UEPtSS: *Unconstrained End-Point Security System*

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About Me

- A very big fan of BRO IDS
- Have been working with Bro for past two years
- Joined UD's Network and Systems Services (IT-NSS Team) in 2015
- Passionate about Cyber-Security
- Also a part-time Ph.D student

Roadmap of today's talk

- What is UEPtSS?
- Motivation
- Why use Bro for UEPtSS?
- How to use Bro for UEPtSS?
- An inventory of End-Points and running software
- Usefulness of UEPtSS
- Some use-cases

What is UEPtSS?

Sniff traffic

Fingerprint device

An inventory of Unconstrained systems

client_ip	latest_time	mac	dmacs	vendor	known_services	software_type	software_info
128.4	08/20/2017 15:01:33	10:41:7f	1	Apple, Inc.		iOS::IPHONE	iPhone,10,3,iPhone7,2AT&T
128	08/20/2017 14:50:17	34:17:eb	1	Dell Inc.	22,tcp,(empty)	SSH::SERVER	OpenSSH,5.3,-
128	08/20/2017 15:06:18.763725	78:2b:cb	1	Dell Inc.	22,tcp,SSH	SSH::SERVER	OpenSSH,6.6,p1
128	08/20/2017 14:54:20	00:1e:68	1	QUANTA COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,5.9,p1
128	08/20/2017 15:04:22.440988	90:b1:1c	1	Dell Inc.	22,tcp,SSH	SSH::SERVER	OpenSSH,6.6,-
128	08/20/2017 14:51:21	14:da:e9	1	ASUSTek COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,7.2,p2
128	08/20/2017 15:02:13	4c:cc:6a	1	Micro-Star INTL CO., LTD.	22,tcp,(empty)	SSH::SERVER	OpenSSH,7.2,p2
128	08/20/2017 14:55:01	98:90:96	1	Dell Inc.		OS::WINDOWS	Windows,10,0,10
128	08/20/2017 14:39:30	14:fe:b5	1	Dell Inc.		OS::WINDOWS	Windows,10,0,10
128	08/20/2017 15:06:00.641491	e0:9d:31	1	Intel Corporate		OS::WINDOWS	Windows,6.1,7 or Server 2008 R2
128	08/20/2017 15:06:21.108368	ac:87:a3	1	Apple, Inc.		MACOS::MACINTOSH	Macintosh,10,10,Yosemite

Motivation….

- Some organizations can’t control some or all of their end user computer systems. Examples include: universities, shared startup spaces, sites offering public Internet access (e.g. restaurants), and conferences.

- If the data pertaining of end user systems is organized and cataloged as part of normal information security logging activities, an extended picture of what the end system actually is may be available to the investigator at a moment’s notice.

Solution??

- Two ways:
- ***Active Scanning***: nmap, Nessus, Qualys other commercial products.
  - Pros: Accuracy, many plugins and scripts targeted towards specific software detection.
  - Cons: Have to be 'active' very frequently, commercial plugins are expensive, user intervention needed. Free versions have limited usability.
- ***Passive Scanning***: Use existing tools, IDS/IPS systems. Ex: Bro.
  - Pros: Active all the time, no user intervention, free and open source, can be customized to detect specific s/w.
  - Cons: Not very highly accurate (depends on the traffic it sees on the n/w).

Why Bro for UEPtSS?

- Why Not! (It's FREE, has great community support, offers different scripts)
- One of the coolest features of BRO is, it's a great sniffer and generates *[User-Friendly]* logs of what it saw on the network. Take Advantage of that!
- Works great for Unconstrained devices, as no knowledge of when and who will be connecting to the network is required

How to use BRO for UEPtSS?

- ***Leverage the built-in scripts*** for software detection and other OS finger printing
- ***Leverage Bro's scripting FW*** to write custom scripts for detecting the interesting stuff from traffic
- ***Leverage different log files*** to dig for the client specific information: software.log, known_services.log, sites_open_ports.log, TLSFingerprint.log

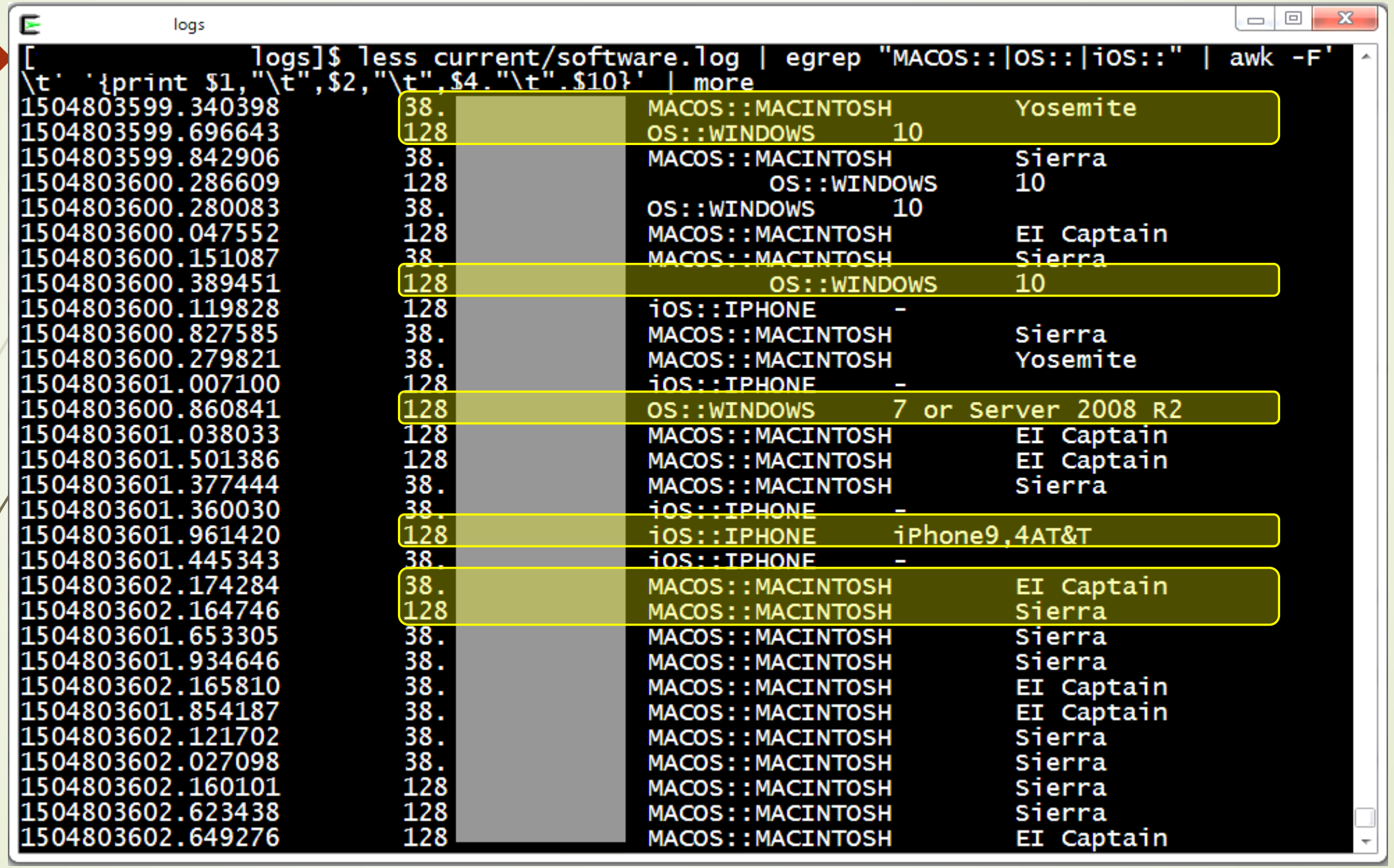
Scripts to load for inventory data logging

