Set up your own malware analysis lab with VirtualBox, INetSim and Burp

blog.christophetd.fr/malware-analysis-lab-with-virtualbox-inetsim-and-burp/

christophetd 5 June 2017

In this post we will set up a **virtual lab for malware analysis**. We'll create an **isolated virtual network** separated from the host OS and from the Internet, in which we'll setup two victim virtual machines (Ubuntu and Windows 7) as well as an analysis server to mimic common Internet services like HTTP or DNS. Then, we'll be able to log and analyze the network communications of any Linux or Windows malware, which will unknowingly connect to our server instead of the Internet. We demonstrate the setup with a real life use case where we analyze the traffic of the infamous TeslaCrypt ransomware, a now defunct ransomware which infected a large number of systems from 2015 to mid-2016.

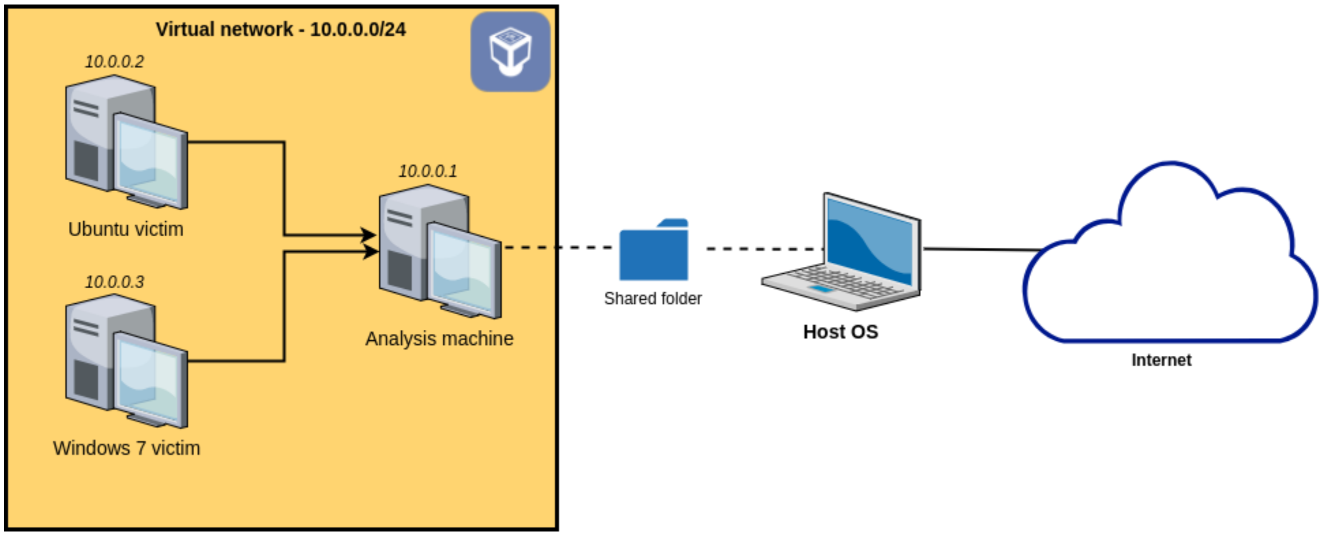


Diagram of our future setup. Note that the machines in the virtual network will be isolated from the host OS and will **not** be able to connect to the Internet.
This guide includes quite a lot of material, so here's a table of contents to give you an overview of what we'll cover and let you jump directly to a section if you'd like.

1. Creating the virtual machines

Here are two links you can use to download Ubuntu and Windows 7 virtual machine images.

- **Ubuntu** (victim machine 1 and analysis machine): download Ubuntu 16.10 64 bits from OsBoxes (**direct link**)
- **Windows 7** (victim machine 2): download from the Microsoft Developer Website (select ***IE 11 on Win 7 (x86)*** and ***VirtualBox***)

Tip: if you already have an Ubuntu virtual machine you're not using, you can simply clone it and reuse it in the next steps (right click > ***Clone***).

Before starting, make sure you have enough disk space available (I'd recommend at least 10-20 GB).

Base Ubuntu machine

OsBoxes provides us with a ready-to-go virtual disk that we can simply plug on a VM and start using right away. Start by extracting the archive you just downloaded.

```
$ 7za e Ubuntu_16.10_Yakkety-VB-64bit.7z
```

You'll be provided with a VDI file representing the virtual disk of the machine. We'll start by setting up the base Ubuntu image, which we will then clone to have our two Ubuntu VMs.

In VirtualBox, create a new machine (**New** button), and call it **Ubuntu analysis**. Then, select how much RAM you want to give it. At this point, VirtualBox will ask you if you wish to create a new virtual hard disk or use an already exiting one. Select **Use an existing virtual hard disk file**, click on the directory icon at the right of the dropdown list, and select the VDI file.

You can then power up the machine. The default password is **osboxes.org**.

Basic setup

The default keyboard uses the QWERTY layout. If like me you're not familiar with it, start by changing it (**Settings > Text Entry**).

Optionally, you can also change the default password using:

```
$ passwd osboxes
```

It can also be a good idea to update your packages.

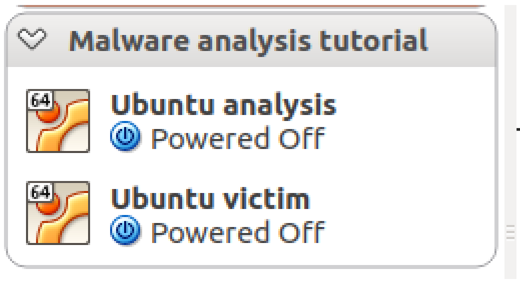
```
$ sudo apt-get update
$ sudo apt-get upgrade
```

Install the guest additions

Select **Devices > Insert guest additions CD image** in the menu of the window in which the VM runs. You will then be asked if you want to run the installer; answer yes, and enter the default password (by default **osboxes.org**). Once the installation is complete, power off the VM.

Cloning

Now that you have a basic Ubuntu VM ready to go, clone it (right click on it in the main VirtualBox interface > **Clone**). Name the clone **Ubuntu victim*,*** and check the checkbox to reinitialize its MAC address. Select **Full clone** for the type of clone.



The two Ubuntu VMs created

Windows 7 machine

The download link I provided earlier points to a ZIP archive containing a OVA file. Unlike a VDI file it's not only a virtual disk, but a full description of the virtual machine (including its virtual disk), so the only thing you need to do to create a virtual machine from it is to select **File > Import Appliance** in the main window of VirtualBox. If you can afford it, it's probably better to give it at least 1024 MB of RAM.

Once the import process is complete (it can take a few minutes), rename the VM **Windows 7 victim** and power it on.

Install the guest additions

Select **Devices > Insert guest additions CD image** in the menu of the window in which the VM runs, and run the installer from the virtual CD which has been inserted. When you're done, power off the machine.

2. Setup of the analysis machine: INetSim, Burp

INetSim

INetSim is a very handy and powerful utility that allows to simulate a bunch of standard Internet services on a machine. By default, it will among others emulate a DNS, HTTP and SMTP that you can easily tune. Since we'll later configure our victim machines to have no Internet access, we will need INetSim to simulate it.

