# HOW TO HACK

# HACKING SECRETS EXPOSED

## A BEGINNER'S GUIDE

SRIKANTH RAMESH

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You implement all the information provided in this book at your own risk.

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# PREFACE

Congratulations on your purchase of "**Hacking Secrets Exposed: A Beginner's Guide**". This book will take you through the concepts of computer hacking in a very simple and easy to follow manner so that even the readers with no prior knowledge of hacking should be able to easily understand the concept. To start off, all you need is a little working knowledge of computers, operating system (Windows) and an Internet connection.

Many of the popular books that I have read on ethical hacking are mostly suitable only for those who already have a considerable amount of knowledge in the field. Also, these books dive too much into the theory part presenting the reader with lots of unnecessary explanation, thereby adding to the bulk of the book. This may cause the reader to gradually lose interest in the book or quit reading in the mid way.

So, I decided to come up with a book that demands no prior knowledge of the topic and is easy for the readers to follow and comprehend at every point. Instead of stuffing the book with conventional paragraphing kind of content, I prefer to present the topics in an easy to follow manner by including bullet points, illustrations and practical examples. This may keep the book slender but it still manages to effectively appeal to the reader's quest for knowledge. I have also decided to drop obsolete concepts and techniques from the book and only keep those that are active and feasible in the present day scenario.

When you finish reading this book, you should be able to apply the knowledge and skills that you have gained in many ways:

- You can *adopt the hacker's mindset* and start to think and react to situations and problems just like the hacker would do. After all, hacking is just a mindset more than a skill set!

- You should easily be able to *protect yourself* from all those wicked hackers out there by maintaining the security of your online accounts, web server or your own personal computer.

- This book *lays the foundation* required to start off your career as an ethical hacker where you can begin to apply the knowledge and skills in your profession.

## HOW TO USE THIS BOOK?

This book will cover the concepts of computer hacking for both *Windows* and *Linux* operating systems. For Windows based practical examples and illustrations, I have used my **Windows 8.1** PC. For Linux based examples I have used **Kali Linux 1.0.9a** live DVD. Since most examples are not specific of the operating system version, you can implement them on any version of Windows and Linux installed on your computer.

Each chapter including all the concepts presented in this book are laid out in a hierarchical

manner where one concept forms the foundation for the other. This may not be true for every chapter but in many cases the concepts discussed in the earlier part of the book may seem to form the key elements in understanding the subsequent concepts. Therefore, I recommend reading this book in an orderly manner and not skip the concepts or chapters in between.

Throughout this book, you will be presented with many illustrative examples, analogies and eye-catching diagrams that will not only make the whole understanding process easier, but also makes the learning process a fun! I hope you like this book and enjoy the concepts presented in it.

# Chapter 1 - Introduction

I bet most of you are really excited to get started. But, before we actually move on to learning how to hack, let us begin to understand what hacking really means.

# WHAT IS HACKING?

In the field of computer security, hacking simply refers to the act of exploiting the weakness that exists in a computer system or a computer network.

In other works, a hacker is someone who has developed a deeper interest in understanding how the computer system or the software program works, so that he can take control of the computer by exploiting any of the existing vulnerabilities in it.

# HACKER CLASSIFICATION

Based on the attitude and skill level they possess, hackers are classified into the following types:

- *White Hat* **Hacker**: A *white hat* hacker (also known as **ethical hacker**) is someone who uses his skills only for defensive purposes such as penetration testing. These type of hackers are often hired by many organizations in order to ensure the security of their information systems.

- *Black Hat* **Hacker**:  A *black hat* hacker (also known as **cracker**) is someone who always uses his skills for offensive purposes. The intention of black hat hackers is to gain money or take personal revenge by causing damage to information systems.

- *Grey Hat* **Hacker**:  A *grey hat* hacker is someone who falls in between the *white hat* and *black hat* category. This type of hacker may use his skills both for defensive and offensive purposes.

- **Script Kiddie**: A *script kiddie* is a wannabe hacker. These are the ones who lack the knowledge of how a computer system really works but use ready-made programs, tools and scripts to break into computers.

# ESSENTIAL TERMINOLOGIES

Before proceeding further, the following are some of the essential terminologies in the field of hacking that one should be aware of:

- **Vulnerability:** A *vulnerability* is an existing weakness that can allow the attacker to compromise the security of the system.

- **Exploit:** An *exploit* is a defined way (piece of software, set of commands etc.) that takes advantage of an existing vulnerability to breach the security of an IT system.

- **Threat:** A *threat* is a possible danger that can exploit an existing vulnerability to cause possible harm.

- **Attack:** An *attack* is any action that violates the security of the system. In other words, it is an assault on the system security that is derived from an existing threat.

# HACKING FAQS

Here is a small list of some of the *frequently asked questions* about hacking:

## How long does it take to become a hacker?

Hacking is not something that can be mastered overnight. It really takes quite some time to understand and implement the skills that actually put you in the hacker's shoes.

So, for anyone who is wanting to become a hacker, all it takes is some creativity, willingness to learn and perseverance.

## What skills do I need to become a hacker?

In order to become a hacker, it is essential to have a basic understanding of how a computer system works. For example, you may start off with basics of operating system, computer networks and some programming.

At this point in time, you need not worry much about this question as this book will take you through all those necessary concepts to establish the skills that you need to possess as a hacker.

## What is the best way to learn hacking?

As said earlier, the best way to learn hacking is to start off with the basics. Once you have established the basic skills, you can take it even further by going through the books that discuss individual topics in a much detailed fashion. Do not forget the power of Internet when it comes to acquiring and expanding your knowledge.

# Chapter 2 - Essential Concepts

Now, let us begin to understand some of the basic concepts that are essential in laying the groundwork for our journey of learning how to hack. Before actually jumping into the hands-on approach, it is highly necessary for one to have a thorough understanding of the basics of computer network and their working model. In this chapter you will find a brief description of various concepts and terminologies related to computer networks, encryption and security.

# COMPUTER NETWORK

A *computer network* is a group of two or more computers linked together so that communication between individual computers is made possible. Some of the common types of computer network include:

## Local Area Network (LAN)

This is a type of computer network where interconnected computers are situated very close to each other say for example, inside the same building.

## Wide Area Network (WAN)

This is a type of computer network where interconnected computers are separated by a large distance (a few km to few hundreds of km) and are connected using telephone lines or radio waves.

## Internet

The *Internet* is the largest network which interconnects various LANs and WANs. It is a global system of various interconnected computer networks belonging to government or private organizations.

# NETWORK HOST

A *network host* (or simply referred to as a host) can be any computer or network device connected to the computer network. This computer can be a terminal or a web server offering services to its clients.

# NETWORK PROTOCOL

A *network protocol* (or just referred to as protocol) is a set of rules and conventions that are necessary for the communication between two network devices. For example, two computers on a network can communicate only if they agree to follow the protocols.

The following are some of the most widely referred network protocols:

## Internet Protocol (IP Address)

An *Internet Protocol* address (*IP* address) is a unique number assigned to each computer or device (such as printer) so that each of them can be uniquely identified on the network.

## Types of IP Address:

**Private IP Address:** A *private IP address* is the one that is assigned to a computer on the Local Area Network (LAN). A typical example of private IP address would be something like:

192.168.0.2

**Public IP Address:** A *public IP address* is the one that is assigned to a computer connected to the Internet. An example public IP address would be something like:

59.93.115.125

In most cases a computer gets connected to the ISP network using a private IP. Once a computer is on the ISP network it will be assigned a public IP address using which the communication with the Internet is made possible.

## How to Find the IP Address of a Computer?

Finding your public IP is extremely simple. Just type "what is my IP" on Google to see your public IP address displayed in search results.



Figure 2. 1

In order to find your private IP, just open the command prompt window (type **cmd** in the "Run" box) and enter the following command:
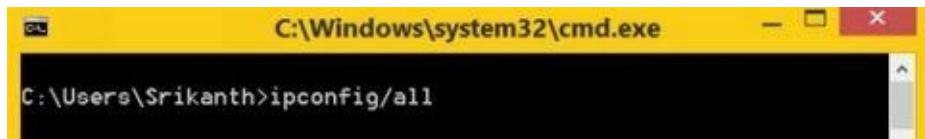
Figure 2. 2

This will display a long list of details about your computer's network devices and their configuration. To see your private IP address, just scroll down to find something as "IPv4 Address" which is nothing but your private IP.



Figure 2. 3

# Hyper Text Transfer Protocol (HTTP)

The *Hyper Text Transfer Protocol* provides a standard for communication between web browsers and the server. It is one of the most widely used protocol on the Internet for requesting documents such as web pages and images.

**Example: http://www.example.com**

# File Transfer Protocol (FTP)

The *File Transfer Protocol* provides a standard for transferring files between two computers on the network. FTP is most widely used in carrying out upload/download operations between a server and a workstation.

**Example:ftp://www.example.com**

# Simple Main Transfer Protocol (SMTP)

The *Simple Mail Transfer Protocol* provides a standard for sending e-mails from one server to another. Most e-mail systems that send mail over the Internet use SMTP to exchange messages between the server.

# Telnet

*Telnet* is a network protocol that allows you to connect to remote hosts on the Internet or on a local network. It requires a telnet client software to implement the protocol using which the connection is established with the remote computer.

In most cases telnet requires you to have a *username* and a *password* to establish connection with the remote host. Occasionally, some hosts also allow users to make

connection as a **guest** or **public**.

After the connection is made, one can use text based commands to communicate with the remote host. The syntax for using the telnet command is as follows:

<span style="color:red">**telnet &lt;hostname or IP&gt; port**</span>

**Example:**<span style="color:red">**telnet 127.0.0.1 25**</span>

## SSH (Secure Shell)

*SSH* is a protocol similar to telnet which also facilitates connection to remote hosts for communication. However, SSH has an upper hand over telnet in terms of security. Telnet was primarily designed to operate within the local network and hence does not take care of security. On the other hand SSH manages to offer total security while connecting to remote hosts on a remote network or Internet.

Akin to telnet SSH also uses a client software and requires a *username* and *password* to establish connection with the remote host.

# NETWORK PORT

A computer may be running several services on it like HTTP (web server), SMTP, FTP and so on. Each of these services are uniquely identified by a number called *network port* (or simply referred to as *port*). If a computer wants to avail a specific service from another computer, it has to establish a connection to it on the exact port number where the intended service is running.

For example, if a terminal is to request a web document from a remote server using HTTP, it has to first establish a connection with the remote server on port 80 (HTTP service runs on port 80) before placing the request.

In simple words, port numbers can be compared to door numbers where each door grants access to a specific service on a computer. The following table shows a list of popular services and their default port numbers:

| Name of Service/Protocol | Port Number |
|:---:|:---:|
| HTTP | 80 |
| FTP | 21 |
| SMTP | 25 |
| TELNET | 23 |
| SSH | 22 |

Table 2. 1

# NETWORK PACKET

A *network packet* (data packet, datagram or simply called as packet) is a basic unit of data sent from one host to another over a network. When data (such as a mail, message or a file) has to be transmitted between two hosts, it is fragmented into small structures called packets and are reassembled at the destination to make the original data chunk.

Each packet consists of the fragmented data along with the necessary information that will help it get to its destination such as the *sender's IP* address, intended *receiver's IP* address, *target port* number, the *total number of packets* the original data chunk has been broken into and the *sequence number* of the particular packet.

# DOMAIN NAME SYSTEM (DNS)

A *Domain Name System* or *Domain Name Service* (DNS) is a network protocol whose job is to map domain names such as "gohacking.com" to its corresponding IP address like "104.28.6.51".

Since Internet is the mother of millions of computers  each having a unique IP address, it becomes impossible for people to remember the IP address of each and every computer they want to access. So, in order to make this process simpler the concept of domain names was introduced. As a result users can easily access any website just by typing their domain names in the browser's address bas such as "google.com" or "yahoo.com" without having to remember their actual IP addresses.

However, since the network protocol understands only the IP address and not the domain names, it is necessary to translate the domain name back to its corresponding IP address before establishing a connection with the target server. This is where DNS comes in handy.

Your Internet Service Provider has a DNS server which maintains a huge record of existing domain names and their corresponding IP addresses. Each time you type the URL such as "http://www.google.com" on your browser's address bar, your computer will use the DNS server from the ISP and translates the domain name "google.com" to its corresponding IP address to make a connection with the Google's server. All this process will happen in a split second behind the scenes and hence goes unnoticed.

## How DNS Works?

Let us understand the working of *Domain Name System* using the following example:

Whenever you type a URL such as "http://www.gohacking.com" on your browser's address bar, your computer will send a request to the *local name server* (the ISP DNS server) to resolve the domain name to its corresponding IP address. This request is often referred to as a **DNS query**.

The local name server will receive the query to find out whether it contains the matching name and IP address in its database. If found, the corresponding IP address (response) is returned. If not, the query is automatically passed on to another DNS server that is in the next higher level of DNS hierarchy. This process continues until the query reaches the DNS server that contains the matching name and IP address. The IP address (response) then flows back the chain in the reverse order to your computer. The following figure 2.4 illustrates the above process.
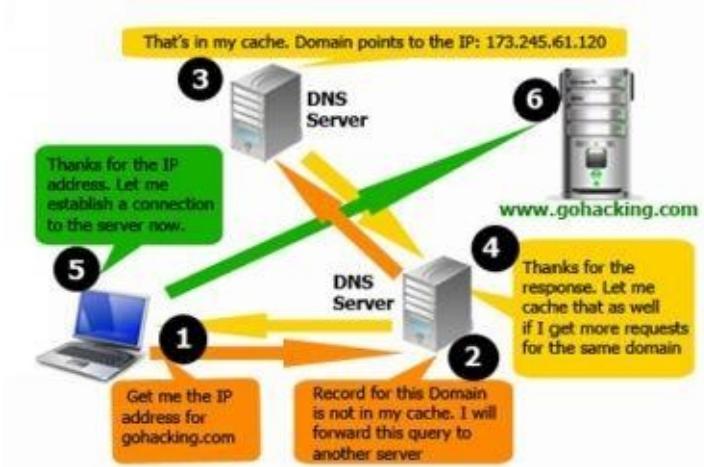
**Figure 2. 4**

# FIREWALL

Firewalls are basically a barrier between your computer (or a network) and the Internet (outside world). A firewall can be simply compared to a security guard who stands at the entrance of your house and filters the visitors coming to your place. He may allow some visitors to enter while deny others whom he suspects of being intruders. Similarly a firewall is a software program or a hardware device that filters the information (packets) coming through the Internet to your personal computer or a computer network.

## How Firewall Works?

Firewalls may decide to allow or block network traffic between devices based on the rules that are pre-configured or set by the firewall administrator. Most personal firewalls such as Windows firewall operate on a set of pre-configured rules which are most suitable under normal circumstances, so that the user need not worry much about configuring the firewall. The operation of firewall is illustrated in the below figure 2.5.
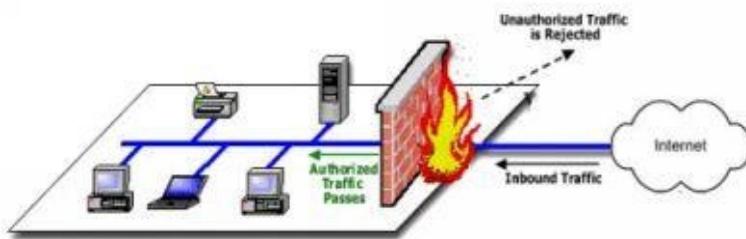


Figure 2. 5

Personal firewalls are easy to install and use and hence preferred by end-users to secure their personal computers. However, in order to meet customized needs large networks and companies prefer those firewalls that have plenty of options to configure.

For example, a company may set up different firewall rules for FTP servers, telnet servers and web servers. In addition, the company can even control how the employees connect to the Internet by blocking access to certain websites and restricting the transfer of files to other networks. Thus, in addition to security, a firewall can give the company a tremendous control over how people use their network.

Firewalls use one or more of the following methods to control the incoming and outgoing traffic in a network:

1. **Packet Filtering:** In this method, packets (small chunks of data) are analyzed against a set of **filters**. Packet filters has a set of rules that come with accept and deny actions which are pre-configured or can be configured manually by the firewall administrator. If the packet manages to make it through these filters then it is allowed to reach the destination; otherwise it is discarded.

2. **Stateful Inspection:** This is a newer method that doesn't analyze the contents of the

packets. Instead, it compares certain key aspects of each packet to a database of trusted source. Both incoming and outgoing packets are compared against this database and if the comparison yields a reasonable match, then the packets are allowed to travel further. Otherwise they are discarded.

## Firewall Configuration:

Firewalls can be configured by adding one or more filters based on several conditions as mentioned below:

1. **IP addresses:** In any case, if an IP address outside the network is said to be unfavourable, then it is possible to set filter to block all the traffic to and from that IP address. For example, if a certain IP address is found to be making too many connections to a server, the administrator may decide to block traffic from this IP using the firewall.

2. **Domain names:** Since it is difficult to remember the IP addresses, it is an easier and smarter way to configure the firewalls by adding filters based on domain names. By setting up a domain filter, a company may decide to block all access to certain domain names, or may provide access only to a list of selected domain names.

3. **Ports/Protocols:** If the services running on a given port is intended for the public or network users, they are usually kept open. Otherwise they are blocked using the firewall so as to prevent intruders from using the open ports for making unauthorized connections.

4. **Specific words or phrases:** A firewall can be configured to filter one or more specific words or phrases so that both the incoming and outgoing packets are scanned for the words in the filter.

   For example, you may set up a firewall rule to filter any packet that contains an offensive term or a phrase that you may decide to block from entering or leaving your network.

## Hardware vs. Software Firewall:

Hardware firewalls provide higher level of security and hence preferred for servers where security has the top most priority. The software firewalls on the other hand are less expensive and hence preferred in home computers and laptops.

Hardware firewalls usually come as an in-built unit of a router and provide maximum security as it filters each packet at the hardware level itself even before it manages to enter your computer. A good example is the Linksys Cable/DSL router.

# PROXY SERVER

In a computer network, a **proxy server** is any computer system offering a service that acts as an intermediary between the two communicating parties, the client and the server.

In the presence of a proxy server, there is no direct communication between the client and the server. Instead, the client connects to the proxy server and sends requests for resources such as a document, web page or a file that resides on a remote server. The proxy server handles this request by fetching the required resources from the remote server and forwarding the same to the client.

## How Proxy Server Works?

An illustration of how a proxy server works is shown in the Figure 2.1.

As shown in the below example, whenever the client connects to a web proxy server and makes a request for the resources (in this case, "Sample.html") that reside on a remote server (in this case, xyz.com), the proxy server forwards this request to the target server on behalf of the client so as to fetch the requested resource and deliver it back to the client. An example of client can be a user operated computer that is connected to the Internet.
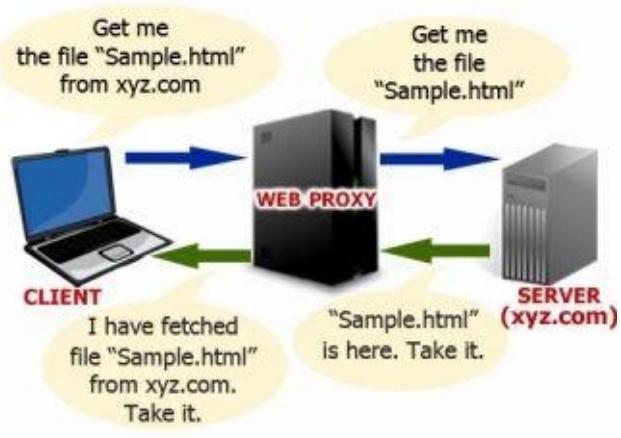


Figure 2. 6

A proxy server is most widely used to conceal the IP address or the origin of the Internet users during their activity. Since it the proxy server which handles the requests between the client and the target, only the IP address of the proxy server is exposed to the outside world and not the actual one. Therefore, most hackers use a proxy server during the attacks on their target so that it would be hard to trace back to them.

# Chapter 3 - Introduction to Linux

Linux is a UNIX-like operating system which is open-source and freely available for download. Compared to Windows operating system Linux is more secure, stable, reliable, multi-user capable and compatible with both server and desktop usage. This makes it one of the most popular operating system next to Windows.

## WHY LINUX?

As an ethical hacker, it is most essential to have a sound understanding of the Linux platform, its usage and commands. Linux is widely recognized as the "hacker's operating system" and if you are wondering why, the reasons are below:

- Since it is a freeware, highly secure and stable operating system, millions of servers on the Internet runs on Linux.

- Unlike Windows OS which is built on graphical user interface (GUI), Linux is built on command user interface (CUI) and thus offers greater control and customization options for hackers.

- Some of the best hacking scripts and programs are designed only for Linux.

# WINDOWS VS. LINUX

It is no doubt that Windows is the most popular desktop operating system known for its user friendliness and graphical user interface. As a result, most computer users across the world are familiar with the Windows operating system but are new to Linux. If you are fairly new to Linux and are wondering what's the difference between Windows and Linux, here is a quick comparison between the two:

### Comparison between Windows and Linux

| Windows | Linux |
|---|---|
| Known for its user friendliness and ease of use. | Known for its security, stability, flexibility and portability. |
| Widely used for desktop usage by home and office users. | Widely used for server usage by enterprise and corporations. |
| The operating system is mainly based on graphical user interface (GUI). | The operating system is mainly based on command user interface (CUI). |
| Designed to operate with only one user at a time. | Designed to support simultaneous multi-user operation. |
| More than 70,000 viruses are reported for Windows till date. | Only around 80-100 viruses are reported for Linux till date and hence more secure. |
| Since it is based on **GUI** it is easy for users to learn and operate. | Since it is based on **CUI** it is somewhat difficult for users to learn and operate. |
| Comes as commercial product and hence available only on purchase. | Comes as an open-source and hence freely available. |
| Examples of Windows based OS include **Windows 2000**, **XP**, **Vista**, **7** and **8.** | Examples of Linux based OS include **Ubuntu**, **Fedora**, **Red Hat**, *Debian*, **CentOS** etc. |

Table 3. 1

# CHOOSING A LINUX DISTRIBUTION

A Linux distribution is a collection of software and applications compiled around the Linux kernel (central component of the operating system). You can choose from a wide variety of Linux distributions like **Ubuntu**, **Fedora** or **Debian** where each of them contain their own collection of software and applications but shares a common Linux kernel. As a beginner you can choose Ubuntu as it easy to install and user friendly. You can find the download link and installation guide from the official Ubuntu website for which the link is mentioned below:

**Official Ubuntu Website: [http://www.ubuntu.com/](http://www.ubuntu.com/)**

# RUNNING LINUX FROM A LIVE DISK

There are two ways to use a Linux operating system. One is to install the operating system on to the hard drive just like you do it for the Windows. However, this method requires a prior experience of installing and configuring the operating systems. If you are new to Linux or do not have a prior experience of OS installation, you can use a live disk option such as CD or DVD to run and use Linux. This in fact is a good alternative to installation and provides an easy way to get Linux running on your system without modifying any of its previous settings and existing file system. But this option does not save your work upon shutting down your computer and hence suitable only for usage like penetration testing and learning.

One of my favourite distribution for hacking and penetration testing is **Kali Linux.** This is based on Debian GNU/Linux platform and comes in the form of a live DVD with an option to install as well. You can download the *ISO image* for the DVD version freely from the Kali Linux official website. The link to the website is given below:

**Kali Website: [https://www.kali.org/downloads/](https://www.kali.org/downloads/)**

After the download is complete you can burn the ISO image onto the DVD using a free program like **ImgBurn**. This should give you a bootable live Kali DVD. For your reference, I have used the 64-bit **1.0.9a** version of the Kali Linux live DVD in all my examples and demonstrations throughout this book.

# LINUX BASICS

Linux operating system was developed in 1991 by *Linus Torvalds* when he was a student of Helsinki University, Finland. He posted about the source code that he developed in the Minix news group. The feedback was good and the source code started to spread around the world via FTP and over the years Linux became a very popular operating system. Today, many great network programs, security tools and servers including DNS, Email and Web server are being developed for Linux by programmers and hackers around the world.

## Linux System Organization

The functioning of Linux is organized in terms of the following layers as shown in the Figure below:

- **Hardware Layer** consists of the actual hardware devices like CPU, Memory, Hard Disk Drive etc.

- **Kernel** is the core component which lies at the heart of the operating system that directly interacts with the hardware using the machine language.



Figure 3. 1

- **Shell** (or the command interpreter) acts as a mediator that takes commands from the user and then conveys them to the kernel which ultimately executes them.

- **Tools and Applications** reside on the outer crust and gives user most of the functionalities of an operating system.

## Linux Directory Structure

A *directory structure* is the way in which the file system and its files of an operating system are displayed to the user. People who are new to the Linux operating system and the structure of its **File System** often find it troublesome and messed up in dealing with the files and their location. So, let us begin to explore some of the basic information about the Linux File System.

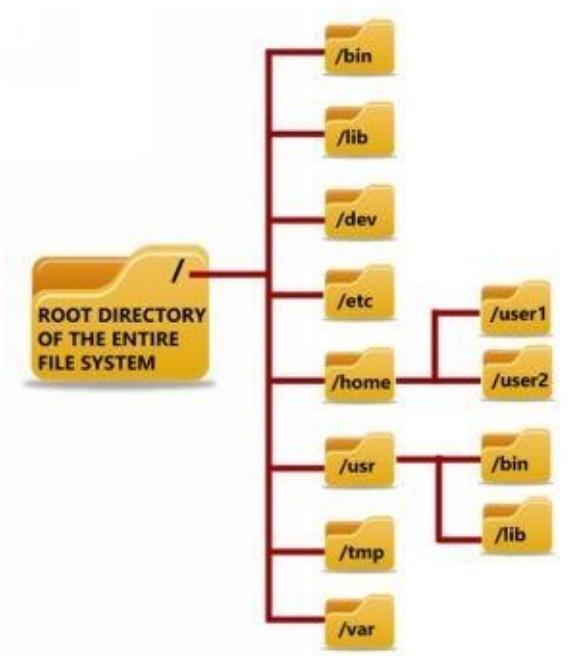Any standard Linux distribution has the following directory structure as shown below:



Figure 3. 2

Below is a brief description of the purpose and contents of each directory:

# / - ROOT Directory

Every single file and the directory of the Linux file system starts from the *root directory*. Only "root" user has the write privilege to this directory.