- **windows-version-detection.bro** – built-in script
- **Mac-version-detection.bro** – custom script
- **iPhone-detection.bro** – custom script
- **tls-fingerprinting.bro** – custom script *[Courtesy: Seth Hall]*
- **host-profiling.bro** – Available with scan-NG package
- **software-browser-plugins.bro** – built-in script
- **known-services.bro** – built-in script
- **Load all the scripts that detect software in various protocols** – built-in scripts

Gathering information for the UEPtSS

- **Machine type** : *Use IEEE Standards Public listing (MA-L)*
- **Operating system and version :** *Bro software.log*
- **Browsers in use:** *Bro software.log*
- **Applications and versions:** *Bro software.log*
- **Different Plugins:** *Bro software.log*
- **TLS Clients:** *custom Bro log TLSfingerprint.log*
- **Open ports (services):** *Bro known_services.log, site_host_open_ports.log*
- **Dangerous behavior history:** *IDS/IPS (snort, Bro etc)*
- **MAC address:** *DHCP logs*

Gathering info for the UEPtSS: Operating systems and version



Gathering info for the UEPtSS: Browsers in use

logs

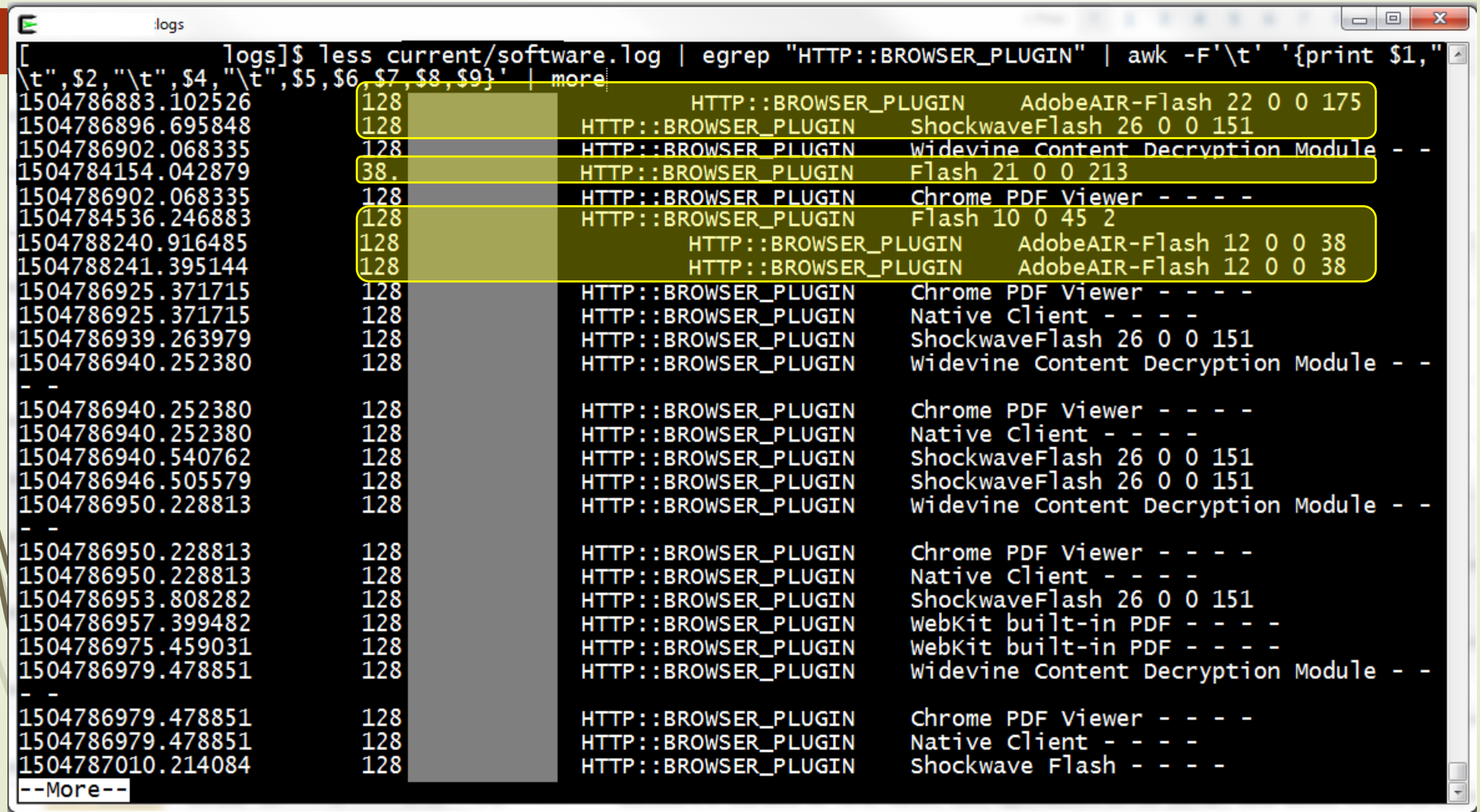
```
[              logs]$ less current/software.log | egrep "HTTP::BROWSER" | awk -F'\t' '{print $1,"\t
",$2,"\t",$4,"\t",$5,$6,$7}' | more
1504803600.782024         128             HTTP::BROWSER   cloudd 651 14
1504803601.066494         128                     HTTP::BROWSER   Chrome 60 0
1504803601.396806         128                     HTTP::BROWSER   MSIE 11 0
1504803601.060423         128             HTTP::BROWSER   AppleCoreMedia 1 0
1504803601.474983         128             HTTP::BROWSER   Safari 10 1
1504803601.283953         128             HTTP::BROWSER   NewsToday 1000 -
1504803600.975556         128             HTTP::BROWSER   Microsoft-CryptoAPI 10 0
1504803601.568334         128             HTTP::BROWSER   Agent 2087369893 -
1504803601.015429         128             HTTP::BROWSER   Omelette 198 -
1504803601.100742         38.             HTTP::BROWSER   Chrome 60 0
1504803601.551074         128             HTTP::BROWSER   Microsoft NCSI - -
1504803601.302071         128             HTTP::BROWSER   AppleNewsWidget 608 5
1504803601.300689         128             HTTP::BROWSER   AppleNewsWidget 608 5
1504803601.505984         128             HTTP::BROWSER   Chrome 60 0
1504803601.786981         128             HTTP::BROWSER   MSIE 8 0
1504803601.807103         128             HTTP::BROWSER   com.apple.appstored 1 0
1504803601.688483         38.             HTTP::BROWSER   Firefox 43 0
1504803602.000256         38.             HTTP::BROWSER   Safari 10 0
1504803602.016258         38.             HTTP::BROWSER   Chrome 60 0
1504803602.040124         38.             HTTP::BROWSER   Chrome 60 0
1504803602.113375         128             HTTP::BROWSER   AppNOS 2 -
1504803601.784988         38.             HTTP::BROWSER   Chrome 52 0
1504803601.906976         128             HTTP::BROWSER   NewsToday 1000 -
1504803601.994771         38.             HTTP::BROWSER   Safari 10 0
1504803601.923709         128             HTTP::BROWSER   Chrome 60 0
1504803601.836647         38.             HTTP::BROWSER   Safari 10 1
1504803601.807896         128             HTTP::BROWSER   com.apple.appstored 1 0
1504803602.031275         128             HTTP::BROWSER   trustd (unknown version) CFNetwork 811 5
1504803601.562576         38.             HTTP::BROWSER   Firefox 55 0
--More--
```

