Ethical Hacking Lab Series

Lab 2: Conducting Active and Passive Reconnaissance against a Target

Certified Ethical Hacking Domains:
Introduction to Ethical Hacking,
Footprinting and Reconnaissance,
Scanning Networks,
Social Engineering

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Introduction

This lab is part of a series of lab exercises intended to support courseware for Ethical Hacker training. The development of this document is funded by the Department of Labor (DOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT) Grant No. TC-22525-11-60-A-48.

In this lab, students will perform passive and active reconnaissance on systems.

This lab includes the following tasks:

- 1 – Performing External Active Reconnaissance
- 2 – Performing Internal Active Reconnaissance
- 3 – Performing Internal and External Passive Reconnaissance

Domains: Introduction to Ethical Hacking, Footprinting and Reconnaissance, Scanning Networks, Social Engineering

Hackers will use various tools to find hosts on the network. After hosts are discovered and detailed information is gathered, the next step usually involves attacking systems.

Nmap – Nmap is a program that can be used in Linux, Mac, or Windows to locate machines on a network. After Nmap is used to discover machines on a network, it can also be utilized to determine which Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) ports the machine has open. Nmap will give an indication of the operating system the remote machine is using. Zenmap is a GUI frontend for Nmap.

Metasploit – Metasploit is an exploitation framework. Version 3 of Metasploit is written in Ruby and has exploits for Microsoft Windows, Mac OS X, Linux, and UNIX. Some exploits are for the operating systems themselves and others are for application software like Adobe Reader and Internet Explorer. There is a detailed description of each exploit, which explains which version of the operating system, or application software is vulnerable.

tcpdump – A Linux/UNIX program that allows you to capture network traffic. The tcpdump program comes installed on many Linux distributions by default.

Sniffer – A Sniffer is used to capture network traffic on a Network. Software programs like tcpdump, Wireshark, and Network Miner can be used to sniff traffic.

Armitage – Metasploit is a very powerful exploitation framework but it requires that the user be comfortable using the command line. Armitage is a GUI frontend for Metasploit that has many powerful capabilities. An attacker can use Armitage to identify and exploit victim machines within an easy to use graphical environment.

Pod Topology

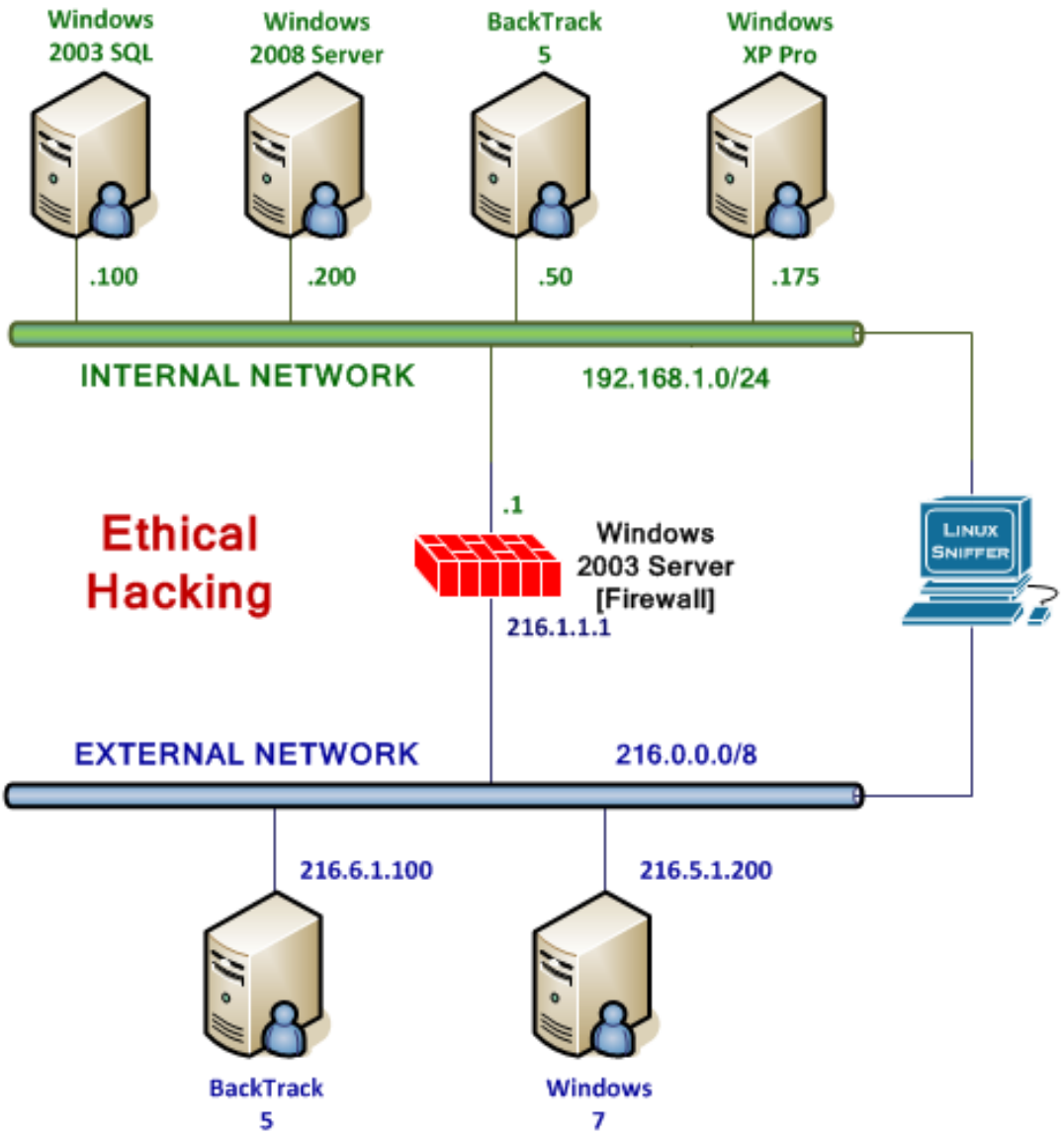


Figure 1: Lab Topology

Lab Settings

The information in the table below will be needed in order to complete the lab. The task sections below provide details on the use of this information.

Required Virtual Machines and Applications

This lab requires the use of the Linux Internal and External BackTrack 5 R3 machines.

External BackTrack 5	216.6.1.100
External BackTrack 5 **root** password	toor
Internal BackTrack 5	192.168.1.50
Internal BackTrack 5 **root** password	toor
Windows 2003 SQL	192.168.1.100
Windows 2003 **Administrator** password	`P@ssw0rd`

1 Performing External Active Reconnaissance

The purpose of performing active reconnaissance against an external target is to learn about the configuration of the systems connected to the Internet. Active Reconnaissance can provide information including which ports are open, the target operating system, as well as the version of the web server software the site is utilizing.

Keep in mind that **Linux commands are case sensitive**. The commands below must be entered exactly as shown.

1.1 Performing Active Reconnaissance Against an External Target

1. Open the *External* **BackTrack 5** attack machine, running BackTrack Linux (version 5 R3), type **root** for the login and **toor** *for* the password.

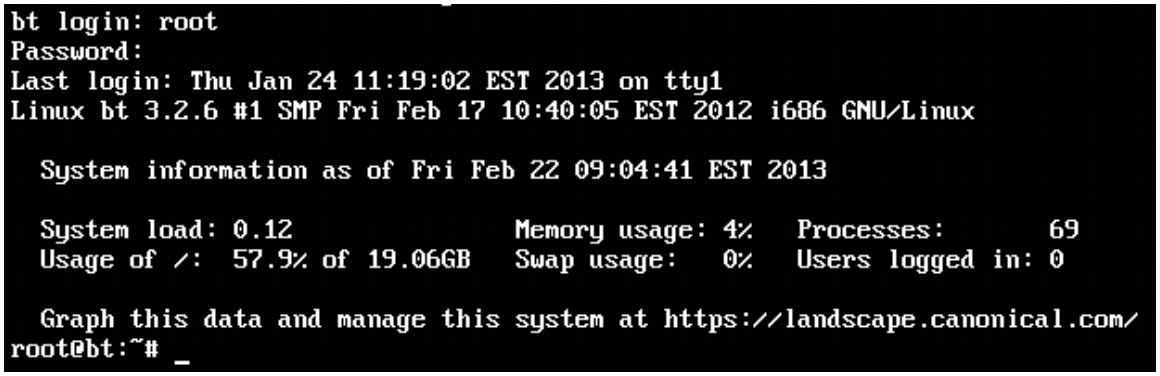


Figure 2: Logging in as root

2. Type the following command to start the Graphical User Interface (GUI).
root@bt:~# **startx**

Figure 3: The startx command

3. Open a terminal on the Linux system by clicking on the picture to the right of the word **System** in the taskbar at the top of the screen in BackTrack 5 R3.

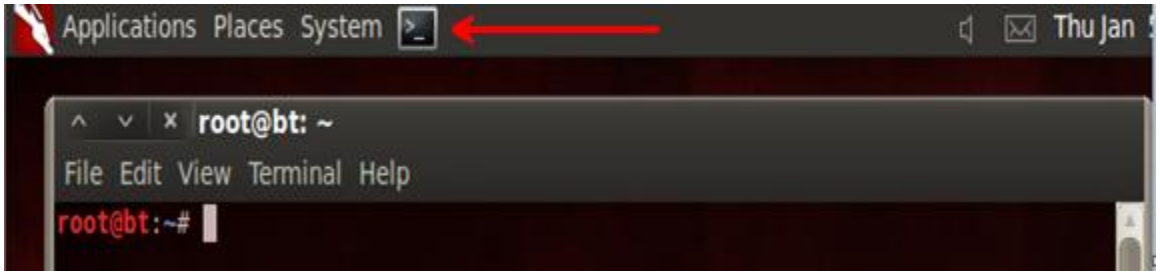


Figure 4: The Linux Terminal

Before we start scanning, it is important to know some information about how networks attached to the Internet commonly function. Our attack machine is using a Public IP address of 216.6.1.100 and the organization we are scanning has a public IP address of 216.1.1.1. The Firewall machine itself is does not have any webserver software installed. Web services, such as FTP or HTTP, are actually running on the Windows 2003 SQL server, not the Firewall itself. When requests come in for those services, the firewall redirects those requests to the Windows 2003 SQL server running on the internal network. So, even though the Windows 2003 SQL server is not directly connect to the Internet, users from the Internet can utilize services on the machine because of the firewall redirection.