# /bin - Binaries

Contains executable binary files required for booting and repairing of the system. Also contains file and commands required to run in single user-mode such as: *ls, ping, grep* etc.

# /lib - System Libraries

Contains system libraries and kernel modules required for the booting of the system.

# /dev - Device Files

Contains device related files for all the hardware devices of the system.

# /etc - Configuration Files

Contains configuration files required by all programs. It also contains *start-up* and *shutdown* shell scripts used to *start* or *stop* individual programs.

## /home - Home Directories

This forms the "home directory" of individual users to store their personal information. Every time a new user is added, a new directory is created in the name of the user under "/home".

## /user - User Programs

This directory is used to store executable **binaries**, **documentation**, **source-code** files and **libraries** for second level programs.

## /tmp - Temporary Files

Contains temporary files for system and users.

## /var - Variable Files

Contains files whose size is expected to grow. Examples of such files include *log files, print queues*, *lock files* and *temp files*.

## Linux Commands

All commands in Linux are typed in lowercase and are case sensitive. Each Linux command has to be typed and executed in a window called "**terminal emulator**" or simply referred to as a **terminal**. It is a program similar to the *command prompt* of Microsoft Windows where a user can run the commands and get the results displayed. A terminal simply takes the user commands, passes it on to the shell for execution and displays the results back to the user.

To run commands in the terminal, you will have to first load the Linux from the Live DVD that you have created. To do this, just insert the Kali Linux DVD into the drive, boot from it and select the "Live option". Once the booting is completed you should see your desktop loaded on your screen.

To start the terminal window, just click **right-click** on the desktop and select the option **Open in Terminal** as shown in the below snapshot 3.1:
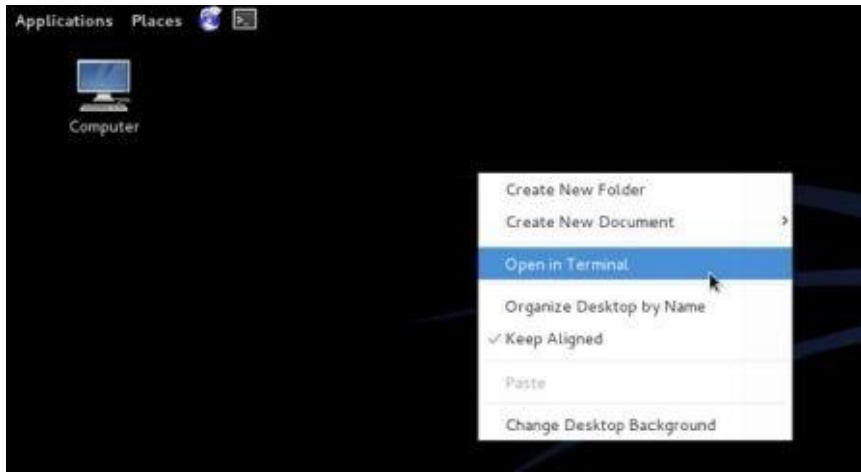
Figure 3. 3

Once the *terminal window* is loaded you should be able to start typing the commands. A snapshot of the *terminal window* is shown below:
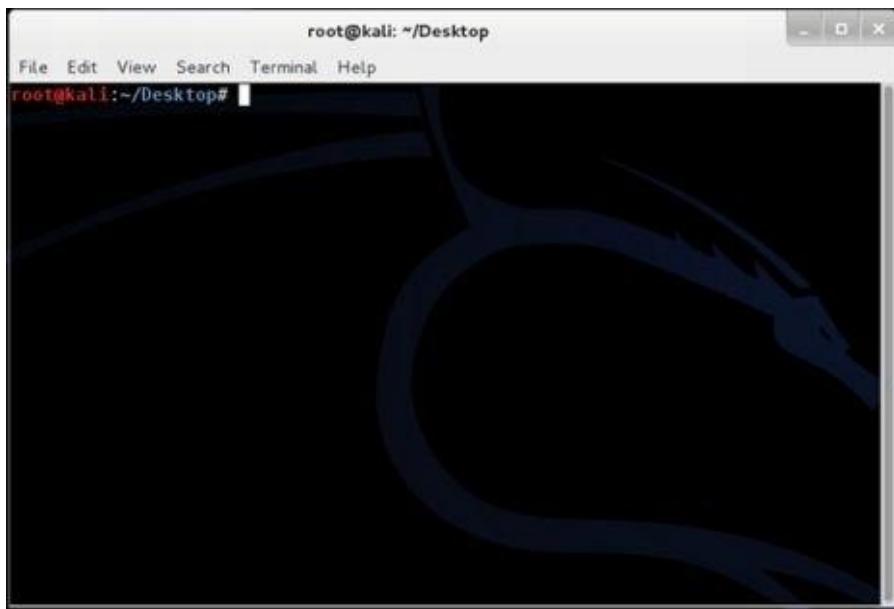


Figure 3. 4

# Creating Files

There are two commands for creating files: **touch** and **cat**. Here is how they are to be used:

# **touch** sample

This creates an empty file called "sample". If you want to create multiple empty files quickly it can be done as follows:

# **touch** sample1 sample2 sample3 sample4 sample5

In order to store a few lines of data onto the file just type the following command:

# **cat** > sample

When you press the **Enter** key, you will find the cursor positioned in the next line waiting for you to type the content that you want to store in the file "sample". Just type in the following line:

*This is a sample file containing some sample text.*

Once you are done, press **Ctrl+D**. This will save the contents onto the file and automatically take you back to the **#** prompt. Now, to display the contents of the file "sample" just type the command as follows:

**#** **cat** sample

This should display the contents of the file as shown in the snapshot below:

# Editing Files

To edit a given file one has to use the vi command. In order to edit a given file "sample" the command is as follows:

**#** **vi** sample

When you type the above command and hit **Enter**, you should see the contents of the file "sample" displayed in the vi editor window as shown in the Figure 3.6:
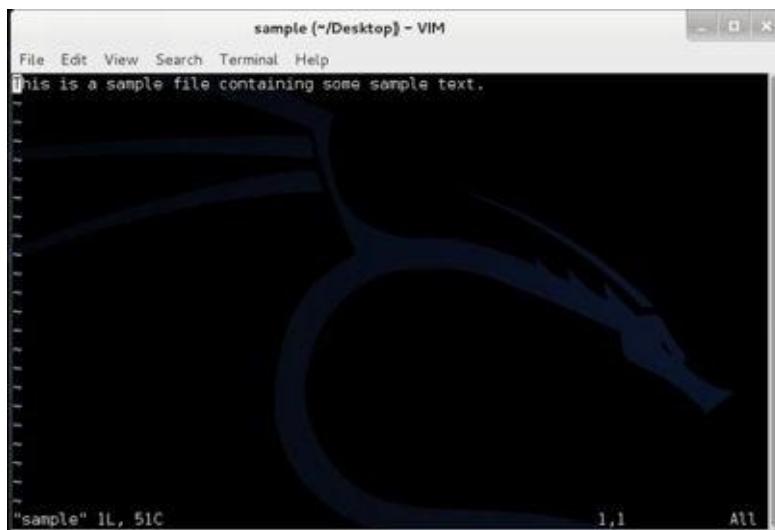


Figure 3. 6

In order to start your edit process you need to enter the **INSERT** mode by pressing the key **i**. Now, your cursor should move freely inside the editor window allowing you to make necessary changes to the content. Once you are done with the editing, press the **Esc** key. Now type **:wq** as shown in the below snapshot and hit **Enter**. The **w** stands for **write/save**

and **q** stands for **quit**. This should save changes to your file, close the vi editor and take you back to the **#** prompt. If you are to quit without saving changes just type **:q!** instead of :wq and hit **Enter**.
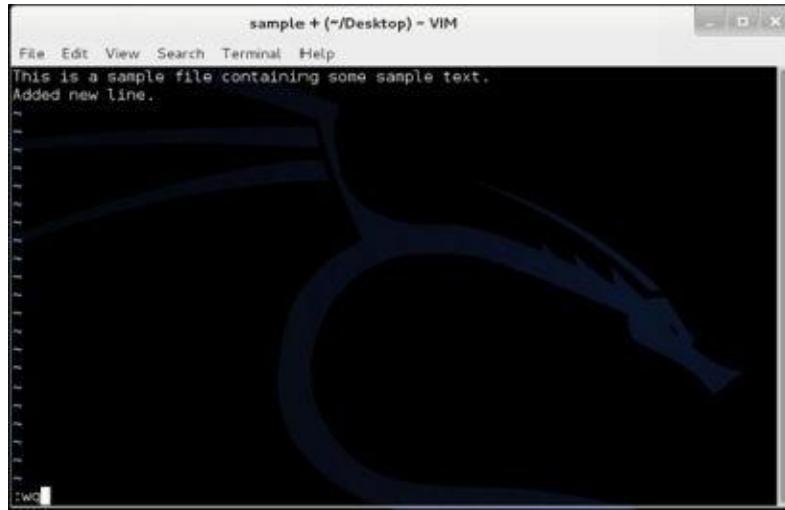


Figure 3. 7

# Listing Files and Directories

To display the list of files and directories the command used is **ls**. **ls** is the Linux equivalent of **DIR** command in Windows. To list the files and directories just type the following command and hit **Enter**.

# **ls**

# Deleting Files and Directories

In Linux rm command is used to delete files and directories. To delete a file use the command as shown below:

# **rm** samplefile

When you hit **Enter**, you are asked for delete confirmation. Just type **y** and hit **Enter** again. This should complete the deletion of the file "samplefile".

To delete a directory and all its contents use the following command:

# **rm -r** sampledir

When you hit **Enter**, you are asked for a delete confirmation. Just type **y** and hit **Enter** again. This should complete the deletion of the directory "sampledir" and all the contents inside it.

# Logging Out

Once you are done with your work, you can close the terminal window using the **exit** command as follows:

# **exit**

# Connecting to a Remote Host

So far we have discussed ways to execute commands on your own Linux computer. However, since Linux is a multi-user operating system it is possible for the users to connect to a computer running Linux even if they are miles away from its physical location. In this section we will discuss some of the ways through which you can connect to a remote computer and execute commands on it.

**SSH** (**Secure Shell**) is the most popular and the easiest way to accomplish this task. This is a protocol that allows a client to connect to a remote host and carry out operations on it.

## SSH on Linux

If you are on a Linux computer, connecting to another Linux computer is very easy. Just open the *Terminal* window and type the following command:

**Command Syntax:ssh** username@host

Here **username** means username of your account on the remote computer and **host** can be a *domain name* such as xyz.com or the *IP address* of the remote computer. The following examples make it more clear:

**#** **ssh** john@xyz.com

**#** **ssh** john@66.226.71.129

**#** **ssh** root@xyz.com

**#** **ssh** root@66.226.71.129

If the user exists on the target machine, the connection will be established and you will be asked to enter the *password*. Once you enter the password and hit **Enter** (password entered will be invisible due to security reasons), you will be granted access to the target Linux machine where you are free to execute any command on it as discussed in the previous section.

## SSH on Windows

You can connect to a remote Linux machine even if you are using a Windows computer. This can be done using a small freeware program called **PuTTY** which is an SSH client and a terminal emulator for Windows. You can download it from the link below:

**Download PuTTY: http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html**

After the download, double-click on the application **putty.exe**, enter the **hostname** or **IP** address of the target machine, select the **SSH** option and click on the button "Open" as shown in the below snapshot:
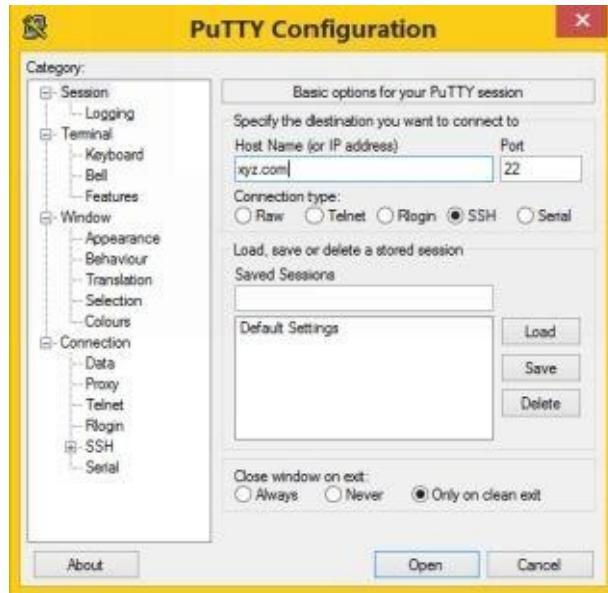
**Figure 3. 8**

This should establish the connection with the remote Linux machine and ask you to enter the *Login as* (username) followed by the *password* (will be invisible due to security reasons). Once you have entered the correct login details you will be able to execute commands on the target machine.

# FURTHER REFERENCES

This chapter has dealt with some of the basic concepts and command examples of Linux operating system so as to lay the groundwork for your further learning. In order to emerge as a professional hacker, it is necessary to have a sound understanding on Linux and master its commands. For this reason, I have a few recommendations for your further references.

Here is a list of some of the useful websites to expand your Linux knowledge:

- **Linux Official Website**

- **Free Linux Training**

- **Linux Knowledge Base**

- **Linux Visual Training**

Here is a list of some of the great books worth reading:

- **How Linux Works**

- **A Practical Guide to Linux Commands, Editors, and Shell Programming**

# Chapter 4 - Programming

The need to possess the knowledge of programming as a hacker is one of the most debated topics in the hacker's community. Even though the availability of a variety of ready-made tools on the Internet has considerably eliminated the need for programming, many still argue that having a knowledge of programming can be a great advantage for the hacker.

# WHY PROGRAMMING?

At this point you might be asking yourself: "Do I need to learn programming?" Well, this question is hard to answer as it all depends on individual goals. While some people hate programming and love to stick with readily available tools, there are a few who would like to give programming a try. Remember, it is still possible to be a fairly good ethical hacker without knowing any programming at all provided you really master the theoretical concepts of hacking and know how to use the tools effectively.

However, if you are to take my personal advice, I still recommend that you learn some basics of programming so that you will have a much better understating of the situations. A knowledge of programming can give you the following added benefits:

- You can code your own exploit for freshly discovered vulnerabilities without having to wait for someone to develop a tool.

- You can modify the existing source code to meet your customized needs.

- You will be regarded as an elite ethical hacker in the hacker's community.

- At last you can avoid people classifying you as a script kiddie.

# WHERE SHOULD I START?

If you are completely new to the world of computer programming, my recommendation is to start off with the basics such as learning programming languages like **C**, **HTML** (Hyper Text Markup Language), **PHP** and **JavaScript**. C is a wonderful programming language for beginners that plays a prominent role in establishing the foundation for learning other languages. The following are some of the freely available websites to learn C:

- **C Programming**

- **Learn-C**

- **C4Learn**

Once you are done with the basics of C, learning HTML**,** PHP and JavaScript becomes fairly simple. The following are the freely available websites to learn HTML, PHP and JavaScript:

- **HTML Tutorial w3schools**

- **PHP Tutorial w3schools**

- **JavaScript Tutorial w3schools**

In addition to free resources you can even consider purchasing books if you are more serious about programming. The following are few of the great books worth reading:

- **The C Programming Language**

- **HTML & CSS: A Beginner's Guide**

- **Programming PHP**

- **JavaScript for Beginners**

Once you have made up your mind, you can start to learn and practice programming as a separate journey without having to pause pursuing your hacking tutorials. In most circumstances ethical hacking or penetration testing is independent of programming and hence you can learn them simultaneously. If you are not yet ready for programming, you may even complete reading this book and later decide on programming.

# Chapter 5 - Footprinting

Before the real fun of hacking begins, there comes two important steps in the intelligence gathering process known as *footprinting* and *scanning* to be performed by the hacker. This chapter will deal with the *first* step called **footprinting** which simply means gathering information about the target.

# WHAT IS FOOTPRINTING?

**Footprinting** refers to the process of gathering information about a specific computer system or a network environment and the company it belongs to. This is the preparatory phase for the hacker where he gathers as much information as he can so as to find ways to intrude into the target. Footprinting can reveal the vulnerabilities of the target system and improve the ways in which they can be exploited.

Footprinting has to be done in a slow and methodological manner where the hacker spends 90% of his time in blueprinting the security profile of the target and only 10% in launching the attack. Footprinting can actually help hacker decide on the type of attack that is most suitable for the target.

# INFORMATION GATHERING METHODOLOGY

Suppose if a hacker decides to break into a target-company, he can only do so after blueprinting the target and assessing the possible vulnerabilities. Based on this information, the hacker can carry out possible attacks such as breaking into the company's database, hacking its website or causing denial of service. The following are some of the different types of information that a hacker could gather before actually carrying out the attack:

## Obtaining the Domain Name Information

Various background information about the target website (domain name) such as the name of its *owner* and *registrar, date of its registration, expiry date, name servers* associated, contact details associated with it such as *email, phone* and *address* can be found out by performing a **Whois lookup**. The following are some of the popular websites where you can perform Whois lookup on any domain to uncover its background information:

[http://www.whois.com/whois/](http://www.whois.com/whois/)

[https://who.is/](https://who.is/)

[http://whois.domaintools.com/](http://whois.domaintools.com/)

A sample Whois Lookup performed on "facebook.com" at [http://www.whois.com/whois/](http://www.whois.com/whois/) shows the following information:



Figure 5. 1

## Finding IP Address and Hosting Provider

Information such as the IP address of the website and its hosting provider can be very

crucial. This can be easily found out using the following website:

**WhoIsHostingThis:** **http://www.whoishostingthis.com/**

Just visit the above website and enter the domain name of your choice to obtain its IP address as well as the name of its hosting provider as shown below.



Figure 5. 2

As you can see from the above snapshot, a query on "facebook.com" reveals its *IP address*, *hosting provider* and also the *name servers* associated with it.

## Finding IP Address Location

Finding out the physical location of the IP address is very simple. Just visit the following website and enter the target IP address to reveal its physical location:

**IP2Location:** **http://www.ip2location.com/demo**

A snapshot of sample query for the IP address **173.252.120.6** on *ip2location.com* website is shown below:



Figure 5. 3

# Finding IP Address Range

While small websites may have a single IP address, big players such as Google, Facebook and Microsoft have a range of IP addresses allocated to their company for hosting additional websites and servers. This range of information can be obtained from the official website of **American Registry for Internet Numbers (ARIN)**. The URL for the ARIN website is listed below:

**ARIN Website:** **https://www.arin.net/**

Visit the above URL and insert the *IP address* of any given website in the "**Search Whois**" box found at the top right corner of the web page. Here is a snapshot showing the results of a sample query performed on the Facebook's IP address **173.252.120.6**.



Figure 5. 4

# Traceroute

**Traceroute** is a network diagnostic tool to identify the actual path (route) that the information (packets) takes to travel from source to destination. The source will be your own computer called *localhost*. The destination can be any host or server on the local network or Internet.

The traceroute tool is available on both Windows and Linux. The command syntax for Windows is as follows:

**tracert** target-domain-or-IP

The command syntax for Linux is as follows:

**traceroute** target-domain-or-IP

Usually, the transfer of information from one computer to another will not happen in a single jump. It involves a chain of several computers and network devices called *hops* to transmit information from source to destination. Traceroute identifies each hop on that list and the amount of time it takes to travel from one hop to another. A snapshot of the traceroute performed on "google.com" using a Windows computer is shown below:

As shown in the above snapshot, the traceroute tool identifies all the hops present in the path traversed by packets from source to destination. Here **192.168.0.1** is the private IP and **117.192.208.1** is the public IP of the source (my computer). **74.125.236.66** is the destination IP address (Google's server). All the remaining IP addresses shown in between the source and the destination belong to computers that assist in carrying the information.

## Obtaining Archive of the Target Website

Getting access to the archive of the target website will let you know how the website was during the time of its launch and how it got advanced and changed over time. You will also see all the updates made to the website, including the nature of updates and their dates. You can use the **WayBackMachine** tool to access the this information.

**WayBackMachine: http://archive.org/web/**

Just use the above link to visit the WayBackMachine website and type in the URL of the target website. You should get a list of archives of the website listed in a month by month and yearly basis as shown in the snapshot below:
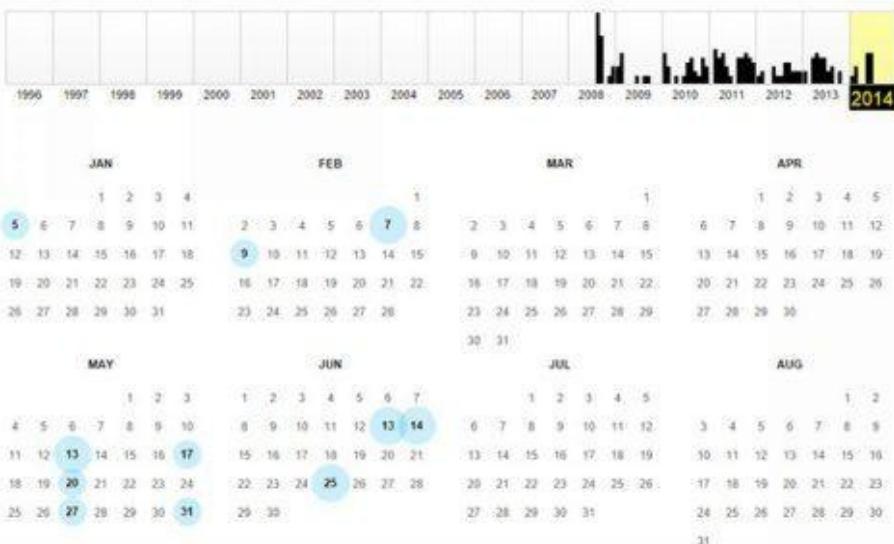
**Figure 5. 6**

# COUNTERMEASURES

I hope you are now aware of several ways using which you can successfully perform footprinting to gather a whole lot of information about the target. Once you are done with organizing the data that you have obtained through the footprinting process, you can sit back and analyze them to find out possible vulnerabilities in any of the technologies used in the website.

Many network administrators often fail to update vulnerable software and scripts running on their server to the latest version. This can open an opportunity for the hacker to exploit and gain access to the system. Therefore, it is important to identify and patch the existing vulnerabilities on a regular basis and also limit the amount of sensitive information leaked to the Internet.

# Chapter 6 - Scanning

After gathering  a variety of information about the target through *footprinting*, it is time to move on to the next step called **scanning**. Scanning is the second step in the intelligence gathering process of a hacker where information about specific IP addresses, operating systems, their architecture and services running on computers can be obtained. Unlike *footprinting* which gathers information passively from various third party sources, *scanning* involves actively engaging with the target to obtain information.

# DETECTING LIVE SYSTEMS

The first step in the process of scanning is to determine whether the target is alive or not. This can be done using the **ping** tool that is readily available on both Windows and Linux computers. Just open the command prompt if you are on Windows or terminal window if you are on Linux and type ping followed by the target IP address as shown below:

**ping** 173.252.120.6

If the target is alive and online, you should get a reply from the target or you if the target is not alive you will get a response saying "ping request cannot find the host".

## Angry IP Scanner

You can even ping a range of IP addresses all at once using a nice tool called "Angry IP Scanner". It is an open-source cross-platform network scanner tool packed with several useful features.

All you need to do is enter the *starting* and the *ending* IP of the range that you want to ping and click on the "Start" button as shown in the below figure. This should tell you which of those IPs are available and which are not.
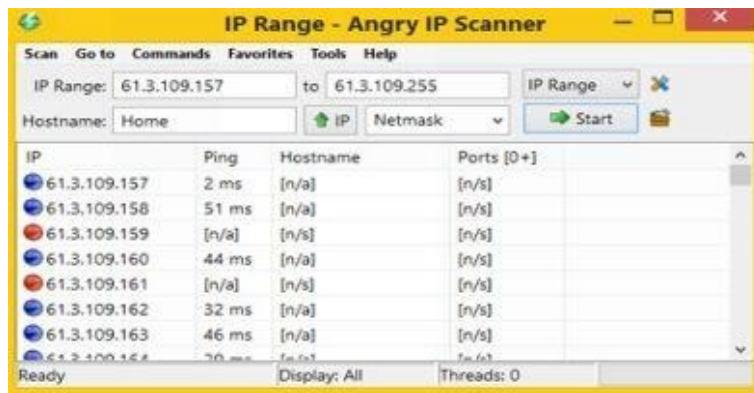


Figure 6. 1

Angry IP Scanner is available for both Windows and Linux operating systems and can be downloaded from the link below:

**Angry IP Scanner: http://angryip.org/download/**

## Online Ping Tool

If you would like to ping the target using a third party computer instead of yours, you can do so using online tools like **Just-Ping** which pings the target from 90 different geo locations worldwide. You can access Just-Ping tool from the link below:

**Just-Ping: http://cloudmonitor.ca.com/en/ping.php**

The following figure 6.2 on the next page shows a sample ping test conducted using the

**Just-Ping** tool:



Figure 6. 2

# TYPES OF SCANNING

Now, let us discuss one by one some of the different types of scanning that are in place.

## Port Scanning

**Port scanning** involves sending a series of messages to the target computer to discover the types of network services running on it. Since each service is associated with a "well known" port number, performing a port scan on the target will reveal the ports that are open. So, when a port is said to be open the service associated with it is said to be active and running, thereby opening up the opportunity for the attacker to break into it.

For example, if a port scan on the target shows that port 80 and port 25 are open, that means the target computer has a HTTP service (web server) and an SMTP service (email service) running on it respectively.

## Network Scanning

**Network scanning** is a procedure for identifying active hosts on the target network either for the purpose of attacking them or for security assessment. In this way it would be possible for the hacker to make a list of vulnerable hosts for direct attack or to use them indirectly to attack other hosts.