Gathering info for the UEPtSS: Applications and versions

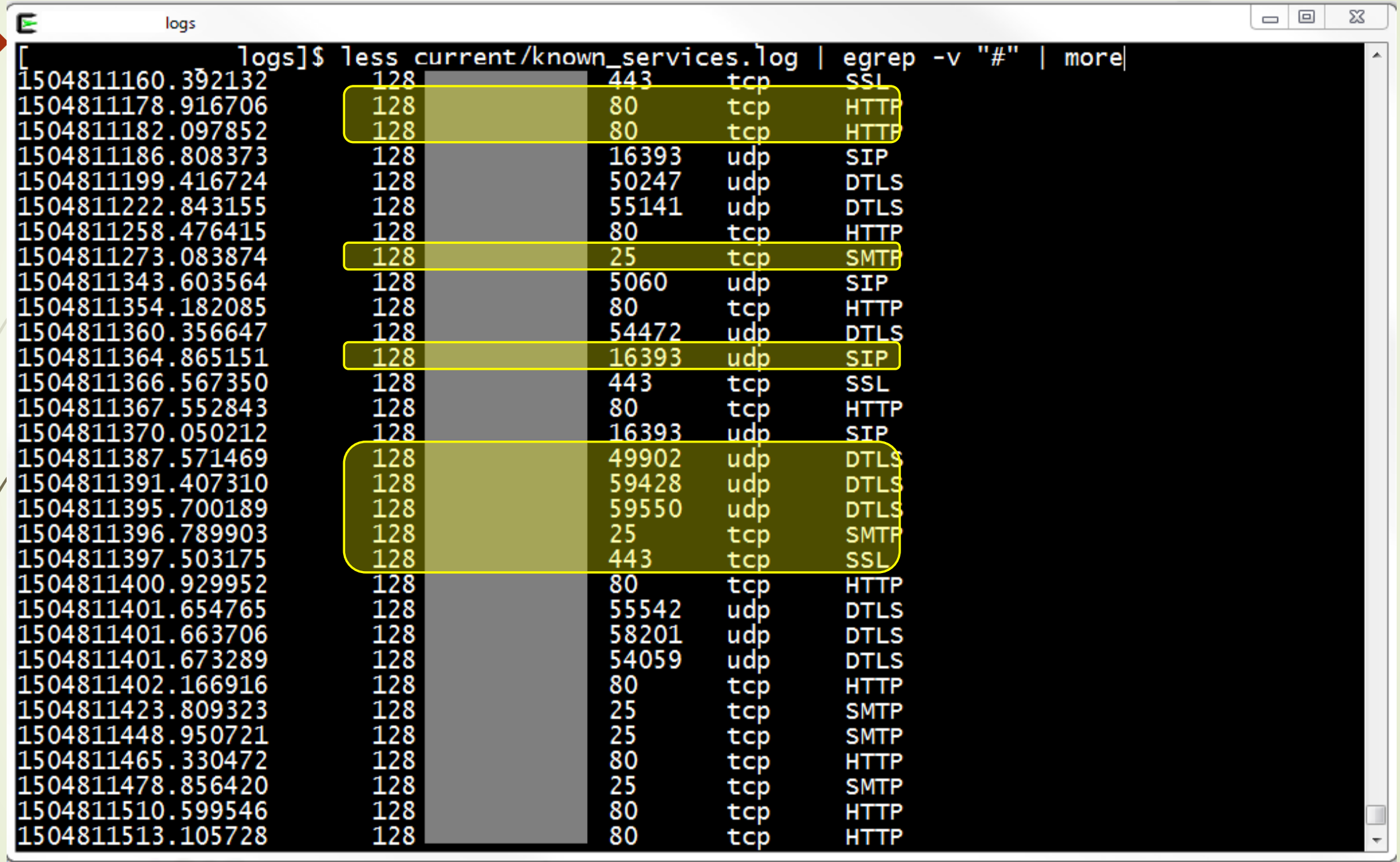
logs

```
[              logs]$ less current/software.log | egrep "HTTP::APPSERVER" | awk -F'\t' '{print $1,"
\t",$2,"  ",$3,"\t",$4,"\t",$5,$6,$7}' | more
1504804710.245566         128                80      HTTP::APPSERVER         ASP.NET - -
1504804728.687649         128                80      HTTP::APPSERVER         PHP 5 3
1504804730.652638         128                 80     HTTP::APPSERVER         PHP 5 3
1504804785.110239         128               80       HTTP::APPSERVER         PHP 5 5
1504804826.774401         128                 80     HTTP::APPSERVER         ASP.NET - -
1504804851.515563         128                  80    HTTP::APPSERVER         ASP.NET - -
1504804863.326578         128               80       HTTP::APPSERVER         PHP 5 3
1504804911.000248         128                 80     HTTP::APPSERVER         PHP 5 6
1504804918.882208         128                80      HTTP::APPSERVER         PHP 5 3
1504804939.647909         128               80       HTTP::APPSERVER         ASP.NET - -
1504804939.647909         128               80       HTTP::APPSERVER         SharePoint 14 0
1504804939.642234         128               80       HTTP::APPSERVER         ASP.NET - -
1504804939.642234         128               80       HTTP::APPSERVER         SharePoint 14 0
1504804939.649749         128               80       HTTP::APPSERVER         ASP.NET - -
1504804939.649749         128               80       HTTP::APPSERVER         SharePoint 14 0
1504804939.648653         128               80       HTTP::APPSERVER         ASP.NET - -
1504804939.648653         128               80       HTTP::APPSERVER         SharePoint 14 0
1504804939.646061         128               80       HTTP::APPSERVER         ASP.NET - -
1504804939.646061         128               80       HTTP::APPSERVER         SharePoint 14 0
1504804944.285301         128                 80     HTTP::APPSERVER         PHP 7 1
1504804985.287677         128                  80    HTTP::APPSERVER         PHP 7 0
1504804985.928326         128                 80     HTTP::APPSERVER         PHP 7 0
1504805135.749526         128                80      HTTP::APPSERVER         PHP 5 6
1504805140.870156         38.               80       HTTP::APPSERVER         ASP.NET - -
1504805146.061972         128                  80    HTTP::APPSERVER         ASP.NET - -
1504805201.409510         128                80      HTTP::APPSERVER         PHP 5 6
1504805201.730019         128               80       HTTP::APPSERVER         PHP 5 5
1504805225.476012         128                 80     HTTP::APPSERVER         PHP 5 6
1504805239.808327         128               80       HTTP::APPSERVER         PHP 5 3
1504805245.854806         128               80       HTTP::APPSERVER         PHP 5 3
```