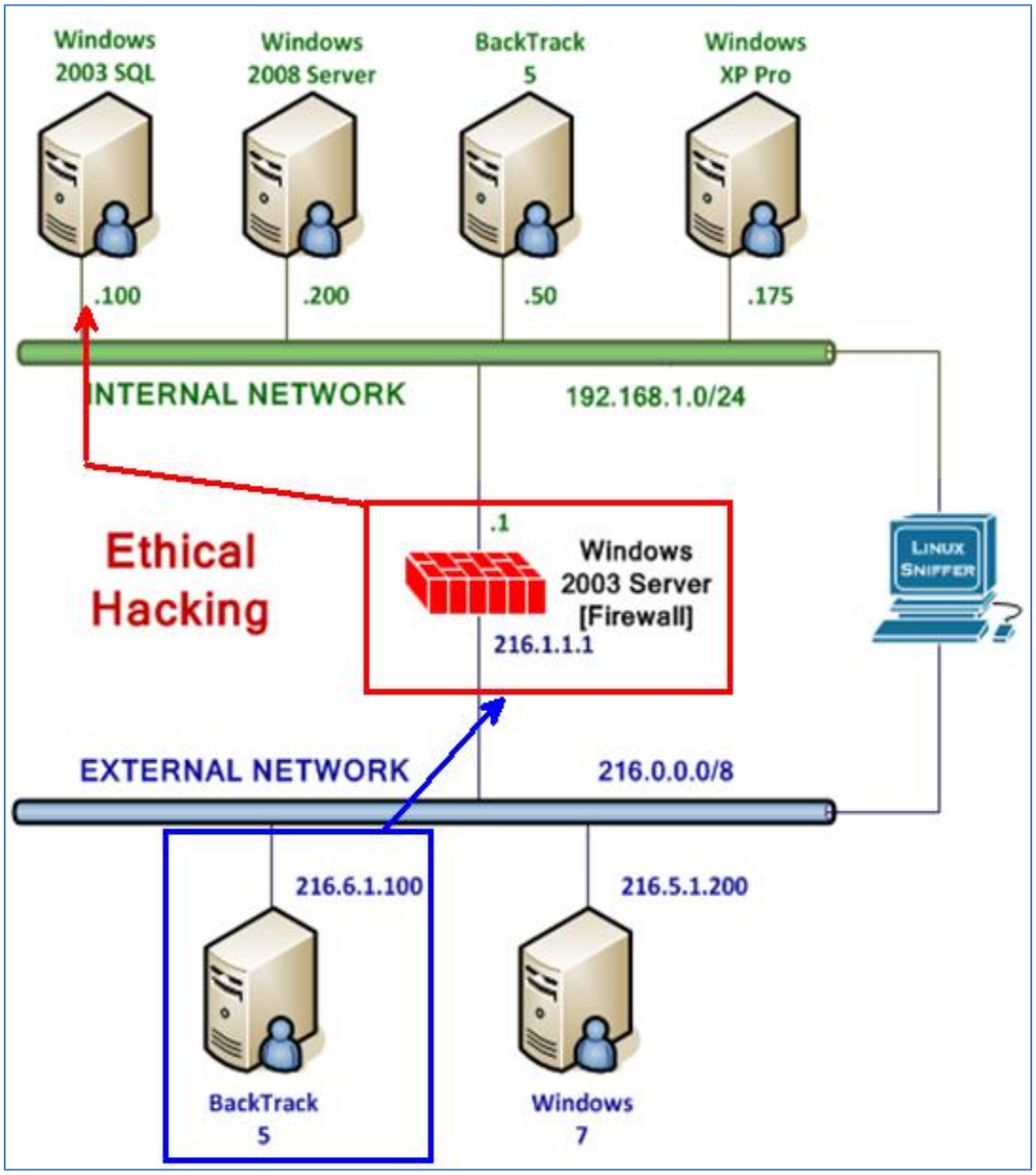


Figure 5: Diagram Explaining Firewall Redirection

Before you start scanning a system, you can perform a banner grab against the target. A banner grab is nothing more than connecting to a remote IP address and a corresponding port. You can use telnet or netcat to perform a banner grab. Note: If you are using Windows Vista, 7, or 8, the telnet client needs to be installed in Programs and Features.

An example using telnet to grab a banner by connecting to a port on a remote system:

Figure 6: Example Banner Grab

Here is a list of common ports that you can try to connect to when you grab banners.

Service Name	Port Number
File Transfer Protocol (FTP)	21
Secure Shell (SSH)	22
Simple Mail Transfer Protocol (SMTP)	25
Hyper Text Transfer Protocol (HTTP)	80
Post Office Protocol Version 3 (POP3)	110
Secure Hyper Text Transfer Protocol (HTTPS)	443
Remote Desktop Protocol (RDP)	3389

4. Type the following to determine if port 21 is open on the remote system:
   root@bt:~# **telnet 216.1.1.1 21**

Figure 7: Determining if Port 21 is Open on the Remote System

5. The following message below will appear, indicating that the port is open and that the system is utilizing a Microsoft FTP Service. Type **quit** to end the session.

Figure 8: A Banner Message Appears

6. Type the following to determine if port 22 is open on the remote system:
root@bt:~# **telnet 216.1.1.1 22**

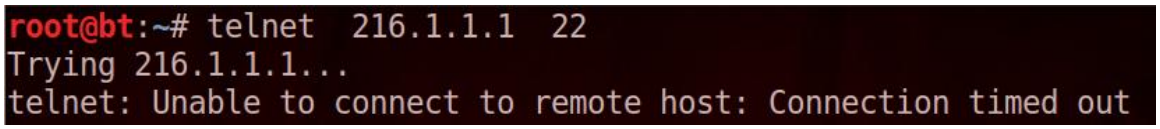


Figure 9: The port is closed

The port is closed on the remote system, so we receive a connection time out message.

7. Type the following to determine if port 25 is open on the remote system:
root@bt:~# **telnet 216.1.1.1 25**

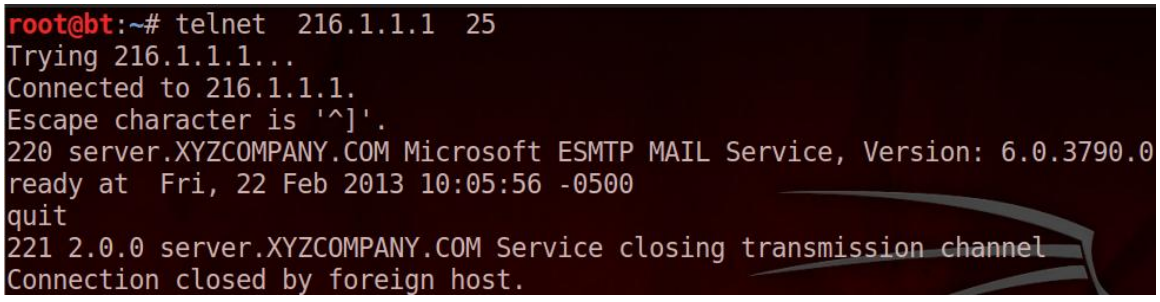


Figure 10: Determining if Port 25 is Open on the Remote System

A simple Google search of Microsoft ESMTP MAIL Service, Version: 6.0.3790.0 indicates that the system is likely running Microsoft Exchange Server 2003, which it actually is.

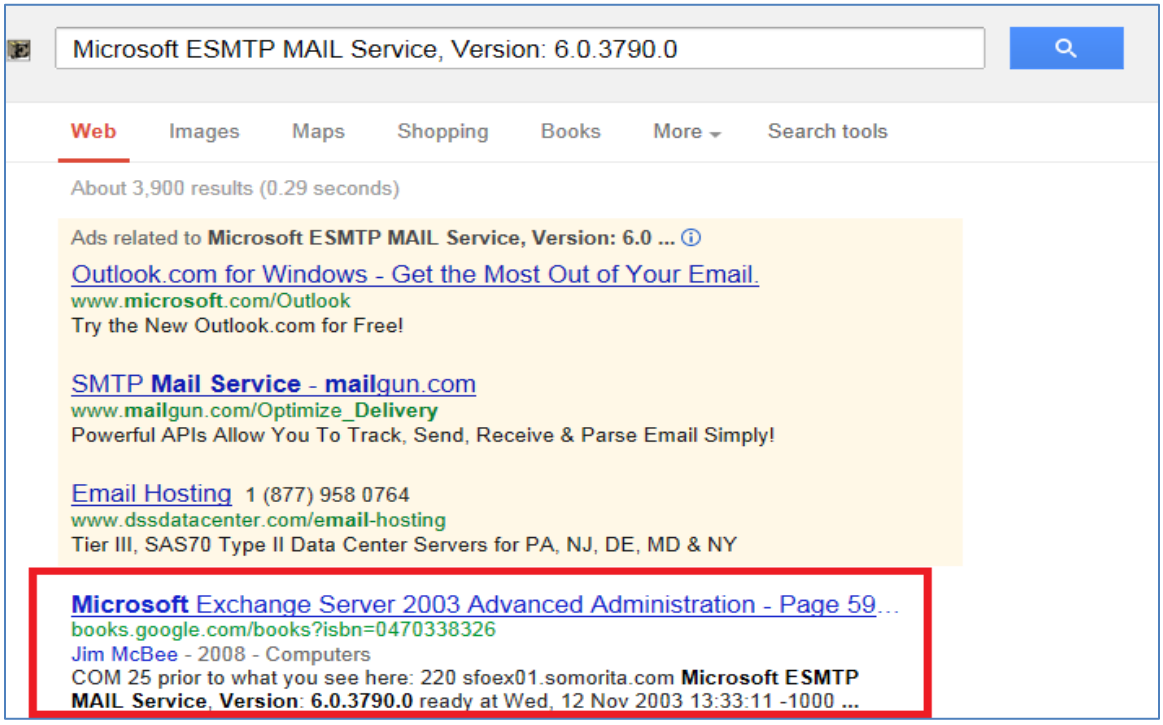


Figure 11: Googling the Banner Message

It is also important to know that banner grabbing is not just something that works in this isolated NETLAB+ environment, it is a technique that is used by people working in the field, such as network administrators, to test connectively to a port on a remote system.