## Vulnerability Scanning

**Vulnerability scanning** involves the use of automated tools known as *vulnerability scanners* to proactively identify security vulnerabilities of computer systems in a network. These tools will scan the target to find out the presence of known flaws that are susceptible to exploits.

# TOOLS FOR SCANNING

The following are some of the popular tools available for scanning:

## Nmap

**Nmap** is a popular open-source tool for network discovery and security auditing that works on different platforms like Linux, Windows and Mac. It basically comes in the form of a command line interface; however, to facilitate the ease of use it is also available in a GUI format called **Zenmap**. For Windows machines, you can install the "self-installer" version of *Nmap* that comes in the ".exe" format. The download link for the same in available below:

**Nmap Download:** [http://nmap.org/download.html](http://nmap.org/download.html)

After installing the tool, run the desktop shortcut to open the *Zenmap* window which typically looks as shown below:
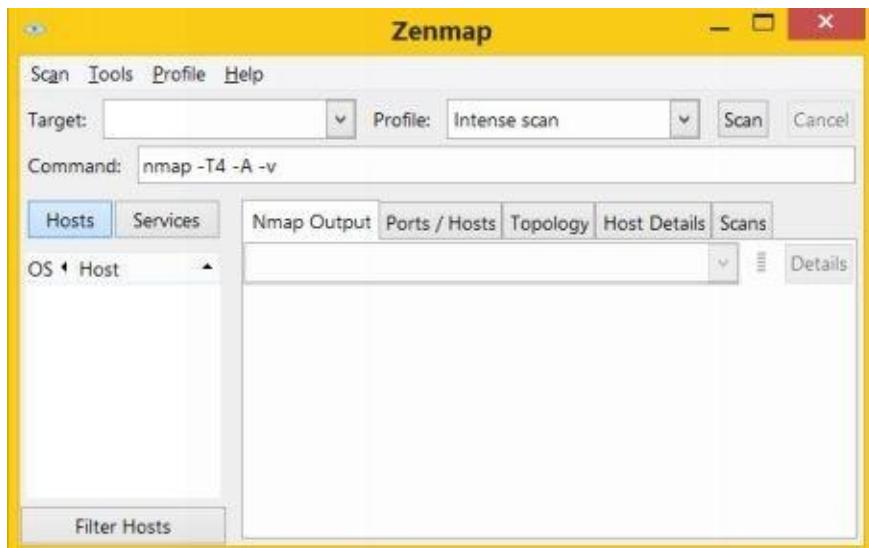


Figure 6. 3

The "Target" box needs to be filled with the target *IP address* or *domain name* on which you want to perform the scan. It also comes pre loaded with 10 different *scan profiles* that you can select from.

## Intense Scan

This scan type should be reasonably quick as it only scans TCP ports. Additionally, it makes an attempt to detect the OS type, various services and their version numbers that are running on the target machine.

## Intense Scan Plus UDP

It is the same *Intense scan* as described above but also includes scanning of UDP ports.

## Intense Scan, all TCP Ports

Unlike the normal *Intense scan* which only scans a list of 1000 most common ports, the "*Intense scan, all TCP ports*" scans all available 65535 ports.

## Intense Scan, No Ping

This option will exclude pinging the target from the *Intense scan*. You may use this option when you already know that the target is up or is blocking ping requests.

## Ping Scan

This option will only ping the target but does not perform port scanning of any type.

## Quick Scan

Scans faster than the *Intense scan* by limiting the number of TCP ports scanned to only the top 100 most common TCP ports.

## Quick Scan Plus

*Quick scan plus* adds OS detection and a bit of version detection features to *Quick scan*.

## Quick Traceroute

This option will show you the route that the packets take to reach the target starting with the localhost (source or your own computer).

## Regular Scan

This will perform the ping and TCP port scan of 1000 default ports on the target.

## Slow Comprehensive Scan

This scan will try all possible options to uncover as much information as it can about the target. It uses three different protocols: TCP, UDP and SCTP in order to detect hosts.

Out of all the 10 scanning options, I reckon *Intense Scan* to be appropriate under most conditions. Just fill the "Target" box, select the "Intense scan" profile and hit the "Scan" button. Let us now analyze the Nmap result output by running it on a sample target.

After the scan is completed the "Nmap Output" tab displays the raw output of all the scan operations such as the *date and time* it was performed, the results from *ping scan*, discovered *open ports, target OS* and *traceroute results* as shown below:

Figure 6. 4

The other tabs split the same results into an organized manner so as to display them in a more user friendly manner using GUI interface. The "Ports/Hosts" tab will display a list of discovered ports, their status as to whether they are closed or open, the protocol associated and the services running on them. A snapshot of the sample output is shown below:



Figure 6. 5

The "Topology" tab displays the result of *traceroute* command in a graphical manner showing each *hop* involved in the path.

**Figure 6. 6**

The "Host Details" tab shows the status of the host, its name, number of ports scanned, uptime, last boot time, type of operating system running including its version number and many other details as shown in the below figure:



**Figure 6. 7**

# NetScanTools Pro

**NetScanTools Pro** is another wonderful program for Windows that has a powerful set of over 50 network tools including both automated and manual ways to retrieve information from the target.
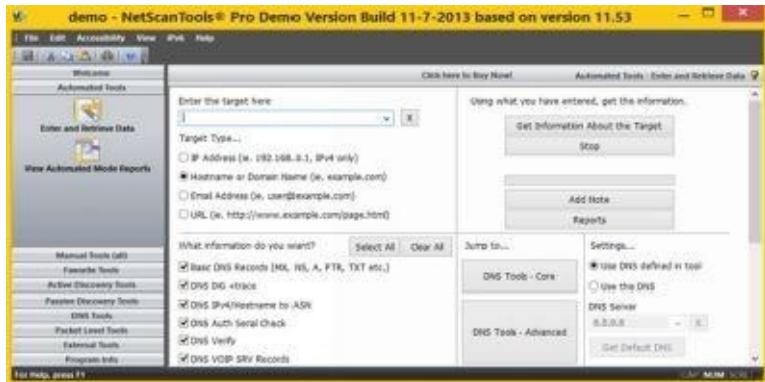
You can use the "Automated Tools" to quickly perform port scan and grab vital information about the target such as DNS records, Whois data, Traceroute details all from a single place. On the other hand the "Manual Tools" section contains individual tools specially crafted to give more control in the scanning process for advanced users.

## Online Tools

You can also make use of online tools to perform port scan and discover important information about the target. The following are some of the links useful online network tools that are worth considering:

- **PenTest-Tools**

- **YouGetSignal**

## Other Popular Tools

Here is a list of some of the other popular tools that you may want to explore:

- **SuperScan**

- **ipEye**

# OS FINGERPRINTING

**OS fingerprinting** is the process of detecting the operating system of the target host or a network. The following are some of the commonly used OS fingerprinting methods.

## Active Fingerprinting

**Active fingerprinting** is the method in which specially crafted packets are sent to the target system and the response is noted. Since different operating systems respond to source packets in different ways, this response can be analyzed to determine the target OS. One of the simple example is the use of *Nmap tool* as discussed in the previous section which employs *active fingerprinting* method to determine the target OS.

## Banner Grabbing

Another commonly used method of active fingerprinting is called **banner grabbing**. This can be done using a simple tool called **telnet**. Telnet is readily available on Windows XP and previous versions. For Windows Vista, 7 and 8 machines you need to activate the in-built telnet tool before you can use it. Just search for "how to enable telnet on windows" on Google to find detailed instructions for enabling telnet client on your computer.

Once you have enabled the telnet client on your computer, banner grabbing is pretty simple. Just type the following command in the command prompt to detect the operating system running on the target:

**telnet** target-domain-or-IP 80

This will open the connection with the target. Next type the text exactly as follows **HEAD / HTTP/1.1** and hit the **Enter** key twice. This should fetch results where there is a possibility of the target OS being mentioned as shown in the below figure.
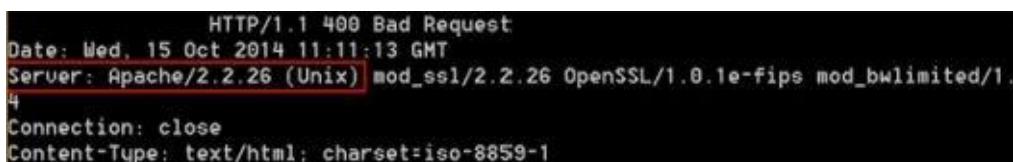


Figure 6. 9

## Passive Fingerprinting

**Passive fingerprinting** is a technique that uses indirect methods to determine the target operating system. Unlike active fingerprinting which sends packets to the target, passive fingerprinting on the other hand uses sniffing technique to analyze the target network traffic and determine the operating system. It is less accurate than active fingerprinting. You can use online tools like **Netcraft** to perform passive fingerprinting.

**Netcraft Tool:** http://toolbar.netcraft.com/site_report

Just visit the above link to access the Netcraft tool and enter the target domain or IP

address to know the target operating system, possible vulnerabilities, its risk rating and other useful information.

# CONCEALING YOUR IDENTITY

Concealing you true identity during the processes like footprinting and scanning is very much necessary as there is a real chance of the target tracing back to you. Some of the methods that you can employ to conceal your identity are discussed below.

## Using a Proxy

A proxy server can be used to conceal your real IP address while performing scanning and hack attempts on the target. Since the IP address tells everything about you, concealing it using a proxy can be highly effective in hiding your origin.

Even though there are different types of proxies available, I recommend using a VPN proxy service to hide your IP address. VPN services are fast and provide reliable ways not only to hide your IP address but also to protect your data and identity over the Internet. Here are a few popular VPN services that you can try:

- **HideMyAss Proxy**

- **VyprVPN Proxy**

Alternatively you can also use a chain of public proxies to further enhance your stealth operation using free tools like **Proxifier** and **SocksChain**. Please note that using public proxies can slow down your speed and hence VPN proxies are more recommended as they best serve the purpose.

The other way to hide your identity is by using online tools for pinging and scanning the target. During the use of online tools, the IP address of the server hosting the tools is exposed to the target and not the one that belongs to the actual attacker.

Once you have gathered a long list of information about the target through *footprinting* and *scanning*, it is time to analyze them for possible vulnerabilities in the operating system, technologies or services running on the target. You can make use of the following websites to find information about latest vulnerabilities and exploits:

1. **http://www.securiteam.com**

2. **http://www.zone-h.org**

3. **http://www.securityfocus.com**

4. **http://www.packetstormsecurity.com**

5. [http://www.cybercrime.gov](http://www.cybercrime.gov)

## COUNTERMEASURES

So far, you have learnt different scanning techniques to discover information about the target. Now let us look into some of the countermeasures that one can take to prevent vital information from leaking into the hands of an attacker.

- Configure web servers to prevent information leakage.

- Disable unwanted/unused services and protocols.

- Use an Intrusion Detection System (IDS) to detect and log port scans.

# Chapter 7 - Hacking Passwords

Password hacking is one of the hottest and most widely discussed topics in the field of computer hacking. In today's world, passwords alone play a key role in deciding the security of a web server or any other computer system. As a result, hacking the password is one of the easiest and sometimes the only way to gain access to the system. In this chapter, you will be introduced to various password hacking techniques that are frequently used in the hacking industry.

To begin with, I will let you know some of the obvious, simple yet effective techniques to hack passwords:

1. **Social Engineering:** This type of technique involves psychological manipulation of people into performing actions that lead to the disclosure of their confidential information. In other words, social engineering is just a trick played by the hacker to gain the trust of people so that they reveal the password by themselves.

- **Scenario-1:** The hacker may call the target person by pretending himself as a bank official and ask him to confirm his password stating that this has to be done as a part of an ongoing verification program. In most cases, the target person on the other end believes this and reveals his password to the hacker.

- **Scenario-2:** In order to avoid suspicion, instead of directly asking the victim to reveal the password, the hacker may obtain other vital information such as the "Date of Birth", "Place of Birth", "High School Details" etc. from the target person. Using these details, the hacker can easily reset the password and gain unauthorized access.

  Even though social engineering seems simple, it is proven that most people would easily fall victim to this attack. Lack of awareness among people is the prime reason for the success behind this trick.

2. **Guessing:** As most people are known to use easy to remember words such as their "pet's name", "phone number", "child's name" etc. as their passwords, it is often possible for the hacker to easily guess the password.

3. **Shoulder surfing:** It is the act of spying on one's keyboard from behind the shoulders as a person types his/her password. This technique works well particularly in crowded areas such as cyber cafes and ATMs where people are usually unaware of what is happening behind their shoulders.

After understanding some of the simple password hacking techniques, it is time to move on to the next level. Now, let us jump into some of the serious methods that hackers use to crack passwords:

# DICTIONARY ATTACK

A **dictionary attack** is a type of password cracking technique where a long list of words from the dictionary is repeatedly tried against the target until the right match is found. This technique can be used to crack passwords that contain words found in the dictionary.

Generally, the success of a dictionary attack is based on the fact that most people have a tendency to use easy to remember passwords that are found in the dictionary. However, if one uses a strong password with a combination of alphabets and numbers or introducing a slight variation to the actual spelling would make it impossible for the dictionary attack to crack such passwords.

One of my favourite tool to carry out the dictionary attack is **Brutus**. It is a remote online password cracker that works on Windows platform and can be downloaded from the following link:

**Brutus Download:** http://www.hoobie.net/brutus/

**NOTE:** Some antivirus programs are known to have conflict with the *Brutus* application. So, it is recommend that you temporarily disable your antivirus before running the *Brutus* application.

Now, let me give you a small demo on how to use *Brutus*. Here is a step-by-step procedure:

1. After downloading the tool from the above link, unzip the package into a new empty folder.

2. Run the "BrutusA2.exe" file to open the application as shown in the figure below:
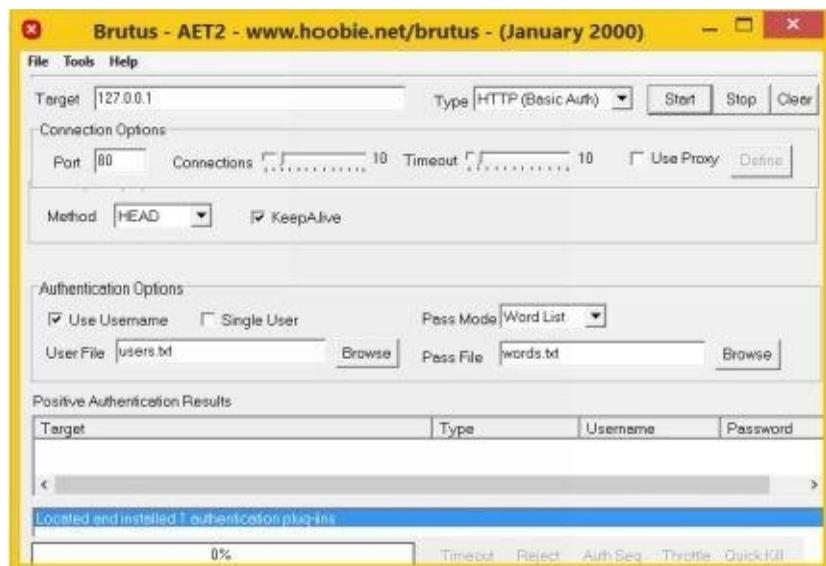


Figure 7. 1

3. Enter the *IP address* (or *domain name*) of the target server in the "Target" field.

Select the type of password that you want to crack from the "Type" field or enter your own custom port number in the "Port" field".

4. If you know the *username* for which you want hack the password for, then check the "Single User" option and enter the *username* in the "UserID" field. Otherwise leave the default settings to work as it is so that the *username list* is loaded from the "users.txt" file.

5. In the "Pass Mode" field select the option "Word List". The *list of words* will be loaded from the "words.txt" file by default which contains around 800+ words. If you've a *.TXT* file that contains more words, then you can use that by selecting the "Browse" option. The more bigger the list is, better the chances of cracking the password. Below is an example of how a *username* and *password* list might look like:
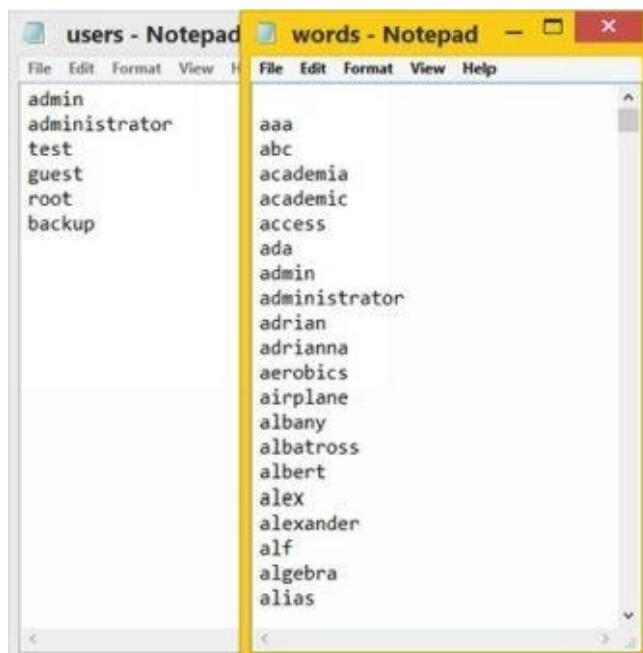


Figure 7. 2

6. Now, hit the "Start" button to begin the cracking process. Brutus will try every word in the *password list* for each of the *usernames* present in the *username list*. It will take a while for the process to complete and if you're lucky, you should get a *positive authentication* response and the cracked password as shown in the below figure:

**NOTE:** It is always a smart idea to *use a proxy* before attempting this hacking process. This will prevent your real IP address from being stored in the logs of remote server and thus reduces the chances of being traced back.

# BRUTE-FORCE ATTACK

Unlike the dictionary attack which tries only those words present in the list, the **brute force attack** on the other hand tries every possible permutation of alphabets, numbers and even special characters until the right password if found.

In theory, it is possible to crack any password using this approach, but here's the catch! *Brute force attack* takes a long time to crack passwords. The time actually depends on the speed of the computer and the complexity of the password.

For example, if the target password is small and doesn't contain any numbers or special characters, it is fairly easy to crack such passwords using this approach. However, if the password is lengthy, contains numbers or even special characters, this approach may take a long time to complete. For some complex passwords, brute force approach may take up even years to finish the cracking process as there are billions of permutations to try.

Here is how you can configure the *Brutus* program to try the brute force approach:

1. Configure the "Target", "Type" and "Port" in the same way as in case of the *dictionary attack*. Under the "Authentication Options", select the "Pass Mode" as **Brute Force** and click on the "Range" button as shown in the Figure 7.4 below:

2. Once you click on "Range" you will see a number of options to select with such as "Digits only", "Lowercase Alpha", "Uppercase Alpha" and so on. You can also set the **Min Length** and **Max Length** to narrow your brute force attack options (Figure 7.5).
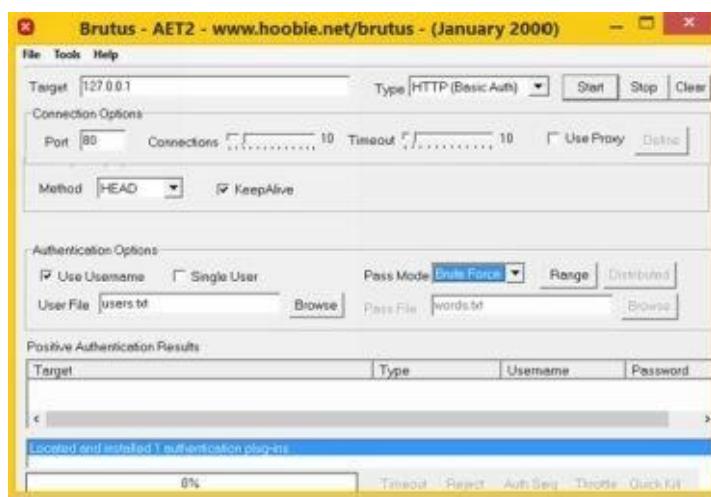


Figure 7. 4
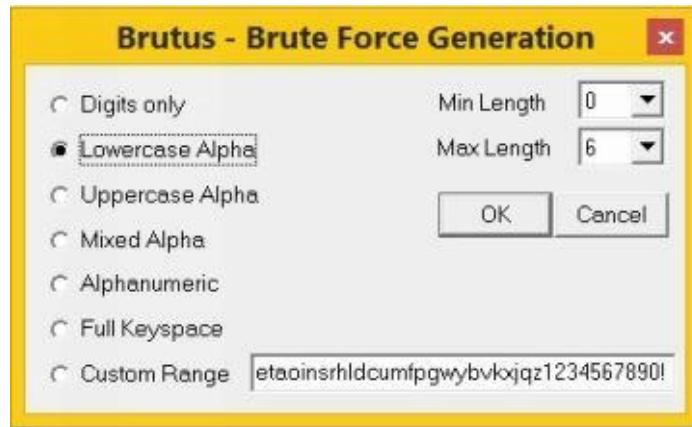
In the above example, Brutus will try all permutations of lower alphabets ranging from 0 to 6 characters in length. Going for options like "Mixed Alpha" or "Alphanumeric" and increasing the **Max Length** would increase the success rate of cracking the password but consequently takes more time to complete.

3. Once your range selection is over, click "OK" and hit the "Start" button. The brute force cracking attempt will begin and will take anywhere from a few minutes to a couple of hours to complete. If the crack attempt is successful, you should see the *username* and its corresponding *password* displayed on the Brutus window!

# RAINBOW TABLE

A **rainbow table** is a pre-computed table that contains a long list of password hashes for dictionary words as well as alphanumeric permutation of words. The hacker initially generates a long list of password hashes and stores them in a rainbow table for later use. Although generating a rainbow table initially takes a long time and utilizes more storage space, once computed it can greatly reduce the time taken for the password cracking process.

Any computer system that requires password authentication will maintain a table of usernames and passwords in its database. In case if the hacker manages to steal this table from the database, he would easily be in a position to gain access to a large number of accounts on the target system. In order to prevent this from happening, most systems store the passwords in a cryptographic hash format as opposed to plain text.

For example, when a user completes the sign-up process on an online portal, the system may convert his password to MD5 hash format and store it in its database table. Suppose if the user has his password as **goldfish**, its MD5 hash would be as follows:

**MD5 Hash:** 861836f13e3d627dfa375bdb8389214e

Thereafter whenever the user tries to log into the portal, his password gets converted to the MD5 hash format on the fly and is compared against the existing hash in the database table. If both the hashes match, access is granted to the user.

Now, even if the hacker manages to gain access to the database and steal the password table, he would only see a long list of cryptographic hashes and not the actual password.

This is where *rainbow tables* come in handy. The hacker can use the *rainbow tables* to compare the long list of pre-computed hashes against the stolen list of password hashes. If the hashes match, the password would be the one that was initially used to generate the hash.

Unlike a *brute force* approach where the hash is computed on every attempt, the *rainbow table* approach on the other hand utilizes a pre-computed list of hashes to directly compare them against an existing password hash. As the time required to compute the hash on every attempt is cut down, the *rainbow table* approach takes significantly less time to complete the cracking process.

A practical example of *rainbow table* approach will be discussed in the next chapter where we take up the topic of cracking Windows passwords.

# PHISHING ATTACK

Phishing is a form of social engineering technique used by hackers to gather sensitive information such as usernames, passwords and credit card details by posing as a trustworthy person or organization.

Phishing scams usually sends an email message to users requesting for their personal information, or redirects them to a website where they are required to enter their personal information.

In most cases, a phishing email directs the victims to follow a link leading to a website where they will have to enter their login details or other confidential information. In reality this website is a fake one created by the hacker (often referred to as spoofed website) which is an exact replica of the original or appears similar. When the victim enters his/her login details on a spoofed page they are actually stolen away by the hacker.

For example, the hacker may send an email that pretends to have been appearing from the bank where the victim maintains an account and ask him/her to update the login details by following the link present in the email. The email further mentions that this update process is mandatory and failing to do so will result in the bank account being locked. As a response, the victim clicks on the link where he/she will be taken to the fake login page that looks similar to the original one. However, when the login details are entered, they are recorded and stored on the website for later access by the hacker. The victim remains unaware of the entire process but the hacker skilfully manages to hack the password.

# COUNTERMEASURES

After addressing some of the popular password cracking techniques, let us now look at some of the countermeasures that can be taken to protect ourselves from the above mentioned attacks.

## Social Engineering

The measures needed to protect yourself from *social engineering* attacks are pretty simple and straight forward. Never disclose your password or any other personal information to anyone via phone or email. Attackers may even try to convince you by pretending to be an authorized person with whom you can share the personal details with. But remember that passwords are meant only to be entered on login pages and not to be shared with any person at all.

## Guessing and Shoulder Surfing

Always make sure that your password does not contain your pet names, birth date, family member names or anything as such that are easy to be guessed. It is recommended that your password contains a combination of hard to guess words, numbers and special characters.

As far as the *shoulder surfing* is concerned, you can avoid the same by making sure that no one else behind you is watching the movement of your fingers over the keyboard when your are typing the password.

## Dictionary Attack

To protect yourself from a *dictionary attack*, all you need to do is make sure that your password does not contain words from dictionary. That means, your password is not something like "apple", "lotus" or "mango". Instead use words that are not in the dictionary. You can also use a phrase like **str0ngpAss??** as your password so that it cannot be cracked using the dictionary attack approach.

## Brute-Force Attack and Rainbow Table

*Brute-Force* attacks often become successful when the passwords are short. That means, by keeping the password long enough you can make it hard for the attacker to crack it. Usually a password whose length is of 8 characters was considered long enough and safe in the past. However, this is not the case in the present day scenario as the modern computers have high speed processing capabilities to try thousands of  guesses per second. So, in order to make your password immune to brute-force attack make sure it is larger than 8 characters and is a combinations of alphabets, numbers and special characters.