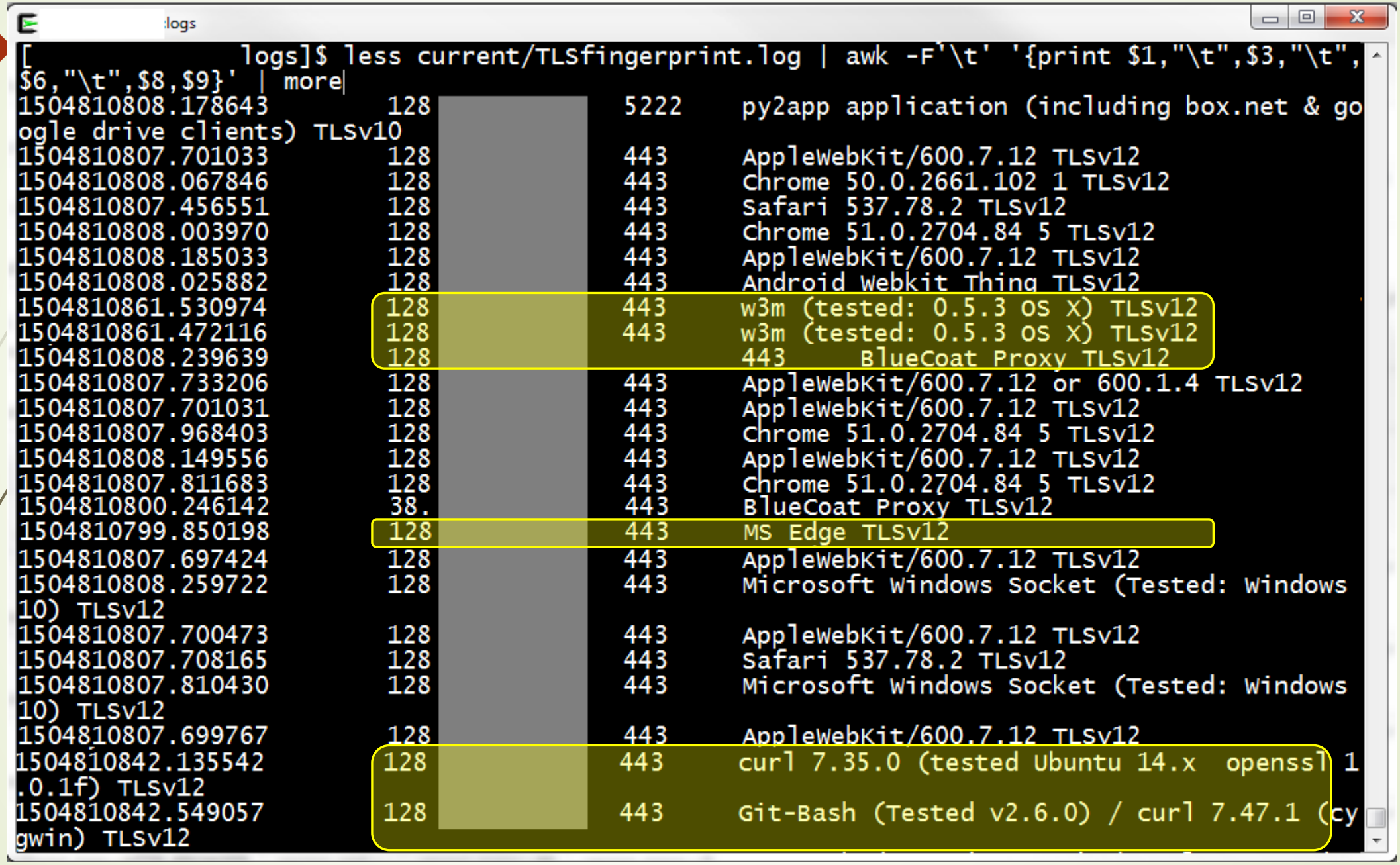
Gathering info for the UEPtSS: Different Plugins