When you work in IT, you sometimes become the de facto help desk for your family. For instance, my sister called me and reported that she could not send email messages. So, I performed a banner grab to test to see if her ISP's mail server was functioning.

```
C:\>telnet smtp.comcast.net 25
```

Figure 12: Banner Grab

At that moment, the port was closed. I advised her to tell the help desk that the SMTP server was down. After she called, they had it back up and running quickly.
When I try to perform a banner grab several minutes later, the port responded fine.

```
220 omta24.westchester.pa.mail.comcast.net comcast ESMTP server ready
```

Figure 13: SMTP Banner

8. Type the following to determine if port 80 is open on the remote system:
root@bt:~# **telnet 216.1.1.1 80**

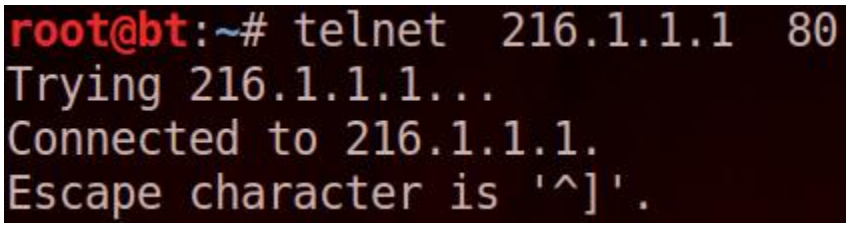


Figure 14: Determining if Port 80 is Open on the Remote System

9. While connected to the remote system, type the following to get a response, **hit enter twice after the command**:
HEAD / HTTP/1.0 <enter> <enter>

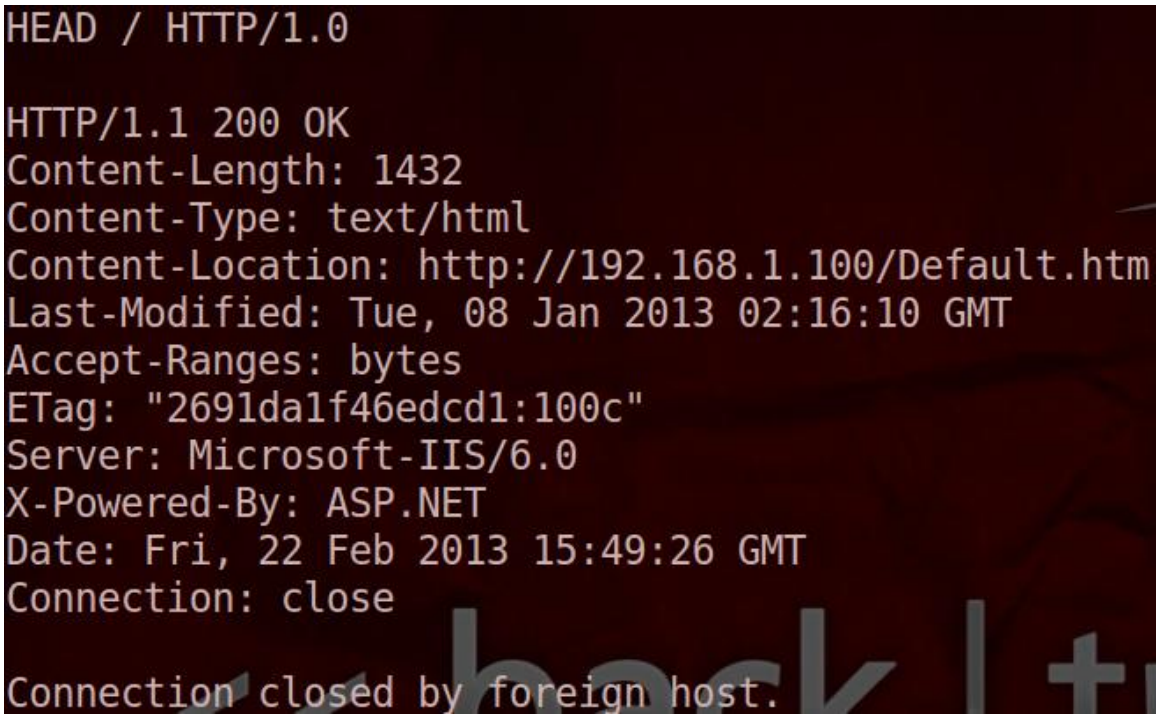


Figure 15: Port 80 is Open

Notice that several things are reported during the banner grab of port 80, including:

Server Response	What This Indicates
Server: Microsoft-IIS/6.0	The Version of Internet Information Services that is Running
http://192.168.1.100/Default.htm	The Internal IP address in Use
X-Powered-By: ASP.NET	Active Server Pages (ASP) are in use
Last-Modified: Tue, 08 Jan 2013	Last Modified Date of the Webpage

Banner grabbing allows you to determine if a port is open and possibly reveal information about the application and operating system software. And, it will also leave a much smaller footprint than when a scan is performed with a tool like Nmap or Zenmap.

10. Type the following command to scan the remote system using Nmap:

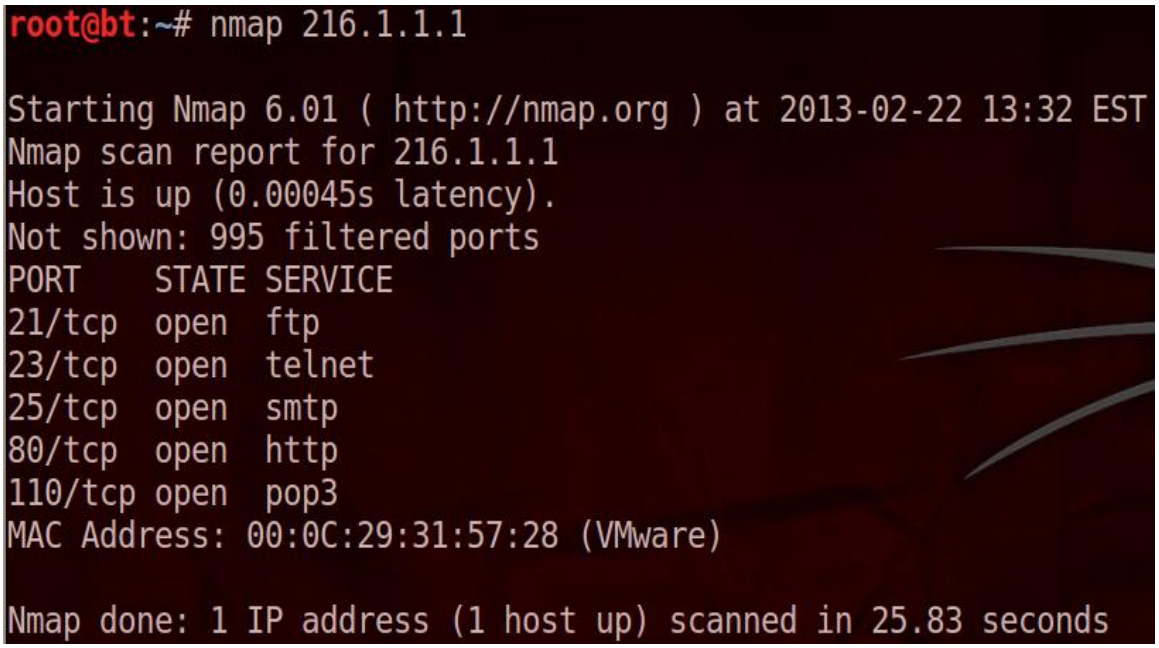


Figure 16: The Results of the Nmap

Keep in mind a few things about this Nmap scan you performed against 216.1.1.1:

- Nmap without any switches will work against machines blocking ICMP.
- A default Nmap scan will scan a large amount of the ports (not all).
- When you scan a machine that is on the Internet, you will not see a MAC address.

