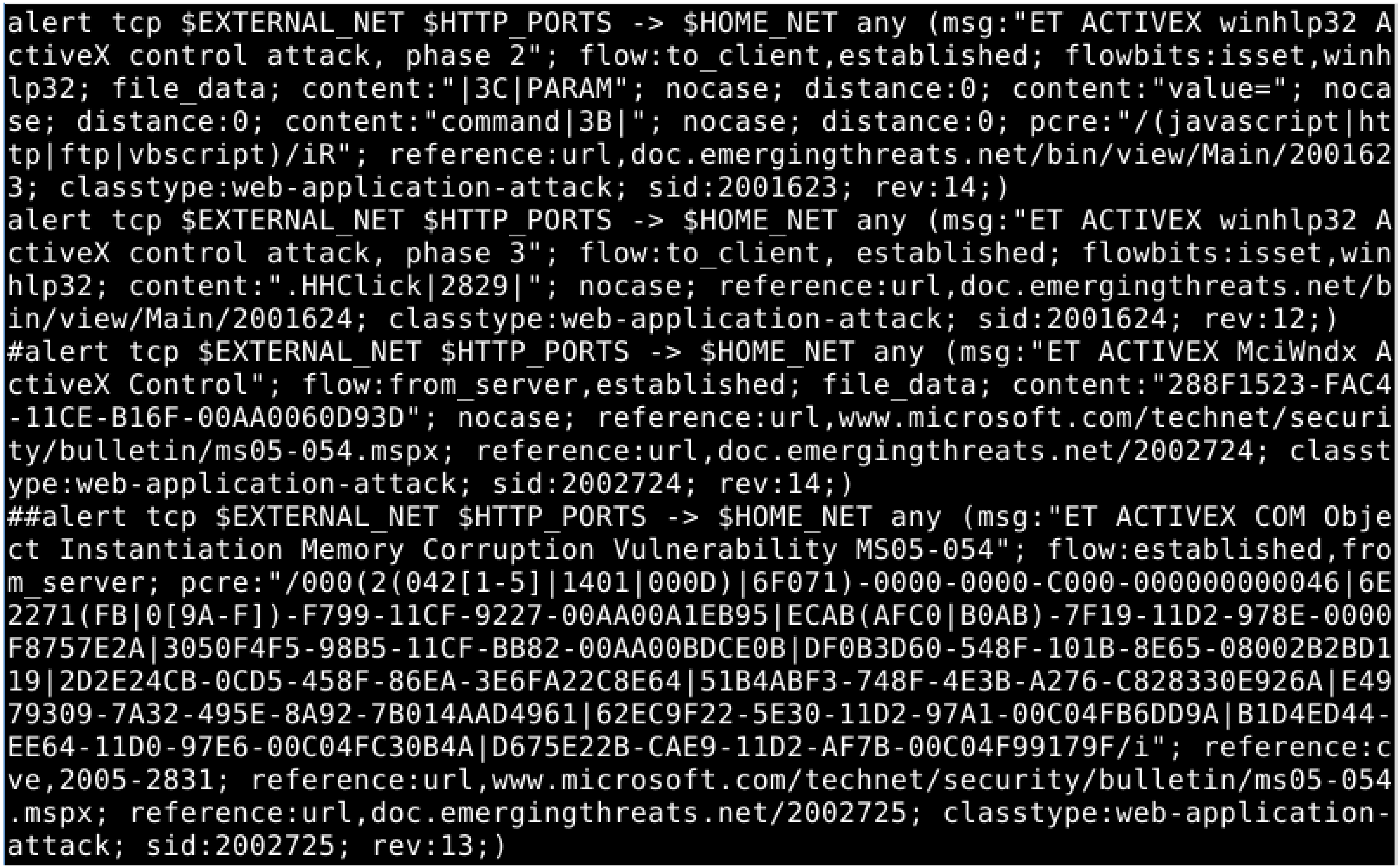
The Problem: Detecting Malicious Network Activity