Gathering info for the UEPtSS: Open ports (Known services)



Gathering info for the UEPtSS: TLS Clients



Putting everything together

- Any log aggregation tool to glue all the info together, with IP being the primary key in each type of log file…

UEPtSS : An inventory of *unconstrained* systems

client_ip	latest_time	mac	dmacs	vendor	known_services	software_type	software_info	TLS_client
128.4.	08/20/2017 15:01:33	10:41:7f:	1	Apple, Inc.		iOS::IPHONE	iPhone,10,3,iPhone7,2AT&T	
128.	08/20/2017 14:50:17	34:17:eb:	1	Dell Inc.	22,tcp,(empty)	SSH::SERVER	OpenSSH,5,3,-	
128.	08/20/2017 15:06:18.763725	78:2b:cb:	1	Dell Inc.	22,tcp,SSH	SSH::SERVER	OpenSSH,6,6,p1	AppleWebKit/535 & Ubuntu Product Search,TLSv12 OpenSSL s_client (tested: 1.0.1f - Ubuntu 14.04TS),TLSv12
128.	08/20/2017 14:54:20	00:1e:68:	1	QUANTA COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,5,9,p1	
128	08/20/2017 15:04:22.440988	90:b1:1c:	1	Dell Inc.	22,tcp,SSH	SSH::SERVER	OpenSSH,6,6,-	
128.	08/20/2017 14:51:21	14:da:e9:	1	ASUSTek COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,7,2,p2	
128.	08/20/2017 15:02:13	4c:cc:6a:	1	Micro-Star INTL CO., LTD.	22,tcp,(empty)	SSH::SERVER	OpenSSH,7,2,p2	
128.	08/20/2017 14:55:01	98:90:96:	1	Dell Inc.		OS::WINDOWS	Windows,10,0,10	
128.	08/20/2017 14:39:30	14:fe:b5:	1	Dell Inc.		OS::WINDOWS	Windows,10,0,10	
128.	08/20/2017 15:06:00.641491	e0:9d:31:	1	Intel Corporate		OS::WINDOWS	Windows,6,1,7 or Server 2008 R2	Microsoft Updater (Windows 7SP1) / TeamViewer 11.0.56083P,TLSv12 Safari 525.21 525.29 531.22.7 533.21.1 534.57.2 / Adobe Reader DC 15.x Updater,TLSv10
128.	08/20/2017 15:06:21.108368	ac:87:a3:	1	Apple, Inc.		MACOS::MACINTOSH	Macintosh,10,10,Yosemite	AppleWebKit/600.7.12 or 600.1.4,TLSv12 AppleWebKit/600.7.12,TLSv12
128.	08/20/2017 14:16:03.244146	ac:87:a3	1	Apple, Inc.		MACOS::MACINTOSH	Macintosh,10,12,Sierra	
128.	08/20/2017 15:02:41.363188	10:9a:dd	1	Apple, Inc.	22,tcp,(empty) 80,tcp,HTTP	HTTP::SERVER SSH::SERVER	Apache,2,4,Unix OpenSSH,6,9,-	Flux,TLSv12
128.	08/20/2017 15:06:02.732062	70:8b:cd:	1	ASUSTek COMPUTER INC.	22,tcp,(empty) 80,tcp,HTTP	HTTP::SERVER SSH::SERVER	Apache,2,4,Ubuntu OpenSSH,7,2,p2	
128.	08/20/2017 14:59:34.233089	00:50:56:	1	VMware, Inc.	80,tcp,(empty)	HTTP::SERVER	Microsoft-HTTPAPI,2,0,-	
128.	08/20/2017 15:05:14.453996	54:9f:35:	1	Dell Inc.	22,tcp,(empty) 3690,tcp,(empty) 443,tcp,SSL 80,tcp,HTTP 8080,tcp,HTTP	HTTP::SERVER	Apache,2,4,Ubuntu	wget 1.18,TLSv12
128.	08/20/2017 14:43:03	00:1c:c0:	1	Intel Corporate		HTTP::BROWSER_PLUGIN	ShockwaveFlash,26,0,-	