Notice that only the following 5 ports are open:

Port Number	Service
21	File Transfer Protocol (FTP)
23	TELNET
25	Simple Mail transfer Protocol (SMTP)
80	Hyper Text Transfer Protocol (HTTP)
110	Post Office Protocol Version 3 (POP3)

11. Type the following command to open Zenmap, the GUI front-end for Nmap:
root@bt:~#**zenmap**

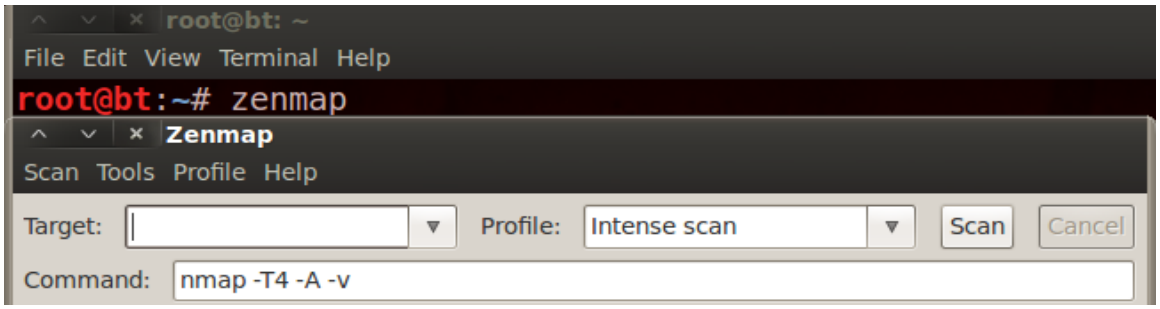


Figure 17: Open Zenmap

12. In the target box, type the public IP address for XYZcompany: 216.1.1.1. Click **Scan**.

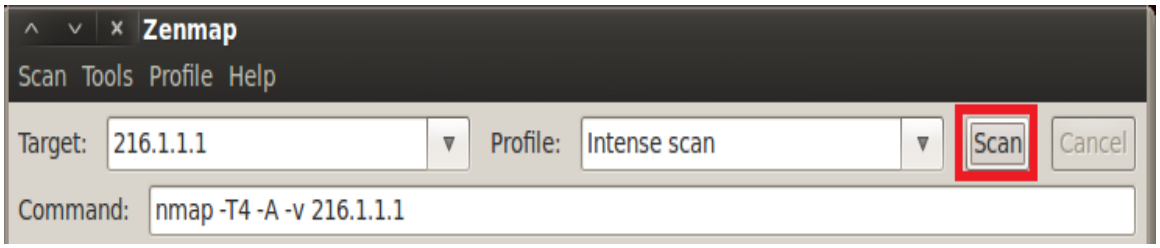


Figure 18: The Target IP

13. After the scan is completed, click on the **Ports/Hosts** tab to view the open ports.

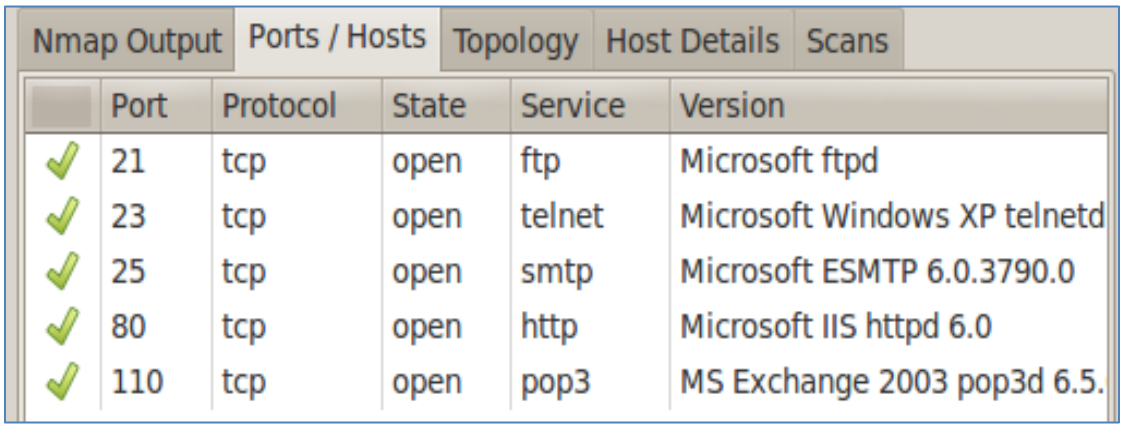


Figure 19: Open Ports

Notice that the banner message is displayed in the version column of Zenmap.
To demonstrate how a scan with Zenmap is much noisier than a simple banner grab, we will log on to the Windows server and check the log files for artifacts.

14. Log on to the **Windows 2003 SQL** machine. Use the PC menu in the NETLAB+ Remote PC Viewer to send a **Ctrl-Alt-Del** (version 2 viewer), or click the **Send Ctrl-Alt-Del** link in the bottom right corner of the viewer window (version 1 viewer). Log on with the username **Administrator** and the password **P@ssw0rd**.

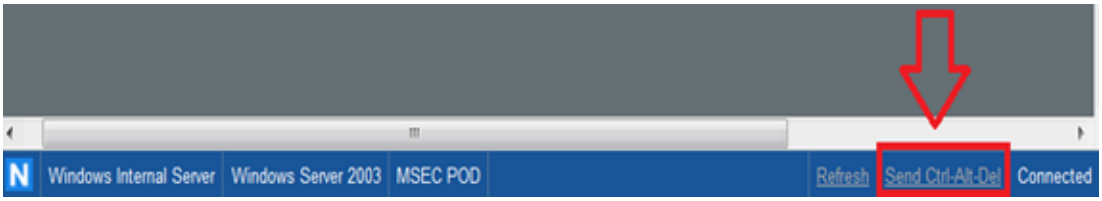


Figure 20: Send Ctrl-Alt-Del to the Windows 2003 Server

15. Click on **My Computer** on the Start Menu.

Figure 21: My Computer

16. Double-click on Local Disk (C:)

Figure 22: Local Disk (C:)

17. Double-click on the Windows directory.

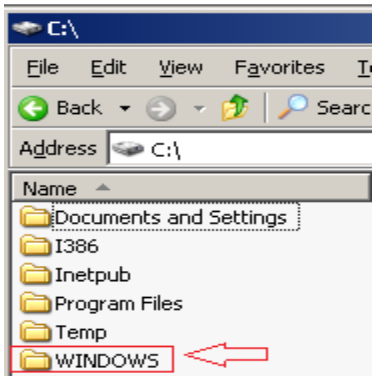


Figure 23: Windows Directory

18. Double click on the System32 directory.

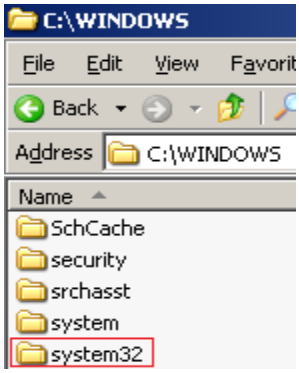


Figure 24: System32 Directory

19. Double-click on the Logfiles directory.

Figure 25: The Logfiles folder in System32

20. Double-click on W3SVC1.

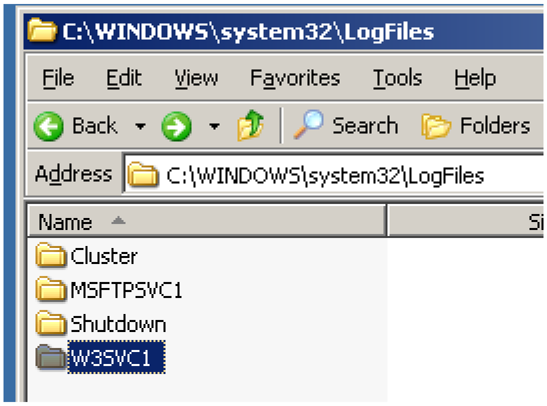


Figure 26: The Web Logs Directory

21. Double-click on the Logfile with today's date. The format is Year/Month/Day (YYMMDD)..

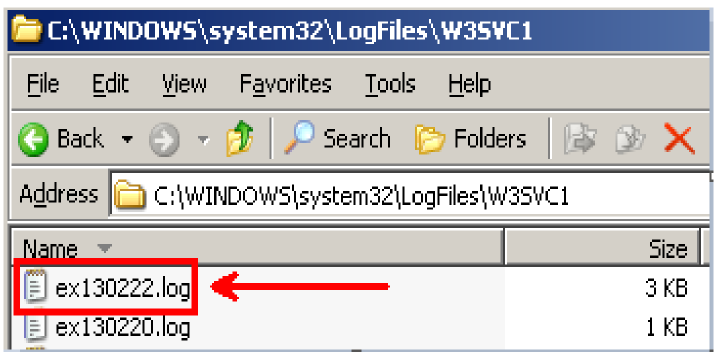
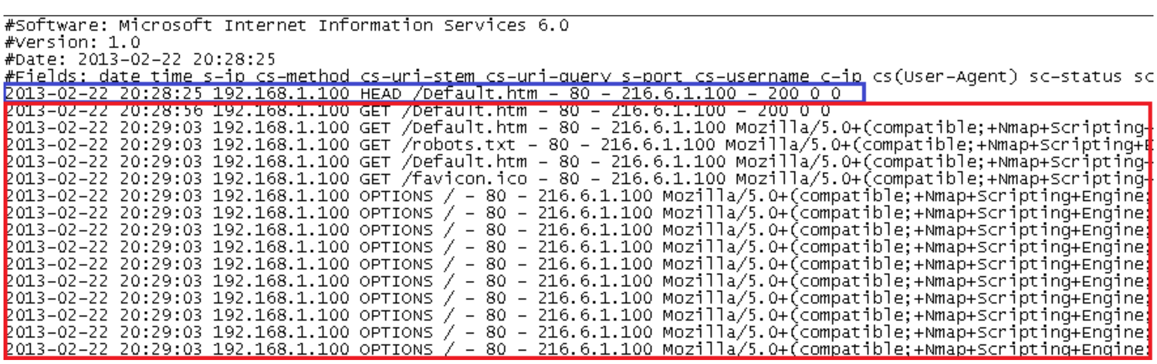


Figure 27: The Web Log files

While there is a single entry from the banner grab on the first line, there are multiple entries from the scans with Zenmap. The word Nmap in the user agent string is usually a red flag for people conducting log analysis and that IP address will be watched carefully.



```
#Software: Microsoft Internet Information Services 6.0
#Version: 1.0
#Date: 2013-02-22 20:28:25
#Fields: date time s-ip cs-method cs-uri-stem cs-uri-query s-port cs-username c-ip cs(User-Agent) sc-status sc
2013-02-22 20:28:25 192.168.1.100 HEAD /Default.htm - 80 - 216.6.1.100 - 200 0 0
2013-02-22 20:28:56 192.168.1.100 GET /Default.htm - 80 - 216.6.1.100 - 200 0 0
2013-02-22 20:29:03 192.168.1.100 GET /Default.htm - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting-
2013-02-22 20:29:03 192.168.1.100 GET /robots.txt - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+E
2013-02-22 20:29:03 192.168.1.100 GET /Default.htm - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting-
2013-02-22 20:29:03 192.168.1.100 GET /favicon.ico - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting-
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
2013-02-22 20:29:03 192.168.1.100 OPTIONS / - 80 - 216.6.1.100 Mozilla/5.0+(compatible;+Nmap+Scripting+Engine;
```

Figure 28: The Web Log file

1.2 Conclusion

A banner grab will allow you to determine if a port is open on a remote system. Sometimes banner messages provide you with information about the operating system or the applications in use. Scanners like Nmap and Zenmap can also be utilized to get information about open ports and banner messages. However, the scans with Nmap and Zenmap will leave more artifacts in the web logs and in network traffic captures.