- Malicious network activity CAN be identified using signatures…



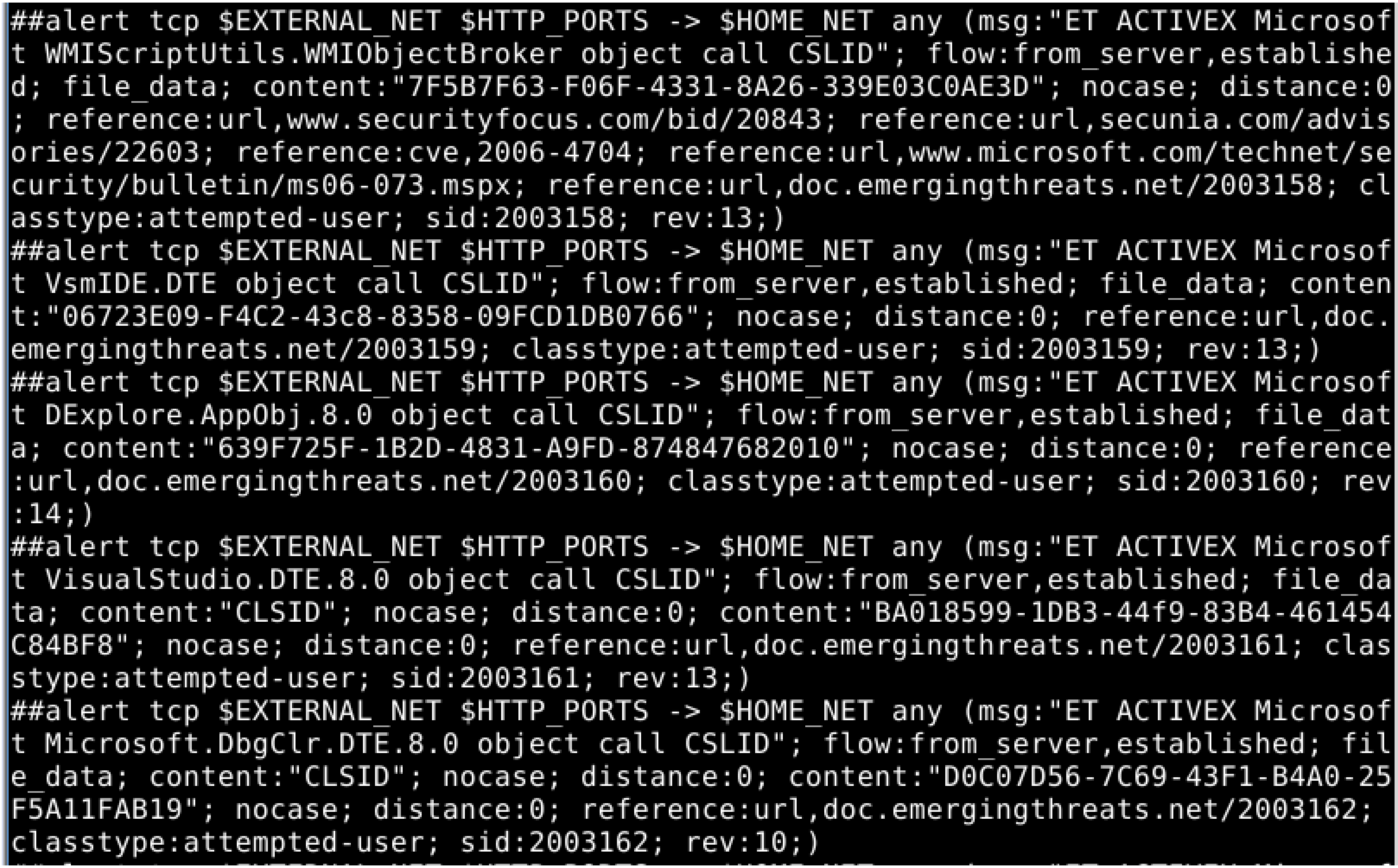
```
# ----- Begin ET-emerging-activex Rules Category ----- #

# -- Begin GID:1 Based Rules -- #

##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Internet
 Explorer Plugin.ocx Heap Overflow"; flow: from_server,established; file_data; c
ontent:"06DD38D0-D187-11CF-A80D-00C04FD74AD8"; nocase; distance:0; content:".loa
d("; nocase; distance:0; reference:url,www.hnc3k.com/ievulnerabil.htm; reference
:url,doc.emergingthreats.net/bin/view/Main/2001181; classtype:misc-attack; sid:2
001181; rev:13;)
alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX winhlp32 A
ctiveX control attack, phase 1"; flowbits:noalert; flow: to_client,established;
file_data; content:"|3C|OBJECT"; nocase; distance:0; content:"application/x-oleo
bject"; nocase; within: 64; content:"codebase="; nocase; distance:0; content:"hh
ctrl.ocx"; nocase; within:15; flowbits:set,winhlp32; reference:url,doc.emergingt
hreats.net/bin/view/Main/2001622; classtype:web-application-attack; sid:2001622;
 rev:14;)
```