Usefulness: Policy enforcement1- All old OpenSSH servers

client_ip	latest_time	mac	dmacs	vendor	known_services	software_type	software_info
128.[redacted]	08/20/2017 15:44:24.125195	00:50:56:[redacted]	1	VMware, Inc.	22,tcp,(empty) 443,tcp,SSL 80,tcp,HTTP	HTTP::APPSERVER HTTP::SERVER SSH::SERVER	Apache,2,4,CentOS OpenSSH,6,6,- PHP,5,4,-
128.[redacted]	08/20/2017 14:33:46.886734	00:50:56:[redacted]	1	VMware, Inc.	22,tcp,(empty) 443,tcp,(empty) 443,tcp,SSL 80,tcp,HTTP	HTTP::APPSERVER HTTP::SERVER SMTP::MAIL_CLIENT SSH::SERVER	Apache,2,2,CentOS Drupal,-,-,- OpenSSH,5,3,- PHP,5,3,-
128.[redacted]	08/20/2017 15:52:12.183246	00:50:56:[redacted]	1	VMware, Inc.	22,tcp,(empty)	SSH::SERVER	FlowSsh: Bitvise SSH Server (WinSSHD),5,59,-
128.[redacted]	08/20/2017 15:25:17.492431	00:50:56:[redacted]	1	VMware, Inc.	22,tcp,(empty) 80,tcp,(empty) 80,tcp,HTTP	HTTP::APPSERVER HTTP::BROWSER HTTP::SERVER SSH::SERVER	Apache,2,4,Ubuntu Debian APT-HTTP,1,3,1.0.1ubuntu2 OpenSSH,6,6,p1 PHP,5,5,ubuntu4 Python-urllib,3,4,-
128.[redacted]	08/20/2017 15:46:15	00:1e:68:[redacted]	1	QUANTA COMPUTER INC.	22,tcp,(empty) 80,tcp,(empty) 80,tcp,HTTP 8080,tcp,(empty) 8080,tcp,HTTP	HTTP::SERVER SSH::SERVER	Apache,2,2,Ubuntu Apache-Coyote,1,1,- OpenSSH,5,9,p1
128.[redacted]	08/20/2017 16:03:41.976476	00:23:8b:[redacted]	1	QUANTA COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,6,6,p1
128.[redacted]	08/20/2017 16:08:56	00:23:8b:[redacted]	1	QUANTA COMPUTER INC.	22,tcp,(empty)	SSH::SERVER	OpenSSH,6,6,p1
128.[redacted]	08/20/2017 16:00:02.696667	c0:3f:d5:[redacted]	1	Elitegroup Computer Systems Co.,Ltd.	22,tcp,(empty) 22,tcp,SSH 8888,tcp,(empty) 8888,tcp,HTTP	HTTP::BROWSER HTTP::SERVER SSH::SERVER	Jetty(,9,1,v20140210 OpenSSH,5,9,p1 Python-urllib,2,7,-
128.[redacted]	08/20/2017 16:07:05.690758	c0:3f:d5:[redacted]	1	Elitegroup Computer Systems Co.,Ltd.	22,tcp,(empty) 22,tcp,SSH 88,udp,KRB 8888,tcp,(empty)	HTTP::BROWSER SSH::SERVER	OpenSSH,5,9,p1 Python-urllib,2,7,-
128.[redacted]	08/20/2017 15:07:23.720996	34:17:eb:[redacted]	1	Dell Inc.	22,tcp,(empty) 88,udp,KRB	HTTP::BROWSER SSH::SERVER	OpenSSH,5,3,- urlgrabber,3,9,yum/3
128.[redacted]	08/20/2017 16:10:40.747024	78:2b:cb:[redacted]	1	Dell Inc.	22,tcp,(empty) 22,tcp,SSH	HTTP::BROWSER OS::WINDOWS SSH::SERVER	<unknown browser>,-,-,- Chrome,60,0,- Microsoft BITS,7,5,- Microsoft-CryptoAPI,6,1,- OpenSSH,6,6,p1 Windows,6,1,7 or Server 2008 R2 Windows-Update-Agent,-,-,-
128.[redacted]	08/20/2017 16:03:31.953283	a4:ba:db:[redacted]	1	Dell Inc.	22,tcp,(empty) 3128,tcp,(empty) 3128,tcp,HTTP 88,udp,KRB	HTTP::SERVER SSH::SERVER	OpenSSH,5,9,p1 squid,3,1,-

Taking a look at software.log: All Old OpenSSL versions

_time	client_ip	software_name	unparsed_version	software_type	version_major	version_minor
8/20/17 4:25:25.775 PM	128.	Apache	Apache/2.4.25 (Fedora) OpenSSL/1.0.2k-fips PHP/7.0.20 mod_perl/2.0.10 Perl/v5.24.1	HTTP::SERVER	2	4
8/20/17 4:25:23.206 PM	128.	Apache	Apache/2.4.25 (Fedora) OpenSSL/1.0.2k-fips PHP/7.0.20 mod_perl/2.0.10 Perl/v5.24.1	HTTP::SERVER	2	4
8/20/17 4:20:41.372 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_auth_gssapi/1.4.0 mod_auth_kerb/5.4 mod_fcgid/2.3.9 SVN/1.7.14 mod_wsgi/3.4 Python/2.7.5	HTTP::SERVER	2	4
8/20/17 4:16:30.994 PM	128	Apache	Apache/2.4.9 (Unix) OpenSSL/1.0.1e-fips PHP/5.4.27	HTTP::SERVER	2	4
8/20/17 4:08:10.901 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.16	HTTP::SERVER	2	4
8/20/17 3:41:02.251 PM	128.	Apache	Apache/2.2.22 (Unix) mod_ssl/2.2.22 OpenSSL/1.0.1e-fips	HTTP::SERVER	2	2
8/20/17 3:34:42.261 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.16	HTTP::SERVER	2	4
8/20/17 3:33:44.377 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.16	HTTP::SERVER	2	4
8/20/17 3:32:53.064 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips	HTTP::SERVER	2	4
8/20/17 3:29:46.740 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips	HTTP::SERVER	2	4
8/20/17 3:25:31.876 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.16	HTTP::SERVER	2	4
8/20/17 3:22:47.964 PM	128.	Apache	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.16	HTTP::SERVER	2	4

Continued, OpenSSL (getting a list of systems)….