You can avoid rainbow table attack on your passwords by making it too long. If your password is more than 12 or 14 characters, it would be extremely time consuming to create tables for them. This should keep you protected from such attacks.

# Phishing Attack

You can avoid phishing attack by following the below mentioned guidelines:

- Do not respond to suspicious emails that ask you to give your personal information. If you are unsure whether an email request is legitimate, verify the same by calling the respective bank/company. Always use the telephone numbers printed on your bank records or statements and not those mentioned in the suspicious email.

- Do not use the links in an email, instant messenger or chat conversation to enter a website. Instead, always type the URL of the website on your browser's address bar to get into a website.

- Legitimate websites always use a secure connection (*https://*) on those pages which are intended to gather sensitive information such as passwords, account numbers or credit card details. You will see a lock icon 🔒 in your browser's address bar which indicates a secure connection. On some websites like "PayPal" which uses an extended validation certificate, the address bar turns **GREEN** as shown below:
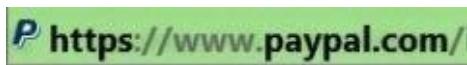


Figure 7. 6

- Even if the login page is not secure (https://) the target website may still be legitimate. However, look for misspellings like **www.papyal.com**, **www.payapl.com** or **paypal.somethingelse.com** instead of the legitimate site **www.paypal.com** and make sure that the login details are only entered on the legitimate web page.

# Chapter 8 - Hacking Windows

Being one of the most popular operating systems in the world, Windows has its presence on almost every computer system today. So, in the field of ethical hacking understanding the techniques to hack into Windows systems becomes highly significant. Let us now look into some of these techniques using which you can successfully manage to hack any Windows computer.

# GAINING ACCESS TO THE SYSTEM

Gaining access to a password protected user account especially the one with "administrator privileges" forms the key element in hacking Windows. The following are the two important techniques using which you can gain access to any protected account on Windows without actually knowing the password.

## Resetting the Windows Password

If you wish to gain access to a Windows computer whose account is password protected, resetting the password is an easy option. Windows stores all its account information and encrypted passwords in a file called "SAM". By modifying the "SAM" file it is possible to reset the password of any user account including that of the "administrator". You can accomplish this task using a small open-source tool known as **Offline NT Password & Registry Editor**. This utility works offline, that means you need to shut down and boot up the target computer using a CD or USB device such as thumb drive. The tool has the following features:

- You **do not** need to know the old password to set a new one.

- This tool will allow you to **reset** the password of any user account.

- This tool can also detect and **unlock** *locked* or *disabled* out user accounts.

You can download the tool from the link below:

**Download: http://pogostick.net/~pnh/ntpasswd/**

Resources to create a bootable CD and bootable USB device are available for download separately. Both works similarly and is a matter of your convenience. However, in this book I will give a demonstration of the USB version to reset the existing password. To create a bootable USB drive, download and unzip the USB version of the tool from the above link by following the simple instructions given in the **readme.txt** file.

Once you have the bootable USB device in your hand, plug-in the device and boot from it. Make sure that you have enabled the USB boot option and set the top boot priority for your USB device in BIOS. Step-by-step instructions to complete the password reset process is given below:

Figure 8. 1

Once the tool is running from your USB device, you should see the screen similar to the one shown above. Just follow the screen instructions and the tool will automatically detect the partition on which the Windows is installed. Usually the right options are preloaded in the square bracket as shown in the below snapshot. So, just pressing **Enter** key should work.
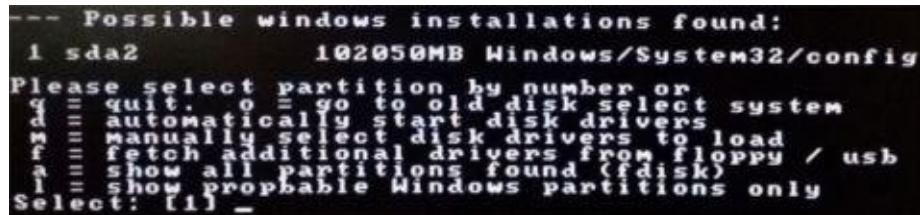


Figure 8. 2

In the next step, you will be asked to "select which part of the registry to load". You need to select the option-**1** that is "Password rest [sam]" which is preloaded by default as shown below. So just press **Enter** to proceed.



Figure 8. 3

In the next step, select the option-**1** which is "Edit user data and passwords" as shown below and hit **Enter**.



Figure 8. 4

Now, you should see a list of "Usernames" and their "Admin" status being displayed.

Select the user who has administrator privilege and hit **Enter**.



Figure 8. 5

In the next screen you will be asked to select from a list of options that you may want to perform on the selected user. Here, just select the option-**1** which is "Clear (blank) user password" and hit **Enter**.



Figure 8. 6

This should reset the password for the user account to make it go blank, so that the next time you reboot your Windows you should be able to login automatically as if there was no password set for that user account.

Now quit editing user by pressing **q** and hit **Enter** until you proceed to the screen where you will be asked to confirm "writing back changes" to the SAM file. This step is very important where you need to press **y** and hit **Enter** as shown in the snapshot below. If you accidentally press **Enter** keeping the default option which is **n**, the reset process will fail and the whole procedure will have to be repeated again from the beginning. So, changing the default option from **n** to **y** before pressing **Enter** is very important.
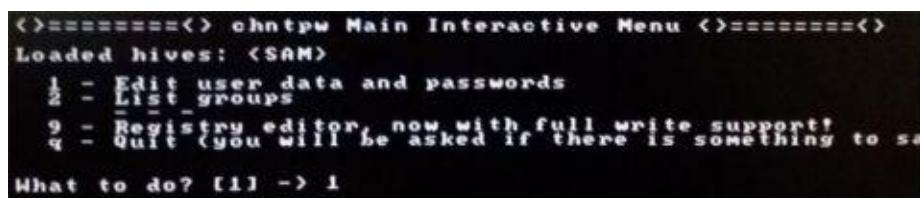


Figure 8. 7

This will complete the reset process where the existing password will be removed and set to blank. Disconnect  the USB device and press **CTRL+ALT+DEL** to reboot the computer. Now, the Windows should let you login to the system without insisting to enter the password.

## Restoring the Password After Breach

Resetting the password is a wonderful option to easily gain access to the password protected accounts. However, this method has a clear drawback as the password reset process is permanent. The administrator of the target machine will easily come to know about the security breach as thereafter no password will be asked during the login process.

To overcome this drawback, we will have to device a means to restore everything back to normal once the purpose of breach is completed. For this we will have to take a backup of the original **SAM** file before modifying it in the password reset process and safely restore it back to make everything look normal.

The **SAM** file is located in the drive where the Windows is installed (usually **C:**) under the following path: **\windows\system32\config**. You can easily access this location by booting up the computer from your live **Kali Linux** DVD. Once the **Kali** DVD is loaded, double-click the "Computer Icon" present on the desktop to open up the explorer window. Now, navigate to the above location to find the **SAM** file and back it up to a different location such as a different drive or to your own USB device.
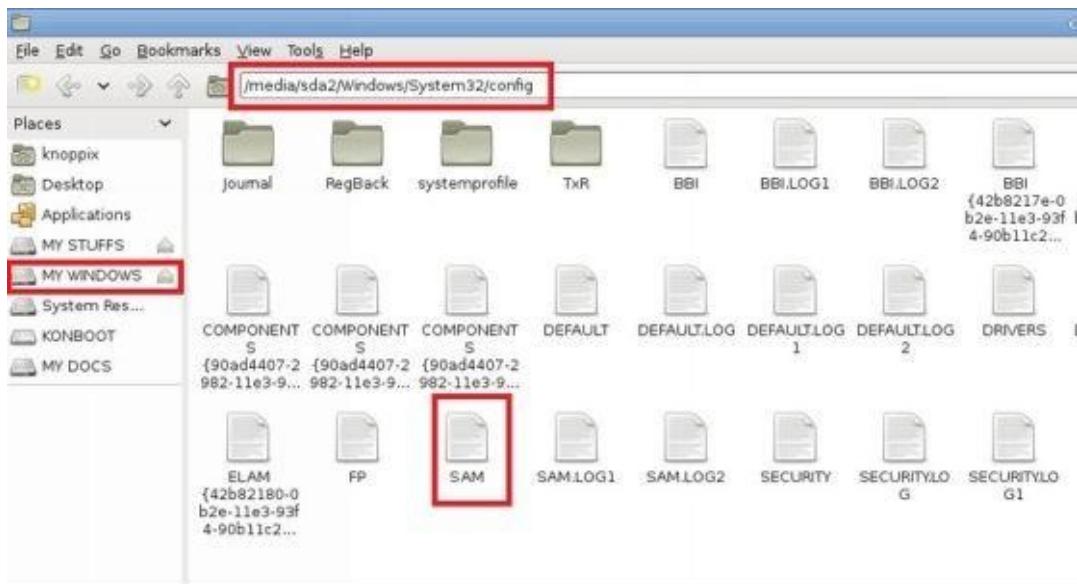


Figure 8. 8

Now reboot the system and perform the password reset process as discussed earlier. Once you are done with your work, reboot the system again with **Kali** DVD and navigate to the location of **SAM** file. Rename the existing file to **SAM.OLD** and restore the original **SAM** file from the backup location. This should bring everything back to normal and avoid suspicion.

## Bypassing the Windows Authentication Process

In the previous section we had discussed on how to reset the password to gain access to the system. But there is another smart way to gain access to the Windows system by silently bypassing the authentication process itself. This is done by applying temporary changes to the Windows kernel on the fly (while booting) to disable the authentication process. A tool called **Kon-Boot** allows you to accomplish this task. You can download it from the link below:

Kon-Boot: **http://www.piotrbania.com/all/kon-boot/**

**Kon-Boot** is a handy tool that allows you to enter any password protected Windows user account without having to enter the password during the log-in process. The tool allows you to create a bootable CD or a USB drive. Once you boot the target computer from this

bootable device, it will virtually modify parts of Windows kernel to load the operating system in a special mode where you will not be insisted to enter the password. The advantage of this tool is that all the changes are temporary and disappear after reboot, so that everything looks normal thereafter and does not arouse suspicion of a possible security breach.

# DUMPING THE PASSWORD HASHES

After understanding some of the techniques to gain access to the system without knowing the password, it is time to move on one step further and find out a means to crack the actual password itself. If it is required to gain access to the target system multiple times over a period, it is always a good idea to unveil the password by cracking it so that you can easily login to the system by entering the password thereby eliminating the need to reset the password each time you want to gain access.

Windows user account passwords are converted into a cryptographic hash format called **NTLM (NT LAN MANAGER)** hash. This **NTLM** hash along with the user profile details is stored in a special file called **Security Accounts Manager** or **SAM**. The **SAM** file is further encrypted with the *syskey* which is stored in a file called **SYSTEM**. Both **SAM** and **SYSTEM** are located in the drive where the Windows in installed (usually C:) under the following path: **\windows\system32\config**.

In order to crack the password, it is necessary to extract the **NTLM** hash and user accounts details stored in the **SAM** file from the target system which is known as dumping. The dumped details are transferred to the hacker's computer and the password is cracked using an offline password cracking tool. The following are the two ways to dump password hashes:

## Dumping Hashes With Administrator Access

If you have administrator access to the system on which you want to dump password hashes, you can use a handy tool called **PWDUMP**. This is an open-source command-line tool to quickly dump password hashes onto a text file. The tool can be downloaded from the link below:

**PWDUMP: http://www.tarasco.org/security/pwdump_7/**

This is a very small tool which is less than a MB in size and can be carried to the target location in a USB thumb drive. To dump the hashes, just open the command prompt with administrator rights, navigate to the location of the tool (PwDump7.exe) and run the following command:

**PwDump7.exe** >> targetfilename.txt

As shown in the below snapshot, I am running the **PwDump.exe** from my USB thumb drive (**M:**) and dumping the hash details in a file called **hash.txt**. This file should get created in the same directory from which **PwDump.exe** is running.

Figure 8. 9

The **hash.txt** file contains a list of existing user accounts on the machine and their corresponding **NTLM** hashes as shown below:



Figure 8. 10

## Dumping Hashes Without Administrator Access

The previous section shows how to dump password hashes when you already have administrator access to the target machine. What if you do not have administrator access? In this case, you can use your **Kali Linux** Live DVD to boot up the system and load the Linux. From here, access the drive on which the Windows OS is installed and navigate to **\windows\system32\config\**. From here copy the two files **SAM** and **SYSTEM** on to your USB device so that you can carry them to your computer for offline password cracking.
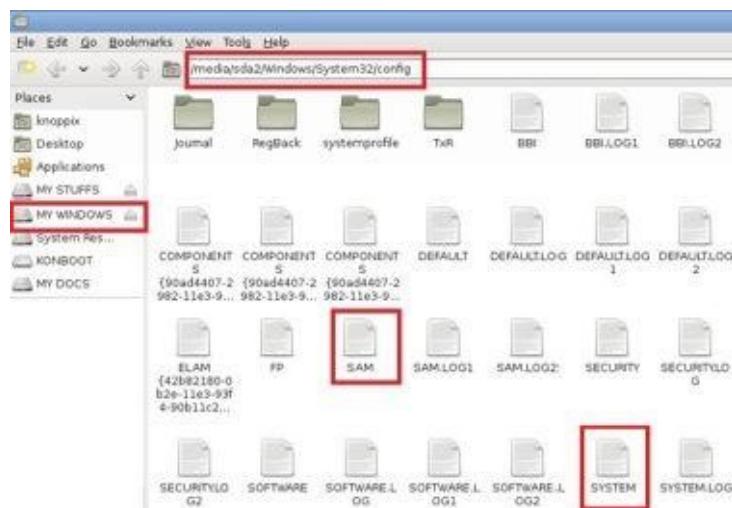


Figure 8. 11

# CRACKING THE WINDOWS PASSWORD

After successfully dumping the password hashes, we can now easily crack them using different tools and approaches as mentioned below:

## Using Rainbow Tables

As discussed in the previous chapter, a rainbow table contains a list of pre-computed hashes that can be instantly compared against the dumped password hash to crack the password. This is so far the best and the fasted method to successfully crack the Windows password. For this we will use an open-source tool called **Ophcrack** that can be downloaded from the link below:

**Ophcrack Website : http://ophcrack.sourceforge.net/**

From the above link, download the installable version of **Ophcrack** (not the Live CD version) and install it on your system. During the installation process, when the option comes up to download rainbow tables, uncheck them all and just install the program. It is always better to download the rainbow tables separately.
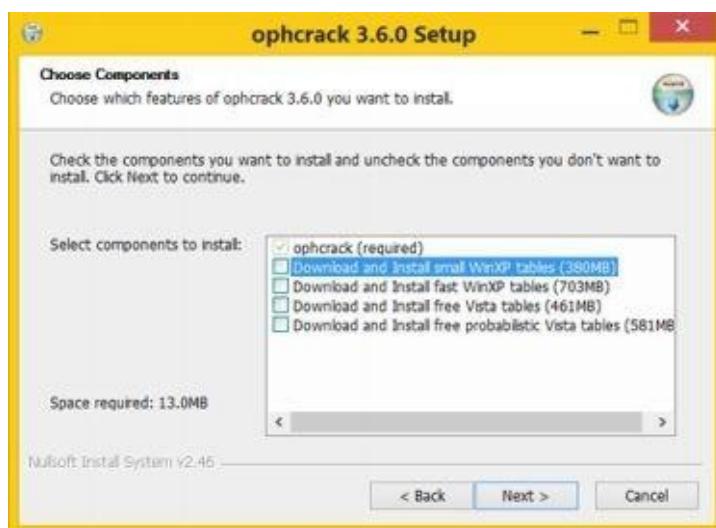


*Figure 8. 12*

Once you have it installed on your system, go to the **Ophcrack website** from the above link and click on **Tables** in the navigation menu. Here you should see a list of rainbow tables you can download.

If you want to crack the passwords of *Windows XP* and prior operating systems download the tables from the **LM hashes** section. For operating systems after XP such as *Windows Vista*, *7* and *8* download the tables from the **NT hashes** section.

## Free XP Rainbow tables

These tables can be used to crack Windows XP passwords (LM hashes). They CANNOT crack Windows Vista and 7 passwords (NT hashes).

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| german | xp_german(7.4GB) | | | | | | | | | | | | |
| special | xp_special(7.5GB) | | | | | | | | | | | | |
| mixedalphanum | xp_free_small(380MB) and xp_free_fast(703MB) | | | | | | | | | | | | |
| length | 1-4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

### XP free small (380MB)
formerly known as SSTIC04-10k

Success rate: 99.0%
Charset: 0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ

md5sum: 17cfa3fc613e275236c1f23eb241bc86

**Figure 8. 13**

### XP free fast (703MB)
formerly known as SSTIC04-5k

Success rate: 99.9%
Charset: 0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ

md5sum: f6f5538975b57c891ed5f2de702a02bd

### XP special (7.5GB)
formerly known as WS-20k

Success rate: 96%
Charset: 0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ
!"#$%&'()*+,-./:;<=>?@[\]^_'{|}~ (including the space character)

**Figure 8. 14**

These tables can be used to crack Windows Vista and 7 passwords (NT hashes).

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| special | | | vista_proba_free(600MB) | | | | | | | | | | |
| mixedalphanum | | | | | | | | | | | | | |
| alphanum | | vista_special(8GB) | | | | | | | | | | | |
| numbers | | | vista_num(3GB) | | | | | | | | | | |
| dictionary based | | | vista_free(461MB) | | | | | | | | | | |
| length | 1-4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
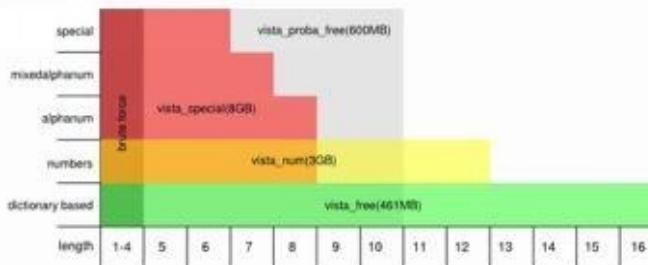
### Vista free (461MB)

Success rate: 99%

Based on a dictionary of 64k words, 4k suffixes, 64 prefixes and 4 alteration rules for a total of $2^{38}$ passwords (274 billion).

md5sum: 403cf58178d7272a48819b47ca8b2e6b

### Vista proba free (581MB)

Success rate: n/a
Passwords of length 5-10
Charset: 0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ
!"#$%&'()*+,-./:;<=>?@[\]^_'{|}~ (including the space character)

$2^{39}$ passwords selected according to the most probable password patterns and the most probable character sequences (2nd order Markov Model) within the patterns. Trained on the Rockyou password set.

md5sum: 3e808b49b8b27aef7fec4o381f1ddb86

**Figure 8. 15**

Figure 8. 16

As shown in the above snapshots, as the character set increases the size of the table grows bigger. Bigger the table higher the chance of successful cracking. You can download the one that best matches your needs. For the purpose of demonstration, I am using the "Vista proba free" table on my Windows 8 machine with **Ophcrack**. Here is a step-by-step guide on how to use this tool to crack passwords.

1. Open the **Ophcrack** tool by double-clicking the icon on the desktop.

2. From the main **Ophcrack** window, click on "Tables" button and select the table that you have downloaded from the list. Now click on "Install" button, load the folder that contains the downloaded tables and click on "OK".



Figure 8. 17

3. Next, to load the dumped password hashes, click on "Load" button, select "PWDUMP file" option and load the **hash.txt** file obtained by running the PWDUMP tool on target machine. If you have **SAM** and **SYSTEM** files instead of **hash.txt**, you can choose the option **Encrypted SAM** instead of "PWDUMP file" and select the folder which contains those two files.
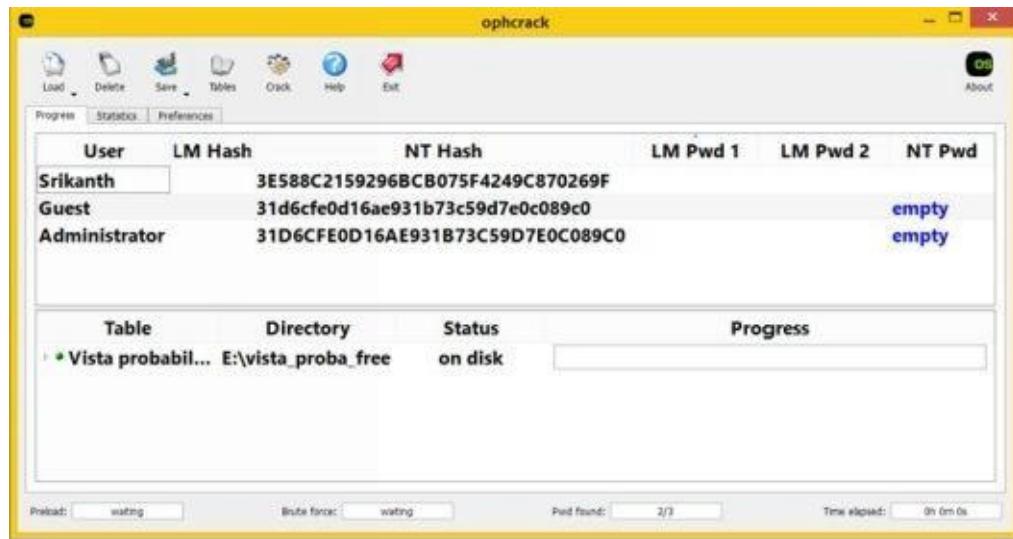
Figure 8. 18

4. When everything is loaded and ready as shown in the above snapshot, click on "Crack" button and site back patiently. The cracking process will take from anywhere between few minutes to few hours to complete depending upon the size of the table and strength of the password. If it is successful, the cracked password will be displayed along with the time taken to crack as shown below:
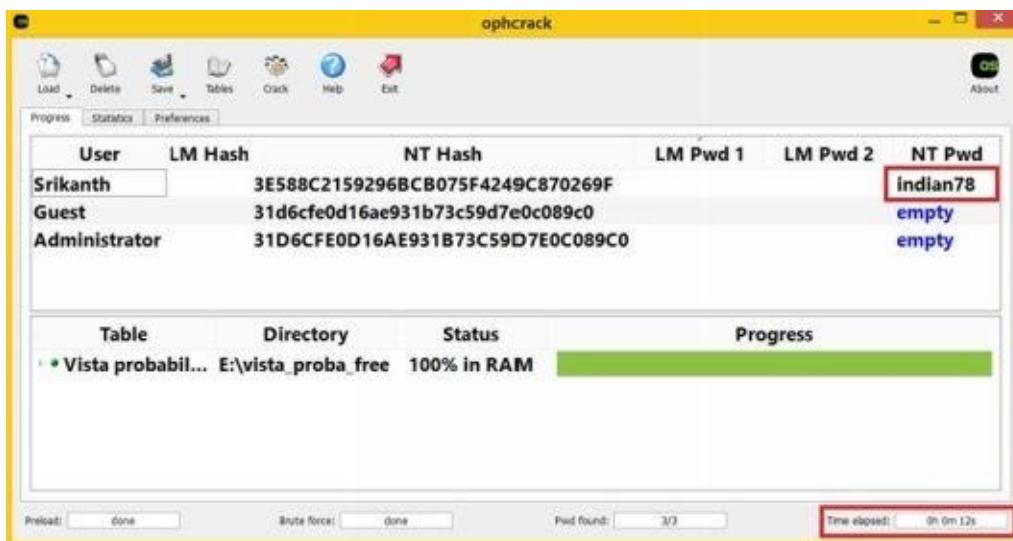


Figure 8. 19

If you become unsuccessful in cracking the password, you may try a different rainbow table that covers more characters and long passwords.

## Using Brute-Force Approach

Even though using rainbow tables is by far the fastest and the best approach to crack passwords, it may not be successful for long and strong passwords as hash tables for such passwords are hard to find. So, brute-force approach becomes inevitable under these situations. But remember it may take a very long time ranging from a few hours to few

days to complete the cracking process. Since **Ophcrack** is not so effective for the brute-force approach, we will use another powerful tool called **L0phtCrack** which is available from the link below:

**L0PhtCrack Download:** http://www.l0phtcrack.com/download.html

After installing **L0phtCrack**, Click on "Import hashes" button from the main window to load the hashes. You have the option to load the hashes from both the "PWDUMP file" as well as "SAM file".
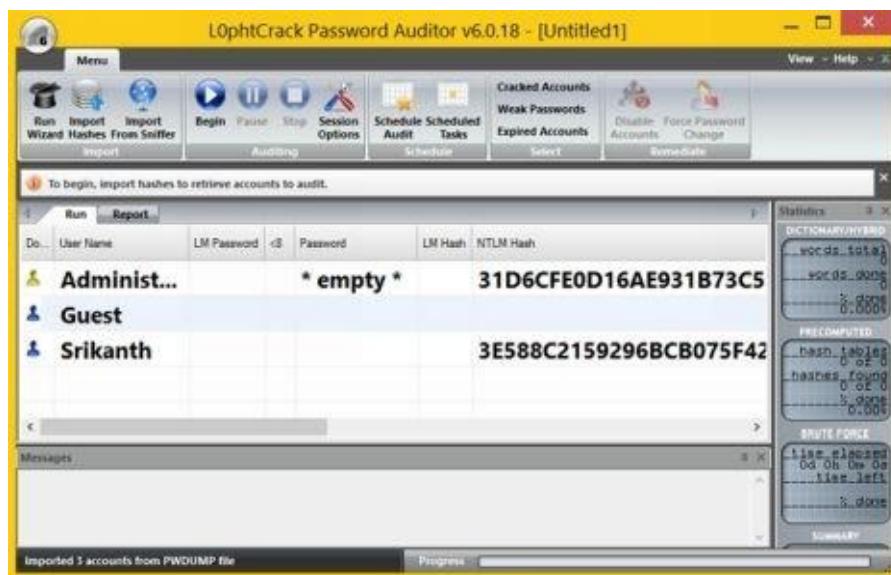


**Figure 8. 20**

Click on the "Session Options" button to further configure different auditing options such as dictionary and brute-force attacks. You can enable or disable specific attacks and also customize character set, password length and range options for brute-force approach. Configuring the auditing options wisely can avoid unnecessary time delay and thereby speed up the password cracking process.