There are several ways to install INetSim. The easiest is to run the following commands (in the analysis machine).

```
$ sudo su
$ echo "deb http://www.inetsim.org/debian/ binary/" >
/etc/apt/sources.list.d/inetsim.list
$ wget -O - http://www.inetsim.org/inetsim-archive-signing-key.asc | apt-key add -
$ apt update
$ apt install inetsim
```

Note: in order to be able to copy-paste those commands in your analysis machine, select **Devices > Shared Clipboard > Bidirectional.**

We’ll come back later on how to use INetSim.

Burp

Unfortunately, it seems that INetSim’s SSL support is quite limited: it comes with a certificate for a single host (*inetsim.org*) and doesn’t support generating SSL certificates on the fly. This is a problem since most malwares nowadays encrypt their communications with SSL. We’ll use Burp as a transparent SSL proxy, which will stand in the middle of the victim machines and INetSim for SSL connections. If you don’t need to intercept SSL traffic for now, you won’t necessarily need Burp.

Burp supports generating on-the-fly SSL certificates for any our victim machines will connect to. It also creates a single root CA certificate, that we’ll later import in our victim machines. This way, we’ll be able to intercept the encrypted communications that our malware sends.

You can download Burp from the official website. The download is a bash installation script, run it to install Burp:

```
$ bash ~/Downloads/burpsuite_free_linux_v1_7_23.sh
```

By default, the Burp executable will be *~/BurpSuiteFree/BurpSuiteFree*.

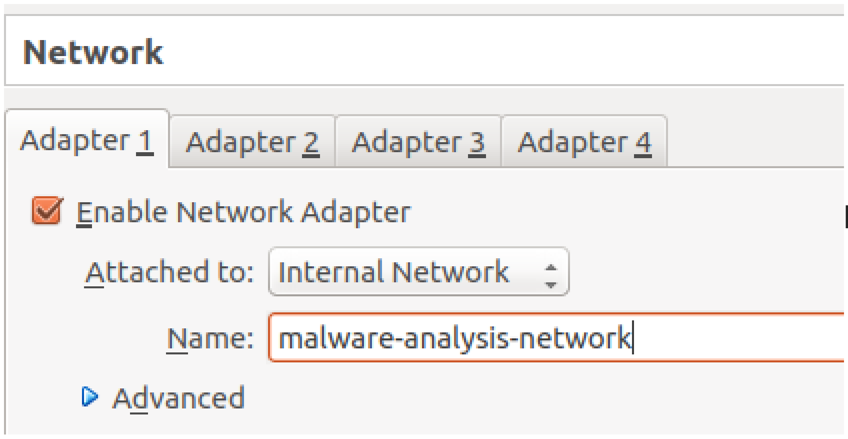
3. Setting up an isolated virtual network

As a reminder, we want to set up an isolated network containing our three VMs. This network will not be able to access the Internet. Also, we want the analysis machine to act as a network gateway to the victim machines in order to easily be able to intercept the network traffic and to simulate various services such as DNS or HTTP.

In order to achieve this, we will use a VirtualBox *Internal Network*. For those familiar with VirtualBox, an internal network differs from a *host-only network* in that an internal network cannot access the host machine at all.

For each of your three virtual machines, do the following:

- Open its settings
- Go to the **Network** section
- Change the **Attached to** field to **Internal network**
- Enter **malware-analysis-network** as the network name


Network
Adapter 1 Adapter 2 Adapter 3 Adapter 4
☑ Enable Network Adapter
Attached to: Internal Network
Name: malware-analysis-network
Advanced

Network configuration

Analysis machine

Power on the analysis machine, open a terminal, and run the **ifconfig** command. You should have an interface named **enp0s3.** If the name differs, just adapt it in the instructions to follow.

Open the file **/etc/network/interfaces** as root, and add the following at the end:

```
auto enp0s3
iface enp0s3 inet static
 address 10.0.0.1
 netmask 255.255.255.0
```

This will assign the machine the static IP **10.0.0.1** on our virtual network. Now that we have configured the network interface, we need to start it up using:

```
$ sudo ifup enp0s3
```

Ubuntu victim machine

The process is very similar here, except that we'll assign it the static IP **10.0.0.2**, and instruct it to use **10.0.0.1** as a gateway and as a DNS server. Append the following at the end of the file **/etc/network/interfaces** :

```
auto enp0s3
iface enp0s3 inet static
 address 10.0.0.2
 gateway 10.0.0.1
 netmask 255.255.255.0
 dns-nameservers 10.0.0.1
```

And run:

```
$ sudo ifup enp0s3
$ sudo service networking restart
```

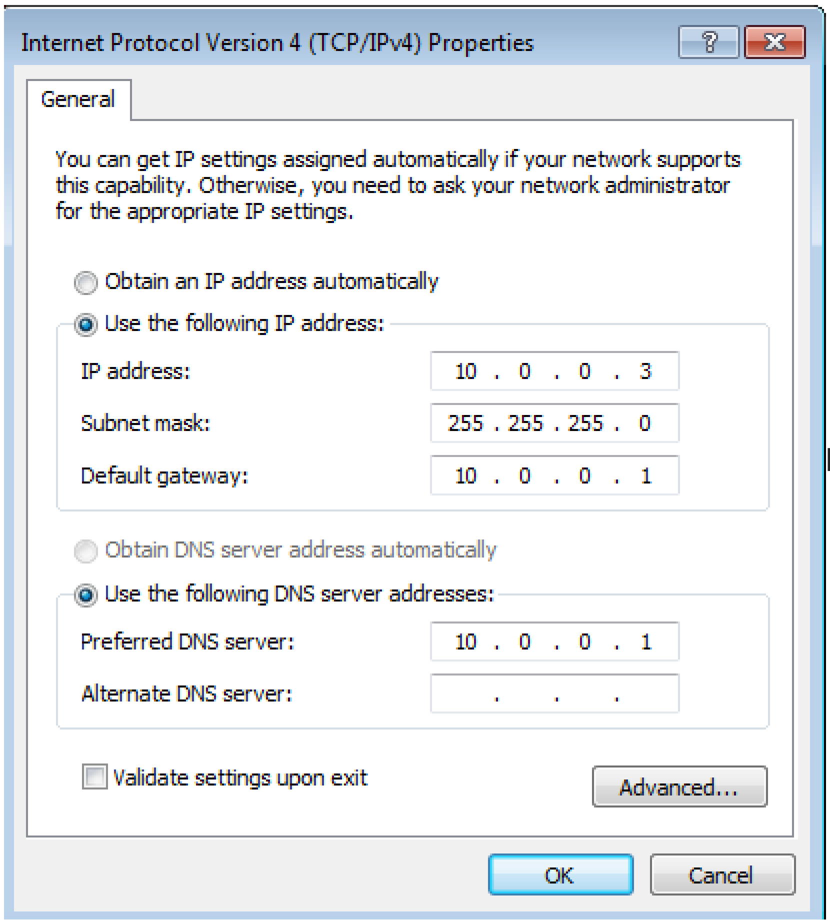
You should now be able to ping the analysis machine:

```
$ ping 10.0.0.1
PING 10.0.0.1 (10.0.0.1) 56(84) bytes of data.
64 bytes from 10.0.0.1: icmp_seq=1 ttl=64 time=0.480 ms
64 bytes from 10.0.0.1: icmp_seq=2 ttl=64 time=0.526 ms
```

Windows 7 victim machine

Right-click on the network icon in the taskbar (or go to **Start Menu > Control Panel > Network and Internet > Network and Sharing center**), click on **Local Area Connection 2 > Properties**, select on **Internet Protocol Version 4**, and click on the **Properties** button.