ip	mac	Operating System	unparsed_version
128.[redacted]	0c:c4:7a:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:e0:81:[redacted]	Unix	Apache/2.4.9 (Unix) OpenSSL/1.0.1e-fips
128.[redacted]	00:19:e3:[redacted]	Unix	Apache/2.2.26 (Unix) OpenSSL/0.9.8za
128.[redacted]	00:14:4f:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:14:4f:[redacted]	Fedora	Apache/2.4.23 (Fedora) OpenSSL/1.0.2j-fips
128.[redacted]	b8:27:eb:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	60:eb:69:[redacted]	Fedora	Apache/2.4.18 (Fedora) OpenSSL/1.0.2j-fips
128.[redacted]	0c:c4:7a:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:16:cb:[redacted]	Unix	Apache/2.2.17 (Unix) OpenSSL/0.9.7l DAV/2
128.[redacted]	c0:8c:60:[redacted]	Unix	Apache/2.2.17 (Unix) OpenSSL/0.9.7l DAV/2
128.[redacted]	0c:c4:7a:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	0c:c4:7a:[redacted]	Unix	Apache/2.4.11 (Unix) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	Unix	Apache/2.2.29 (Unix) OpenSSL/1.0.1e-fips
128.[redacted]	40:6c:8f:[redacted]	Unix	Apache/2.2.31 (Unix) OpenSSL/1.0.2d DAV/2
128.[redacted]	ac:cc:8e:[redacted]	Unix	Apache/2.4.16 (Unix) OpenSSL/1.0.2d
128.[redacted]	ac:cc:8e:[redacted]	Unix	Apache/2.4.16 (Unix) OpenSSL/1.0.2d
128.[redacted]	44:a8:42:[redacted]	Red Hat Enterprise Linux	Apache/2.4.6 (Red Hat Enterprise Linux) OpenSSL/1.0.1e-fips
128.[redacted]	00:22:19:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:22:19:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:56:cd:[redacted]	Unix	Apache/2.2.29 (Unix) OpenSSL/0.9.8zg
128.[redacted]	a0:39:f7:[redacted]	Unix	Apache/2.2.29 (Unix) OpenSSL/0.9.8zg
128.[redacted]	60:e3:ac:[redacted]	Unix	Apache/2.2.29 (Unix) OpenSSL/0.9.8zg
128.[redacted]	00:56:cd:[redacted]	Unix	Apache/2.2.17 (Unix) OpenSSL/0.9.7l
128.[redacted]	48:d7:05:[redacted]	Unix	Apache/2.2.17 (Unix) OpenSSL/0.9.7l
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	00:50:56:[redacted]	CentOS	Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	34:e6:d7:[redacted]	Win32	Apache/2.4.17 (Win32) OpenSSL/1.0.2d
128.[redacted]	90:e2:ba:[redacted]	CentOS	Apache/2.2.15 (CentOS) OpenSSL/1.0.1e-fips
128.[redacted]	64:00:6a:[redacted]	Fedora	Apache/2.4.25 (Fedora) OpenSSL/1.0.2k-fips
128.[redacted]	00:50:56:[redacted]	Ubuntu	Apache/2.4.7 (Ubuntu) OpenSSL/1.0.1f

Usefulness: Policy enforcement2- All Windows systems on the N/W

client_ip	latest_time	mac	dmacs	vendor	known_services	software_type	software_info	dhcp_comment	TLS_client
128.	08/20/2017 15:00:38	a4:1f:72:	1	Dell Inc.		OS::WINDOWS	Windows,6,1,7 or Server 2008 R2		Safari 525.21 525.29 531.22.7 533.21.1 534.57.2
128.	08/20/2017 15:00:34	a4:1f:72:	1	Dell Inc.		OS::WINDOWS	Windows,6,1,7 or Server 2008 R2		Safari 525.21 525.29 531.22.7 533.21.1 534.57.2
128.	08/20/2017 16:12:39	90:b1:1c:	1	Dell Inc.		OS::WINDOWS	Windows,10,0,10	PROV-SSA-09	
128.	08/20/2017 11:30:25	6c:0b:84:	1	Universal Global Scientific Industrial Co., Ltd.	88,udp,KRB	HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows,6,3,8.1 or Server 2012 R2 client connection,-,-,-		
128.	08/20/2017 15:41:50	00:50:56:	1	VMware, Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows,6,3,8.1 or Server 2012 R2 client connection,-,-,-		
128.	08/20/2017 12:48:21	00:50:56:	1	VMware, Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows,6,3,8.1 or Server 2012 R2 client connection,-,-,-		
128.	08/20/2017 07:43:33	00:50:56:	1	VMware, Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows,6,3,8.1 or Server 2012 R2 client connection,-,-,-		
128.	08/20/2017 15:17:22	00:50:56:	1	VMware, Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows,6,3,8.1 or Server 2012 R2		
128.	08/20/2017 16:15:18	20:1a:06:	1	COMPAL INFORMATION (KUNSHAN) CO., LTD.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows Store,1,0,- Windows,6,3,8.1 or Server 2012 R2 Windows-Update-Agent,7,9,Client	Jiao-VersaStat	
128.	08/20/2017 16:16:52	74:86:7a:	1	Dell Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows Store,1,0,- Windows,6,3,8.1 or Server 2012 R2	ADSA	
128.	08/20/2017 16:30:57	74:e2:8c:	1	Microsoft Corporation		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Windows Phone Search (Windows Phone OS,8,10,NOKIA Windows,6,3,8.1 or Server 2012 R2	Windows-Phone	Trident/7.0,TLSv12
128.	08/20/2017 16:13:38.630316	00:50:56:	1	VMware, Inc.	20000,udp,DNP3_UDP 80,tcp,(empty) 80,tcp,HTTP 8000,tcp,HTTP 88,udp,KRB	HTTP::BROWSER HTTP::SERVER OS::WINDOWS	Microsoft-CryptoAPI,6,3,- Microsoft-HTTPAPI,2,0,- Microsoft-IIS,8,5,- Windows,6,3,8.1 or Server 2012 R2 client connection,-,-,-		
128.	08/20/2017 16:27:52	98:90:96:	1	Dell Inc.		HTTP::BROWSER OS::WINDOWS	Microsoft-CryptoAPI,6,2,- Windows,6,2,8 or Server 2012 Windows-Update-Agent,-,-,- client connection,-,-,-	WINDOWS-RRASK6T	FireFox 49 (dev edition),TLSv12 Tracking something (noted with Dropbox Installe