1.3 Discussion Questions

1. Name two utilities that can be used to perform a banner grab.
2. Is there ever a need for someone besides a hacker to perform banner grabbing?
3. How do you check to see if port 110 is open on the remote system 216.1.1.1?
4. What message will you receive when you perform a banner grab against a remote system that has a closed port?

2 Performing Internal Active Reconnaissance

The purpose of performing active reconnaissance against one or more internal targets is also to learn about the configuration of the systems. With an internal scan, you are likely to be able to detect more machines and it is highly probable that systems will have more ports open on the LAN as opposed to systems connected to a the WAN. Insiders can be a big threat to companies because they have access to many more resources.

2.1 Performing an Internal Scan

1. Open the Internal **BackTrack 5** attack machine, type **root** for the login and **toor** for the password.

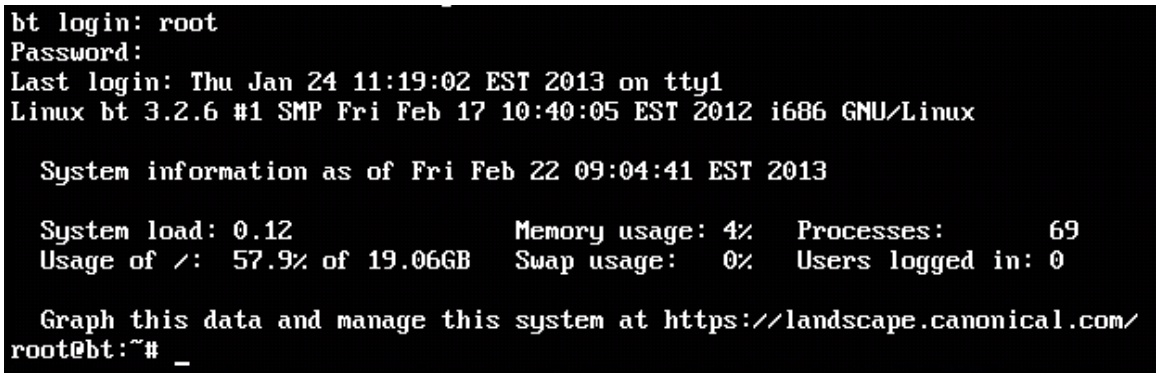


Figure 29: Logging in as root

2. Type the following command to start the Graphical User Interface (GUI).
root@bt:~# **startx**

Figure 30: The startx command

3. Open a terminal on the Linux system by clicking on the picture to the right of the word **System** in the taskbar at the top of the screen.

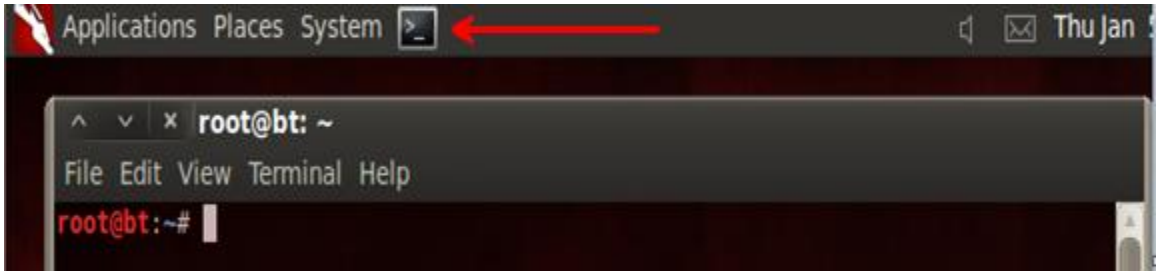


Figure 31: The Linux Terminal

We are on the Internal Network, so we have a lot more access than those machines trying to attack the company from the Internet. Right now we have 3 other IP addresses that we can scan, while the Internet attackers need to target a single IP address (the firewall: 216.1.1.1).

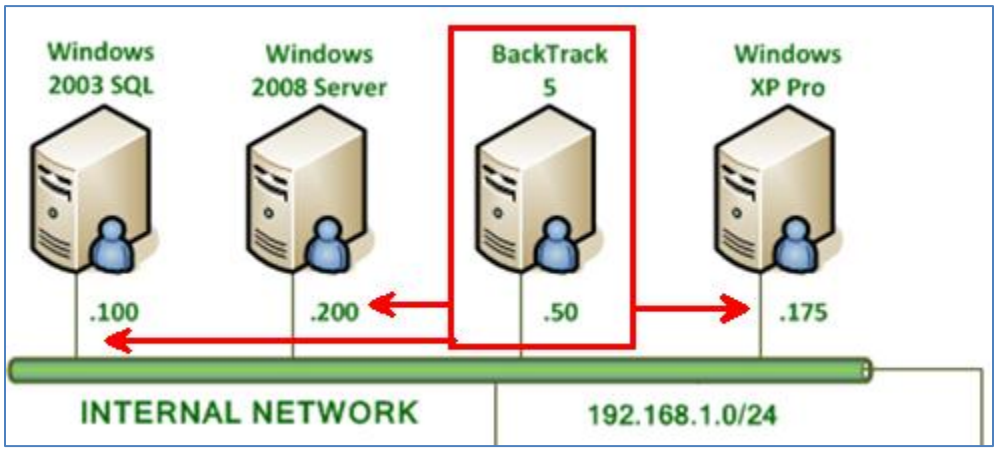


Figure 32: The Internal Network

4. On the Internal BackTrack machine, type the following to launch Metasploit:
   root@bt:~# **msfconsole**

Figure 33: Launching Metasploit

A random Metasploit banner message will appear with the current version number. Note: It may take a moment for the Metasploit banner to appear.

Figure 34: Metasploit Banner

5. Type the following to perform an Nmap scan and send the output to a database:
msf > **db_nmap 192.168.1.0/24**

Figure 35: Nmap information Sent to Database

Watch as the Nmap runs a scan on hosts in the 192.168.1.0/24 network. Open ports are displayed on the screen as they are discovered.

6. Type the following to view hosts that were enumerated during the Nmap scan:
msf > **hosts -u**

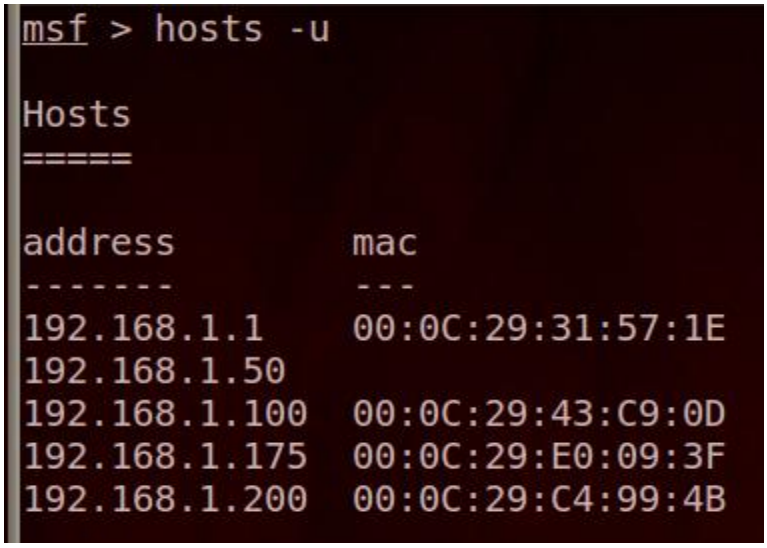


Figure 36: Listed Hosts

7. Type the following command to search for the SMB Scanner auxiliary module:
msf > **search smb_version**

Figure 37: Searching for the SMB Scanner

8. Type the following command to use the SMB Scanner auxiliary module:
msf > **use auxiliary/scanner/smb/smb_version**

```
msf > use auxiliary/scanner/smb/smb_version
msf  auxiliary(smb_version) >
```

Figure 38: Using the Scanner

If typed correctly, your sub-prompt will change to msf auxiliary(smb_version) >

9. Type the following command to view a list of module options:
msf auxiliary(smb_version) > **show options**

```
msf  auxiliary(smb_version) > show options

Module options (auxiliary/scanner/smb/smb_version):

   Name       Current Setting  Required  Description
   ----       ---------------  --------  -----------
   RHOSTS                      yes       The target address range or CIDR identifier
   SMBDomain  WORKGROUP        no        The Windows domain to use for authentication
   SMBPass                     no        The password for the specified username
   SMBUser                     no        The username to authenticate as
   THREADS    1                yes       The number of concurrent threads
```

Figure 39: Showing the Options

10. Type the following to load the hosts from the database as RHOSTS values.
msf auxiliary(smb_version) > **hosts -R**

```
msf  auxiliary(smb_version) > hosts -R

Hosts
=====

address        mac                name  os_name  os_flavor  os_sp  purpose  info  comments
-------        ---                ----  -------  ---------  -----  -------  ----  --------
192.168.1.1    00:0C:29:31:57:1E        Unknown                   device
192.168.1.50                            Unknown                   device
192.168.1.100  00:0C:29:43:C9:0D        Unknown                   device
192.168.1.175  00:0C:29:E0:09:3F        Unknown                   device
192.168.1.200  00:0C:29:C4:99:4B        Unknown                   device

RHOSTS => 192.168.1.1 192.168.1.50 192.168.1.100 192.168.1.175 192.168.1.200
```