Once you are done with loading the hashes and configuring the options, click on the "Begin" button. This will initiate the cracking process and the time consumed to crack the password depends on various factors like the password strength (length + presence of alphanumeric + special characters), type of attack (dictionary, hybrid or brute-force) and the speed of your computer.

If the password cracking process is successful you should see the cracked password next to the user name in the **L0phtCrack** window as shown below:
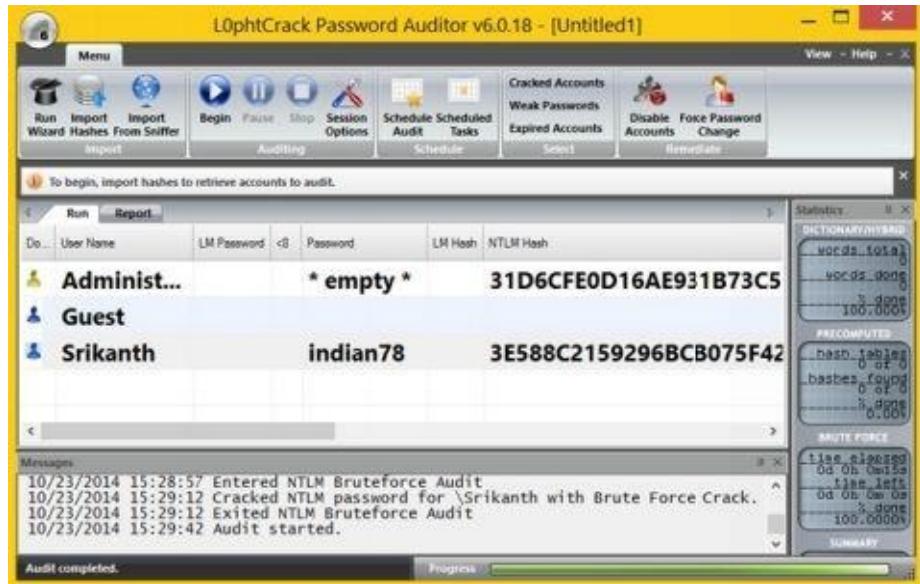
Figure 8. 21

## Sniffing Password Hashes on a Network

If your computer is on a network such as office or school, it is possible to remotely import the password hashes of other computers on the network without the need to gain physical access to them. This method is called sniffing and **L0phtCrack** 6 and above supports this option.

To sniff password hashes from other computers, just click on the "Import From Sniffer" button on the main window. If more than one network interface is detected, the "Select Network Interface" dialog box allows you to choose the interface to sniff on. After choosing your interface, the "SMB Packet Capture Output" dialog box appears where you need to click on "Start Sniffing".

If the hashes are captured, they are immediately displayed in the dialog box after which you can hit "Stop Sniffing" and click on "Import" button to load the password hashes for cracking.

# COUNTERMEASURES

In order to secure your Windows computer from all those possible attacks as mentioned in this chapter, the following are some of the countermeasures that you need to follow:

- Do not allow strangers to access your computer during your absence.

- If the computer is on a public network such as school or office, password protect those accounts with administrator access and only give limited accounts to the users.

- Always use a strong password that is hard to guess. Strong passwords contain a mix of alphanumeric and special characters that are long enough to avoid rainbow table and brute-force approaches.

- Disable access to CD/DVD drives and USB devices on public networks.

- Configure BIOS to disable booting from USB, CD/DVD and other portable devices.

- Password protect your computer BIOS so that it would not be possible for an attacker to modify its settings and gain access.

# Chapter 9 - Malware

Malware is a collective term used to represent virus, worms, spyware and other malicious programs out there on the Internet. In simple words, any software program that is intended to cause direct or indirect harm to the computer system is referred to as a malware.

Some malware programs can cause serious problems such as destroying the system files, causing disruption to the computer operation or gathering sensitive information while others may only have a light impact such as redirecting websites to load pornographic content or annoying the users with pop-ups and banners.

## MALWARE VARIANTS AND COMMON TECHNIQUES

Once the hacker has gained access to the target and has administrator privileges on it, the following are some of the malware programs that he can use to take further control of the system:

# Computer Virus

As we all know, this is the type of malware that has become highly popular and is one of the most widely discussed topic in the field of computer security. A **virus** is just a computer program that is designed to take unauthorized control of the infected computer so as to cause harm to the system's data or degrade its performance.

## *Mode of Operation:*

Computer viruses operates by attaching themselves to an already existing file or program and replicates itself to spread from one computer to another. In most cases, they tend to infect executable files that are parts of legitimate programs. So, whenever the infected file is executed on a new computer, the virus gets activated and begins to operate by replicating further or causing the intended damage to the system.

A virus cannot perform its task of harming and replication unless it is allowed to execute. This is the reason why viruses often choose an executable file as its host and get attached to them. Viruses are mainly classified into two types:

**Non-Resident Viruses:** This kind of virus will execute along with its host, perform the needful action of finding and infecting the other possible files and eventually transfers the control back to the main program (host). The operation of the virus will terminate along with that of its host.

**Resident Viruses:** In case of resident viruses, whenever the infected program is run by the user, the virus gets activated, loads its replication module into the memory and then transfers the control back to the main program. In this case, the virus still remains active in the memory waiting for an opportunity to find and infect other files even after the main program (host) has been terminated.

## *Damages Caused:*

Viruses are known to cause destruction of data and software programs. In some cases, a virus may do nothing other than just replicating itself. However, they are responsible for using a large portion of the system resources such as CPU and memory which results in the performance degradation of the computer.

# Worms

**Worms** are standalone computer programs with a malicious intent that spread from one computer to another. Unlike viruses, worms have the ability to operate independently and hence do not attach themselves to another program.

## *Mode of Operation:*

Worms often use a computer network to spread itself by exploiting the security vulnerabilities that exist inside the individual computers. In most cases, worms are designed only to spread without causing any serious change to the computer system.

<u>*Damages Caused:*</u>

Unlike viruses, worms do not cause damage to the system files and other important programs. However, they are responsible for consuming the bandwidth thereby degrading the performance of the network.

# Remote Administration Tools (RATs)

A **remote administration tool** (**RAT**) is a piece of software that allows a hacker to remotely take control of the target system to execute commands and carry out operations on it. With the help of RATs a hacker can control the target system as if he has physical access to it.

<u>*Mode of Operation:*</u>

A RAT can be installed manually by the attacker when he gets administrator access to a system. They can also be attached to other malicious programs like a trojan horse to deliver it to the target system. Once installed a RAT can immediately allow the hacker to remotely take control of the system.

<u>*Damages Caused:*</u>

With the help of a RAT, an attacker can carry out the following operations on the target system:

- Watch Live screen activities and capture screenshots.
- Read/Write/Upload/Download files and folders.
- Install/Uninstall additional malware programs.
- Modify Registry such as add/edit/delete entries.
- Power off/Reboot the system.

As you can see from the above list, there is virtually no operation that the attacker cannot perform with the use of a RAT. Some of the examples of popular RATs include **PsTools**, **Radmin** and **LogMeIn**.

# Keystroke Loggers

A **keystroke logger** (or simply known as a **keylogger**) is a program that is designed to record every keystroke typed on the computer's keyboard.

<u>*Mode of Operation:*</u>

A keylogger program can be installed manually with physical access to the system or

remotely using a other programs like RAT. Once the installation is complete a keylogger operates in a complete stealth mode by hiding itself from well known places such as the programs folder, system tray, add/remove programs, task manager etc. so that the victims of the computer will remain unaware of its presence.

### *Damages Caused:*

A keylogger will capture every keystroke typed on the computer's keyboard including passwords, bank logins, credit card details, emails, chat conversation etc. and stores the logs in a safe place so as to be accessible only to the attacker. Some keyloggers can also send the logs via email or upload them to the hacker's FTP account.

Some of the popular keystroke loggers include **Elite Keylogger**, **Powered Keylogger** and **Actual Keylogger**.

## Spyware

**Spyware** is a type of malicious software that can collect information about the activities of the target computer without the knowledge of its users. Most spyware programs also come pre-loaded with a keylogger which makes them more powerful. These type of programs are often installed by the owner or administrator of the computer in order to monitor the activities of the users on it. This can be a parent trying to monitor his/her child or a company owner trying to monitor their employees. Unfortunately, it can also be used by hackers and criminals to spy on users of their target machines.

### *Mode of Operation:*

Spywares are designed to operate in a totally stealth mode so that its presence is completely hidden from the users of the computer. Once installed, they silently monitor all the activities of the computer such as keystrokes, web activity, screenshots, emails, IM logs etc. These logs are stored secretly for later access or uploaded online so that the installer of the spyware program can have access to them.

### *Damages Caused:*

Apart from monitoring, spywares do not cause any damage to the computer. However, in some cases the affected computer may experience degradation in its performance.

**SniperSpy**, **SpyAgent** and **WebWatcher** are some of the examples of popular spyware programs.

## Rootkits

**Rootkit** is a special type of malicious program designed by the hacker to hide certain programs like spyware, keyloggers and other processes from normal methods of detection so as to enable continued privileged access to the target computer.

### *Mode of operation:*

Rootkits are often installed by the attacker as soon as he gains administrator level access to the target. Rootkits operate by modifying the kernel of the operating system itself which makes it really hard to detect.

### *Damage caused:*

Rootkits cause a serious damage to the system as it modifies the OS kernel to carry out operations. Unless it is removed completely, it can be very dangerous.

## Trojan Horse

A **trojan horse** or simply called as **trojan** is a type of malicious program that disguises itself as something that is legitimate or useful. The main purpose of a trojan is to gain the trust of the user by disguising itself as a useful program or other utility, so that it gets the permission to be installed. But, from the back end it is designed to grant unauthorized control of the computer to the hacker by installing a RAT, Spyware or a Rootkit.

### *Mode of Operation:*

A Trojan horse do not depend on the host to carry out its operation. So, unlike a computer virus, it does not tend to attach itself to other files. Trojans are often disguised as video codec, software cracks, keygens and other similar programs downloaded from untrusted sources. So, one has to be careful about those untrusted websites that offer free downloads.

One of the most popular example is the **DNSChanger Trojan** that was designed to hijack the DNS servers of the victimized computers. It was distributed by some of the rogue pornographic websites as a video codec needed to view online content.

### *Damages Caused:*

Trojan horses are known to cause a wide variety of damages such as stealing passwords and login details, electronic money theft, logging keystrokes, modifying or deleting files, monitoring user activity and so on.

# COUNTERMEASURES

The following are some of the countermeasures that you can take to prevent malware attack on your systems:

- Deploy a two-way firewall which manages both inbound as well as outbound traffic.
- Install a good antivirus program and keep it up to date. Periodically run full system scans to detect and remove keylogger, spyware and rootkits.
- Keep up to date on all security software patches. Use automatic updates to keep your Windows patched for latest threats and vulnerabilities.
- Install additional security programs such as antispyware, anti-keyloggers and anti-rootkits.
- Run with least privilege. Log in as administrator only when required. For lighter activities like browsing the Internet and reading emails login with an account that has limited access.
- Scan unknown programs with an up to date antivirus software before installing them on your system.
- Take periodic backups of your system so that in case of data loss or damage from malware you could easily revert back to a previous date of normal working condition.

# Chapter 10 - Hiding Information

Once the hackers gain access and take control of the system, the next step they may try to do is to hide some critical files and information on it. The hacker may decide to hide files for later execution or use the victim's compromised system to store information secretly so that it can be accessed later and sent to the final destination where it is intended to go. In this chapter we will discuss some of the popular techniques to hide files and information on a system. Let us start with the simple ones and gradually advance to more complex techniques.

# WINDOWS HIDDEN ATTRIBUTE

Using the Windows built-in hidden attribute is by far the simple and easiest way to hide files and folders on a system. To enable hidden attribute just follow the instructions as given below:

1. Right-click on the file or folder that you intend to hide and select "Properties" from the pop-up menu.

2. In the "Properties" window, under the "Attributes" section check the box which says "Hidden" and click on "OK".

This will make the selected file or folder go invisible. To view the hidden files and folders follow the instruction below:

1. Open the "Control Panel" by clicking the "Start" button

2. Now click on "Appearance and Personalization" and then on "Folder Options".

3. Switch to "View" tab, check the option "Show hidden files, folders and drives" under "Advanced Settings" and click on "OK".

This should unhide all the hidden files and folders. However, the drawback of this method is that most users are aware of this and hence the hidden files can easily be uncovered. In order to counter this drawback, some of the advanced information hiding methods are discussed below.

# NTFS ALTERNATE DATA STREAMS

**Alternate Data Stream (ADS)** is a Windows hidden stream supported on NTFS file system used to store metadata of a file such as attributes, word count, access and modification time etc. Whenever a file is created on NTFS file system, Windows automatically creates an ADS for it. Even in directory listing only the actual file is visible but its ADS is kept hidden.

It is even possible to add additional ADS to an existing file to store hidden information in it. Hackers often use this technique to store malicious codes in compromised systems without the knowledge of the victims.

Suppose if you want to hide information inside an image or any other file, just follow the steps mentioned below:

1. Open the Windows command prompt.

2. Type the following command and hit Enter.

   **Command Syntax: notepad** file-name:ADS-name

   **Example Command: notepad** flowers.jpg:hiddeninfo



Figure 10. 1

As shown in the above snapshot, I am issuing the above command on **flowers.jpg** present inside the folder named **Hidden Info**.

3. Now Windows will create a new **ADS** for the specified file and open it in a new notepad with a message window "Do you want to create a new file?" as shown below.

Figure 10. 2

4. Click on "Yes", and type the content that you wish to hide on to it and once you are done save and close the notepad.

5. Now, all your secret message will be stored in a new **ADS** called **hiddeninfo** inside the file **flowers.jpg**.

To the outside world, the **flowers.jpg** is just an image file but only the hacker know that it contains hidden data inside it. Even if the file is moved to another system (NTFS only), it still carries the hidden information along with it.

To view the hidden info all you need to do is again type the same command as **notepad flowers.jpg:hiddeninfo** in the command prompt. This will open up the **ADS** contained inside the **flowers.jpg** file in a notepad displaying all the hidden text that was previously stored.

**ADS** technique has a small drawback! If this file is copied or moved on to a different file system such as **FAT32**, all the **ADS** information will be dropped and the hidden information will be lost.

# STEGANOGRAPHY

**Steganography** is a means of obscuring data where secret messages are hidden inside computer files such as images, sound files, videos and even executable files, so that no one except the creator will know about the existence of stealth information in it.

Steganography may also involve the usage of cryptography where the message is first encrypted before it is concealed in another file. Generally, the messages appear to be something else such as an image, sound or video so that the presence of secret data in it remains unsuspected.

The main advantage of steganography over other information hiding methods is that, it will not arose suspicion even if the files fall in the hands of a third party. Unlike cryptography which only encrypts information, stegnography uses both encryption and obscurity of data in a normal file. This makes stegnanography hard to detect as the files look completely normal from outside.

Stegnographic tools implement intelligent algorithms to carefully embed the encrypted text messages or binary data inside other larger files such as an image, audio, video or an executable file. Some tools will embed the encrypted data at the end of another file so that there will be enough room for storing larger data.

There are many steganograpic tools available online but only a few are able to work flawlessly. I did not find any tool that worked perfectly on both small and large data. To counter this problem, I have  managed to develop my own tool that can work perfectly on all types of files and all size of data. I have named the tool as **StegoMagic**. You can download it from the following link.

**Download StegoMagic**

The zip file contains two versions of *StegoMagic*: One for encrypting the text messages and the other for encrypting binary files. *StegoMagic_TXT* can be used to hide text messages in other files such as an image or a sound file. *StegoMagic_BIN* can be used to hide one binary file in another such as an executable file inside an image or an image inside a video file and so on.



Figure 10. 3

With *StegoMagic*, there is no limitation on the size and type of the file that you are intending to hide. For example, you can hide a video of size 1 GB in an image of size 1 MB or hide an executable file inside a WORD document. The tool is pretty straightforward to use and requires no special understanding of the concept.

At the end of the encryption process, a secret decryption key will be generated and the same is required during the decryption process.

## How to Use StegoMagic?

Suppose you want to hide a **text message** inside a .**JPG image** file:

1. **Place the .JPG image file and the text file (.txt) in the same folder as that of** *StegoMagic_TXT.exe*

2. Run *StegoMagic_TXT.exe* (with administrator rights) and follow the screen instructions to embed the text message inside the JPG image.

3. Note down the *secret decryption key*.

4. Now you can send this image to your friend via email. To decrypt the hidden message, your friend should load this **JPG file** onto the *StegoMagic* tool and use the *secret decryption key*.

# USING TOOLS FOR HIDING INFORMATION

You can also use several open-source tools and programs to hide important files and folders on a given system. Here is a list of are some of the handy tools that you can use:

## 1. Free Hide Folder

This is a freeware tool for Windows that can hide any number of folders and make them go completely invisible for others. You also have the option to password protect the program for additional safety.

## 2. Wise Folder Hider

**Wise Folder Hider** is a freeware used to hide your personal folder(s) or file(s) to somewhere else in your PC or in removable devices, in which way you can protect your privacy with passwords by following easy steps.

## 3. WinMend Folder Hidden

**WinMend Folder Hidden** is a free file/folder hiding tool. While ensuring the absolute system safety, this application can quickly hide files and folders on local partitions and/or on removable devices. The hidden files/folders will be safely hidden whether the drive is accessed in another operating system on the same computer or reinstalled on another computer. You can set a password for this application. Hidden data can be displayed and unhidden only when the user enters the valid password.

# Chapter 11 - Sniffing

**Sniffing** (also called as **packet sniffing**) refers to the use of a device or program to capture vital information from a wired or wireless network traffic using data interception technology. The objective of sniffing is to steal various information such as passwords of applications like email and FTP, contents in the email, chat conversations, files that are in transfer from one system to another and so on.

Protocols that send and receive data in a raw format without encryption are easily susceptible to sniffing attack. Here is a list of some of the common protocols that are vulnerable to sniffing:

- **Telnet:** Keystrokes including usernames and passwords.

- **HTTP:** Data sent in clear text.

- **SMTP:** Passwords and data sent in clear text.

- **FTP:** Passwords and data sent in clear text.

- **POP:** Passwords and data sent in clear text.

# TYPES OF SNIFFING

Sniffing is mainly classified into two types as follows:

## Passive Sniffing

**Passive sniffing** is fairly simple which involves just connecting to the target network and waiting for the packets to arrive at your host for sniffing. This type of sniffing works only in an unswitched network environment where the individual hosts are interconnected using a **hub**.

In a hub type of network environment, traffic (packets) from all hosts are sent to all ports on the network. This makes it possible for the hacker's computer to secretly intercept and sniff packets that belong to other computers on the same network.

In order to carry out passive sniffing, the hacker will simply hook up his laptop to the network and runs a sniffing software to silently capture the packets that arrive at his port. Since passive sniffing works by simply exploiting the existing vulnerability of unswitched networks without making additional modifications, it is often hard to detect.

## Active Sniffing

**Active sniffing** is the one that is often performed on a switched network environment. Here individual hosts on the network are interconnected using **switches** that keeps record of MAC addresses (hardware addresses) of all hosts connected to it. With this information the switch can identify which system is sitting on which port so that when the packets are received they are intelligently filtered and forwarded only to the intended ports.

This makes the packet sniffing very difficult on switched network as the traffic from all hosts does not flow to all ports on the network. However, it is still possible to actively sniff packets on switched networks using techniques such as **ARP poisoning** and **MAC flooding** which are discussed below.

# TECHNIQUES FOR ACTIVE SNIFFING

Since most computer networks today uses switches instead of hubs, active sniffing proves more feasible under practical conditions. The following are some of the important techniques used in *active sniffing*:

## ARP Poisoning

Before actually going into **ARP poisoning**, let us first try to understand what **ARP** actually means.

**What is an ARP?**

**ARP** which stands for **Address Resolution Protocol** is responsible for converting *IP address* to a physical address called *MAC address* in a network. Each host on a network has a MAC address associated with it which is embedded in its hardware component such as **NIC** (Network Interface Controller). This MAC address is used to physically identify a host on the network and forward packets to it.

When one host wants to send data to another, it broadcasts an ARP message to an IP address requesting for its corresponding physical address. The host with the IP address in the request replies with its physical address after which the data is forwarded to it. This ARP request is cached immediately and stored in an ARP table to ease further lookups.

So, **ARP poisoning** (also known as **ARP spoofing**) is where the hacker goes and pollutes the entries in the ARP table to perform data interception between two machines in the network. For this, whenever a source host sends an ARP message requesting for the MAC address of target host, the hacker broadcasts the MAC address of his machine so that all the packets are routed to him and not the target host that is intended to receive. The following figure shows an illustration of how ARP poisoning is performed.
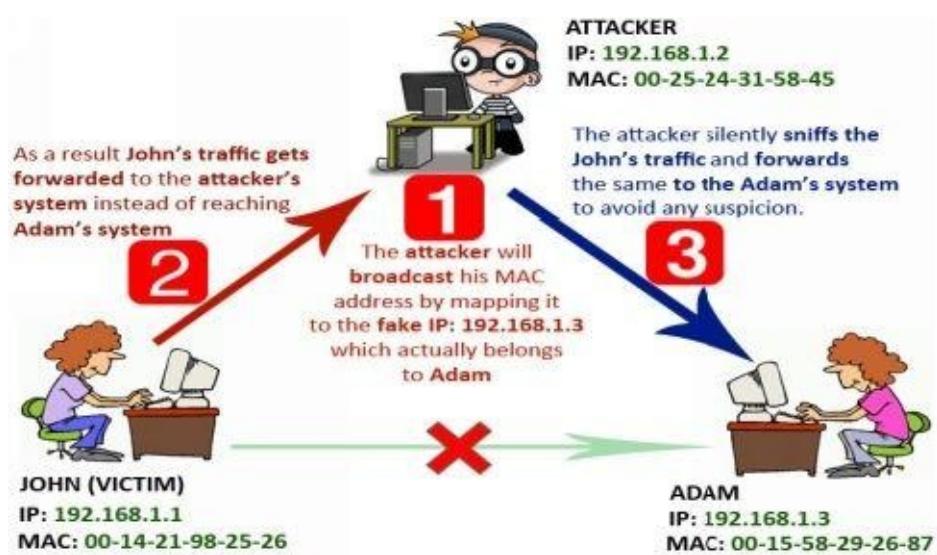


Figure 11. 1

As shown in the above example **John**, **Adam** and the **attacker** all three share the same network. John decides to send a message to Adam where his computer knows the IP

address of Adam as 192.168.1.3 but does not know its MAC address. So it will broadcast an ARP message requesting for the MAC address of 192.168.1.3. But, the Attacker will poison the ARP cache table by spoofing Adam's IP address and mapping his (attacker's) MAC address on to. As a result, John's traffic gets forwarded to the attacker's computer where he sniffs all the vital information and forwards the same to Adam so as to make everything look normal.

## Tools for APR Poisoning

The following are some of the tools that can be used to carry out ARP poisoning:

### 1. Ettercap

This is an open-source network security tool used for performing sniffing and man-in-the-middle attacks on a local network. It is capable of intercepting network traffic and capturing vital information like passwords and emails. It works by putting the network interface device into promiscuous mode and poisoning ARP entries of the target machines to sniff traffic even on switched network environment. It can be downloaded from the link below:

**Download Ettercap: http://ettercap.github.io/ettercap/**

### 2. Nightawk

This is a simple tool for performing ARP spoofing and password sniffing. It has the ability to capture passwords from web login forms implemented on protocols like HTTP, FTP, SMTP and POP. It can be downloaded from the link below:

**Download Nightawk: https://code.google.com/p/nighthawk/**

## MAC Flooding

**MAC flooding** is another type of sniffing technique used in a switched network environment that basically involves flooding the switch with numerous unnecessary requests. Since switches have limited memory and processing capabilities to map MAC addresses to physical ports, they gets confused and hits their limitation.

When switches hits their limitation they will fall into an open state and starts acting just like a hub. That means, all traffic gets forwarded to all ports just like in case of an unswitched network so that the attacker can easily sniff the required information.

## Tools for MAC Flooding

**EtherFlood** is an easy to use open-source tool to carryout MAC flooding in a switched network environment. The download link EtherFlood is mentioned below:

**Download EtherFlood: http://ntsecurity.nu/toolbox/etherflood/**

# DNS CACHE POISONING

**DNS cache poisoning** (also known as **DNS spoofing**) is a technique similar to *ARP poisoning* where the Domain Name System (DNS) resolver's cache is polluted by introducing manipulated data into it. So, whenever users try to access websites, the poisoned DNS server returns an incorrect IP address thereby directing the users to the attacker's computers.

The DNS is responsible for mapping the human readable domain names to their corresponding addresses. In order to improve the speed of resolution, DNS servers often cache the previously obtained query results. Before caching or forwarding the query results, the DNS server has to validate the response obtained from other servers to make sure that it has come from an authoritative source.