We'll assign the static IP **10.0.0.3** to the machine, and configure the rest similarly to the Ubuntu victim machine.


Internet Protocol Version 4 (TCP/IPv4) Properties

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically [✓ Use the following IP address:]

IP address: 10 . 0 . 0 . 3
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 10 . 0 . 0 . 1

Obtain DNS server address automatically [✓ Use the following DNS server addresses:]

Preferred DNS server: 10 . 0 . 0 . 1
Alternate DNS server: . . .

Validate settings upon exit

Network settings

Make sure to validate the settings (click on **OK, Apply**, etc. until all the settings windows are gone). You should now be able to ping the analysis machine:

```
> ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:
Reply from 10.0.0.1: bytes=32 time<1ms TTL=64
Reply from 10.0.0.1: bytes=32 time<1ms TTL=64
```

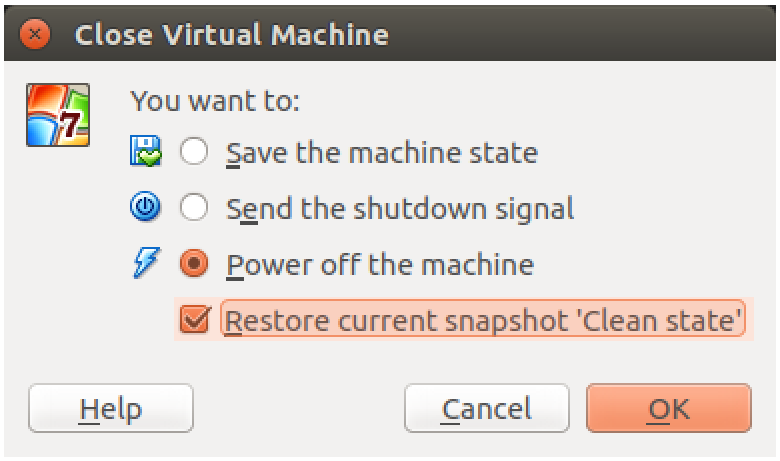
All set!

4. Creating and restoring snapshots

Now that our victim VMs are properly configured and are in a clean state (i.e. not infected by any kind of malware), we are going to make a snapshot of their current state. This way, we will be able to easily reset them to this clean state at any point time.

VirtualBox makes this very easy: in the window in which the VM is running, just select **Machine > Take Snapshot.** You can name the snapshot **Clean state.** Make sure to do this for both your Ubuntu and Windows 7 victim machines. It doesn't hurt to do it for your analysis machine as well.

When you'll want to reset a machine to its clean state, simply power it off and check the checkbox **Restore current snapshot 'Clean state'**.



Close Virtual Machine

You want to:

○ Save the machine state

○ Send the shutdown signal

[✓ Power off the machine]

[✓ Restore current snapshot 'Clean state']

5. Using INetSim and Burp on the analysis machine to analyze the network traffic

INetSim

As previously mentioned, INetSim enables us to wide range of standard Internet services including DNS, HTTP(S), SMTP, etc. It has a default configuration file **/etc/inetsim/inetsim.conf** which is very well documented. It also ships with a data directory (**/var/lib/inetsim**) containing various default files.

Since you'll probably want a different INetSim configuration each time you make a new analysis, I suggest you create a directory **analysis** which will contain a sub directory for each analysis.

```
$ mkdir analysis
```

We'll already create a sub directory for the sake of example, and copy the default INetSim configuration file and data folder in it.

```
$ mkdir analysis/test-analysis
$ cp /etc/inetsim/inetsim.conf analysis/test-analysis
$ sudo cp -r /var/lib/inetsim analysis/test-analysis/data
$ sudo chmod -R 777 data
$ cd analysis/test-analysis
```

By default, INetSim listens on the local interface only. To make it available to all the machines of our virtual network, replace the following line in the configuration file we just copied:

```
#service_bind_address   10.0.0.1
```

By:

```
service_bind_address    0.0.0.0
```

Now, we need to disable systemd-resolved, which is a local DNS server shipped by default with Ubuntu and will conflict with INetSim's DNS server.

```
$ sudo systemctl disable systemd-resolved.service
$ sudo service systemd-resolved stop
```

By default, INetSim's DNS server will resolve all the domain names to 127.0.0.1. We want any domain name to resolve to 10.0.0.1 (the analysis machine IP) instead; uncomment the following line:

```
#dns_default_ip    10.0.0.1
```

I mentioned earlier that INetSim's SSL support is not optimal since it only has a single certificate for a single hostname (*inetsim.org*) and doesn't allow to generate per-host certificates on the fly. To overcome that, we'll run Burp on port 443 as a transparent proxy in front of INetSim. Therefore, we need to bind INetSim's HTTPS server to a different port, say port 8443. Replace the following line:

```
#https_bind_port 443
```

By:

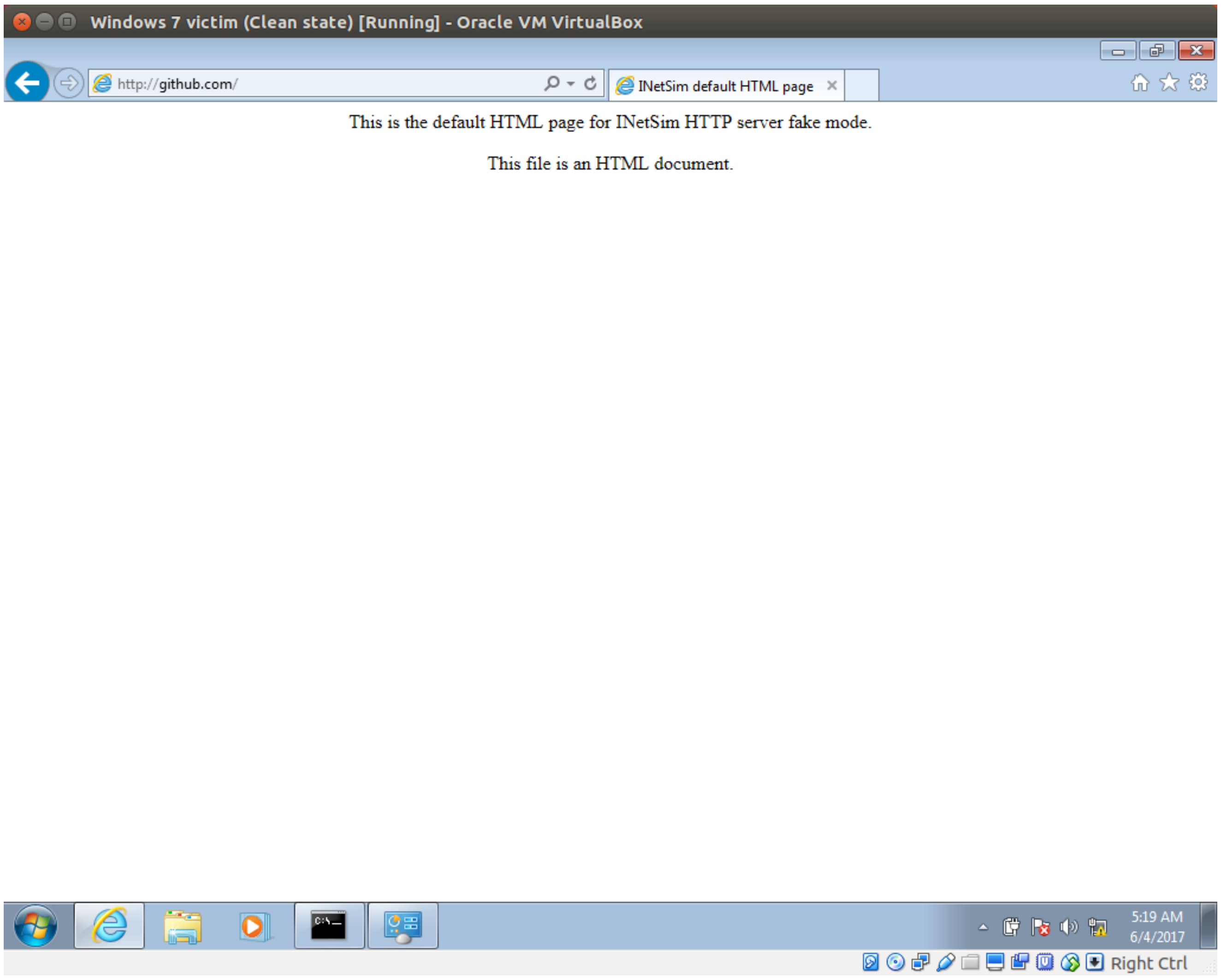
```
https_bind_port 8443
```

Now, let's run INetSim!

```
$ sudo inetsim --data data --conf inetsim.conf
INetSim 1.2.6 (2016-08-29) by Matthias Eckert & Thomas Hungenberg
[...]
=== INetSim main process started (PID 3605) ===
Session ID: 3605
Listening on: 0.0.0.0
Real Date/Time: 2017-06-04 12:58:07
Fake Date/Time: 2017-06-04 12:58:07 (Delta: 0 seconds)
 Forking services...
 * dns_53_tcp_udp - started (PID 3621)
 * irc_6667_tcp - started (PID 3631)
 * daytime_13_tcp - started (PID 3638)
 * discard_9_tcp - started (PID 3642)
 * discard_9_udp - started (PID 3643)
 * ident_113_tcp - started (PID 3634)
 * syslog_514_udp - started (PID 3635)
[...]
```

As you can see, INetSim has launched a bunch of network services. Those are all configurable and can be disabled in the configuration file. This configuration file is very well documented and explains all the options of INetSim; I recommend you take a few minutes to read it.

Now, power on of your victim VM, open a web browser, and browse to any address (e.g. github.com). You should see the following:


Windows 7 victim (Clean state) [Running] - Oracle VM VirtualBox
http://github.com/
INetSim default HTML page
5:19 AM
6/4/2017
Right Ctrl

This is the default HTML page for INetSim HTTP server fake mode.

This file is an HTML document.

*(Note that this default file corresponds to the HTML file **data/http/fakefiles/sample.html**.)*

Back on the analysis machine, shut down INetSim (CTRL + C).

```
* dns_53_tcp_udp - stopped (PID 3621)
* irc_6667_tcp - stopped (PID 3631)
* daytime_13_tcp - stopped (PID 3638)
[...]
Simulation stopped.
 Report written to '/var/log/inetsim/report/report.3877.txt' (24 lines)
```

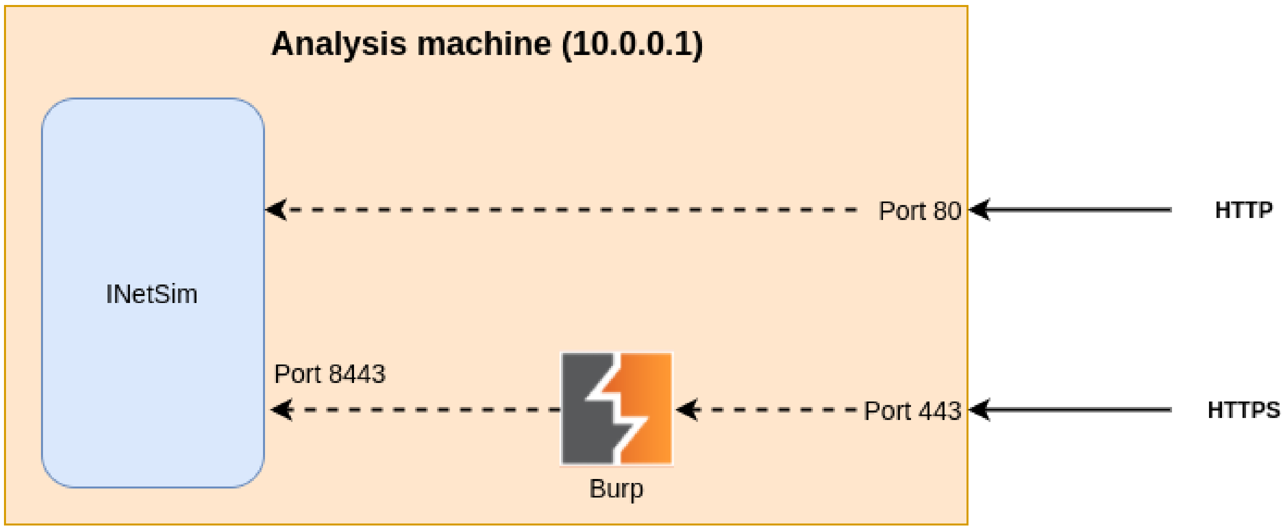
As you can see, INetSim has created a summary report for us. It contains all the interactions our victim machine had with INetSim services.

```
=== Report for session '3877' ===

Real start date : 2017-06-04 13:18:27
Simulated start date : 2017-06-04 13:18:27
Time difference on startup : none

2017-06-04 13:18:38 First simulated date in log file
2017-06-04 13:18:40 DNS connection, type: A, class: IN, requested name: github.com
2017-06-04 13:18:40 HTTP connection, method: GET, URL: http://github.com/, file name:
data/http/fakefiles/sample.html
2017-06-04 13:18:40 HTTP connection, method: GET, URL: http://github.com/favicon.ico,
file name: data/http/fakefiles/sample.html
2017-06-04 13:18:40 Last simulated date in log file
```

Burp for SSL interception

To be able to analyze the SSL traffic, we also need to run Burp. We'll run it as a transparent proxy in front of INetSim. When a victim machine will initiate a SSL connection, it will first go to Burp, which will then proxy it to INetSim. *This section is not mandatory: if you don't need to intercept SSL traffic right now, just jump to the next section.*

Here's how it will look like with Burp in the middle:

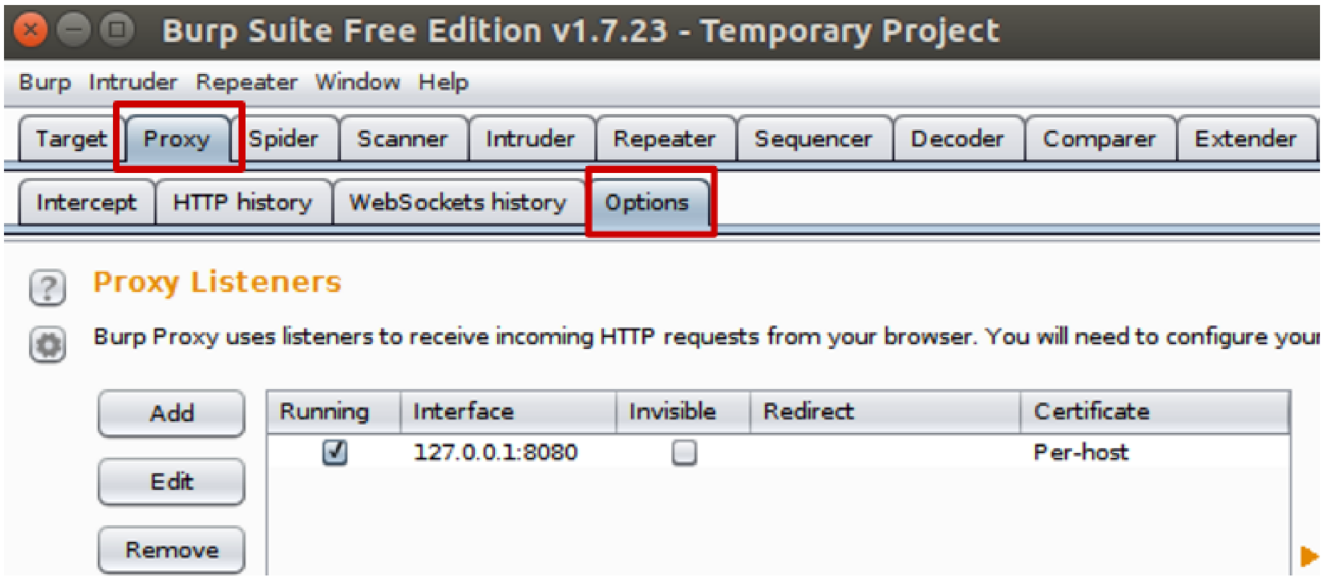


Start Burp as root:

```
$ sudo /home/osboxes/BurpSuiteFree/BurpSuiteFree
```

(We need to run it as root otherwise it won't be able to bind port 443, which is a privileged port. There are other ways to do this, but let's not bother here)

Create a temporary project (you don't have any other options with the free version anyway), and go to the **Proxy** tab, then to the **Options** sub-tab. You'll see Burp's default listener listening on port 8080.


Burp Suite Free Edition v1.7.23 - Temporary Project
Burp Intruder Repeater Window Help
Target Proxy Spider Scanner Intruder Repeater Sequencer Decoder Comparer Extender
Intercept HTTP history WebSockets history Options
Add
Edit
Remove

Proxy Listeners

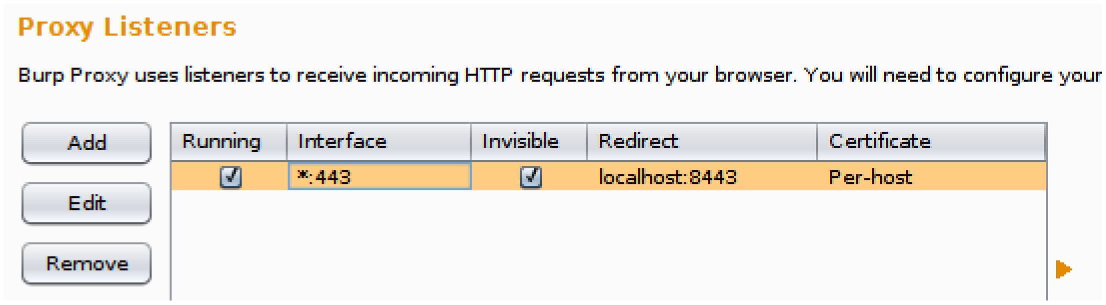
Burp Proxy uses listeners to receive incoming HTTP requests from your browser. You will need to configure your

Running	Interface	Invisible	Redirect	Certificate
✓	127.0.0.1:8080	☐		Per-host

Click on the row corresponding to the default listener, and edit it (**Edit**) button. Configure it as follows:

- **Binding** tab
  - Bind to port: *443*
  - Bind to address: *all interfaces*
- **Request handling** tab:
  - Redirect to host: *localhost*
  - Redirect to port: 8443
  - Check *Support invisible proxying*

Validate the settings, and you should get a listener similar to:



Proxy Listeners

Burp Proxy uses listeners to receive incoming HTTP requests from your browser. You will need to configure your

Running	Interface	Invisible	Redirect	Certificate
✓	*:443	✓	localhost:8443	Per-host

By default, Burp intercepts the incoming requests and waits for you to explicitly let them pass through. To avoid this, go to the **Intercept** tab and click the button **Intercept is on** to disable it.

Since Burp Free doesn't allow you to save a project, you can export the settings we just made in order to import them next time you start Burp. To do this, use **Burp > Project options > Save project options**.

Let's make sure our setup if correctly working. Start INetSim, and run:

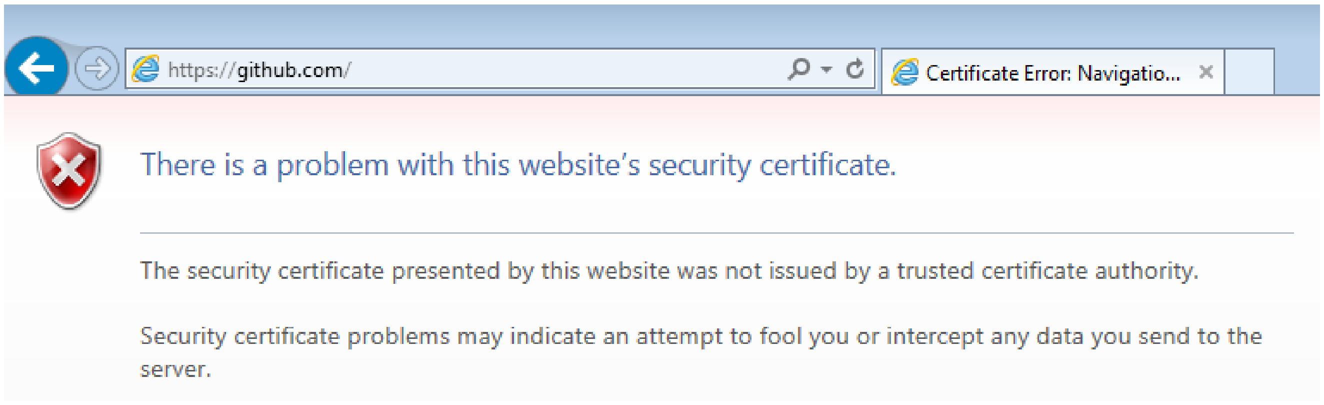
```
$ curl --insecure https://localhost
```

You should get:

```
<html>
 <head>
 <title>INetSim default HTML page</title>
 </head>
 <body>
 <p></p>
 <p align="center">This is the default HTML page for INetSim HTTP server fake mode.
</p>
 <p align="center">This file is an HTML document.</p>
 </body>
</html>
```

Importing Burp's CA certificate on our victim machines

Power on your Windows 7 victim machine, and try to browse to a HTTPS URL (e.g. https://github.com), you'll see a warning similar to:



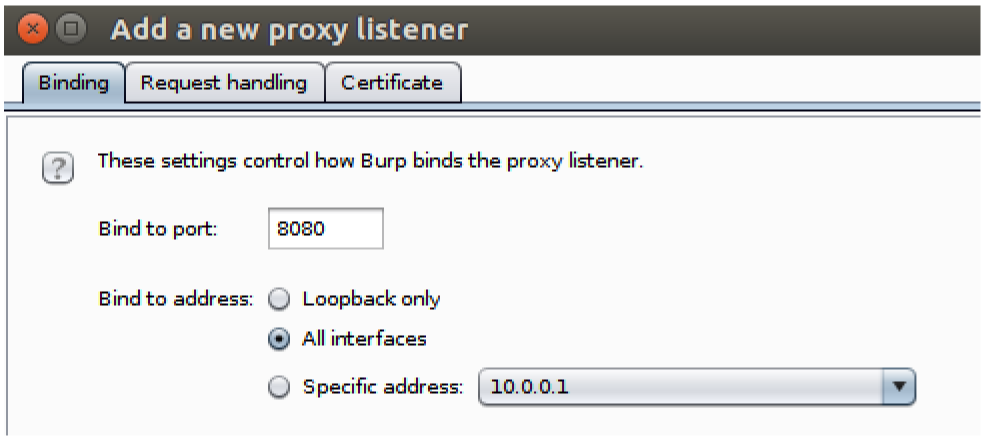
There is a problem with this website's security certificate.