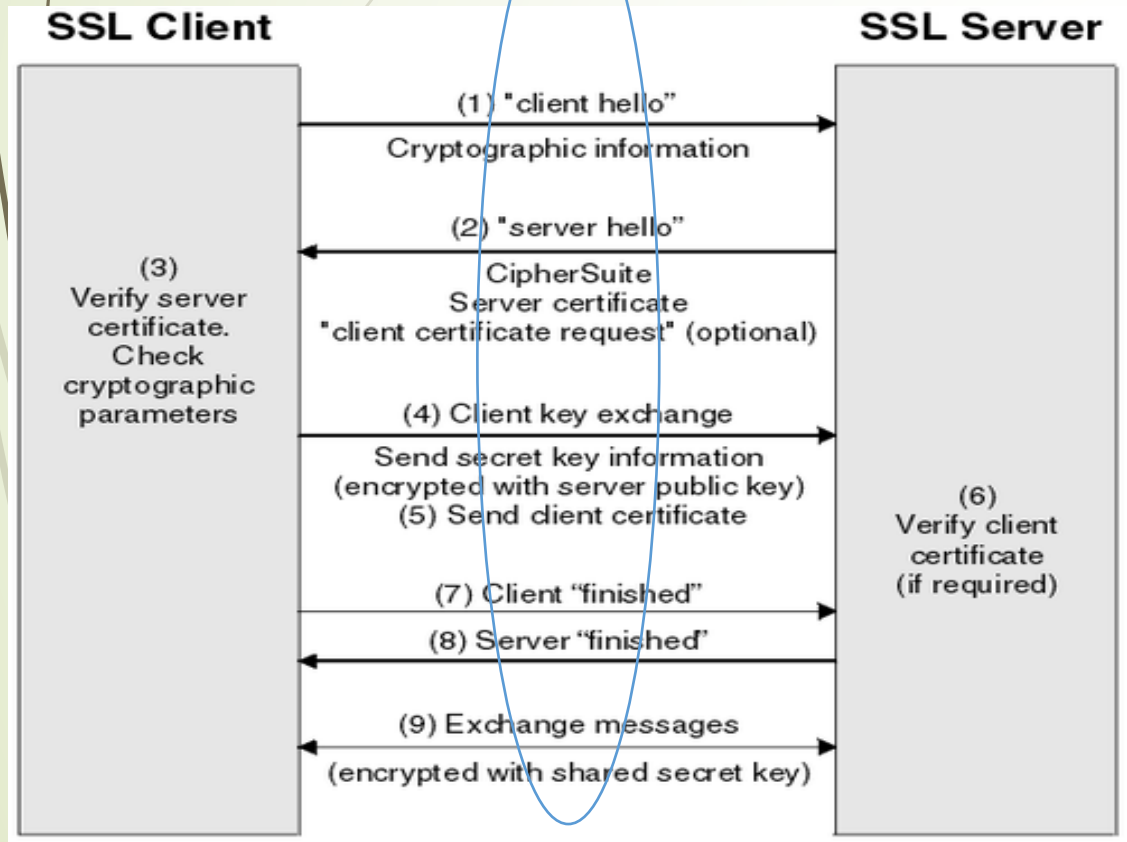
Summary: Ask UEPtSS anything you want

- Enumerating various services/servers: Which services & How many servers:
  - What all servers providing DNS service on the network?
  - What all servers providing Web service on the Network?
  - What all systems have xyz service running or xx port open?
- Malware IR: Get all possible information of an infected system
  - Hmm, one of the IDSs has detected Petya downloaded on a box.
  - Is the system actually vulnerable To Petya?
  - A new vulnerability just got released that exploits a particular software/version. What all systems on my Network are running that piece of software.

TLS Fingerprinting

[Special Thanks to Seth]

- Detecting the TLS Client in use by fingerprinting TLS traffic.
- Use a table of data set to compare the sniffed TLS traffic to fingerprint the known TLS client.
- Bro has all the events to capture all the information transpired in TLS handshake.
- How it works? Explained in next Slide.



TLS FP Data Set

```
#fields c_ts conn_uid c_id.orig_h c_id.orig_p c_id.resp_h
c_id.resp_p c_history TLSclient TLSversion
#types time string addr port addr port string string string
1503518399.695575 CzkJHy381vUQWhK2yj 128.4.61.52
39769 72.21.207.120 443 ShAD RingCentral App (unknown
platform) #2 TLSv12
1503518399.969706 C9n2DFsCzzpeVxQC5 128.175.93.225
53336 157.56.77.141 443 ShAD Windows 10 Native Connection
TLSv12
1503518399.964234 CqhIcA4gl316hUOFO7 128.175.10.83
54977 192.229.211.36 443 ShAD MS Edge TLSv12
1503518399.243547 C35BFhWjur9EAWtjf 128.175.26.139
62201 172.217.3.110 443 ShAD BlueCoat Proxy TLSv12
```

TLS Fingerprinting- Block the Offensive clients

- Look for ‘Metasploit’ OR ‘BurpSuite’ OR ‘SkipFish’ OR ‘w3af’ OR ‘mitmproxy’ in the log file.

_time	src_ip	src_port	dest_ip	dest_port	TLSClient	TLSVersion	Country	Region
2017-08-15 21:44:05.118	23.[redacted]	56692	128[redacted]	443	Metasploit SSL Scanner	TLSv10	United States	Arizona
2017-08-15 15:15:47.134	23.[redacted]	57973	128[redacted]	443	Metasploit SSL Scanner	TLSv10	United States	Arizona
2017-08-15 14:40:01.856	149[redacted]	60940	128[redacted]	443	BurpSuite Free (1.6.01)	TLSv10	France	
2017-08-15 22:38:46.128	128[redacted]	14765	128[redacted]	443	w3af (tested: v1.6.54 Kali 2)	TLSv12	Canada	Ontario
2017-08-15 22:07:06.339	131[redacted]	58158	128[redacted]	443	w3af (tested: v1.6.54 Kali 2)	TLSv12	United States	Washington
2017-08-15 07:08:24.083	23.[redacted]	41349	128[redacted]	443	Metasploit SSL Scanner	TLSv10	United States	Arizona
2017-08-15 02:02:28.008	149[redacted]	46979	128[redacted]	443	BurpSuite Free (1.6.01)	TLSv10	France	
2017-08-15 16:02:46.018	54.[redacted]	60912	128[redacted]	4450	BurpSuite Free (1.6.01)	TLSv10	United States	Oregon
2017-08-15 16:02:45.696	54.[redacted]	60867	128[redacted]	4450	BurpSuite Free (1.6.01)	TLSv10	United States	Oregon
2017-08-15 08:53:32.030	54.[redacted]	39672	128[redacted]	4450	BurpSuite Free (1.6.01)	TLSv10	United States	Oregon
2017-08-15 08:53:31.708	54.[redacted]	39591	128[redacted]	4450	BurpSuite Free (1.6.01)	TLSv10	United States	Oregon
2017-08-15 05:04:34.312	23.[redacted]	51485	128[redacted]	443	Metasploit SSL Scanner	TLSv10	United States	Arizona
2017-08-15 05:04:19.293	23.[redacted]	58384	128[redacted]	443	Metasploit SSL Scanner	TLSv10	United States	Arizona

Where to find scripts?

- Custom scripts used in this presentation can be found at :

  https://github.com/fatemabw/bro-scripts

- The TLS Fingerprint Dataset can be found at:

  https://github.com/LeeBrotherston/tls-fingerprinting/blob/master/fingerprints/fingerprints.json

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Questions???