However, some servers are configured with less security features where they fail to properly validate the source of response. Hackers can exploit this vulnerability to introduce malicious records to the DNS cache so as to redirect a large group of Internet users to their computers. When a DNS cache is said to be poisoned, it will affect all those Internet users who have configured their systems to use it as their DNS server. The following figure illustrates the working of DNS cache poisoning attack.
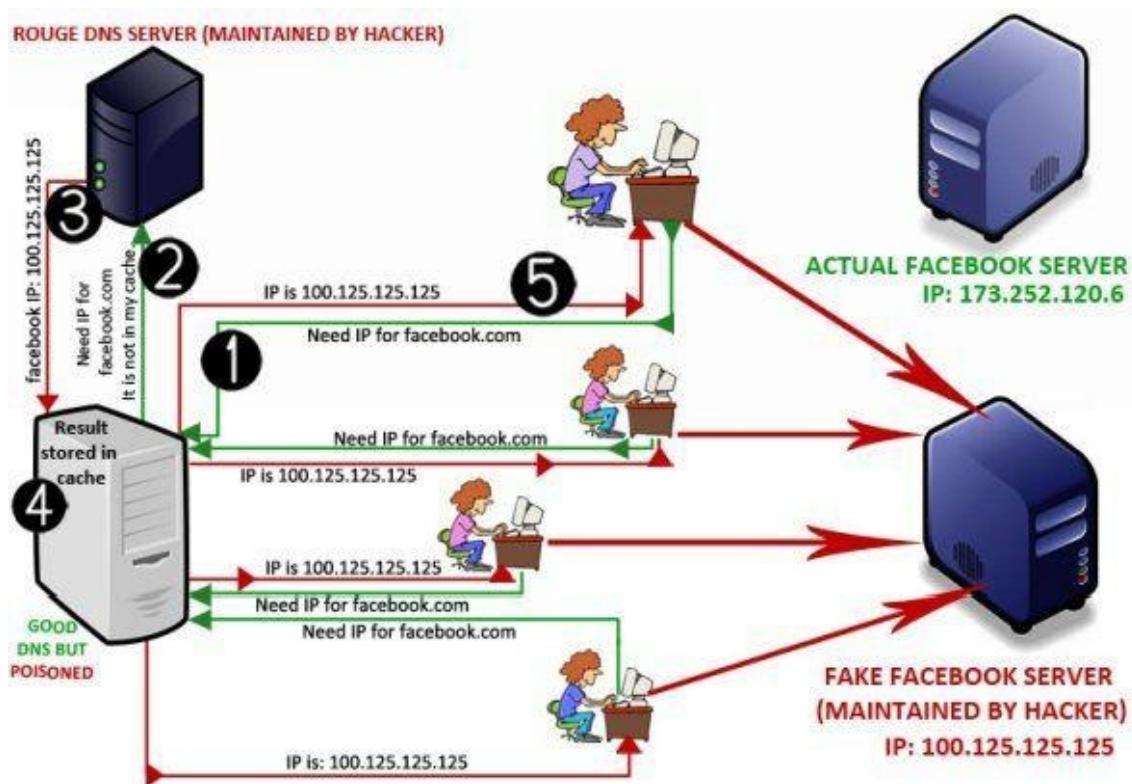


Figure 11. 2

As shown in the above figure, a user will place a request to the DNS server for resolving "facebook.com". Since the DNS server does not have the IP in its cache, it forwards the same request to the next DNS server. Now, a rouge DNS server picks up the request and replies with a fake IP for the query "facebook.com". Without actually validating the response, the DNS server forwards the result to the user and also stores the result in its cache. As a result the cache gets poisoned.

The user is now directed towards the **fake** "Facebook" server maintained by the hacker instead of the real one. All the subsequent requests from other users for "facebook.com" is also answered by the compromised DNS server using its poisoned cache data.

In this way it is possible for the hacker to victimize a large group of people and hijack their personal information such as passwords, emails, bank logins and other valuable data.

# MAN-IN-THE-MIDDLE ATTACK

**Man-in-the-middle** is referred to a kind of attack where the attacker intercepts an ongoing communication between two hosts in a network with an ability to sniff the data or manipulate the packets exchanged between two communicating parties. This attack is somewhat similar to the one shown in the figure 11.1 from the previous section.

Another good example of man-in-the-middle attack is an active eavesdropping carried out by the attacker by making two independent connections with the victims to make them believe that they are chatting with each other. But the entire conversation is actually controlled by the attacker as illustrated in the following figure 11.3.
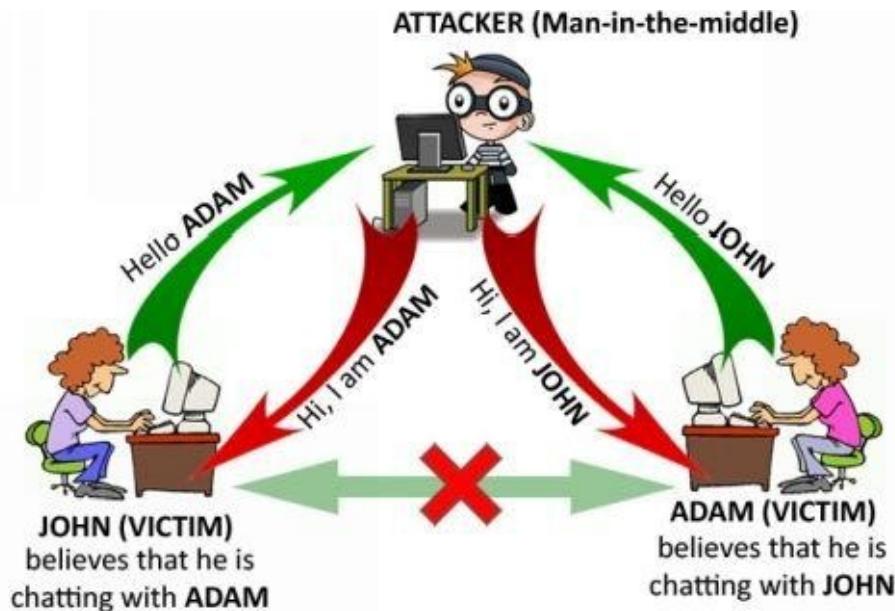
Figure 11. 3

# TOOLS FOR SNIFFING

After going far enough into the theoretical concepts of sniffing, let us now look at some of the popular sniffing tools and learn how to use them to carry out various kinds of attacks.

## WireShark

**Wireshark** is free and open-source packet analyzer program used for network troubleshooting and analysis. It is available for both Windows and Linux operating systems and can be downloaded from the following link:

**Download WireShark: https://www.wireshark.org/download.html**

Once you have installed **WireShark** on your Windows computer, start the program by running it with administrator privileges.
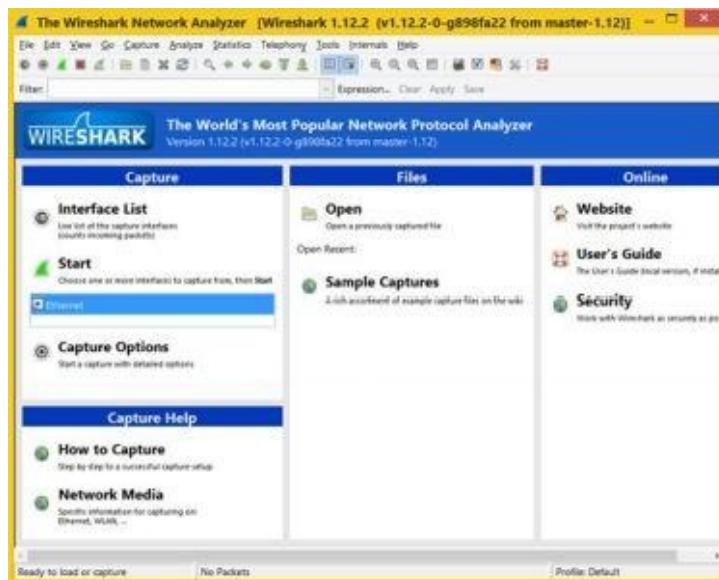


Figure 11. 4

From the menu options, click on "Capture" and select "Options" from the drop down menu. This will show a list of available interface devices for sniffing.
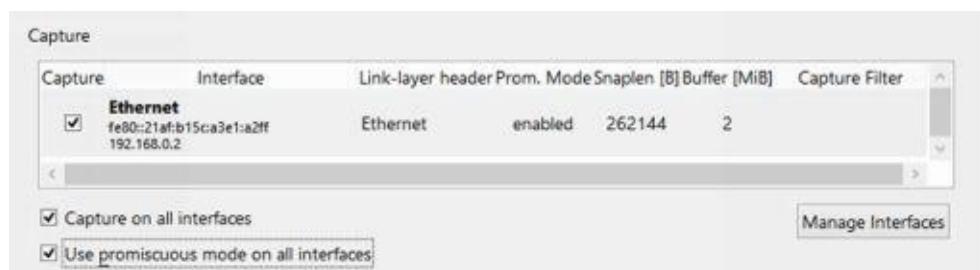


Figure 11. 5

You can either select a particular device or choose to capture on all interfaces. Also make sure that "promiscuous mode" is activated. When you are done click on the "Start" button to begin the sniffing process.

This will start capturing all the incoming and outgoing traffic on the network as shown in the figure 11.6 below:
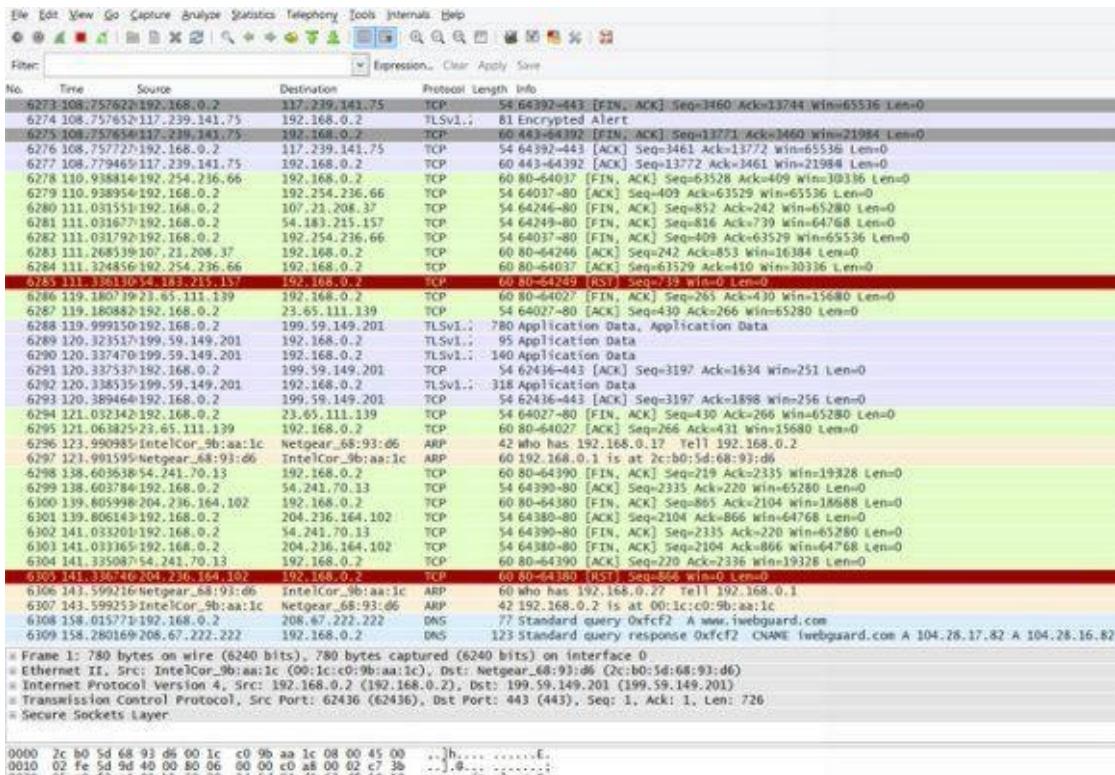
Run this tool for as long as you want and when you feel that you are done with capturing enough data, stop the sniffing process by pressing the "Stop" button displayed in red colour at the top.

In order to analyze the captured data, you will have to set filters in for filtering the type of data that you are looking for. For example, if one is looking to capture passwords from login forms which are normally sent using the HTTP POST request method, you can set the filter as **http.request.method == "POST"**. This will help you narrow your results and find what you are looking for.

Once the filter is set, right-click on the desired result that you want to analyze and select "Follow TCP Stream". This will open up the entire TCP stream in a new window. Here you can carefully analyze the data to find out the password entered by users in unencrypted login forms as shown in the sample snapshot below.

Figure 11. 7

You can use different filters for analyzing different types of data. For instance if you want to analyze the FTP results, set the filter as **ftp** and follow the TCP stream.

## Cain & Abel

This is another powerful network sniffer which has many other built-in features such as password cracking, ARP poisoning and MAC spoofing. It proves as an all-in-one tool for performing various attacks such as sniffing, man-in-the-middle attack and ARP cache poisoning.
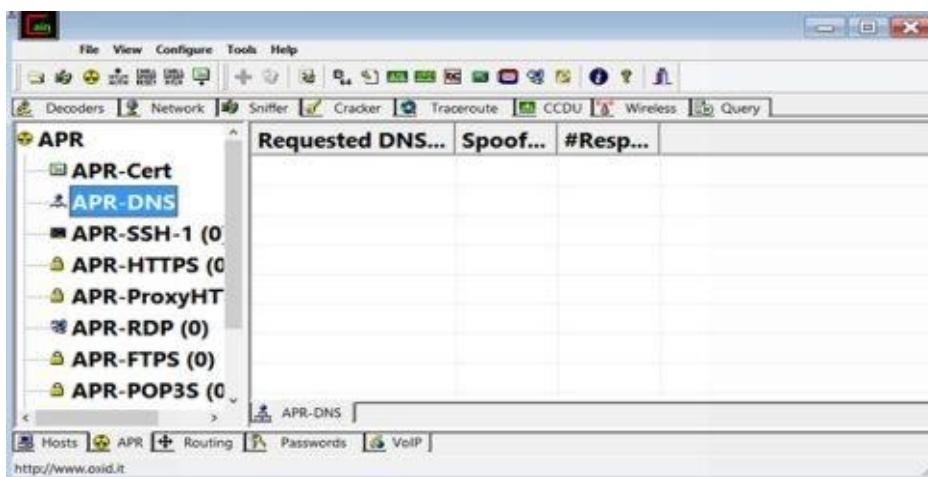


Figure 11. 8

You can download this tool from the following link:

**Download Cain & Abel: http://www.oxid.it/cain.html**

## SMAC

**SMAC** is a handy tool that allows you to spoof the MAC address on your machine. Using this tool it is possible to set the MAC address of your choice so as to easily fool other machines on the network to send their information to your machine.

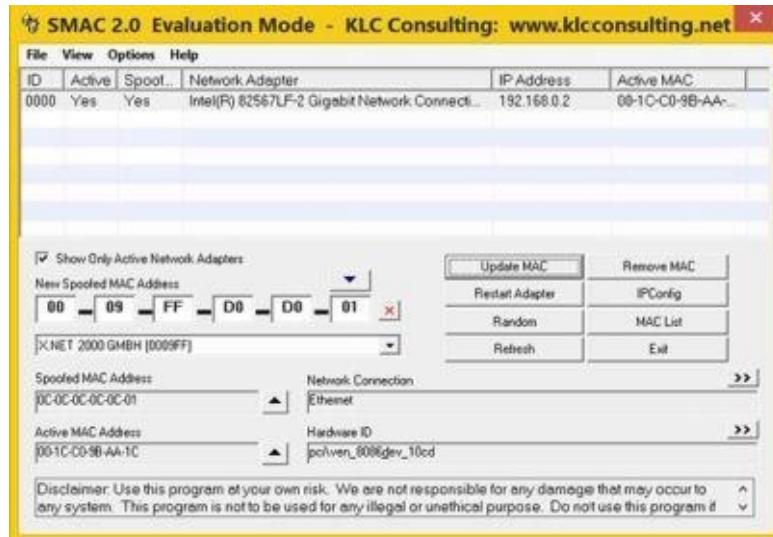The following snapshot shows the SMAC tool in action:

Figure 11. 9

The download link for SMAC is given below:

**SMAC Download : http://www.klcconsulting.net/smac/**

# COUNTERMEASURES

After knowing about various sniffing methods and the tools used to carry out them, it is time to shed some light on possible countermeasures that can be taken to prevent such attacks on your network.

- Restrict physical access to the network for unintended users. This will stop the attacker from installing the packet sniffer on the network.

- Use encryption on the network so that even if the attacker manages to sniff the packets, he will not be able to see the information in a plain text format.

- Permanently adding the MAC address of the gateway to the ARP cache will prevent the attacker from ARP spoofing the gateway.

- In case of a small network using static IP addresses and static ARP tables will prevent hackers from adding spoofed ARP entries.

- In case of a large network install switches that come with port security features which makes it impossible to spoof.

- Use tools like **Arpwatch** or an **IDS** (Intrusion Detection System) to monitor and detect sniffing activities on the network.

# Chapter 12 - Denial of Service

In this chapter we will take a closer look at what exactly are **denial of service (DoS)** attacks, their different types and tools used to perform them. In the recent years, DoS attacks have simply grown from mere annoyances to more serious and high-profile threats to business and e-commerce websites. This is the type of attack that the hackers have successfully used to temporarily bring down major online providers like *Yahoo!*, *eBay* and other big players. So, having a clear understanding of the DoS attacks and their working principle seems highly essential for anyone who needs to excel in the field of ethical hacking.

# WHAT IS DENIAL OF SERVICE (DOS) ATTACK?

A **denial of service (DoS)** attack is an attempt to make a system, service or network completely unusable to its intended users or significantly slow down its performance by overloading its resources.

In most cases, if an attacker is unable to gain unauthorized access to the target system he finally decides to carry out a DoS attack by trying to crash its resources. The aftermath of the DoS attack can lead to financial losses especially if the affected website or server is associated with e-commerce activities. It may also affect the goodwill of the company or organization that has become a victim of the attack as there is a clear chance of people losing trust in using its services.

## Objectives of DoS Attacks

The objective of a DoS attack is not to gain unauthorized access to the system but rather to prevent the legitimate users of its service from accessing it. To accomplish this, an attacker may use different means such as:

- Attempt to **flood the traffic** to the target network so as to make it unreachable to its intended users.

- Attempt to **disrupt connections** between two machines on the network which may lead to denial of service.

- Attempt to **prevent a particular individual** from accessing the service or **disrupt only a specific service** from getting accessed.

## DoS Attack Techniques

The following are some of the common techniques employed in denial of service attack:

## 1. Smurf Attack (ICMP flood)

In this type of DoS attack, the attacker broadcasts a large amount of Internet Control Message Protocol (ICMP) echo request packets to a computer network with a spoofed IP address of the target host (victim). This will flood the target host with lots of ping replies (ICMP echo replies) from the network which makes it impossible to handle. There is also a variant of smurf attack called **fraggle** attack where UDP packets are used instead of ICMP packets. The following figure illustrates the mechanism of a smurf attack:
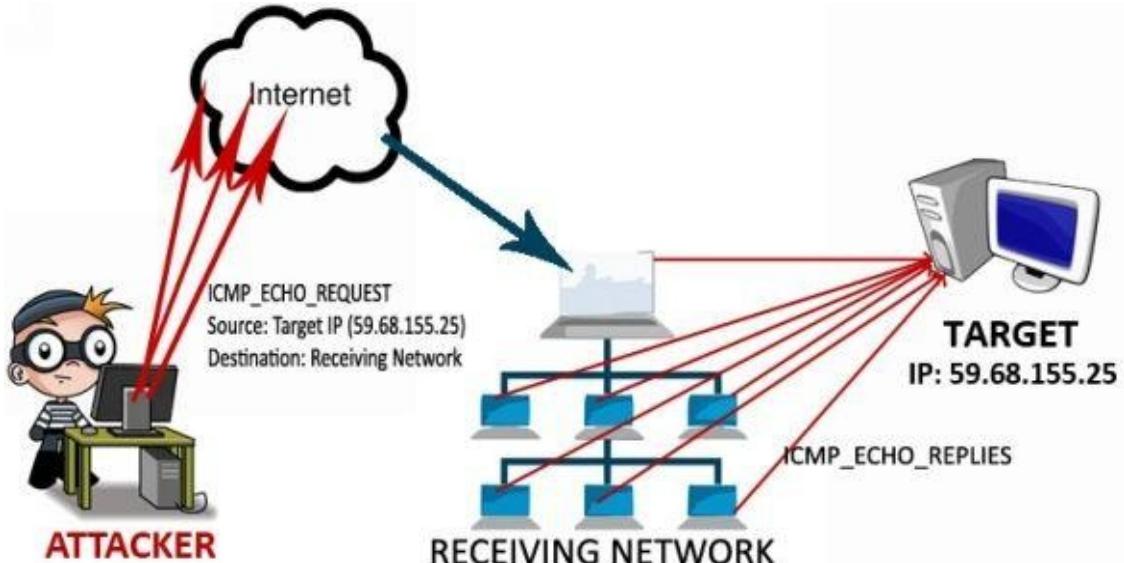
Figure 12. 1

## 2. Ping of Death (POD)

In this kind of attack, the attacker deliberately sends an IP packet larger than the allowed size of 65,535 bytes. Since the size exceeds the maximum allowed limit, it is split across multiple IP packets known as fragments and sent to the target host. However, when the target tries to reassemble the packet on its end, the fragments add up to more than the allowed size of 65,535 bytes. Being unable to handle oversized packets, the operating system will freeze, reboot or simply crash thereby causing all the services running on it to become unavailable to the legitimate users.

In this way, the attacker becomes successful in causing a denial of service using the **ping of death** technique.

## 3. Teardrop Attack

Teardrop attack involves sending IP fragments with oversized payload and overlapping offset value especially in the second or later fragment. If the receiving operating system is unable to aggregate the packets accordingly, it can lead to system crash.

## 4. SYN Flood Attack

The SYN flood attack exploits a known weakness in the TCP connection sequence called the "three-way handshake". According to this, a host sends **SYN Request** to the target server which responds with a **SYN-ACK** back to the host. Finally the requesting host sends an **ACK Response** back to the server which completes the three-way handshake process to establish the connection.

However, in case of a SYN attack, a large number bogus TCP SYN requests are sent to the target server but the SYN-ACK response sent back from the server is not answered. Sometimes the attacker may even use a spoofed IP address while sending a SYN request. For each SYN request from the attacker, the victim server allocates resources and keeps waiting for the ACK from the requesting source (attacker). Since no ACK is received, the server gets flooded with a large amount of half-open connections thereby leading to

resource exhaustion resulting in a denial of service. SYN flood attack is demonstrated in the following figure.
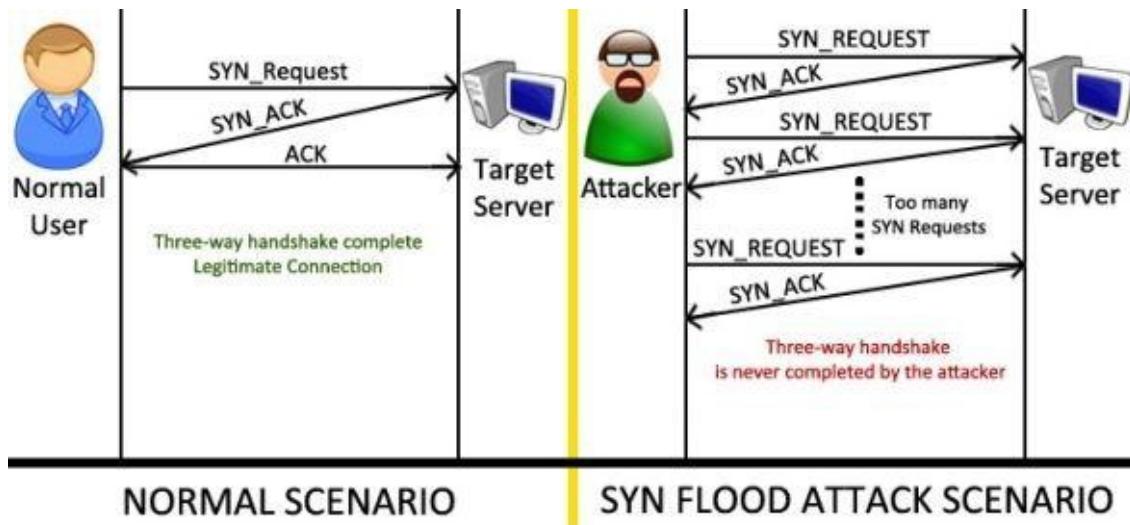


Figure 12. 2

## Tools for DoS Attacks

Now, let us look at some of the popular tools used for DoS attacks.

### 1. Slowloris

**Slowloris** is a tool built for Linux platform that targets hosts running web servers such as *Apache, dhttpd, Tomcat* and *GoAhead*. This tool works by sending too many HTTP headers to the target server but never completes it. Slowloris is designed to take down a target web server from a single machine by holding as many connections to it as possible. This will eventually overflow the maximum connections that the target web server can handle thereby leading to a denial of service for other legitimate connections.

### 2. QSlowloris

This tool works on the same principle as that of Slowloris but has a graphical user interface for ease of use and works on Windows platform.

### 3. PyLoris

**PyLoris** is basically a testing tool for servers but can also be used to perform DoS attacks. It can target various protocols including *HTTP, FTP, SMTP, IMAP* and *Telnet*.

### 4. LOIC (Low Orbit Ion Cannon)

**LOIC** is an open-source network stress testing and DoS tool. It floods the target server with a large amount of TCP or UDP packets resulting in a denial of service.

# DISTRIBUTED DENIAL OF SERVICE (DDOS) ATTACK

A distributed denial of service attack happens when the attack on the target host originates from multiple compromised systems. Before launching the attack, the attacker compromises multiple systems from one or more networks using trojans and other techniques. These compromised systems are known as **zombies** where the attacker uses them to launch a DDoS attack on the final target.