The Problem: Detecting Malicious Network Activity



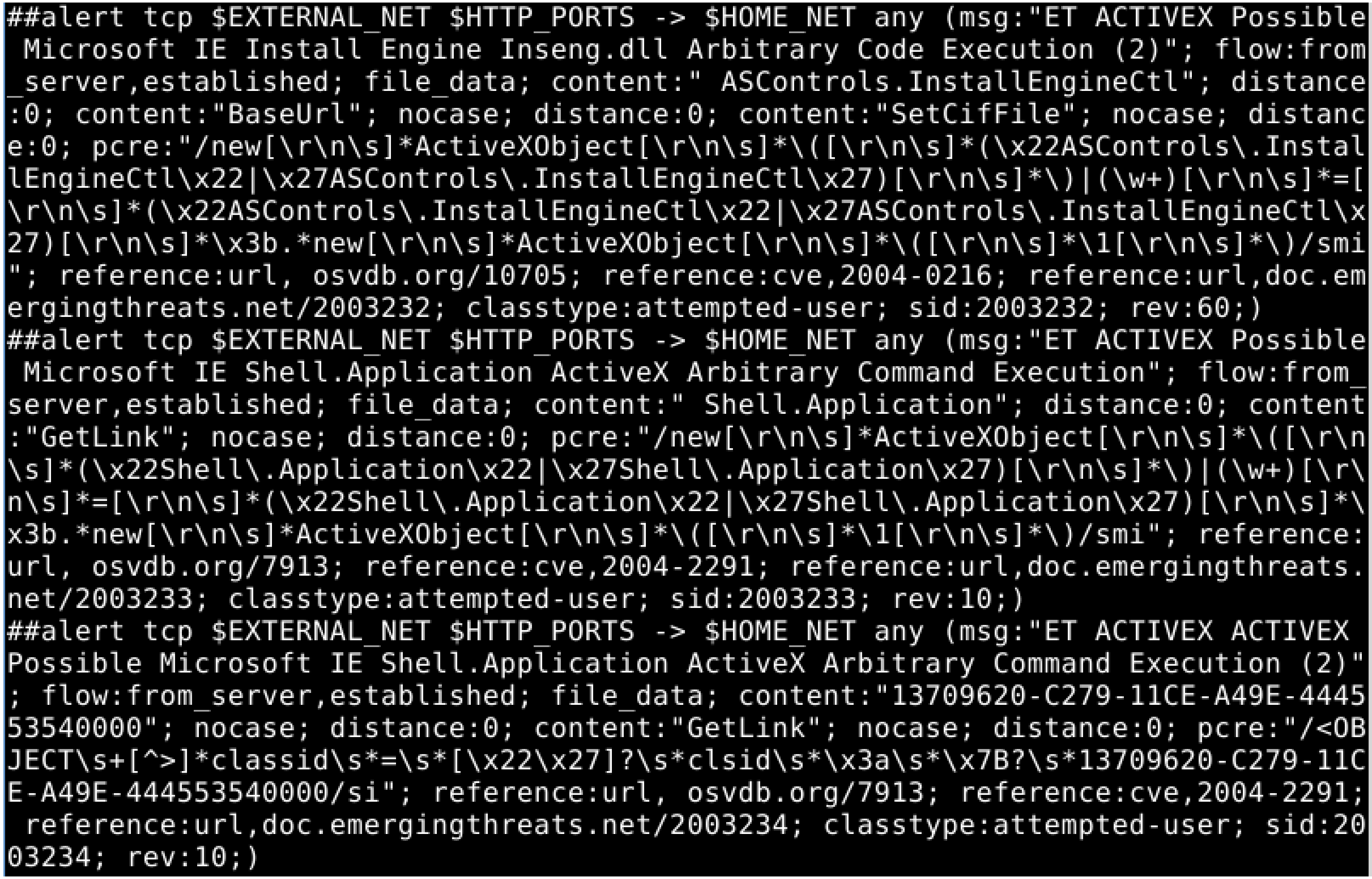
```
alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX winhlp32 A
ctiveX control attack, phase 2"; flow:to_client,established; flowbits:isset,winh
lp32; file_data; content:"|3C|PARAM"; nocase; distance:0; content:"value="; noca
se; distance:0; content:"command|3B|"; nocase; distance:0; pcre:"/(javascript|ht
tp|ftp|vbscript)/iR"; reference:url,doc.emergingthreats.net/bin/view/Main/200162
3; classtype:web-application-attack; sid:2001623; rev:14;)
alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX winhlp32 A
ctiveX control attack, phase 3"; flow:to_client, established; flowbits:isset,win
hlp32; content:".HHClick|2829|"; nocase; reference:url,doc.emergingthreats.net/b
in/view/Main/2001624; classtype:web-application-attack; sid:2001624; rev:12;)
#alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX MciWndx A
ctiveX Control"; flow:from_server,established; file_data; content:"288F1523-FAC4
-11CE-B16F-00AA0060D93D"; nocase; reference:url,www.microsoft.com/technet/securi
ty/bulletin/ms05-054.mspx; reference:url,doc.emergingthreats.net/2002724; classt
ype:web-application-attack; sid:2002724; rev:14;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX COM Obje
ct Instantiation Memory Corruption Vulnerability MS05-054"; flow:established,fro
m_server; pcre:"/000(2(042[1-5]|1401|000D)|6F071)-0000-0000-C000-000000000046|6E
2271(FB|0[9A-F])-F799-11CF-9227-00AA00A1EB95|ECAB(AFC0|B0AB)-7F19-11D2-978E-0000
F8757E2A|3050F4F5-98B5-11CF-BB82-00AA00BDCE0B|DF0B3D60-548F-101B-8E65-08002B2BD1
19|2D2E24CB-0CD5-458F-86EA-3E6FA22C8E64|51B4ABF3-748F-4E3B-A276-C828330E926A|E49
79309-7A32-495E-8A92-7B014AAD4961|62EC9F22-5E30-11D2-97A1-00C04FB6DD9A|B1D4ED44-
EE64-11D0-97E6-00C04FC30B4A|D675E22B-CAE9-11D2-AF7B-00C04F99179F/i"; reference:c
ve,2005-2831; reference:url,www.microsoft.com/technet/security/bulletin/ms05-054
.mspx; reference:url,doc.emergingthreats.net/2002725; classtype:web-application-
attack; sid:2002725; rev:13;)
```

The Problem: Detecting Malicious Network Activity



```
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Microsof
t WMIScriptUtils.WMIObjectBroker object call CSLID"; flow:from_server,establishe
d; file_data; content:"7F5B7F63-F06F-4331-8A26-339E03C0AE3D"; nocase; distance:0
; reference:url,www.securityfocus.com/bid/20843; reference:url,secunia.com/advis
ories/22603; reference:cve,2006-4704; reference:url,www.microsoft.com/technet/se
curity/bulletin/ms06-073.mspx; reference:url,doc.emergingthreats.net/2003158; cl
asstype:attempted-user; sid:2003158; rev:13;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Microsof
t VsmIDE.DTE object call CSLID"; flow:from_server,established; file_data; conten
t:"06723E09-F4C2-43c8-8358-09FCD1DB0766"; nocase; distance:0; reference:url,doc.
emergingthreats.net/2003159; classtype:attempted-user; sid:2003159; rev:13;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Microsof
t DExplore.AppObj.8.0 object call CSLID"; flow:from_server,established; file_dat
a; content:"639F725F-1B2D-4831-A9FD-874847682010"; nocase; distance:0; reference
:url,doc.emergingthreats.net/2003160; classtype:attempted-user; sid:2003160; rev
:14;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Microsof
t VisualStudio.DTE.8.0 object call CSLID"; flow:from_server,established; file_da
ta; content:"CLSID"; nocase; distance:0; content:"BA018599-1DB3-44f9-83B4-461454
C84BF8"; nocase; distance:0; reference:url,doc.emergingthreats.net/2003161; clas
stype:attempted-user; sid:2003161; rev:13;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Microsof
t Microsoft.DbgClr.DTE.8.0 object call CSLID"; flow:from_server,established; fil
e_data; content:"CLSID"; nocase; distance:0; content:"D0C07D56-7C69-43F1-B4A0-25
F5A11FAB19"; nocase; distance:0; reference:url,doc.emergingthreats.net/2003162;
classtype:attempted-user; sid:2003162; rev:10;)
```