The security certificate presented by this website was not issued by a trusted certificate authority.

Security certificate problems may indicate an attempt to fool you or intercept any data you send to the server.

This is because Burp generates a SSL certificate signed by its own CA certificate, which our victim machine doesn't trust for now.

In Burp, add a new proxy listener on port 8080, listening on all interfaces (tab **Proxy > Options >** button **Add**):

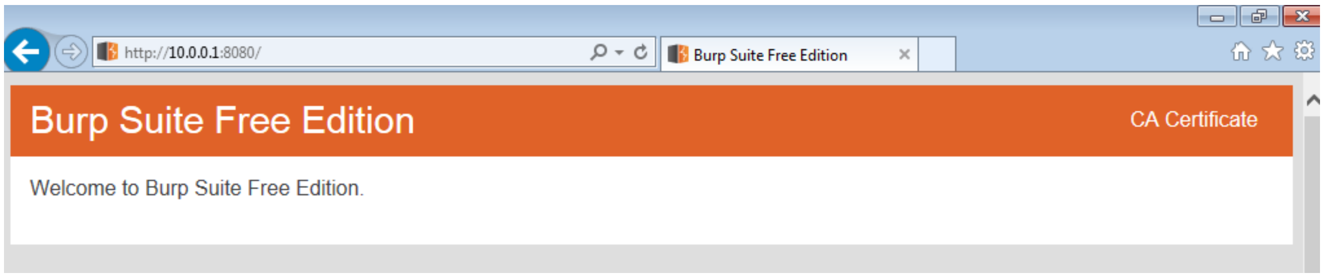


These settings control how Burp binds the proxy listener.

Bind to port: 8080

Bind to address: ( ) Loopback only [✓ All interfaces] ( ) Specific address: 10.0.0.1

Then, from the victim machine, browse to **http://10.0.0.1:8080**.



Burp Suite Free Edition

Welcome to Burp Suite Free Edition.

Click on **CA Certificate** in the top-right corner to download Burp's CA certificate.

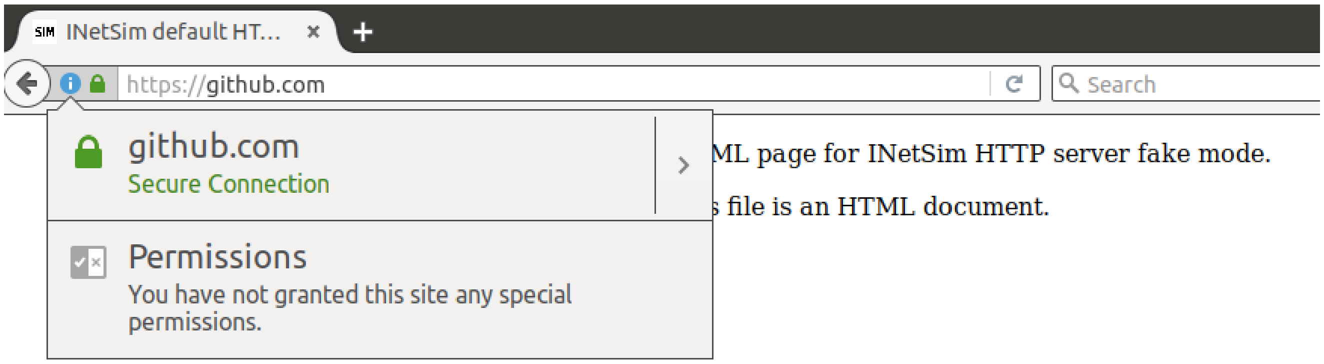
On the Windows 7 victim machine: open the file, click **Install certificate >Next > Place all certificates in the following store: *Trusted Root Certification Authorities* > Next**

On the Ubuntu victim machine:

- Convert the certificate to the appropriate format (.crt) using
- `$ openssl x509 -in ~/Downloads/cacert.der -inform DER -out burp.crt`
- Copy it to /usr/local/share/ca-certificates
- `$ sudo cp burp.crt /usr/local/share/ca-certificates/`
- Run
- `$ sudo update-ca-certificates`

> Firefox by default doesn't use the system's certificate store. If you want the SSL connection to work properly in Firefox as well, go to the Firefox settings into **Advanced > Certificates > Import**. Choose *burp.crt*, check **Trust this CA to identify websites**

All set!



You have not granted this site any special permissions.

ML page for INetSim HTTP server fake mode.

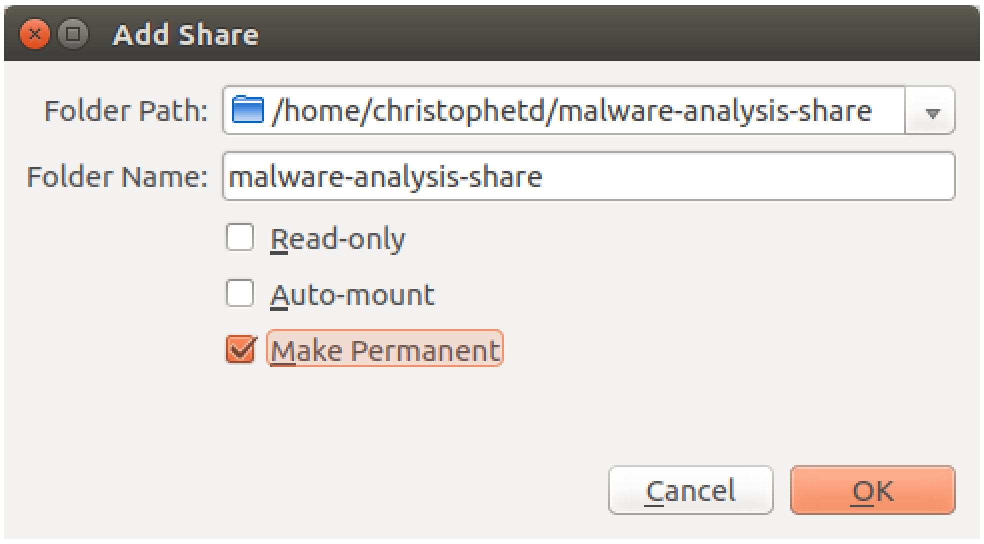
s file is an HTML document.

Once you imported Burp's CA certificate in the victim machines, make sure to create a new snapshot (e.g. *Clean state with Burp's CA certificate installed*).

6. Setting up a shared folder between the analysis machine and the host OS

At some point, you'll obviously want to transfer some files to the analysis machine or to one of the victim machine; we'll set up a file share to achieve it.

In the VirtualBox running the analysis machine, go to **Devices > Shared Folders > Shared folders settings**. Create a new shared folder, choose the local folder of your host OS it should be mapped to, and choose a name. Check the checkbox to make it permanent.


