CHIRON TRAINING

Arming Small Security Programs

Troopers17

Arming Small Security Programs

OVERVIEW

Network baseline generation with Bropy

Disclaimer

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- I “borrowed” my employers slide template
  - Creating .POT files is hard
- This is NOT my employers material
- TLDR; You can sue me, not my employer

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About Me

Matt Domko

- Beard Enthusiast
- Giessen American High School
- Former:
  - Parachutist
  - Enterprise Admin
  - "Cyber Network Defender"
- Instructor at Chiron Technology Services
- Started blogging about Blue Team stuff
  http://goo.gl/uznCag
- Brakesec Slack
  https://brakesec.signup.team
- @hashtagcyber

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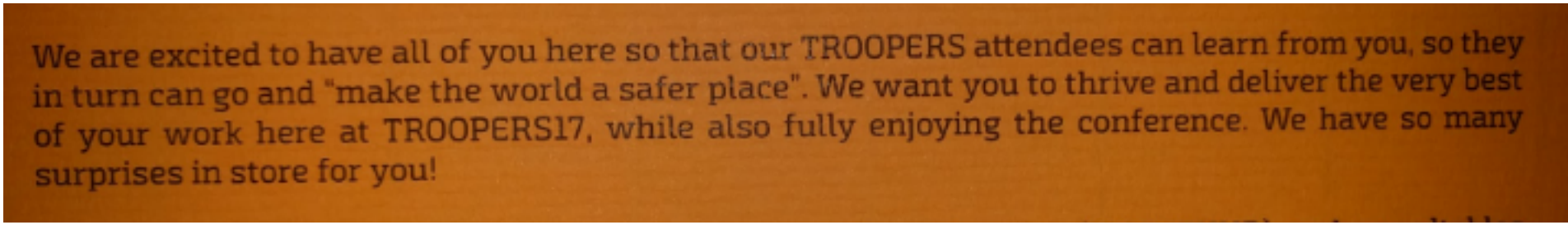
Why I'm here



"Make the world a safer place"
{by sharing information}

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Get Out!

Leave now if:

- You were looking for a red team talk
  - Joffrey Czarny is talking about pentesting Citrix in one room
  - Rebecca Shapiro is breaking down bootloaders in the other

Please stay if:

- You want to know every host your critical assets communicate with
- You want a list of every port a server listens on
- You want to do it all in less than 5 mins

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The Problem: Detecting Malicious Network Activity

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- 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;)
```


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The Problem: Detecting Malicious Network Activity

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```
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;)
```


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The Problem: Detecting Malicious Network Activity

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```
##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;)
```


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The Problem: Detecting Malicious Network Activity

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```
##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;)
```


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The Problem: Detecting Malicious Network Activity

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- 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