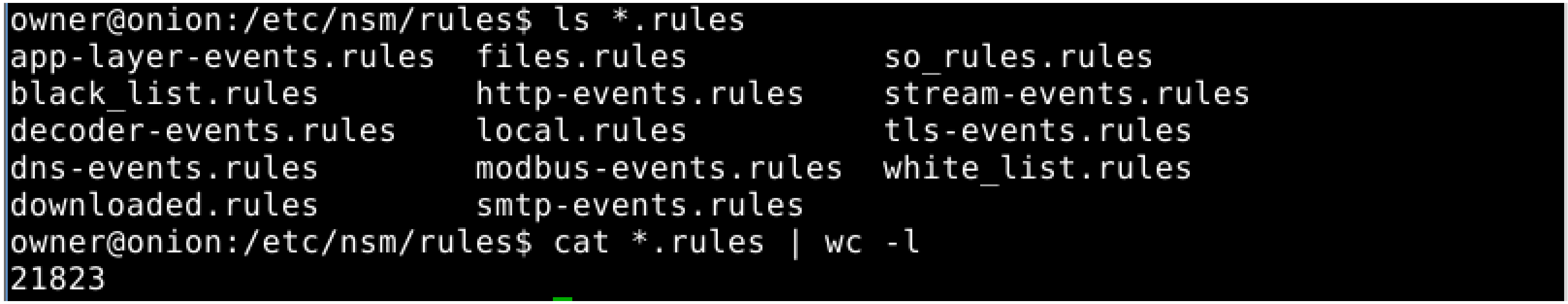
The Problem: Detecting Malicious Network Activity



```
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Possible
 Microsoft IE Install Engine Inseng.dll Arbitrary Code Execution (2)"; flow:from
_server,established; file_data; content:" ASControls.InstallEngineCtl"; distance
:0; content:"BaseUrl"; nocase; distance:0; content:"SetCifFile"; nocase; distanc
e:0; pcre:"/new[\r\n\s]*ActiveXObject[\r\n\s]*\([\r\n\s]*(\x22ASControls\.Instal
lEngineCtl\x22|\x27ASControls\.InstallEngineCtl\x27)[\r\n\s]*\)|(\w+)[\r\n\s]*=[
\r\n\s]*(\x22ASControls\.InstallEngineCtl\x22|\x27ASControls\.InstallEngineCtl\x
27)[\r\n\s]*\x3b.*new[\r\n\s]*ActiveXObject[\r\n\s]*\([\r\n\s]*\1[\r\n\s]*\)/smi
"; reference:url, osvdb.org/10705; reference:cve,2004-0216; reference:url,doc.em
ergingthreats.net/2003232; classtype:attempted-user; sid:2003232; rev:60;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX Possible
 Microsoft IE Shell.Application ActiveX Arbitrary Command Execution"; flow:from_
server,established; file_data; content:" Shell.Application"; distance:0; content
:"GetLink"; nocase; distance:0; pcre:"/new[\r\n\s]*ActiveXObject[\r\n\s]*\([\r\n
\s]*(\x22Shell\.Application\x22|\x27Shell\.Application\x27)[\r\n\s]*\)|(\w+)[\r\
n\s]*=[\r\n\s]*(\x22Shell\.Application\x22|\x27Shell\.Application\x27)[\r\n\s]*\
x3b.*new[\r\n\s]*ActiveXObject[\r\n\s]*\([\r\n\s]*\1[\r\n\s]*\)/smi"; reference:
url, osvdb.org/7913; reference:cve,2004-2291; reference:url,doc.emergingthreats.
net/2003233; classtype:attempted-user; sid:2003233; rev:10;)
##alert tcp $EXTERNAL_NET $HTTP_PORTS -> $HOME_NET any (msg:"ET ACTIVEX ACTIVEX
Possible Microsoft IE Shell.Application ActiveX Arbitrary Command Execution (2)"
; flow:from_server,established; file_data; content:"13709620-C279-11CE-A49E-4445
53540000"; nocase; distance:0; content:"GetLink"; nocase; distance:0; pcre:"/<OB
JECT\s+[^>]*classid\s*=\s*[\x22\x27]?\s*clsid\s*\x3a\s*\x7B?\s*13709620-C279-11C
E-A49E-444553540000/si"; reference:url, osvdb.org/7913; reference:cve,2004-2291;
 reference:url,doc.emergingthreats.net/2003234; classtype:attempted-user; sid:20
03234; rev:10;)
```

The Problem: Detecting Malicious Network Activity

- And more signatures….