Figure 40: Setting the RHOSTS

11. Type the following command to view the options with the RHOSTS set:
    msf auxiliary(smb_version) > **show options**

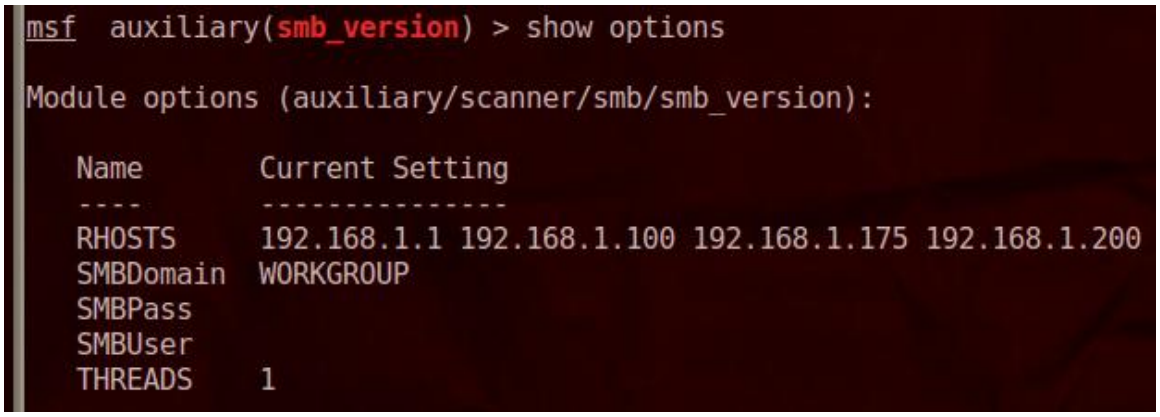


Figure 41: Showing the Options

The value for RHOSTS should be set to the multiple hosts on the 192.168.1.0/24 subnet.

12. Type the following to discover information about the hosts' operating systems.
    msf auxiliary(smb_version) > **run**

Figure 42: OS Information about the Remote Hosts is Disclosed

IP address	Operating Systems
192.168.1.1	Microsoft Windows 2003 NO Service Pack
192.168.1.100	Microsoft Windows 2003 NO Service Pack
192.168.1.175	Microsoft Windows XP SP2
192.168.1.200	Microsoft Windows 2008 Without Hyper V

13. Type the following to list the hosts and their corresponding operating systems.
msf auxiliary(smb_version) > **hosts -R**

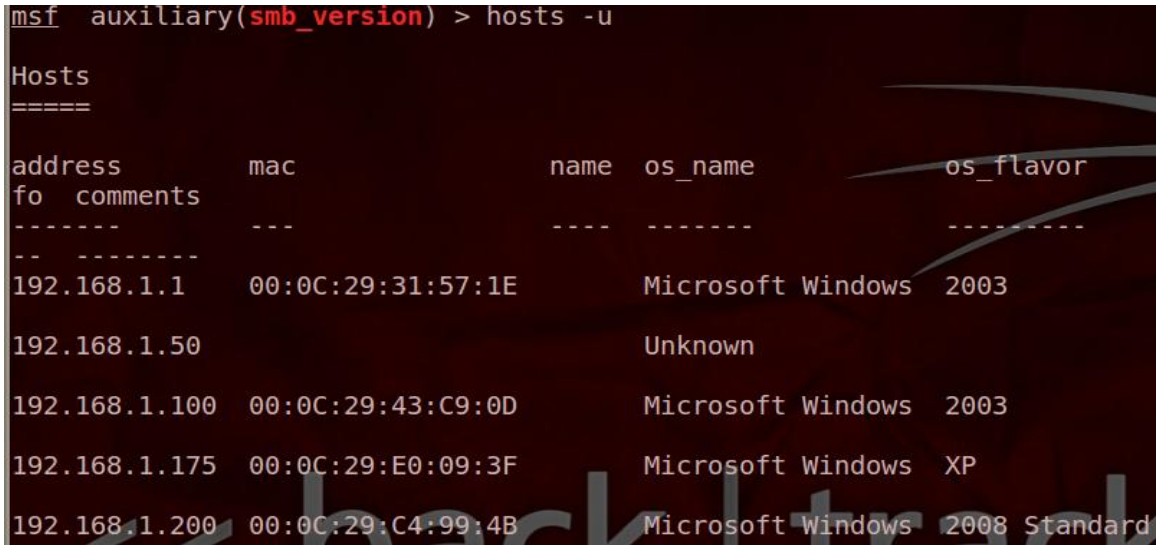


Figure 43: Relisting the Hosts with the OS Identified

14. Type **quit** to return to the **root@bt:~#** prompt.
15. Type the following to launch Armitage:
root@bt:~# **armitage**

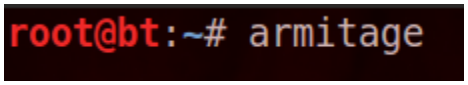


Figure 44: Launching Armitage

16. Click **Connect** to connect to the localhost as user msf with the password test.

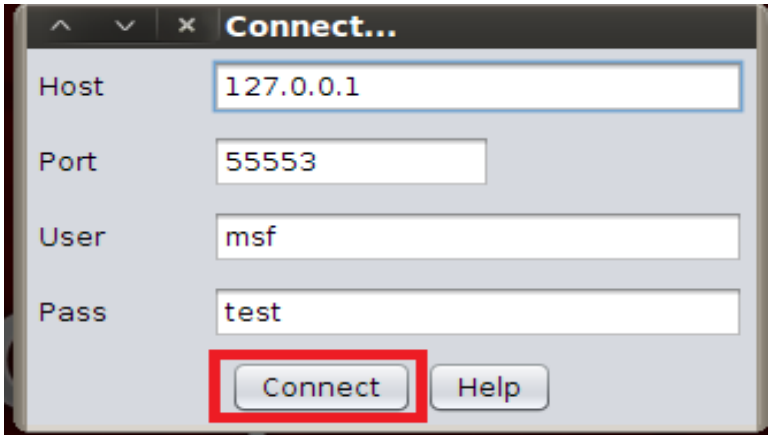


Figure 45: Connecting Armitage

17. Click **Yes** to start Metasploit's Remote Procedure Call(RPC) Server.

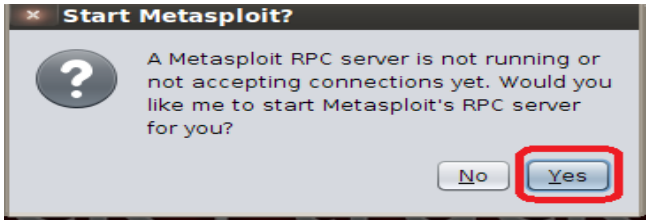


Figure 46: Start Metasploit RPC Server

You will initially get a java.net connection error. Do not click cancel, just wait briefly…

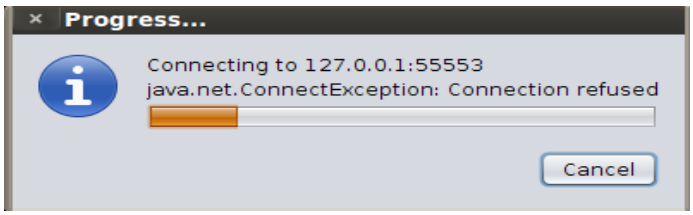


Figure 47: Java Connection Message

The Armitage windows will appear. Notice the Metasploit console on the bottom left.

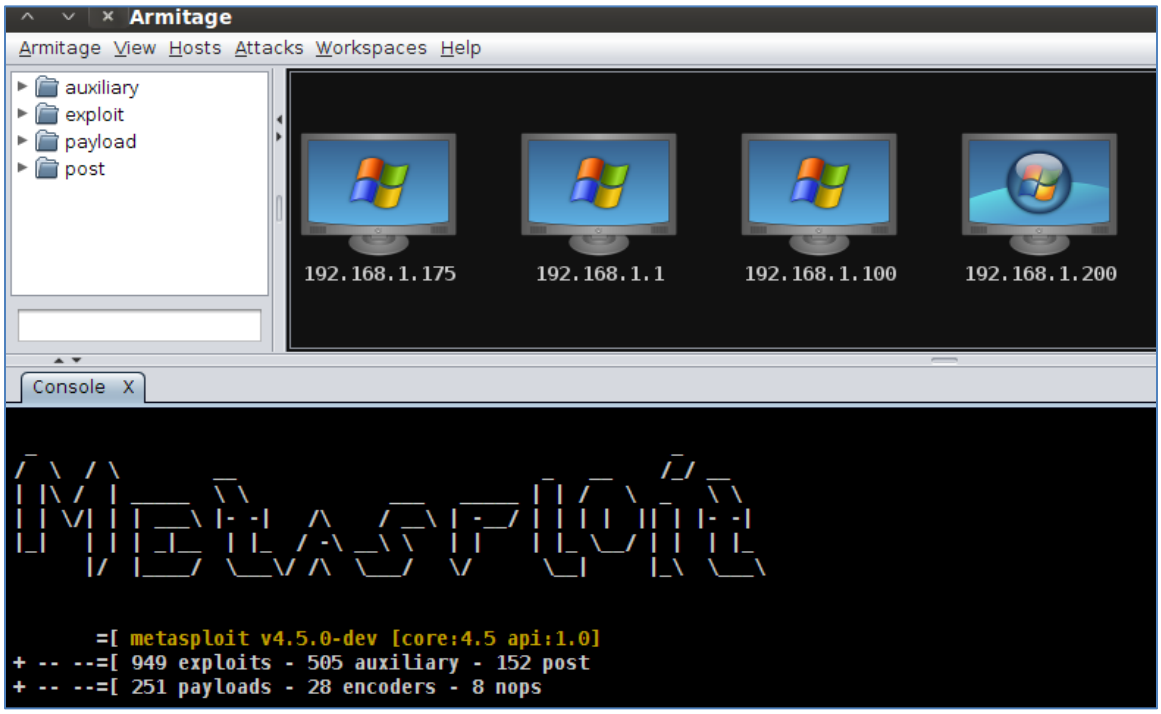


Figure 48: Armitage

Armitage is a front end for Metasploit, so the hosts are already identified because their information was loaded into the database when you ran commands in the msfconsole.