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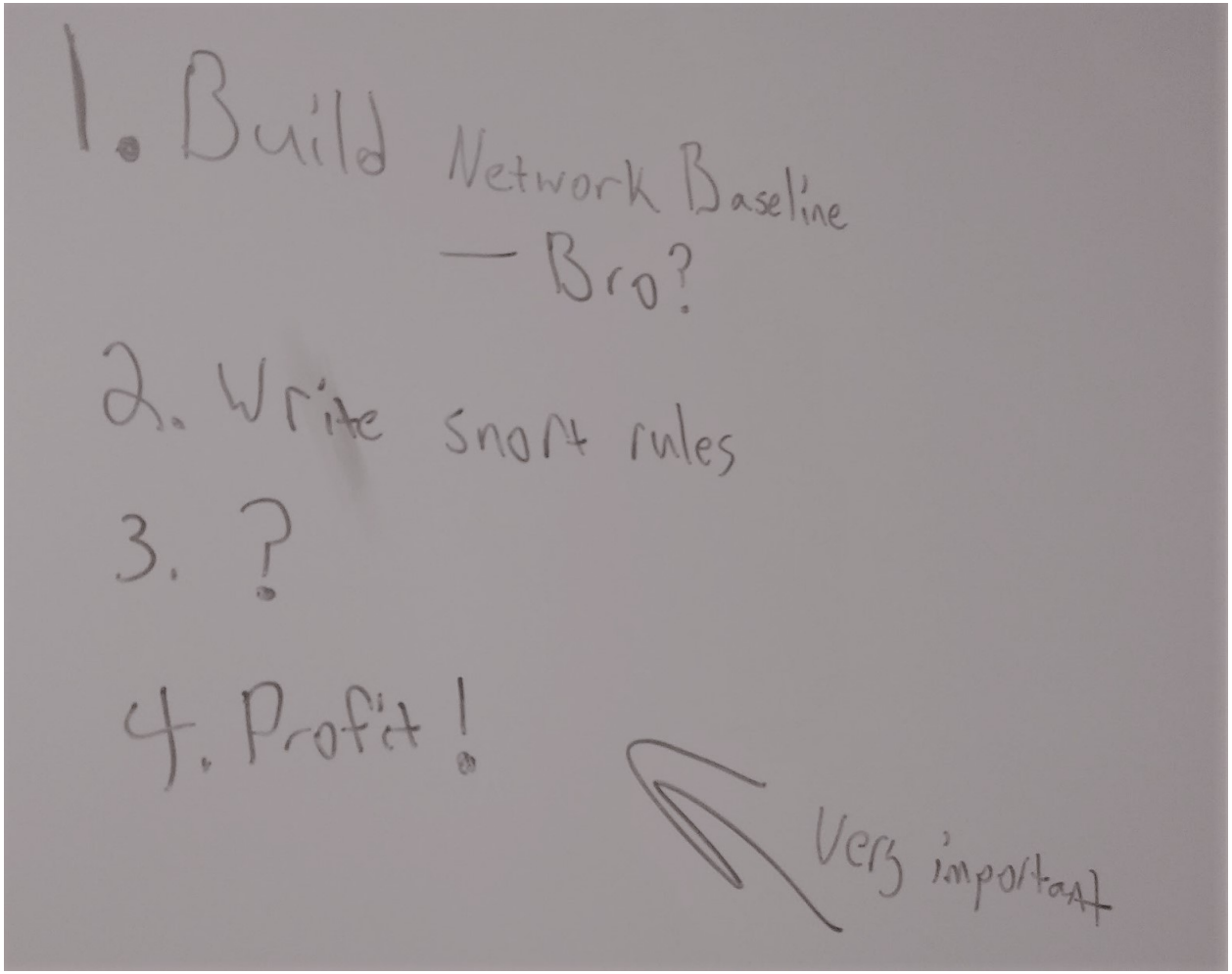
The Initial Idea



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The Initial Idea

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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

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A Similar Problem: Malicious Binaries

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- 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

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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

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A Similar Problem: Malicious Binaries

CHIRON TRAINING

- 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)

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Simple Application Whitelisting Implementation

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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

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Malicious Network Activity : Anomaly Detection

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- 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

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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?

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Disclaimer

- Robin Summer gave a MUCH BETTER presentation on Bro at TROOPERS14

https://www.youtube.com/watch?v=BBl0yaUdq4c

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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

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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)