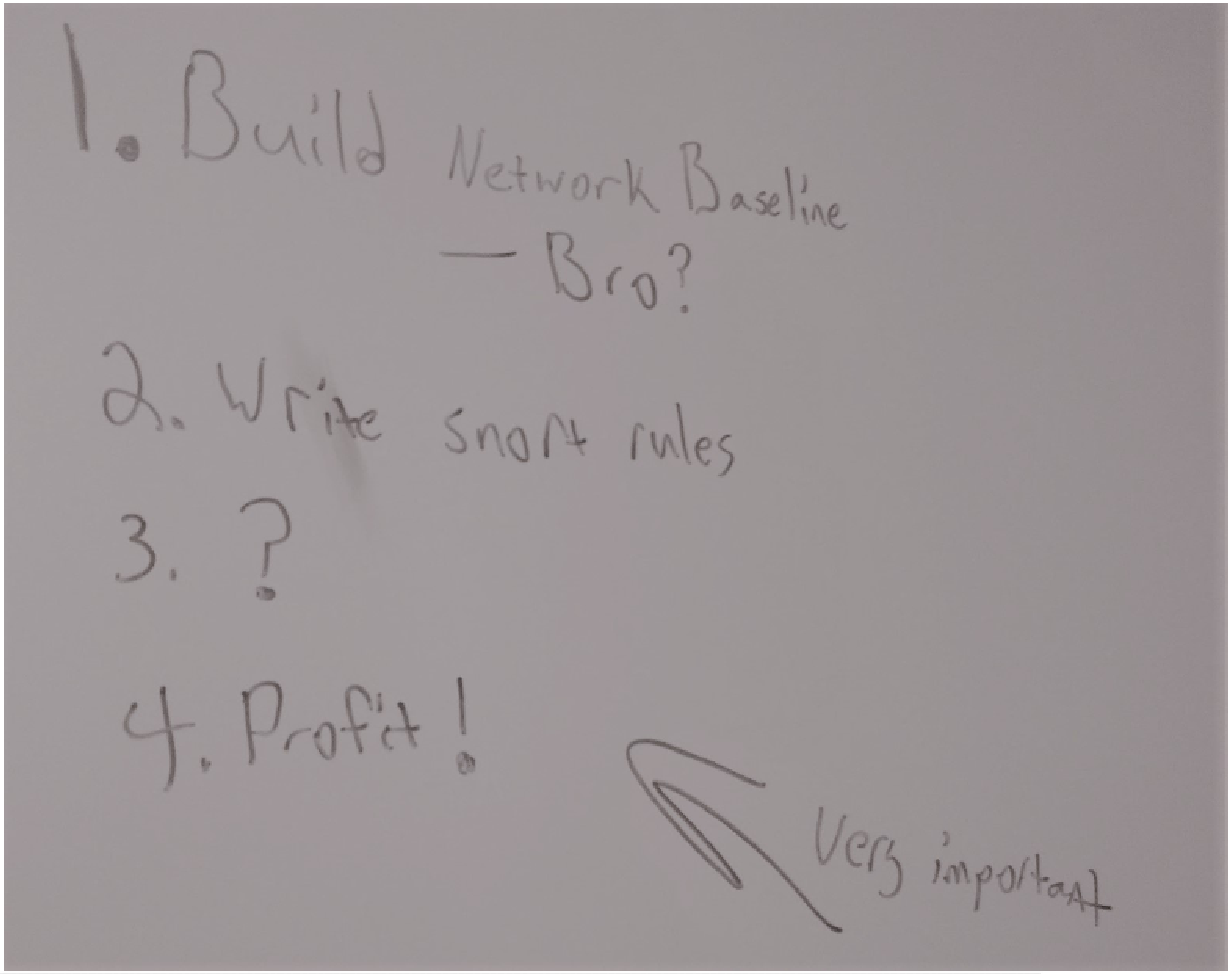


```
owner@onion:/etc/nsm/rules$ ls *.rules
app-layer-events.rules  files.rules            so_rules.rules
black_list.rules        http-events.rules      stream-events.rules
decoder-events.rules    local.rules            tls-events.rules
dns-events.rules        modbus-events.rules    white_list.rules
downloaded.rules        smtp-events.rules
owner@onion:/etc/nsm/rules$ cat *.rules | wc -l
21823
```

- Fingerprinting EVERY attack is impossible

- Signature based detection is USELESS if a signature does not exist for the attack being performed

The Initial Idea



1. Build Network Baseline
   — Bro?
2. Write snort rules
3. ?
4. Profit!

Very important

The Initial Idea

Step 1: Build a network baseline.

- Bro?
- Netflow?

Step 2: Write SNORT rules.

- I need alerts for non-standard traffic

Step 3: ?

- Something … Something … Something…

Step 4: Profit!

- Or at least spend less time worrying

A Similar Problem: Malicious Binaries

- Administrators face a similar problem with detecting malicious binaries.

- Antivirus products initially only used file signatures to identify malware:
  - Evil Hashes
  - Ego Strings
  - Reused code blocks

- This eventually failed, as attackers could easily modify malware to avoid signatures faster than they are generated
  - MSFVenom, Veil-Evasion, Hyperion

A Similar Problem: Malicious Binaries

- Heuristic detection helped, but does it catch everything?
  - No. (Malware still exists/functions today)
- What else can we do?
  - Enter Application Whitelisting

A Similar Problem: Malicious Binaries

- Application Whitelisting provides ability to:
  - Log execution of all files except explicitly authorized (whitelist):
    - File Hashes (tedious)
    - File Names (poor protection)
    - Signed Code (Awesome)
    - Source Directory (simple)
  - Prevent execution of files that are not in the whitelist.
  - Prevent execution of explicitly defined files (Blacklisting)

Simple Application Whitelisting Implementation

1. Start with an empty whitelist

2. Apply a policy to log everything not in whitelist

3. Use logs to generate a whitelist

4. Modify policy to block everything not in whitelist

5. Review new logs
    - Investigate blocked files
    - Update whitelist as needed

Malicious Network Activity : Anomaly Detection

- The same concept can be applied to network activity:
  - Start with an empty whitelist
  - Apply a policy to log all traffic not in the whitelist
  - Use logs to update the whitelist
  - Review new logs
    - Investigate new ports/hosts
    - Update whitelist as needed

But Matt, How Do I <do thing>?

- Get data for my whitelist?
  - Bro.
- Create a policy to log traffic?
  - Bro scripts
- Create logs from new traffic?
  - Bro scripts
- Review new logs?
  - ELSA

- Last question… Can you tell me more about Bro?