The advantages of distributed denial of service is that since multiple systems are used, the target can easily be flooded with too much traffic eventually causing it to go down. A more clear understanding can be obtained using the following figure 12.3 which illustrates the mechanism involved in a typical DDoS attack.
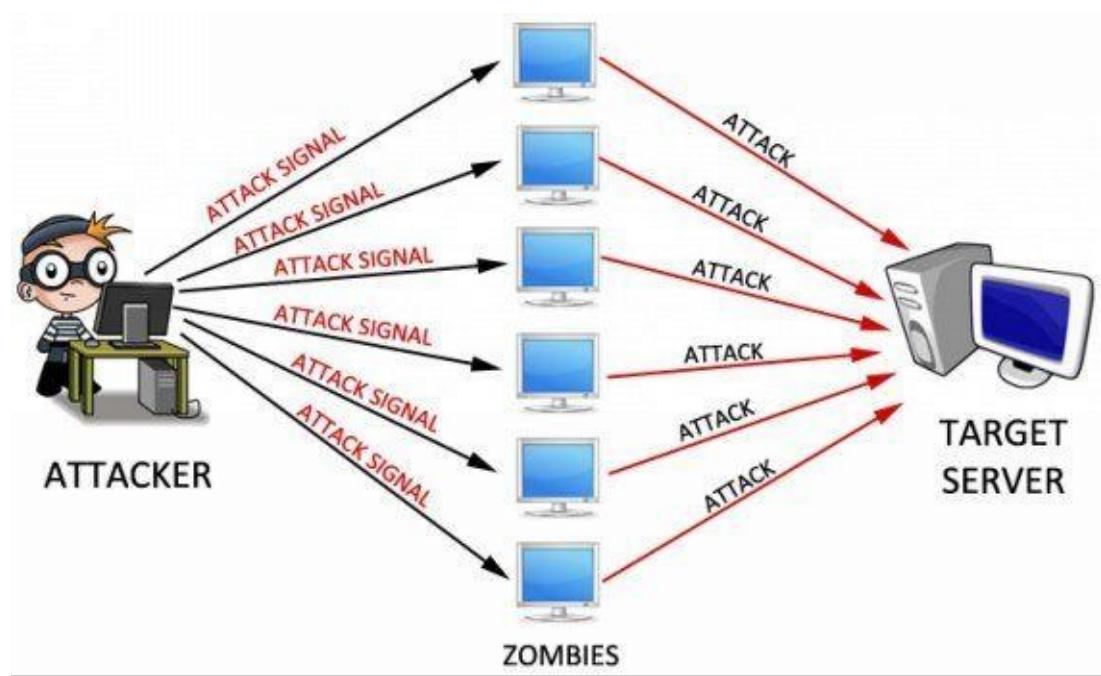


Figure 12. 3

## Characteristics of DDoS Attack

- When compared to a DoS attack, DDoS is a large scale coordinated attack on the target using large number of pre-compromised systems (zombies).

- DDoS attack works under two levels. The final target which is under direct attack is known as the "primary victim" while the zombies used to attack it are referred to as "secondary victims".

- As the attack originates from multiple network locations and involves large number of zombies, it is often hard to detect or prevent.

- A simple DoS attack which originates from a single IP address can easily be blocked at the firewall level. But a DDoS attack which originates from twenty to thirty

thousand different systems (IP addresses) is extremely hard to detect.

- Even if the company makes a guess work and manages to block multiple IP addresses at its firewall, there is a clear chance of real users being adversely affected as it is hard to differentiate between genuine and malicious traffic.

## DDoS Attack Mechanism

Now let us look at some of the DDoS attack models that are commonly in place:

### Agent Handler Model

**Agent handler model** is one of the popular DDoS mechanisms where the attacker cleverly designs the attack in a hierarchical manner so as to improve its effectiveness and also make it hard to detect and trace back.

At the first level, the attacker compromises a set of computers and installs a handler program on them. At the second level, the attacker compromises another large set of computers commonly referred to as "agents" or "zombies" which are controlled by the "handlers".
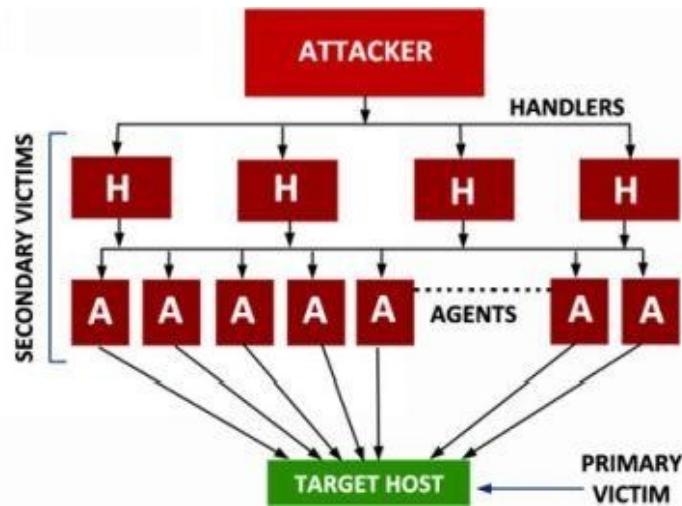


Figure 12. 4

So, during the time of attack, the attacker cleverly sits at the top of the hierarchy controlling the handlers which in turn initiate the agents (zombies) to attack the target host (victim). Since the attacker safely hides in the background, this type of attack makes it really hard to trace back to the source.

### IRC Based Model

**IRC based model** is similar to the above discussed "agent handler model" but the only difference is that, the attacker makes use of an "Internet Relay Chat (IRC) network" instead of handlers to connect to the agents.
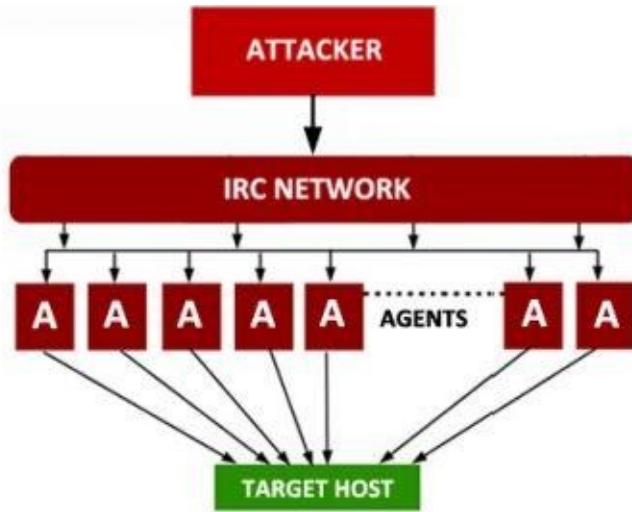
Figure 12. 5

The advantage of this model is that the attacker can use legitimate IRC port to easily connect himself to agents and initiate the attack. Also, huge amount of traffic on IRC network makes it difficult for the network administrator to trace the presence of attacker on the server.

## Tools for DDoS Attacks

The following are some of the popular tools used in performing DDoS attacks:

### 1. Trinoo

**Trinoo** is a popular tool for DDoS attacks that has a record of taking down large sites like Yahoo! It is designed to cause coordinated DDoS attacks on the target from different locations. This tool basically uses the "remote buffer overrun" vulnerability of systems to get installed and later use them as zombies.

### 2. DDoSim

**DDoSim** also known as *Layer 7 DDoS simulator* is an excellent tool to carry out DDoS attack on the target by simulating several zombies. These zombies create full TCP connection to the target using random IP addresses. It can also perform HTTP based DDoS attacks with both valid and invalid requests.

### 3. Tor's Hammer

This is another nice DDoS tool written in Python. It is a highly effective tool that has the capability to take down machines running Apache and IIS servers in a very short time. The advantage of this tool is that it has the ability to run through a TOR network ( anonymous network) to keep the whole attack unidentified.

### 4. Davoset

**Davoset** is yet another impressive tool for performing DDoS attacks. It makes use of the

"abuse of functionality" vulnerability on sites to use them as zombies and cause DDoS attacks on the target.

# COUNTERMEASURES

After exploring a fair amount of information about different types DoS attacks, their mechanism and various tools used in performing them, let us now look at some of the countermeasures that one can take to stop or mitigate such attacks from happening on your systems.

- Using an **IDS** (Intrusion Detection System) and **IPS** (Intrusion prevention System) can be of a great advantage when it comes to detection and prevention of DoS/DDoS attacks at an early stage.

- Blacklist IP addresses that are found to be the source of a possible DoS attack.

- **Ingress Filtering:** Make sure that the incoming packets are coming from a valid source.

- **Egress Filtering:** Scan all the outgoing packets for malicious data before they actually leave the network.

- Since it is possible to easily spoof the IP address of incoming DDoS packets, there is a good chance that the packets will not represent a valid source. So, configure the firewall to drop packets that do not represent a valid source address.

- Place a firewall or packet sniffer that filters out all incoming traffic that does not have an originating IP address.

- Increase the available bandwidth or resources to prevent the services from going down quickly during an attack.

- **Load Balancing:** Use a multiple server architecture and balance the incoming load on each server. This can help improve performance as well as mitigate the effects of DDoS attacks.

# Chapter 13 - Wireless Hacking

The usage of wireless networks are becoming increasingly popular these days due to their operation flexibility and low cost setup. Wireless networks such as WLANs allow users to access network resources from anywhere in the campus using mobile devices like laptops and tablets. This offers a great deal of flexibility to students and employees, thereby eliminating the need to always stick to their desks during their work time.

However, on the flipside of all its advantages lies major security issues. As more and more companies have now started using wireless technologies in their network, these security issues puts the business on a high risk. As opposed to wired networks, wireless technology does not limit physical access to an outsider such as a hacker. Today, with all the readily available tools it is easily possible for the hacker to compromise loopholes in the wireless security system and gain access to the network.

In this chapter we will look at some of the common vulnerabilities that exists in the wireless networking technology, ways to exploit them for gaining access and also the countermeasures for preventing them.

# WIRELESS NETWORK BASICS

Before jumping into the actual hacking, let us go through some of the basic concepts of wireless networking.

The wireless standard is commonly represented as **802.11** and is used to setup wireless local area networks (**WLANs)** in environments such as schools and offices. 802.11 standard has 3 leading protocols (or extensions) as follows:

1. **802.11a** - It offers higher speed (up to 54-Mbps), more channels and less interferences.

2. **802.11b** - This protocol is also popularly known as **"Wi-Fi"**. This is the standard that was used in most of the Wi-Fi hotspots.

3. **802.11g** - This is similar to the 802.11b protocol but provides much faster transmission.

## Components of Wireless Network

A wireless network comprises of the following 3 basic components:
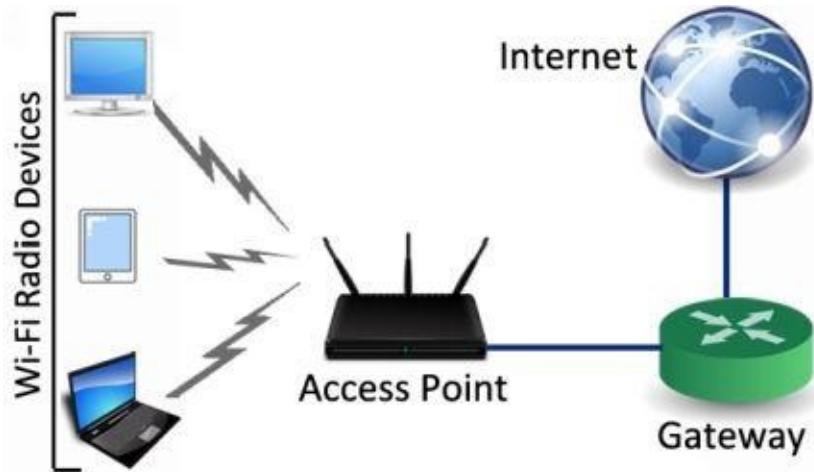


Figure 13. 1

1. **Wi-Fi Radio Device:** This can be any device that has a wireless card (NIC) built into it such as a laptop, tablet, Wi-Fi enabled PC or a cell phone.

2. **Access Point:** This is the device which allows Wi-Fi radio devices to connect to the wireless network using Wi-Fi- standards. The **AP** then has a wired connection to the router. However, most modern routers now come with built-in **APs** to eliminate the need for an extra device.

3. **Gateway:** Routers are connected to the gateways which then connects the whole network to the Internet.

## Detecting Wireless Networks (War-Driving)

To detect a wireless network such as a *Wi-Fi Access Point*, you can start roaming in a technology park, downtown area or simply through the walls of your own building using your Wi-Fi capable device (such as laptops and palm devices) with a "war-driving" software. Some of the popular war-driving software programs are listed below:

- **Netstumbler:** This is a Windows based war-driving tool that can detect wireless networks and also mark their position with a GPS.

- **MiniStumbler:** This is a portable version of *NetStumbler* that can be installed on handheld computers.

- **Vistumbler:** This is another handy war-driving tool for Windows based operating systems.

- **Kismet:** This is a Linux based wireless sniffing tool that also has the ability to perform war-driving.

- **Wifi Scanner:** This is a GUI based Windows tool to detect all the available APs in your surroundings.

Please note that all wireless network cards (NICs) are not same and some may not be compatible with the above mentioned war-driving tools. In that case you will have to use the software that came with your wireless NIC for detecting access points.

# WIRELESS SNIFFING

**Wireless sniffing** is no different than the "wired sniffing" that we have already discussed in the earlier chapter but the only difference here is that this one is performed on a wireless environment. In this case the protocol used for sniffing is 802.11. Since radio waves are omnidirectional, it is easily possible to carry out a "man-in-the-middle" attack and capture all the packets from the wireless traffic available in your range.

## Configuring Wireless Cards for Promiscuous Mode

**Promiscuous mode** allows the NIC (Network Interface Card) to capture all the network traffic that arrives at it instead of capturing only those that are intended for the NIC. Unless your wireless card is configured to operate in promiscuous mode, it is not possible to perform wireless sniffing.

Most wireless network cards do not support promiscuous mode on Windows operating system and hence one has to use Linux to successfully perform wireless sniffing. If you still want to perform sniffing on Windows, you can use a special type of wireless card known as **AirPcap** which is far too expensive compared to normal ones. AirPcap cards can be used on Windows with sniffing programs like "WireShark" and "Cain&Abel", but for all other cards one has to use Linux platform.

## Tools for Wireless Sniffing

Let us look at some of the widely used tools for performing wireless sniffing:

## Wireshark

**Wireshark** is one of my favourite packet sniffing tool as it is easy to use and supports GUI. Even though it works on Windows, I am using Linux operating system in my wireless sniffing demonstration as promiscuous mode is not supported on Windows platform. I am using **TP-LINK TL-WN722N** for this demo as it is fully compatible with Kali Linux that I am running it on. If you have a different wireless card or need to purchase one, please make sure that it is compatible with the Linux kernel that you will be using it on. Since Kali Linux is packed with Wireshark and all other useful tools there is no need to install it separately. Follow the below instructions to perform a sample wireless sniffing:

1. Boot up your computer from your Live Kali Linux DVD.

2. Once the Linux is loaded, plug-in your USB wireless card.

3. Open the "Terminal" window and type the following command:

   **iwconfig**

Figure 13. 2

4. If your wireless card is compatible, you should see your device listed as shown in the above snapshot as "wlan0".

5. The next step is to put the card into the monitoring mode (promiscuous mode). For this, type the following command:

   **airmon-ng start wlan0**

   On my computer, wireless card is listed as "wlan0". So, I have entered "wlan0" in the command. If your computer has a different listing such as "wlan1" or "wlan2", then you need to replace the same in the above command.

6. After you execute the command successfully, your computer will create a new virtual wireless card and enable "monitor mode" in it. In my case it is "mon0" as shown in the below snapshot.



Figure 13. 3

7. Now it is time to use Wireshark to start capturing the packets. To start Wireshark, click on **Applications -> Kali Linux -> Top 10 Security Tools -> wireshark** as
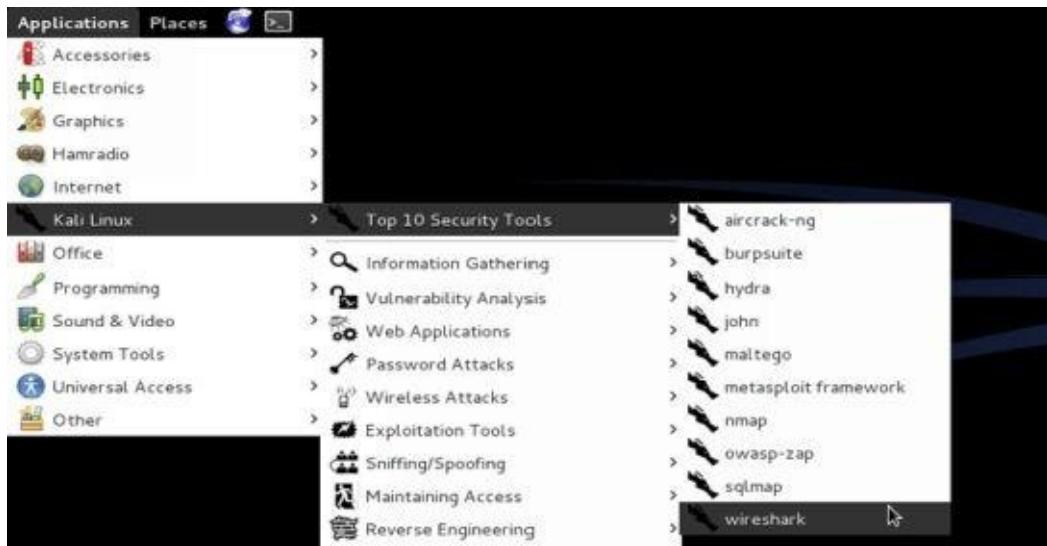
shown below:



Figure 13. 4

8. Now, from the Wireshark main window, select "mon0" from the **Interface List**, double-click on it and select option to capture packets in both "promiscuous mode" and "monitor mode". Next click on **OK**.
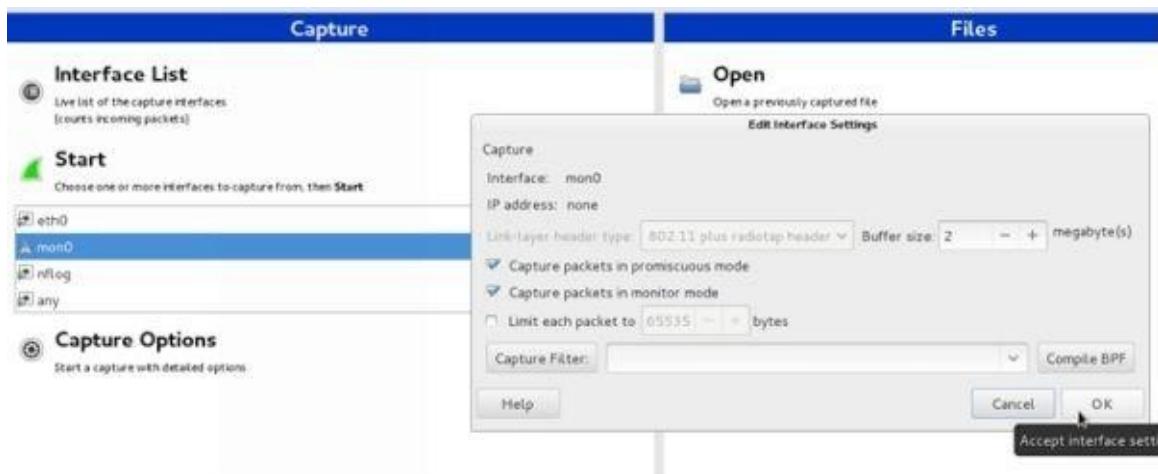


Figure 13. 5

9. Once you are done, click on the "Start" button to begin sniffing. This should capture packets from all the nearby available wireless networks. The following snapshot shows a sample packet capture:
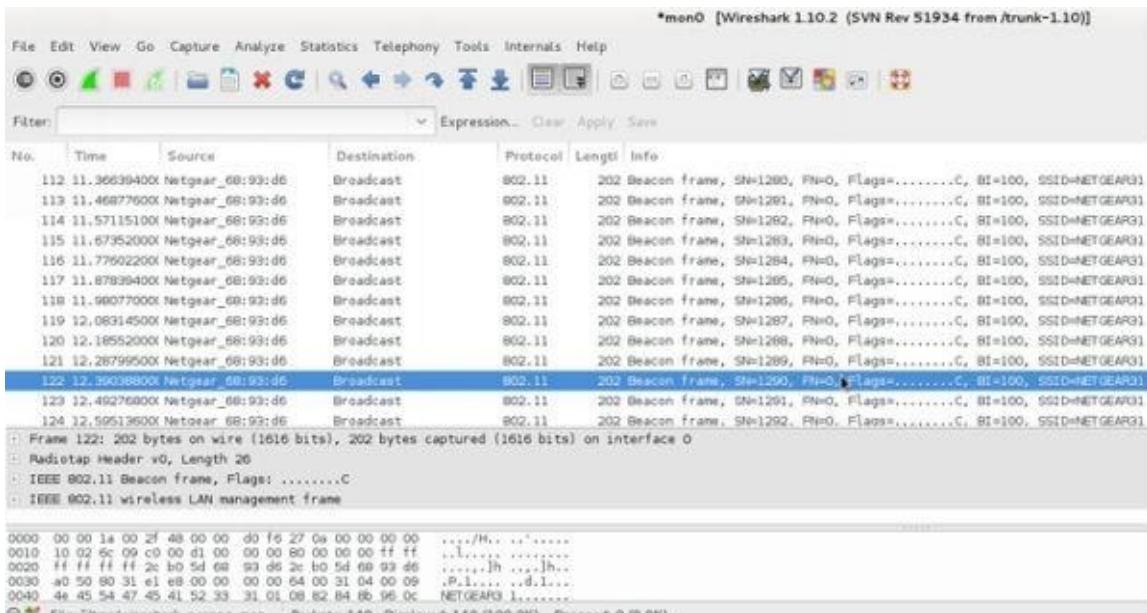
Figure 13. 6

The following are some of the other wireless sniffing tools worth considering:

## Ethereal

This is another Linux based sniffing tool that works both on wired and wireless networks. It comes as a built-in security testing tool in Kali Linux.

## OmniPeek Wireless

OmniPeek is a commercial 802.11 sniffer tool packet with tons of useful features for network monitoring. It works on Windows platform.

# WIRED EQUIVALENT PRIVACY (WEP)

**WEP** is a component of 802.11 WLAN networks designed to provide confidentiality of data in the wireless networks. Unlike wired networks where it is possible to limit physical access only to trusted users, the same is not possible in case of a wireless network. Therefore, in order to overcome this limitation a special type of encryption called WEP is used to prevent attackers from intercepting the wireless data.

However, there is a clear weakness in the WEP security system that can be exploited. Once enough data packets are captured and given ample time, the attacker can easily crack the WEP key used for encryption so as to decrypt all information back to raw data.

## Cracking WEP Encryption

The following tools are used popularly for cracking WEP encryption key/password:

### Aircrack-NG

This is a popular tool used on Linux to crack 802.11 WEP encryption keys. It is a command line tool that comes as a built-in feature in Kali Linux package and can easily be used by loading it from the live DVD. Since it takes a long list of commands and procedures to crack WEP passwords, I have decided to omit the demo of the cracking process from this book. But you can still Google for "how to crack WEP encryption" to find many step-by-step procedures that describe the actual cracking process.

### WEPCrack

**WEPCrack** is another popular tool for cracking 802.11 secret keys. This is the first tool to give a public demonstration on how WEP encryption can be exploited.

# WI-FI PROTECTED ACCESS (WPA)

**WPA** is another wireless security standard that was mainly developed to address the shortcomings of WEP. WPA uses a different encryption standard which is better than that of WEP and is designed as a software upgrade.

However, a flaw in this security feature called **Wi-Fi Protected Setup** (**WPS**) allows WPA passwords to be cracked using brute-force approach. Most access points have WPS enabled by default and hence remain vulnerable.

## Cracking WPA Passwords

Here is a step-by-step demonstration of cracking WPA password using the **Reaver** tool that comes with Kali Linux.

1. Boot your computer using the Kali Live DVD and also plug-in the USB wireless card.

2. Open the terminal window and type the command **iwconfig** to make sure that your card is detected.

Figure 13. 7

3. Once you see your card listed (wlan0) as shown above, type the following command to put your card into the "monitoring mode" and start using it.

   **airmon-ng start wlan0**

   This should activate "monitoring mode" for your card. On my computer it is enabled on "mon0" as shown in the below snapshot.

Figure 13. 8

4. Now type the following command to detect nearby WPS enabled access points.

**wash -i mon0 -C**

This should perform a scan and list all the nearby access points as shown below. Once access points are detected, press **Ctrl+C** to stop the scanning process.



Figure 13. 9

5. As shown above, there is one listing which shows a vulnerable access point with an "ESSID" **NETGEAR31**. Now issue the following command to perform brute force attack on the target.

**reaver -i mon0 -b 2C:B0:5D:68:93:D6 -vv**

Please note that you will have to replace "2C:B0:5D:68:93:D6" with the **BSSID** of the target AP in your case.

6. The cracking process will take a few hours to complete and if everything goes well you should see the cracked PIN and passphrase in the results as shown in the below snapshot:

**Figure 13. 10**

## Other Tools for Cracking WPA

The following are some of the other WPA cracking tools that you can try:

- **coWPAtty:** This is a Linux based tool which uses dictionary approach and pre-computed hash files (similar to rainbow tables) to crack WPA passphrases.

- **Hashcat:** This is one of the fastest CPU-based password cracking tool which uses different approaches like dictionary, brute-force and hybrid types of attacks. It comes for both Windows and Linux operating systems.

# DENIAL OF SERVICE (DOS) ATTACKS

Just like wired networks, wireless networks are also susceptible to denial of service attacks. Since WLANs use radio waves on public frequencies for sending and receiving the traffic, it is easy to use other traffic from the same band to cause interference. If the attacker fails to gain access to the network, he may use DoS as a final option to attack the network. DoS attacks cause all the existing connections to the network to get dropped and also prevents new connections from happening thereby causing the WLAN virtually unusable.

## Tools for Wireless DoS

Kali Linux has a handful of built-in tools and features to cause DoS attacks on WLANs. Most of these tools works by sending de-authentication packets instead of authentication packets to access points which causes the network to drop all the existing connections. Other way to flood network is by sending authentication requests to APs with inappropriate status codes or random client MACs.

Some of the popular tools for wireless DoS include **Void11, Fatajack** and **FakeAP** (for spoofing or creating large number of fake access points in an attempt to confuse clients).