18. Hover over any of the Windows machines to get an exact OS determination.

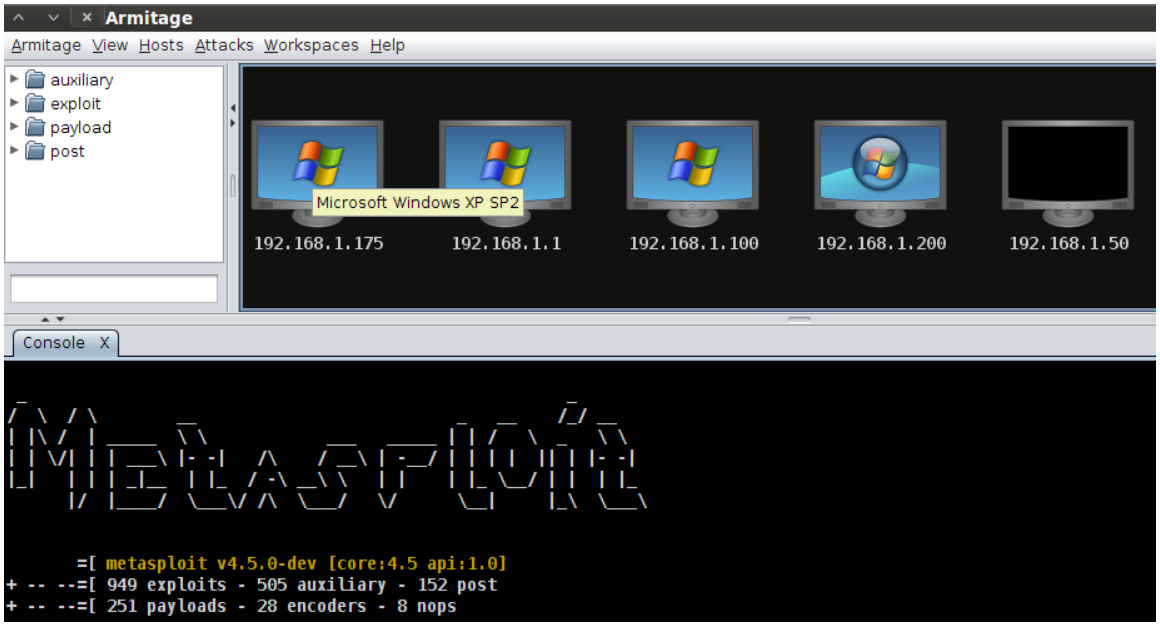


Figure 49: Operating System Identification

2.2 Conclusion

Scanning devices is much easier when you are on the inside of a network. There are more ports open and there is usually access to a greater number of machines. For this reason, insiders can be a huge threat and internal network traffic should be monitored.

2.3 Discussion Questions

1. What is the command to start Metasploit?
2. What will the hosts command do within msfconsole?
3. What is the command to set all of the computers listed in hosts to the RHOST?
4. How do you determine the exact OS fingerprint within Armitage?

3 Performing Internal and External Passive Reconnaissance

Performing reconnaissance of external and internal hosts and achieving very accurate depictions of what ports were open and what operating systems the remote machines were running, using any kind of active tools may get us caught. The use of passive tools like Wireshark or tcpdump will not be noticed on the network.

3.1 Passive Reconnaissance Using tcpdump and Wireshark

1. On the *internal* **Backtrack 5** machine, type the following to view tcpdump switches:
   root@bt:~# **tcpdump --help**

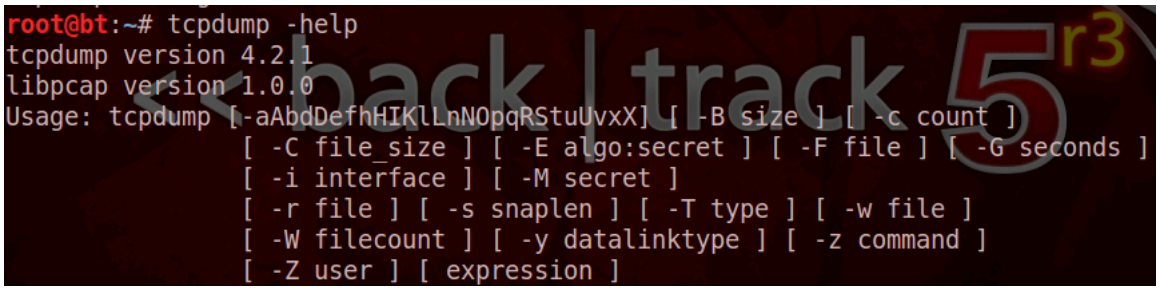


Figure 50: The tcpdump command

On the Internal 192.168.1.0/24 network, broadcasts are sent to 192.168.1.255.

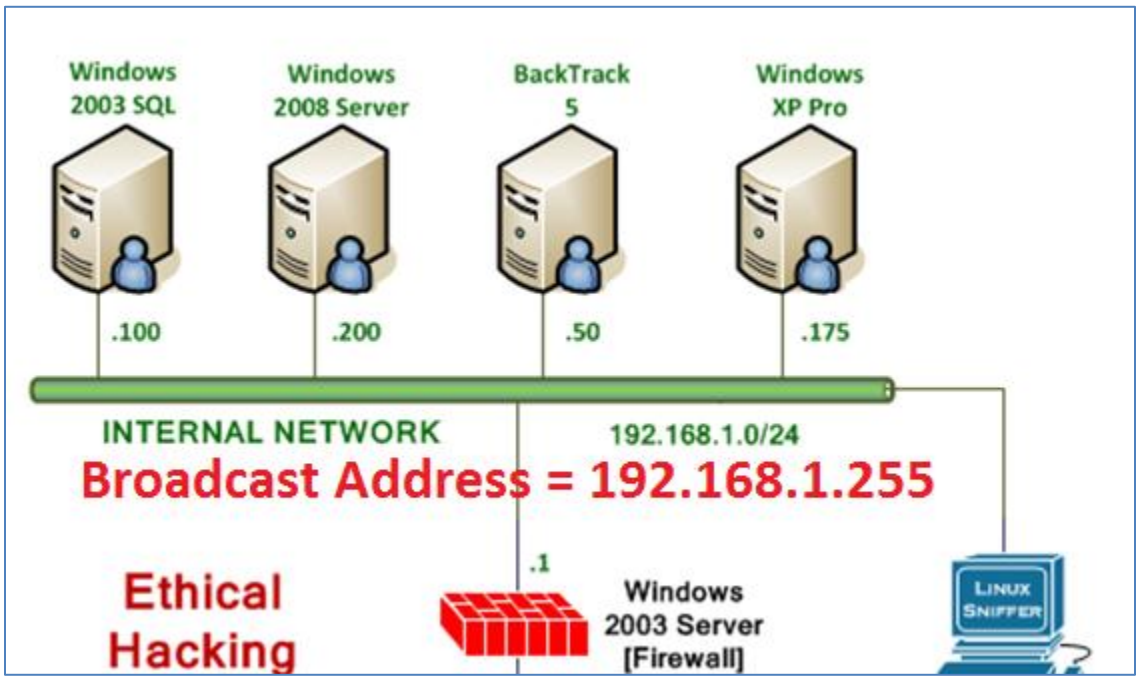


Figure 51: The Broadcast Address is 192.168.1.255.

2. Type the following command to passively sniff traffic on interface eth0:
root@bt:~**#tcpdump**

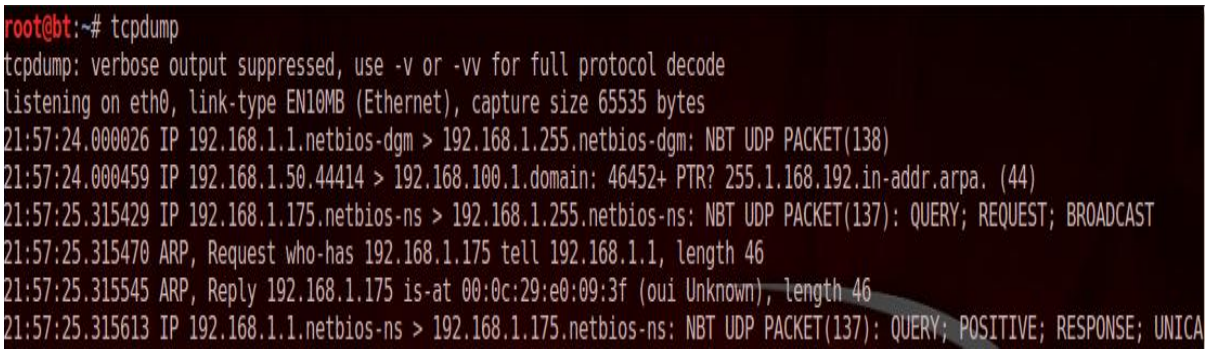


Figure 52: Passive Sniffing

Most of the IP addresses announce themselves on the network, without doing any type of scan. User Datagram Protocol (UDP) NetBIOS Datagrams are sent to the network broadcast address of 192.168.1.255. Address Resolution Protocol (ARP) uses the broadcast MAC address of FF:FF:FF:FF:FF:FF. These broadcasts are sent to all machines within a single broadcast domain; meaning ARP broadcasts are not forwarded off a LAN segment.