Gathering Data with Bro

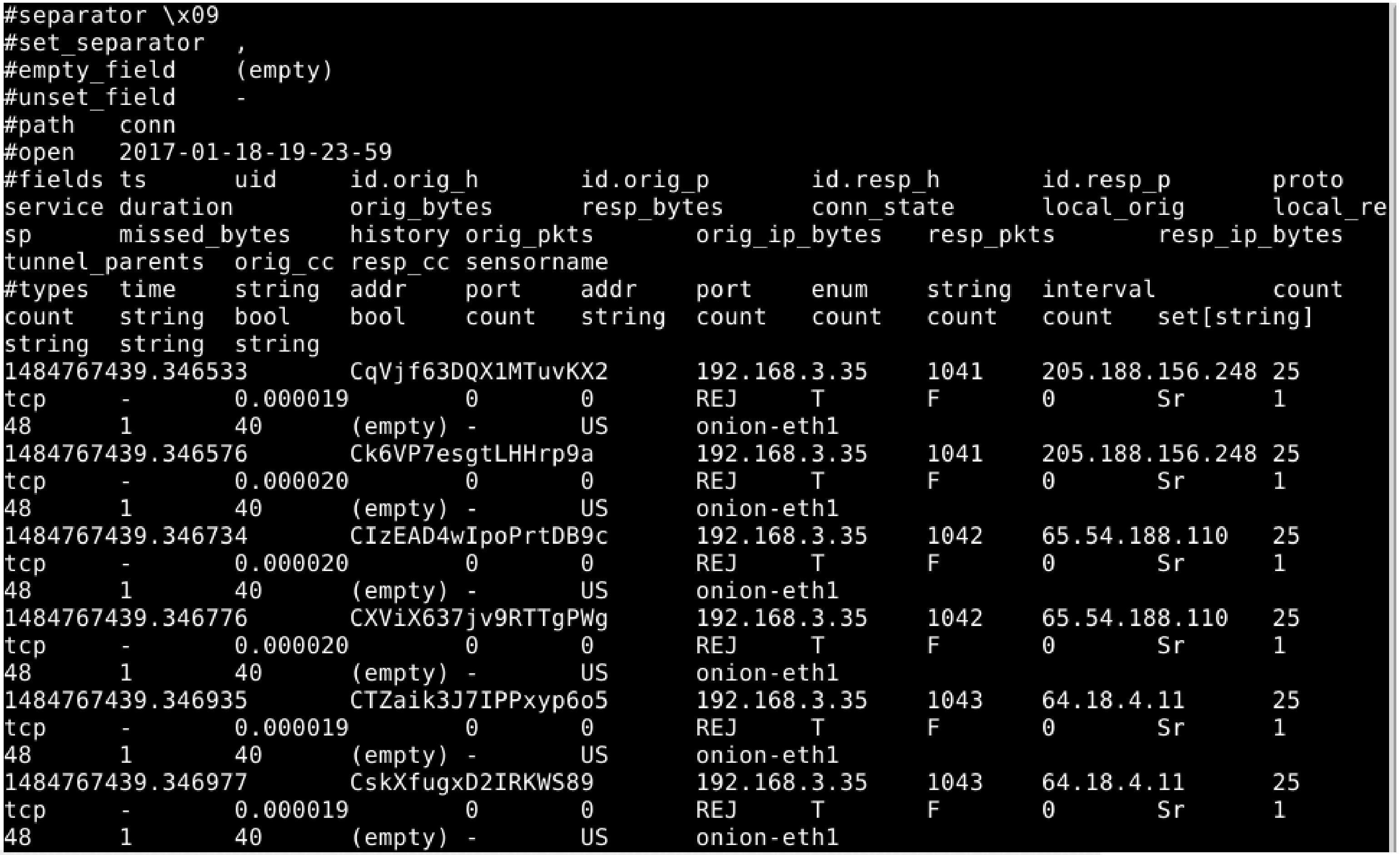
- Bro in 30 Seconds
  - Much more than an IDS
  - Logs multiple layers of traffic
    - “Packet String”
    - Similar to NETFLOW
  - Plugins/Scripts
    - Interpret Data
    - Take action
  - Logs are small
    - Allows for longer retention than PCAP
  - Open Source, Built-in to Security Onion

Gathering Data with Bro

- Bro Data Formatting
  - Tab Separated table
  - Headers at top
  - Common Fields:
    - Timestamp (ts)
    - Connection ID (uid)
    - IP Source (id.orig_h)
    - Source Port (id.orig_p)
    - IP Destination (id.resp_h)
    - Dest Port (id.resp_p)