Add Share

Folder Path: /home/christophetd/malware-analysis-share

Folder Name: malware-analysis-share

☐ Read-only

☐ Auto-mount

☑ Make Permanent

Now on the analysis machine, mount the shared folder:

```
$ mkdir ~/malware-analysis-share
$ sudo mount -t vboxsf -o uid=$UID,gid=$(id -g) malware-analysis-share ~/malware-
analysis-share
```

And you're good to go. In my case, all the files of my host machine located in /home/christophetd/malware-analysis-share will also end up in ~/malware-analysis-share in the analysis machine.

Transferring files to a victim machine

At some point, you'll most probably need to transfer some files (e.g. malware samples) to one of the victim machines. Setting up a file share for them is a bad idea, because it means the victim machine (and by extent, the malware sample you're running on it) have access to it.

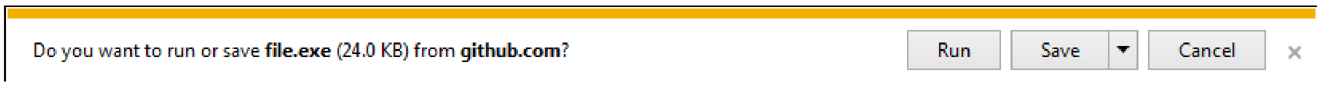
The simplest way to achieve a file transfer to the Ubuntu victim machine is to use netcat. Here's a quick example.

```
# Receiving machine having IP 10.0.0.2
$ nc -lvp 4444 > file.exe

# Analysis machine (sender)
$ cat file_to_transfer.exe | nc 10.0.0.2 4444
```

For a Window victim, we unfortunately don't have netcat available. Alternatives might exist, but they probably don't ship by default. One option is to use INetSim to serve your file to the victim machine.

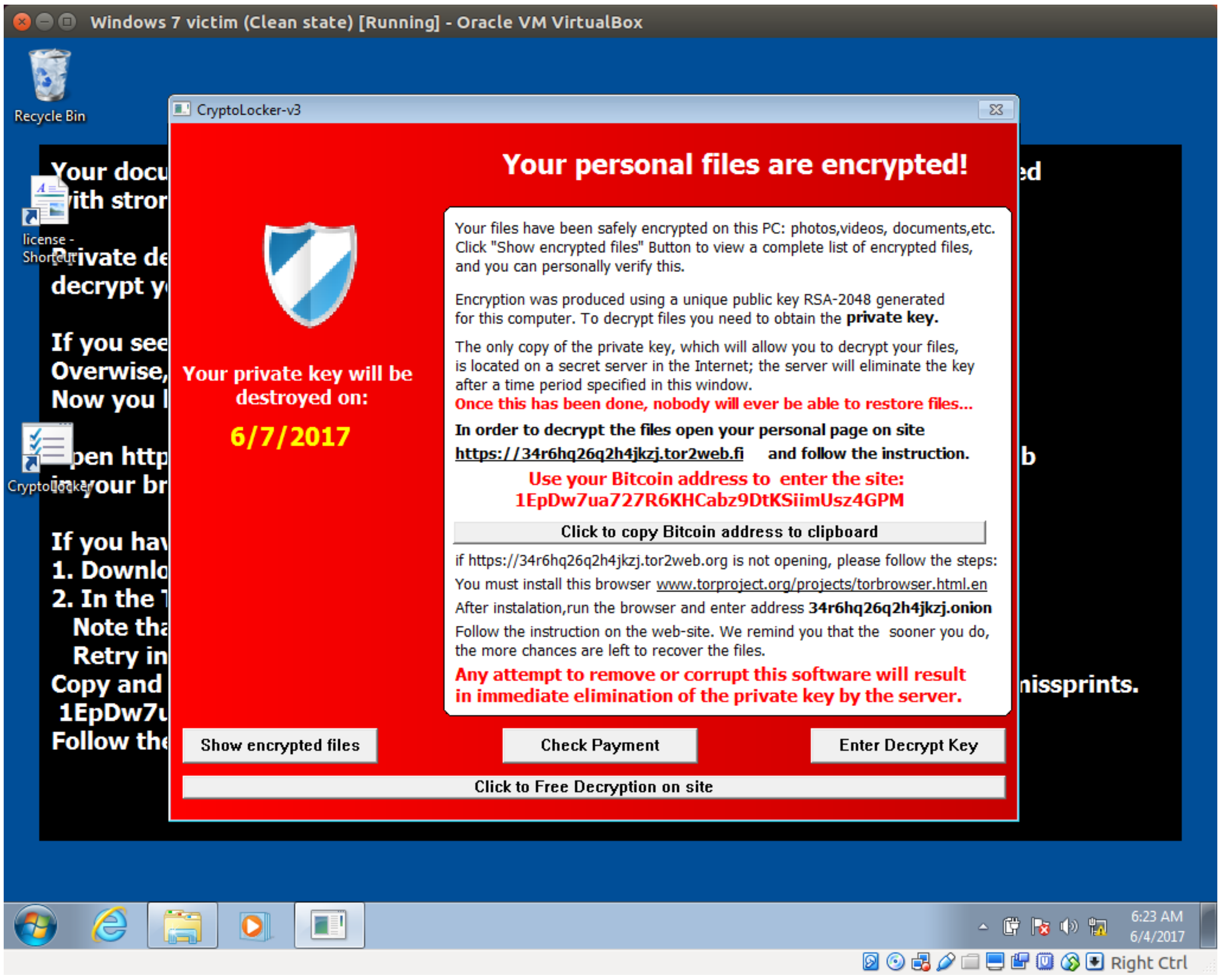
```
# inetsim.conf

# Remove the default line: http_fakefile           exe     sample_gui.exe  x-msdos-
program
# Replace it by
http_fakefile           exe     file_to_transfer.exe  x-msdos-program

# And put file_to_transfer.exe in ./data/http/fakefiles
```

With this of configuration, just browse any URL ending with a '.exe' (e.g. http://github.com/file.exe).


Do you want to run or save **file.exe** (24.0 KB) from **github.com**?

7. Demo time: the TeslaCrypt ransomware

Time for a quick demo! I downloaded a sample of the ransomware TeslaCrypt, transferred it to our Windows 7 victim machine, and executed it. After a few seconds, all the files of the VM have been encrypted and the following window pops-up.



Your personal files are encrypted!

Your private key will be destroyed on:

6/7/2017

Your files have been safely encrypted on this PC: photos,videos, documents,etc.
Click "Show encrypted files" Button to view a complete list of encrypted files,
and you can personally verify this.

Encryption was produced using a unique public key RSA-2048 generated
for this computer. To decrypt files you need to obtain the **private key.**

The only copy of the private key, which will allow you to decrypt your files,
is located on a secret server in the Internet; the server will eliminate the key
after a time period specified in this window.
Once this has been done, nobody will ever be able to restore files...