Another way we can listen passively on the internal network is by using Wireshark.

3. On the sniffer machine, type the following command to launch Wireshark:
root@bt:~# **wireshark**

Figure 53: Typing Wireshark

4. Check the *Don't show the message again* box and click the OK button.

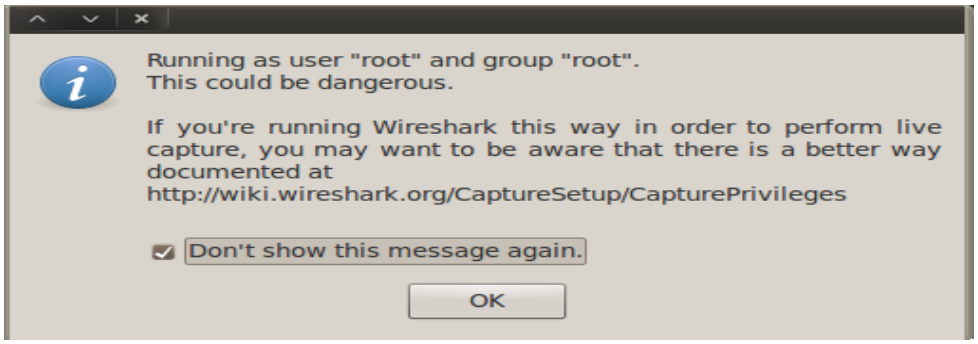


Figure 54: Wireshark Message

5. Select Capture from the Wireshark menu bar, and choose Interfaces.

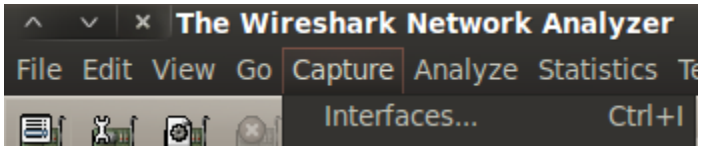


Figure 55: Capture Sub-Menu

6. Check the box in front of eth0. Click the **Start** button at the bottom of the screen.

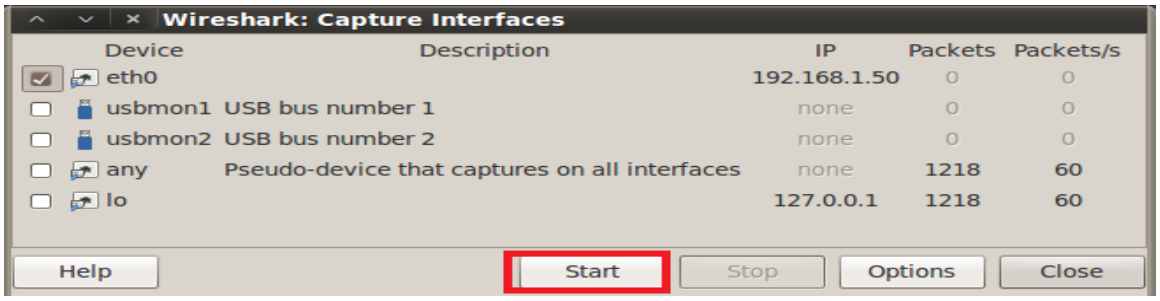


Figure 56: Starting Wireshark on the Internal Interface

You will notice IP addresses appear in the list after some time elapses.

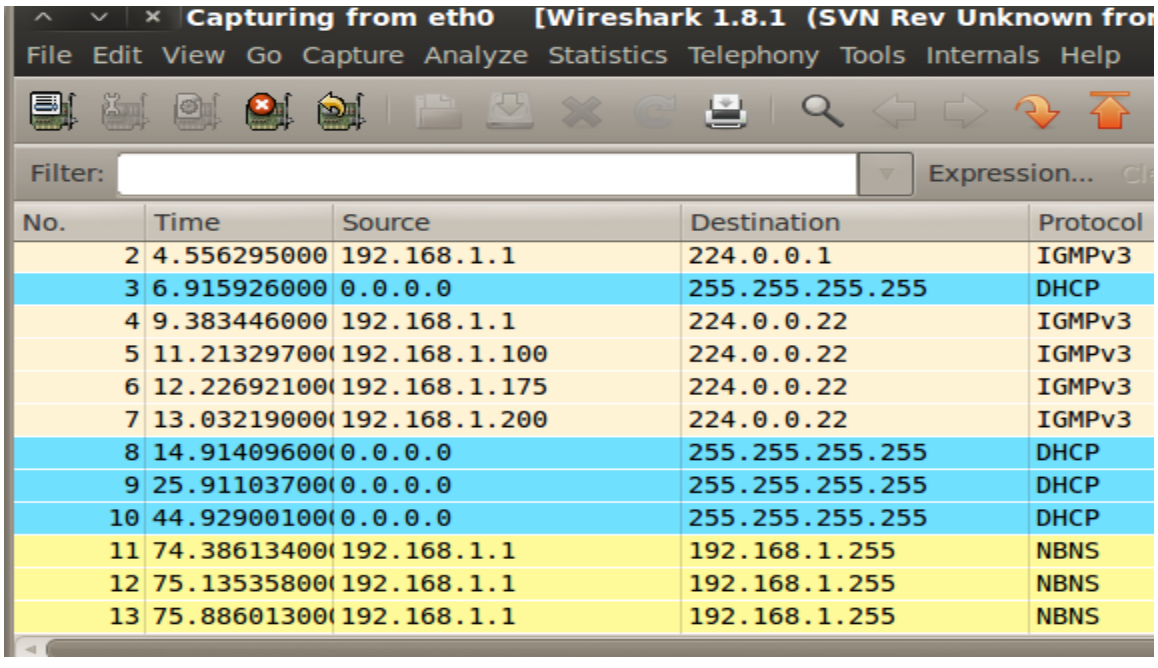


Figure 57: Passively Discovering IP addresses

There are also passive ways to discover information about hosts on the Internet. One way is to use a site that already aggregated the information you need. Sites, such as netcraft.com, will identify information such as the IP address, operating system, and version of the web server software that the remote host is utilizing.

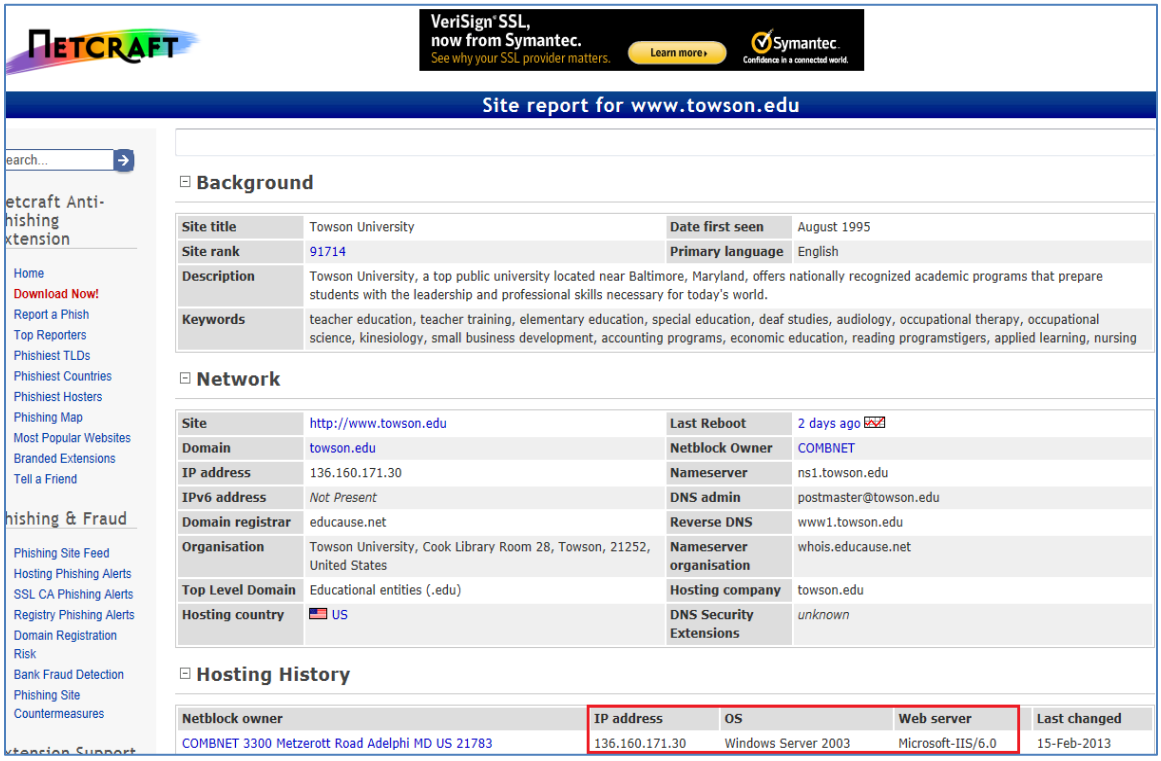


Figure 58: The Netcraft Website

3.2 Conclusion

While performing active reconnaissance against targets provides the attacker with valuable information, it can set off network sensors and be detected within logs. Passive reconnaissance gives an attacker the ability to gain information without being detected.

3.3 Discussion Questions

1. What is a good website to get information about the version of the operating system and the web server software that the site is utilizing?
2. What are two good tools that can be used to collect information passively?
3. What is the command to see all of the available options for tcpdump?
4. What type of traffic will you see when you listen on the network with Wireshark?

References

1. Wireshark:
   www.wireshark.org

2. tcpdump:
   http://www.tcpdump.org/

3. Banner Grabbing (Ethical Hack):
   http://www.firewalls.com/blog/banner_grab_ethical_hack/

4. Banner Grabbing:
   http://wcosughacking.blogspot.com/2011/06/banner-grabbing.html

5. Metasploit:
   www.metasploit.com