Gathering Data with Bro

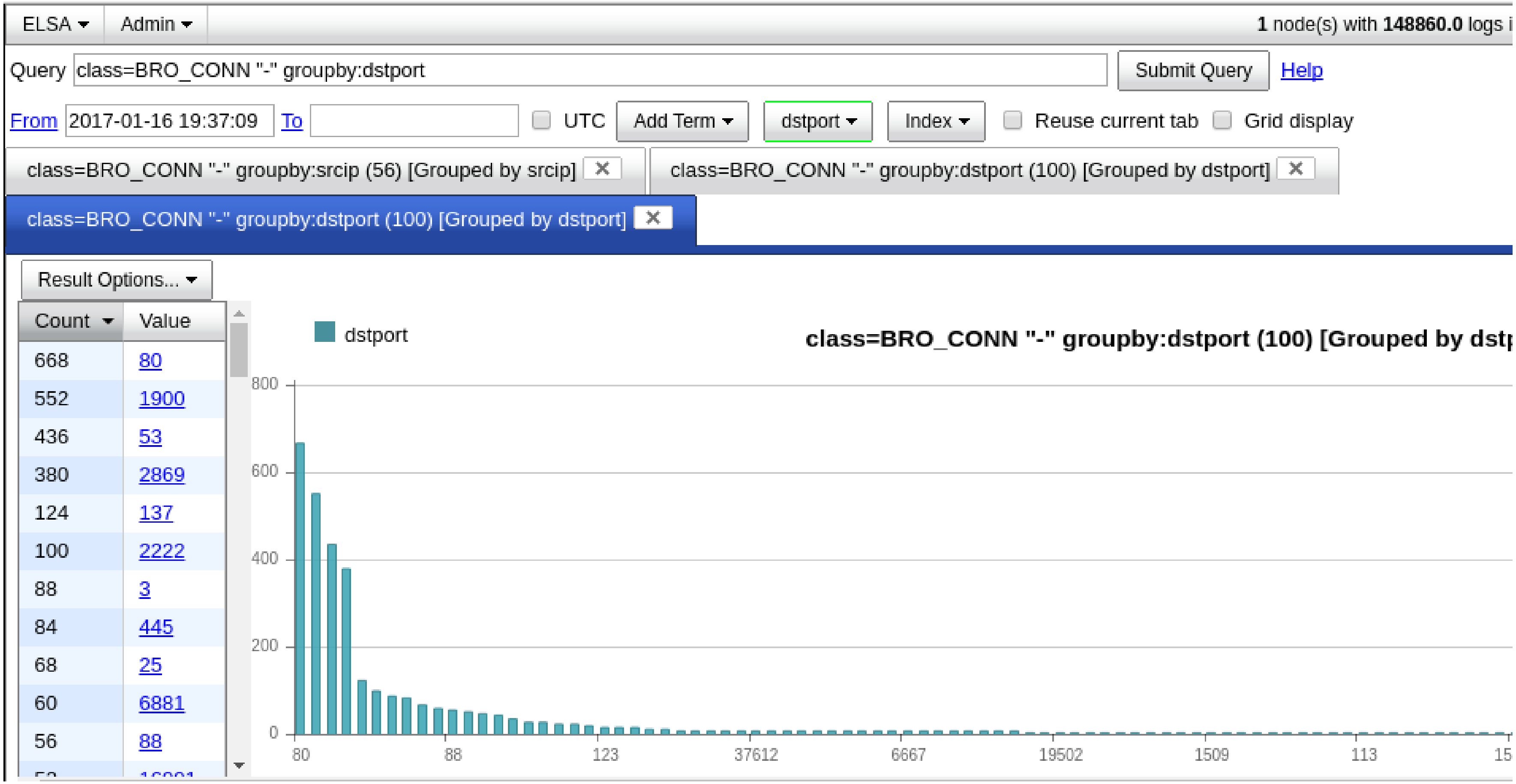
- Logs are simple to parse …. programmatically



```
#separator \x09
#set_separator  ,
#empty_field    (empty)
#unset_field    -
#path   conn
#open   2017-01-18-19-23-59
#fields ts      uid     id.orig_h       id.orig_p       id.resp_h       id.resp_p       proto
service duration        orig_bytes      resp_bytes      conn_state      local_orig      local_re
sp      missed_bytes    history orig_pkts       orig_ip_bytes   resp_pkts       resp_ip_bytes
tunnel_parents  orig_cc resp_cc sensorname
#types  time    string  addr    port    addr    port    enum    string  interval        count
count   string  bool    bool    count   string  count   count   count   count   set[string]
string  string  string
1484767439.346533       CqVjf63DQX1MTuvKX2      192.168.3.35    1041    205.188.156.248 25
tcp     -       0.000019        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
1484767439.346576       Ck6VP7esgtLHHrp9a       192.168.3.35    1041    205.188.156.248 25
tcp     -       0.000020        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
1484767439.346734       CIzEAD4wIpoPrtDB9c      192.168.3.35    1042    65.54.188.110   25
tcp     -       0.000020        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
1484767439.346776       CXViX637jv9RTTgPWg      192.168.3.35    1042    65.54.188.110   25
tcp     -       0.000020        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
1484767439.346935       CTZaik3J7IPPxyp6o5      192.168.3.35    1043    64.18.4.11      25
tcp     -       0.000019        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
1484767439.346977       CskXfugxD2IRKWS89       192.168.3.35    1043    64.18.4.11      25
tcp     -       0.000019        0       0       REJ     T       F       0       Sr      1
48      1       40      (empty) -       US      onion-eth1
```

Gathering Data with Bro

- Humans should use ELSA, Splunk, etc…



1 node(s) with 148860.0 logs i

Query: class=BRO_CONN "-" groupby:dstport

From: 2017-01-16 19:37:09

class=BRO_CONN "-" groupby:srcip (56) [Grouped by srcip] ✕

class=BRO_CONN "-" groupby:dstport (100) [Grouped by dstport] ✕

class=BRO_CONN "-" groupby:dstport (100) [Grouped by dstport] ✕

Count	Value
668	80
552	1900
436	53
380	2869
124	137
100	2222
88	3
84	445
68	25
60	6881
56	88