In order to decrypt the files open your personal page on site
https://34r6hq26q2h4jkzj.tor2web.fi **and follow the instruction.**

Use your Bitcoin address to enter the site:
1EpDw7ua727R6KHCabz9DtKSiimUsz4GPM

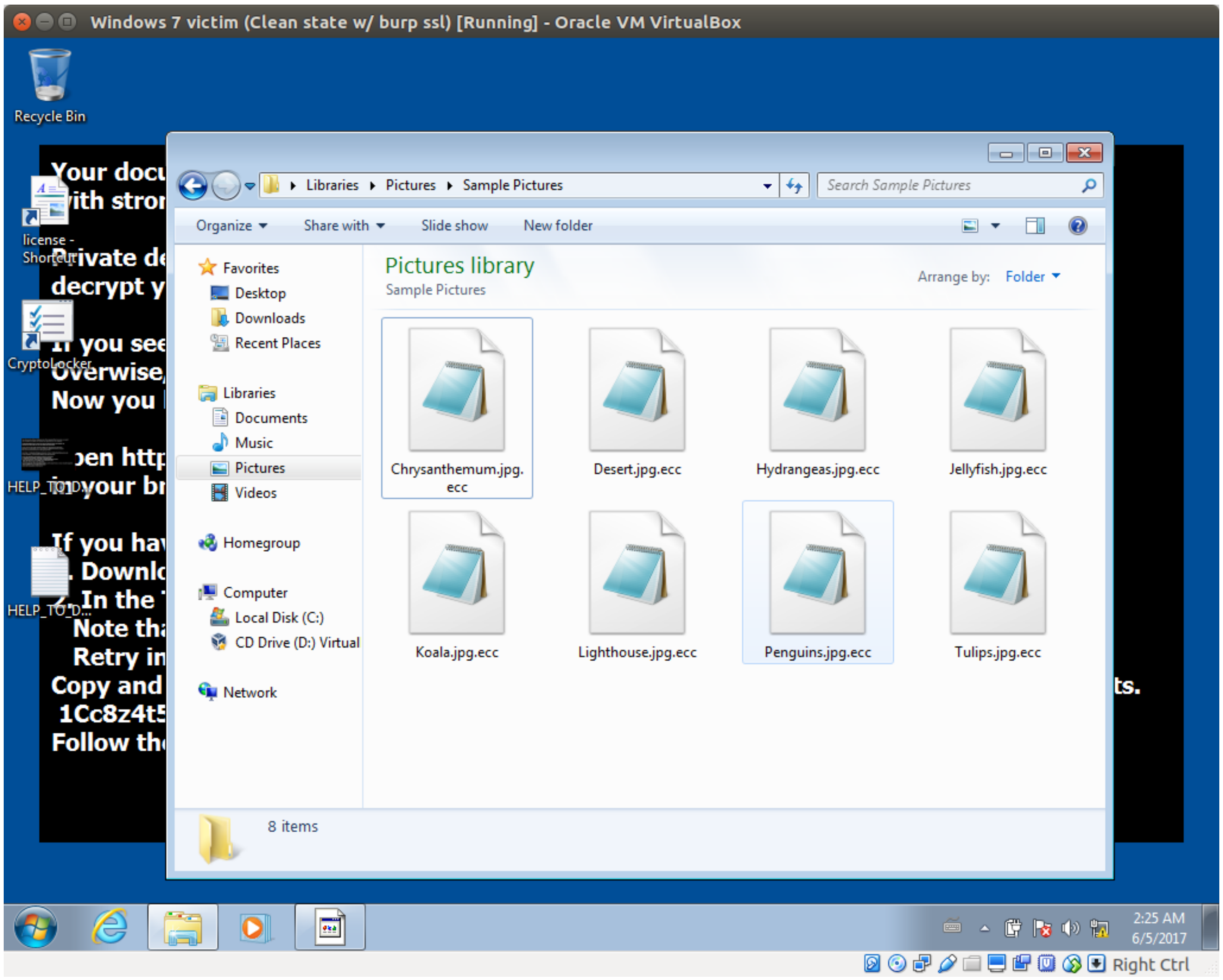
Click to copy Bitcoin address to clipboard

if https://34r6hq26q2h4jkzj.tor2web.org is not opening, please follow the steps:
You must install this browser www.torproject.org/projects/torbrowser.html.en
After instalation,run the browser and enter address **34r6hq26q2h4jkzj.onion**
Follow the instruction on the web-site. We remind you that the sooner you do,
the more chances are left to recover the files.
Any attempt to remove or corrupt this software will result
in immediate elimination of the private key by the server.

Show encrypted files | Check Payment | Enter Decrypt Key

Click to Free Decryption on site

TeslaCrypt main window (click for full-size image)



The machine's files have been encrypted and replaced by files with the ECC extension After checking the logs of INetSim, we can see that the ransomware did the following DNS lookups:

- 7tno4hib47vlep5o.tor2web.org
- 7tno4hib47vlep5o.tor2web.blutmagie.de
- 7tno4hib47vlep5o.tor2web.fi
- bitcoin.toshi.io

And sent several HTTP requests to those domains.

```
HTTPS connection, method: GET, URL: https://7tno4hib47vlep5o.tor2web.org/state.php?
U3ViamVjdD1QaW5nJmtleT0xNUIzOEIxOEFGMjBDMERCMkE3Qzc3MUUwMTQzNjNGMkNCODc4MUIxNTZENTE5Q

HTTPS connection, method: GET, URL:
https://7tno4hib47vlep5o.tor2web.blutmagie.de/state.php?
U3ViamVjdD1QaW5nJmtleT0xNUIzOEIxOEFGMjBDMERCMkE3Qzc3MUUwMTQzNjNGMkNCODc4MUIxNTZENTE5Q

HTTPS connection, method: GET, URL: https://7tno4hib47vlep5o.tor2web.fi/state.php?
U3ViamVjdD1QaW5nJmtleT0xNUIzOEIxOEFGMjBDMERCMkE3Qzc3MUUwMTQzNjNGMkNCODc4MUIxNTZENTE5Q

HTTPS connection, method: GET, URL:
https://bitcoin.toshi.io/api/v0/addresses/1LNUF3BqL3ob1CT2aVp3cW4Nb8zkkViVwT
```

We see similar requests are made to **tor2web.org**, **tor2web.blutmagie.de** and **tor2web.fi**. Those services allow to access the Tor network without having to install Tor Browser or a similar tool.

The malware contacts the Tor hidden service **7tno4hib47vlep5o.onion**, which is probably some kind of C&C server. The payload of the request is a base64 encoded string, which decodes to:

```
Subject=Ping
&key=15B38B18AF20C0DB2A7C771E014363F2CB8781B156D519CC5F220335D4714AA3
&addr=1LNUF3BqL3ob1CT2aVp3cW4Nb8zkkViVwT
&files=0
&size=0
&version=0.2.6a
&date=1496648675
&OS=7601
&ID=16
&subid=0
&gate=G1
```

It also makes an API call to **bitcoin.toshio.io** (which doesn't exist anymore), most probably to check if the ransom has been paid to the bitcoin address *1LNUF3BqL3ob1CT2aVp3cW4Nb8zkkViVwT*. It seems like the malware generates an unique bitcoin address for each infected computer, since the address didn't receive or send out any money.

Conclusion

Hopefully this guide will be helpful and allow you to safely analyze the network interactions of a malware. Keep in mind that some malwares detect when they are being run in a virtual machine and might adapt their behavior (e.g. do nothing). Here's an article from MalwareBytes on the subject.

Also, remember that while analyzing a malware's network traffic can be very useful, it's only one kind of dynamic analysis. Others include monitoring the register, the system calls, the files opened / created, etc. Open Security Training offers a full hands-on course on the topic, for free.

Don’t hesitate to leave a comment if you found this guide useful / awesome / too long / too detailed. A big thank you to lbarman for the proofreading and numerous suggestions.

Stay safe!

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