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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
```


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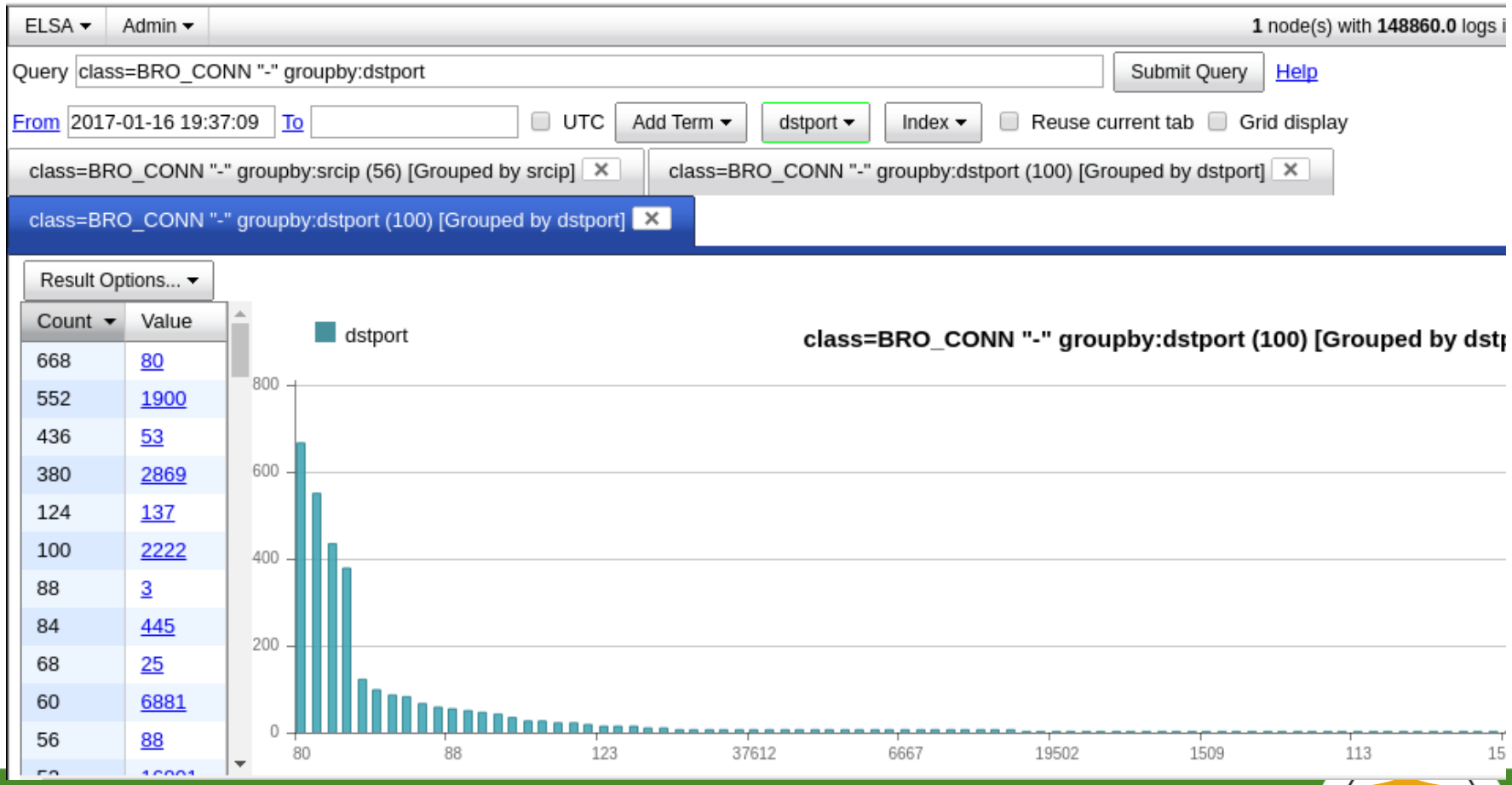
Gathering Data with Bro

- Humans should use ELSA, Splunk, etc…



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Gathering Data with Bro

- Key Directories:
  - /nsm/bro/logs/current
    - notice.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

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Bro Scripts

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"The best way to learn to write Bro scripts, is to write Bro scripts"

– Seth Hall, SecurityOnion Conference 2015

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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);
        };
};
```


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Bro Scripts

CHIRON TRAINING

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

global myports: set[port] = {21/tcp, 22/tcp, 0/icmp};

#Create a list

```
        print fmt("Port %s connection detected", c$id$resp_p);
        };
};
```


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Bro Scripts

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

event bro_init()
{
```

```
event bro_init()
{

#Do stuff when Bro loads


};
```


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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|);
```

print fmt ("There are %d in the list.", |myports|);

#Format string

|var| gets length of list

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Bro Scripts

event new_connection(c:connection)
{

Do the thing in curley braces when Bro detects a new connection

```
    }
event new_connection(c:connection)
{
    if (c$id$resp_p in myports)
        {
        print fmt("Port %s connection detected", c$id$resp_p);
        };
};
```


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Bro Scripts

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if (cidresp_p in myports)
{

#If the destination port (cidresp_p) is in the list, do the thing in curley brackets

```
    }
event new_connection(c:connection)
{
    if (c$id$resp_p in myports)
        {
        print fmt("Port %s connection detected", c$id$resp_p);
        };
};
```


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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"

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Installing Baselinereport.bro

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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

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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*

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Updating Baseline w/ ELSa & VI

```
#DNS Client
156.22.10.10    53      udp     156.22.10.0/24,156.22.11.0/24
#Kerberos
156.22.10.10    88      tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    88      udp     156.22.10.0/24,156.22.11.0/24
#LDAP
156.22.10.10    389     tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    389     udp     156.22.10.0/24,156.22.11.0/24
#SMB
156.22.10.10    445     tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    445     udp     156.22.10.0/24,156.22.11.0/24
#RPC
156.22.10.10    135     tcp     156.22.10.0/24,156.22.11.0/24
#NetBIOS
156.22.10.10    139     tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    137     udp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    138     udp     156.22.10.0/24,156.22.11.0/24
#Dynamic Ports-NeedToLockItDown
156.22.10.10    49155   tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    49155   udp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    49158   tcp     156.22.10.0/24,156.22.11.0/24
156.22.10.10    49158   udp     156.22.10.0/24,156.22.11.0/24
#Windows Time
156.22.10.10    123     udp     156.22.10.0/24,156.22.11.0/24
```


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But ....