class=BRO_CONN "-" groupby:dstport (100) [Grouped by dst

Gathering Data with Bro

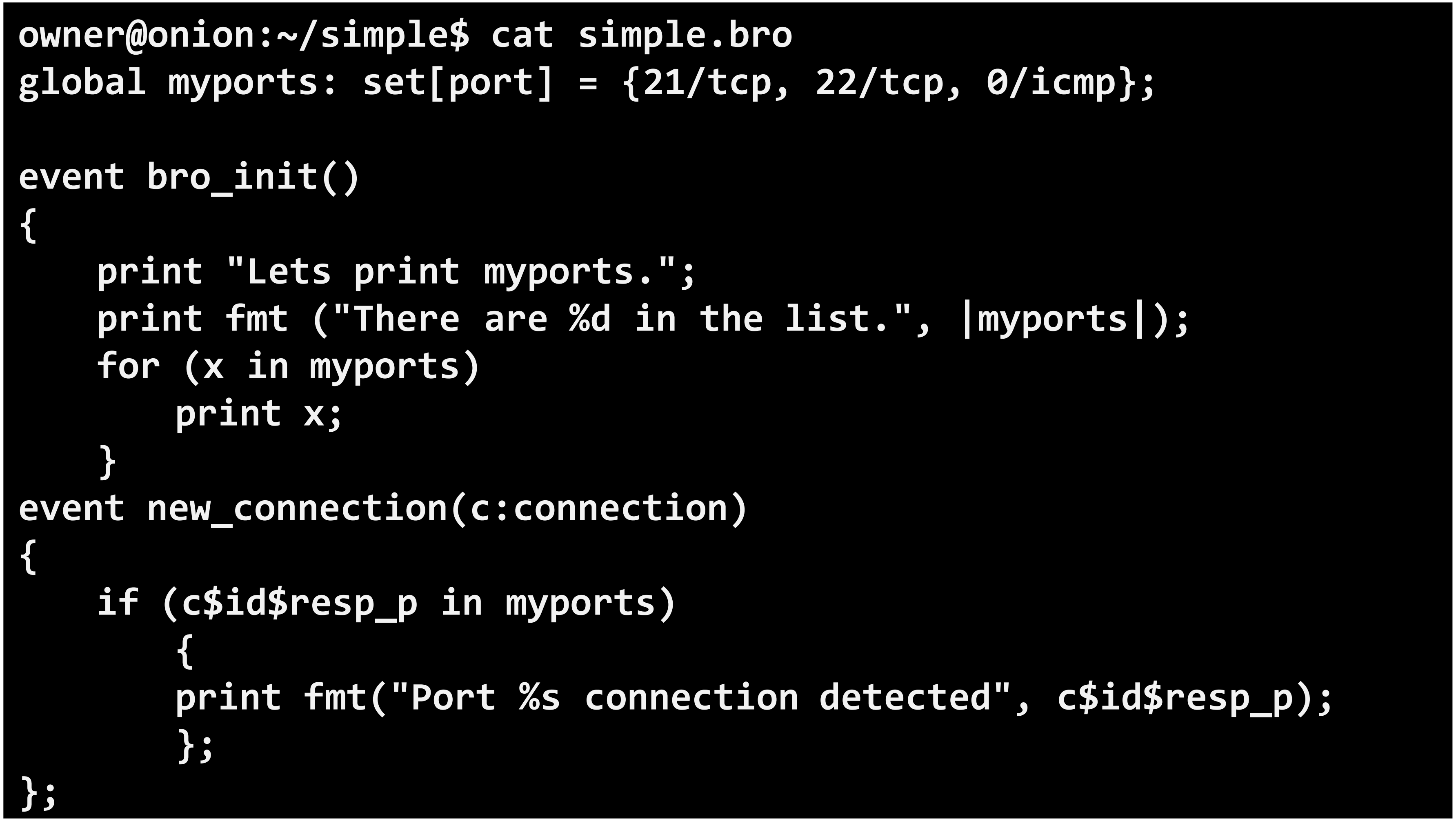
- Key Directories:
  - /nsm/bro/logs/current
    - notices.log
    - conn.log
    - weird.log
  - /opt/bro/share/bro/policy
    - Contains scripts loaded by Bro
  - /opt/bro/share/bro/site/local.bro
    - Add path to custom scripts to this file to load when bro starts

Bro Scripts

“The best way to learn to write Bro scripts, is to write Bro scripts”

– Seth Hall, SecurityOnion Conference 2015

Bro Scripts



```
owner@onion:~/simple$ cat simple.bro
global myports: set[port] = {21/tcp, 22/tcp, 0/icmp};

event bro_init()
{
    print "Lets print myports.";
    print fmt ("There are %d in the list.", |myports|);
    for (x in myports)
        print x;
    }
event new_connection(c:connection)
{
    if (c$id$resp_p in myports)
        {
        print fmt("Port %s connection detected", c$id$resp_p);
        };
};
```

Something a little more useful…

Baselinereport.bro ::Pseudocode

```
1. Load table (baseline.data)
2. Check every new connection:
   – Is the destination on the baselined subnet?
      • If so, is it in the baseline?
   – If it's in the baseline, is the source address allowed to use that port?
3. Log any "No's"
```

Installing Baselinereport.bro

1. git clone https://github.com/hashtagcyber/baseliner.git

2. Edit line 32 of baselinereport.bro, replace with a comma separated list of subnets
3. Copy both files to /opt/bro/share/bro/policy/misc

4. Add “@load misc/baselinereport” to /opt/bro/share/bro/site/local.bro

5. Restart Bro

ELSA Demo

- Useful search terms:
  - Show all notice’s generated by baselinereport
    - class=BRO_NOTICE "-" notice_type="TrafficBaselineException“
  - Show all connections to an IP, grouped by destination port
    - BRO_CONN.dstip=156.22.10.10 groupby:dstport
  - Show all connection to an IP/Port pair grouped by source IP
    - *BRO_CONN.dstip=156.22.10.10 BRO_CONN.dstport=445 groupby: srcip*

Updating Baseline w/ ELSa & VI

- Baselinereport.bro

CHIRON
TRAINING

Questions?