- That sounds like a lot of work…

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Bropy

- Written in Python
- Installs baselinereport.bro script
- Parses notice.log
- Generates network baseline automatically
- Simple Yes/No interface

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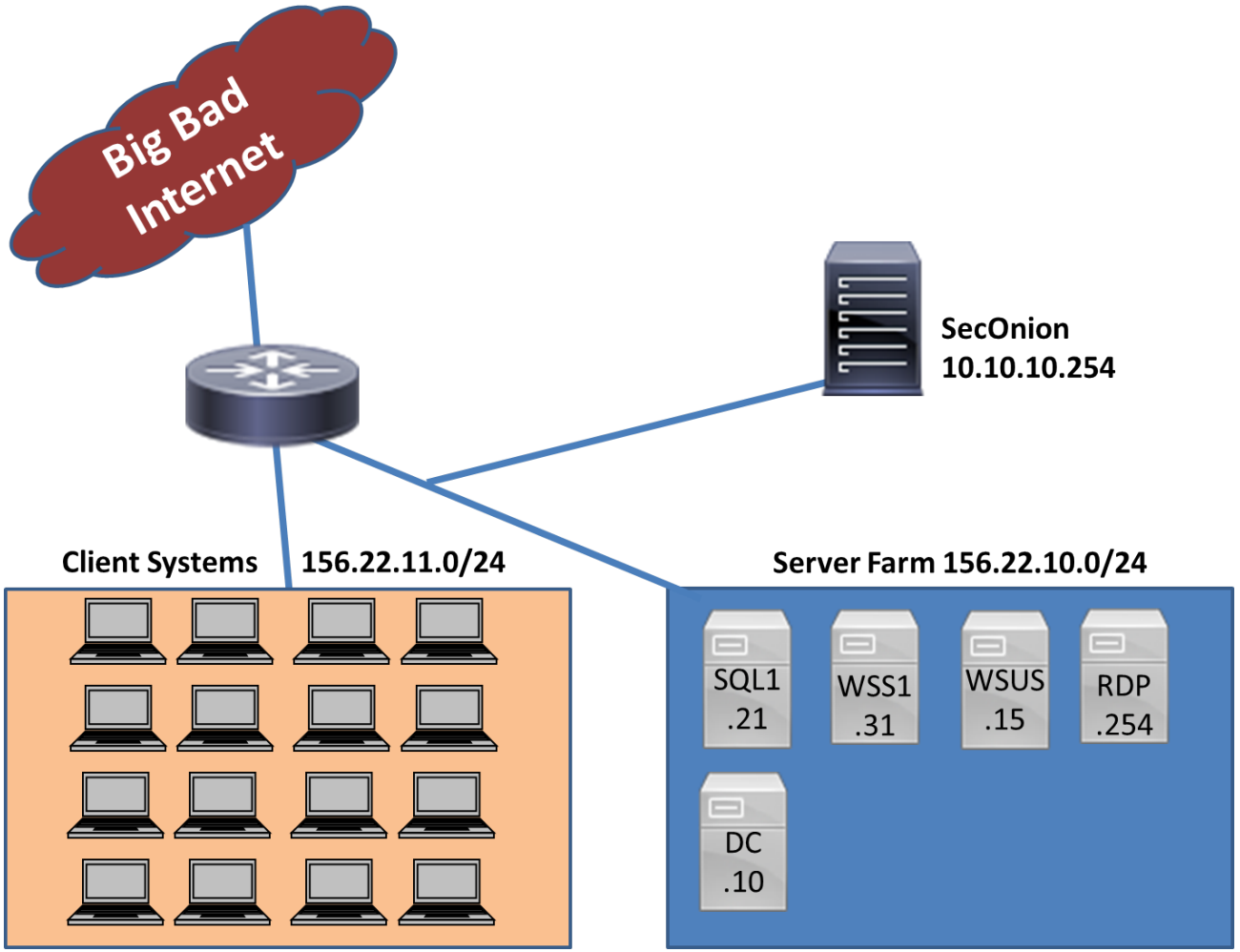
Scenario Network



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Bropy

- Demo Time

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Bropy on SecurityOnion

1. git clone https://github.com/hashtagcyber/bropy
2. cd bropy
3. sudo ./bropy.py
   - Select option 3 to install
     - Enter the subnet and CIDR that you would like to monitor
     - Example: 156.22.10.0/24
4. Select Y to restart Bro
5. Wait for logs to be generated….
6. sudo ./bropy.py
   - Select option 1 to “Auto Baseline”
   - Select option 2 for Y/N prompting

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Use Case

- Generate a list of every port/protocol critical hosts receive connections on
- Receive alerts when non-standard connections are detected
- Baseline data can be used to generate firewall lists

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CHIRON TRAINING

Questions?