# COUNTERMEASURES

The following are some of the countermeasures that one can employ to prevent possible attacks on a wireless network:

- **MAC Address Filtering:** This feature uses a pre-defined list of MAC addresses of the clients' wireless NICs who are allowed to connect to the network. This way it is possible to prevent strangers from accessing the WLANs.

- **Hidden SSID:** Preventing an AP to stop broadcasting its SSID makes it go invisible and hence becomes inaccessible to attackers.

- **WPA instead of WEP:** Since WEP has well known security issues, it is always safe to use alternate encryption standards such as WPA or WPA2 over WEP.

- **Disable WPS:** Since WPS (Wi-Fi Protected Setup) is said to have flaws, enabling it makes WPA vulnerable. Therefore, it is necessary to manually disable the WPS feature where in most routers it comes pre-activated by default.

- **Firewall:** Using a firewall with strong rules helps filter unauthorized traffic and prevent brute-force attacks.

# Chapter 14 - Web Application Vulnerabilities

Weakness in web applications allow hackers to carry out various malicious attacks such as hijacking accounts, stealing identities, gaining access to confidential information and so on. In this chapter we will look at some of the common vulnerabilities found in web applications and ways to exploit them.

# WEB APPLICATION BASICS

A web application is a client/server software that runs on a computer and interacts with the users or other systems using protocols such as HTTP. Most web applications are typically written using programming languages like Java, PHP, Perl, Microsoft .NET and so on. Each server has multiple web applications running on it using which it is possible to make back and forth communication between the client and the server for carrying out tasks such executing database queries, retrieving files etc. The following steps explain the working of web applications on a server:

1. The client makes a request for a web page by typing its URL on the browser.

2. The target web server receives this request and forwards the same to the web applications residing on it.

3. The web applications will process the request to fetch all the necessary information required for the output (such as querying database, processing image etc.) and sends it back to the web server.

4. The web server forwards the output back to the requesting client's browser.



1. Browser requests a web page
2. Web server receives the request and the same is forwarded to the web applications

Internet

4. The received output is forwarded by the web server back to browser.
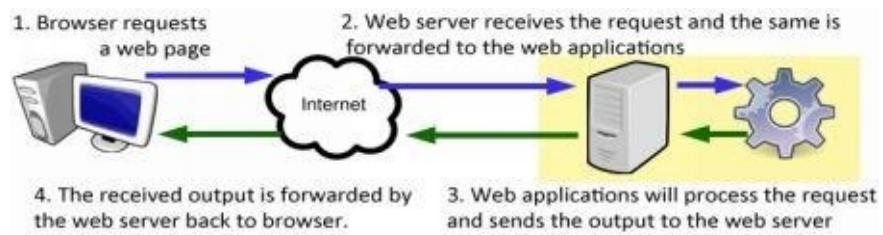3. Web applications will process the request and sends the output to the web server

**Figure 14. 1**

# TYPES OF WEB APPLICATION VULNERABILITIES

Now, let us discuss some of the different types of vulnerabilities found in web applications, how they work and ways to exploit them.

## Cross-Site Scripting (XSS)

**Cross-site scripting** (also known as **XSS**) is a type of attack that injects malicious scripts (such as JavaScript, ActiveX, VBScript, Flash etc.) into vulnerable web pages of a site. This malicious script gets stored on the website itself and whenever users visit this site or browse its pages the script gets launched on the client's side to initiate an attack. In simple words XSS is a type of attack that exploits a vulnerable site and uses it as an intermediary to carry out attacks on the end users.

### Key Concepts of XSS

- XSS is a web based attack performed on vulnerable web applications.

- In XSS attacks, the final target or the victim is the end-user and not the vulnerable application.

- Here, the vulnerable web page or application is used just as a conduit to reach the final target who is the end user.

### Impact of XSS Attack

When attackers succeed in exploiting XSS vulnerabilities, they can perform the following activities on the client side:

- Gain access to session cookies and hijack user accounts.

- Spread worms, virus and Trojans.

- Gain access to the end user's files and directories.

- Remotely control the user's browser activity.

### XSS Scenario

Let us assume that a hacker discovers an XSS vulnerability in one of the web applications of a large website like *facebook.com*. The hacker exploits this vulnerability and injects a malicious code on to one of the Facebook's web page. Whenever users visit this page, the

malicious code runs on their browser and steals their session cookie and sends this information back to the hacker. The attacker will now use this cookie to hijack the user's session and easily gain access to his/her Facebook account.

## XSS Countermeasures

Today, modern websites rely heavily on complex web applications to deliver dynamic content outputs based on user specific needs and preferences. Unlike static websites, it is not possible for the dynamic websites to exercise complete control over how their output is interpreted by the client. This may open up a possibility for the presence of XSS vulnerabilities in one or more web applications used by the dynamic website. You can take up the following countermeasures to stop XSS attacks on your websites:

- Strictly validate all the incoming data to the web applications before execution.

- Adopt a strict security policy to prevent people from directly submitting scripts to the server.

- Filter the input data to remove any of the existing scripts in it before processing them.

## SQL Injection

Web applications use databases to store data needed for websites to deliver specific content to visitors and render other useful information. Databases may also contain other vital information such as user credentials, financial documentations, user specific data and many other confidential information. Whenever legitimate users place a request to view or modify this information, SQL queries (also called SQL commands) are used by web application to fetch or modify the data stored in the databases.

**SQL injection** is a type of attack where the attacker tries to pass SQL command itself (instead of text data) through the web application for execution by the backend database. Here the attacker injects specially crafted SQL commands to input fields such as search boxes, login fields, feedback forms etc. that are meant to receive valid data. If the web applications fail to properly validate the input before passing it on to the database, this may grant unauthorized access to the attacker and permit him to view or modify information from the database.

## Key Concepts of SQL Injection

- SQL injection is a software vulnerability that occurs when user data inputs are sent directly to the SQL interpreter for execution without proper validation.

- Attackers use input fields to pass specially crafted SQL queries in an attempt to trick the interpreter to execute unintended commands on the database.

# Impact of SQL Injection Attack

Upon success, an SQL injection attack may allow the hacker to perform the following activities:

- Bypass user authentication and gain unauthorized access.

- Gain access to important parts of the database and view unintended data.

- Add or remove new entries to the database.

- Sometimes it is even possible to completely wipe out the contents of the database.


## SQL Injection Example

Let us assume that there exists a login page designed to allow users to access a restricted area of the website upon authenticating their credentials. When a genuine user enters his "username" and "password" in the login field, the web application executes an SQL query in the background on a database which contains a list of usernames and passwords. If the "username-password" pair is said to be matching the user is granted access; otherwise access is denied.

Suppose when a genuine user enters his credentials as follows:

**Username: tom**

**Password: pass2000**

The SQL query used to perform this match would be something as follows:

**SELECT * FROM users WHERE username='tom' and password='pass2000'**

Here the above SQL query is trying to find a row in the database by matching the "username-password" pair using the **logical and** operator. The **and** operator returns **TRUE** only when both the operands (username & password) matches. Otherwise access will be denied.

Imagine what would happen when a hacker discovers a SQL injection vulnerability on this login page. He would inject a specially crafted SQL command into the login field as follows:

**Username: tom**

**Password: ' or '1'='1**

The vulnerable web application simply passes the data in the password field without proper validation and hence it gets interpreted as an SQL command instead of a normal text data. Now, the SQL query used to perform this match would be something as follows:

**SELECT * FROM users WHERE** username='tom' **and** password=" **or** '1'='1'

Here the **logical operator or** holds **TRUE** even if only one of its operands matches. In this case **'1'='1'** matches and hence the hacker is granted access to the restricted area for the website. This way, the SQL injection vulnerability helps hacker bypass the authentication system and gain unauthorized access to the system.

## SQL Injection Countermeasures

- Adopt an input validation technique to sanitize the user input before passing it on to the database applications for execution.

- Users must be given least permission when they are allowed to access the database.

- Web applications must not be allowed to access database with administrator privileges. Instead use a limited account when accessing databases via web applications.

## Command Injection

**Command injection** (also known as **shell injection**) is a type of attack where the attacker exploits vulnerable web applications to inject malicious codes into the backend applications in order to seek unauthorized access to data or network resources. This attack is very similar to the SQL injection attack described above.

Dynamic web pages use web applications to present user specific data and carry out other dynamic operations such as retrieving the contents of a file, sending emails etc. These web applications in turn make use of underlying programs such as shell scripts and operating system calls to complete specific requests and actions.

If web applications such as form fields fail to sanitize user input data before passing the same to the backend applications, an attacker can easily exploit them to perform command injection attack.

## Command Injection Countermeasures

The following are some of the countermeasures that can be employed to prevent command injection attacks:

- Properly sanitize and validate the user input data to remove any of the existing malicious content.

- Structure requests so that all supplied parameters are treated as data instead of potentially executable content.

- Make sure that you strip out potentially dangerous characters like semicolons, pipes (|) and ampersands (&) from user input before passing it onto the underlying programs.

- If possible, avoid passing user given arguments to OS programs.

## Buffer Overflow

**Buffer overflow** (also known as **buffer overrun**) is a type of exploit that takes advantage of vulnerable applications that are waiting to process user inputs. A web application is said to be vulnerable to this kind of attack when the application, while writing data to the buffer overruns the buffer limit and overwrites to adjacent memory.

## Key Concepts of Buffer Overflow

- Buffer overflow happens when the size of user input data is larger than its allocated buffer size and the application overruns its buffer's boundary when writing the input to the memory.

- The goal is to trigger buffer overflows in vulnerable applications through inputs that are designed to execute malicious codes or alter the normal flow of the program to the flow determined by the hacker.

## Types of Buffer Overflows

Buffer overflow attacks can be classified into two main types as follows:

- **Heap based attacks**

- **Stack based attacks**

Heap based attack works by flooding the memory space that is dynamically allocated to a program, but the difficulty involved in carrying out such attacks makes them rare. On the other hand stack based attacks are the easiest and hence most widely performed by the attackers.

## Stack Buffer Overflow Example

A stack is a computer memory used when one function within a program calls another. This stack contains data, local variables (variables that are private to a function), function arguments and most importantly the return address of the instruction to return when one function finishes. In other words, when "FunctionA" calls "FunctionB", the CPU needs to

know where to go back when "FunctionB" finishes its task and this return address (back to "FunctionA") is stored in the stack.

Consider the following sample code:

```
void functionA ()
{
functionB ( ReadUserName (socket) );
}


void functionB (char *name)
{
char name_arr[10];
strcpy (name_arr, name);
}
```

In the above example, **functionA** reads the string (user name) from the from the user and passes it on to the **functionB** for copying the same to a buffer (name_arr[10]) for which the size allocated is 10 bytes. When the attacker enters a cleverly devised input name whose size is larger than 10 bytes, the data can overflow beyond the memory parts assigned to "name_arr" resulting in a buffer overflow. Remember that a stack also contains return address for **functionA** when **functionB** completes its execution. When the buffer overflows, the attacker can manipulate the stack to set his own return address to the point where his malicious program exists in the buffer. In this way, the attacker can exploit stack overflow vulnerability in web applications to execute his own malicious codes and take control of the system.

# Buffer Overflow Countermeasures

- Validate input length of data in forms before passing them on to the functions.

- Practice safe and secure coding habits when dealing with buffers.

- Use tools like **Stack Shield** and **Stack Guard** for Linux systems to defend against stack overflow attacks.

## Directory Traversal

**Directory traversal** is a type of HTTP vulnerability used by hackers to gain access to restricted directories and file system on a web server. Directory traversal attack happens due to the web servers's inability to validate/filter user inputs. Web applications developed using programming languages like PHP, Python, Perl, Apache and ColdFusion are commonly vulnerable to this type of attack.

## Key Concepts of Directory Traversal

- Using this vulnerability attackers can browse directories and files that are outside normal application access.

- This type of attack exposes directory structure, underlying web server and operating system of the vulnerable machine.

- Attack allows hacker to gain access to restricted pages and confidential information on the system.

## Directory Traversal Countermeasures

- Properly validate user inputs from browsers.

- Employ filters to block URLs containing commands and escape codes that are commonly used by attackers.

- Define access rights to protected areas of the website so as to restrict normal user access.

- Keep your web server software up-to-date with latest patches and updates.

# TOOLS FOR VULNERABILITY SCANNING

The following are some of the popular tools that can be used to find vulnerabilities in web applications.

- **Acunetix:** This is an enterprise level web application vulnerability scanner and penetration testing tool available for Windows machines.

- **W3af:** This is an open source web application attack and audit tool for Linux, BSD, Mac and Windows machines.

- **Vega:** This tool is used to find and fix commonly found web application vulnerabilities like XSS, SQL injection and more. It is an open source tool written in Java and available for both Windows and Linux operating systems.

- **Arachni:** This is a powerful open source tool used by penetration testers and system administrators to evaluate the security of web applications. The tool is available for Linux and Mac platforms.

- **X5S:** X5S is a powerful tool designed to find cross-site scripting vulnerabilities in web applications.

# Chapter 15 - Hacking Internet Users

Due to a rapid increase in the number of Internet users in the recent years, malicious hackers have now started to target individual users for their attack. Numerous client side vulnerabilities such as browser flaws and lack of security awareness among the Internet users has made them an easy target for hackers. In this chapter let us look at some of the popular ways to hack Internet users and also the countermeasures to prevent them.

## Objectives of Hacking Internet Users

Hackers target individual users for a wide variety of reasons as mentioned below:

- For gaining access to confidential information such as credit cards details, bank logins, account information etc.

- To take control of user's online accounts such as Email, Facebook and other social network accounts.

- To earn advertising revenue by forcefully driving users to online advertisements such as banners and pop-ups.

- To use individual users for attacking other systems such as causing a DDoS attack.

- Sometimes even for fun or to show-off talent among the hacker's community.

# COMMON HACKING TECHNIQUES

The following are some of the popularly used techniques to hack individual users on the Internet:

## Session Hijacking (Cookie Hijacking)

Since web pages have no memories, they have to use a means to identify and authenticate individual users accessing web pages. Especially when people are accessing restricted pages or secure area which require password authentication, the website needs a means to remember users individually after their successful logins. For example, when people log into their Facebook account (by entering password), they may access several different pages until they finally sign out. It would be impractical to ask users to re-enter password each time they access a different page.

## Session Cookies

Therefore, in order to remember individual users, websites store a small file called **session cookie** on the client side (in the user's browser) which contains unique authentication information about the user's active session. These cookies help identify individual users throughout the website. When the user hits the log out button or closes the browser, the session is said to expire.

So, when a hacker manages to steal the cookies of an active session he may inject them to his browser to gain unauthorized to any online account such as emails, social media accounts and so on. This technique is known as **session hijacking** (also referred to as **cookie hijacking** or **cookie stealing**).

## Session Hijacking Demo

Below is a demonstration of typical session hijacking performed on a sample Facebook account. Here the hacker may use different techniques such as *cross-site scripting (XSS)* or *packet sniffing* to steal the target user's session cookies.

Even though Facebook stores several cookies in the browser after successful login, there are only two important cookies that contains authentication data to decide an active session. The names of these two cookies are as follows:

1. **c_user**

2. **xs**

In order to hijack an active session, one has to gain access to the contents of the above two cookies. Snapshots of the sample data contained in these two cookies are shown below:

**Figure 15. 1**



Figure 15. 2

Once you have access to the contents of the above two session cookies "**c_user**" and "**xs**" it is time to inject them to your browser and gain access to the target user's Facebook account. A Firefox extension called "**Advanced Cookie Manager**" makes this job a lot simpler. It provides an option to add and edit cookies stored on Firefox. Here is a step-by-step instruction to inject cookie to Firefox browser:

- Install the add-on **Advanced Cookie Manager** to your Firefox browser and open it by clicking the icon present in the toolbar.

- Switch to the "Manage Cookies" tab and click on the "Add Cookies" button.

- To create the "**c_user**" cookie fill in all the details exactly as shown in the below snapshot expect for the "Value" field which has to be replaced by the content from the hijacked cookie. Once you are done click on "Add" button.
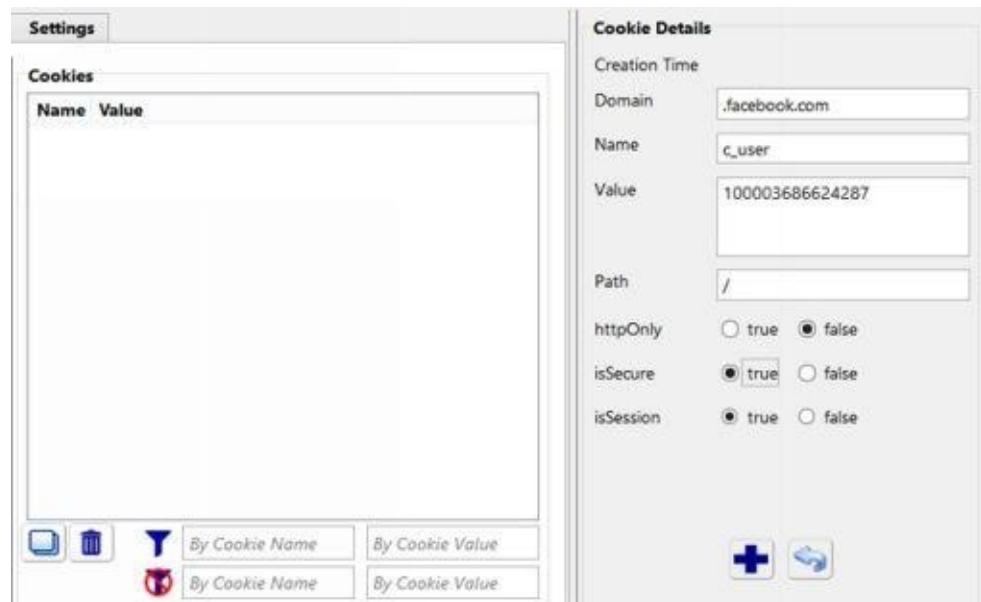
**Figure 15. 3**

- Again click on "Add Cookie" button to create the cookie "**xs**" in the same way. After filling the details as shown below click on "Add" button. Do not forget to replace the "Value" field with the content from your hijacked "xs" cookie:
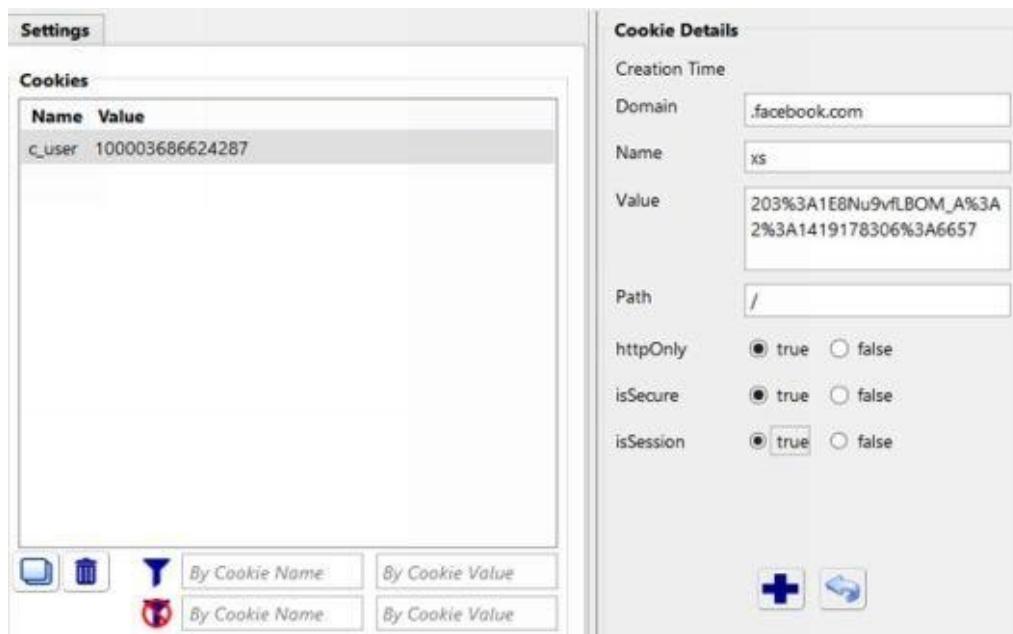


**Figure 15. 4**

- After you have finished creating these two cookies, close the "Advanced Cookie Manager" and load the Facebook page. You should automatically be logged into the target user's account where you have the complete access.

Once you are logged, you can access the account as long as the target user's session is active. That means, you can access the account in parallel from your own computer until the user hits "Log Out" button on his/her computer.

# Session Hijacking Countermeasures

The following are some of the countermeasures to prevent session hijacking on your computer:

- Use encryption standards such as SSL (HTTPS) to prevent cookie hijacks via packet sniffing.

- Use an up-to-date browser program to prevent browser exploits.
- Configure browser to stop running unverified scripts and also avoid using browser plug-ins from untrusted sources.

## Email Hacking

Email hacking is one of the prevailing hot topics in the field of ethical hacking. A hacker can gain access to a wide variety of private information about the target user if he manager to hack his/her email account. Some of the possible ways to hack email accounts are discussed below.

## Keylogging

Using a spyware program such as keylogger is the easiest way to hack an email or any other online account password. All you need to do is just install the keylogger program on the computer where the target user is likely to access his/her email account from. These spyware programs are designed to operate in a total stealth mode and hence remains completely hidden from normal users. Once the keystrokes are recorded you can unlock the program using a hot key combination or password to view the logs. The logs contain all the keystrokes typed on the computer keyboard including the usernames and passwords.

Modern keylogger programs like **Realtime-Spy**, **SpyAgent** and **SniperSpy** supports remote monitoring feature where you can view the logs even from a remote location. Some of them also have a feature to send logs through email and FTP.

Even though keyloggers can make the hacking process a lot simpler, they have a few drawbacks. Most of these programs have to be installed manually on the target computer for which you need to have physical access to it. Also, there is a chance of anti-spyware programs detecting and deleting the keylogger installation on the computer.

## Phishing

Phishing is another popular and highly effective technique used by attackers to hack email and other online accounts. Most Internet users would easily fall prey and become victims to this type of attack. However, to device a phishing attack, one has to have at least a basic knowledge of HTML and programming.

Steps Involved in Phishing Attack:

- The hacker first creates a replica of the target login page such as Gmail, Yahoo! or any other online account.

- This page is designed to submit all login information (username and password) on the form fields to a local database instead of the actual website. Hacker would use a scripting language such as PHP and a database such as MySQL to accomplish this.

- Once the page is integrated to the script and database, the hacker uploads the whole setup to a hosting server so as to make the phishing page go online.

- The hacker chooses a matching domain (such as *gamil.com, gmail-account.com, yahoo-mail.com* etc.) for his phishing page so as to avoid any suspicion.

- Once the phishing page is live and working, the hacker drives people to this phishing page by spreading the phishing link via email, Internet Messenger and forums.

- Since phishing pages look exactly the same as the real one, people enter their login details on these pages where they are stolen away and gets stored in the hacker's database.

## Session Hijacking

As discussed earlier, it is possible to gain access to an email account through session hijacking. By stealing the cookies of an active session and injecting them to one's own browser, it is possible to gain access to the target email account. However, if the target user closes his/her ongoing session by logging out, you will no longer be able to access the account. Also, unlike keylogging and phishing, this method does not grant you the password of the target account and hence you will not be able to re-access it at a later time.

## Unlocking Stored Passwords

Most users prefer to store the password details of email and other online accounts in the browser to enable speedy access. Sometimes login details of offline email clients such as Outlook are also stored on the computer. This makes them vulnerable to hackers. **Nirsoft** provides a handful of free tools to recover such stored passwords on Windows. You can download the tools from the link provided below:

**Download: http://www.nirsoft.net/password_recovery_tools.html**

## Email Hacking Countermeasures

Below are some of the countermeasures that you can adopt to prevent your email and other online accounts from getting hacked:

- Install a good antivirus and anti-spyware program on your computer and keep them up-to-date.

- Password protect your operating system so that no one can access your computer in your absence.

- Always perform a malware scan on programs before installing them.

- Avoid accessing your accounts in public places such as cyber cafes.

- Make sure that HTTPS is on when you are accessing your emails.

- Do not click on the links in your email or forum to enter the login page. Instead always type the URL of the website in the browser's address bar and also make sure that HTTPS is enabled on your login page.

- Avoid storing your login details on the browser unless you are the only user on the computer.

## Other Ways to Hack Internet Users

The following are some of the other hacking methods that are common in practice:

- **JavaScript:** Since most client-side applications are written in JavaScript, it also makes a wonderful tool for hackers to write malicious programs for exploiting browser vulnerabilities. Due to lack of security awareness among users, they can easily be fooled into entering sensitive information or navigating to malicious websites. It can also be used to carry out other attacks such as cross-site scripting and phishing.

- **Malware:** Using malware is another popular way of hacking Internet users. Hackers make use of malware programs like virus and Trojan horses to accomplish their task by affecting large number of people. A popular example of such attack is the use of "**DNSChanger**" Trojan which affected millions of Internet users by hijacking their DNS servers.

- **Instant Messaging:** Attackers can also target IM users by sending them unsolicited offers in the form of files and links. This may mislead the users into installing malware or navigating to malicious websites.

# CONCLUSION

I would like to congratulate your effort for making it through the whole book. Throughout the course of this book you have been introduced to various hacking techniques and security concepts that has laid a solid foundation to present yourself as an ethical hacker. However, as the name of this book itself suggests, this is just a beginning. In the field of information security, there is always a room and need for learning new things and quest for expanding knowledge remains forever. Remember, present day hacking techniques may no longer work for the future! As new vulnerabilities get discovered old ones get patched. So, you as an ethical hacker must always have an update on the latest security news and newly discovered vulnerabilities.

# FURTHER READING

In order to make it easy for the beginners and first time readers, I have simplified some of the topics in the book. However, each of them can be expanded and discussed in a much deeper way. You can always choose your favourite topic from the book and begin to learn more about it.

One of the best way to expand knowledge is by purchasing a book on a specific topic and further pursuing it. In addition you can learn more on individual topics by joining online communities where you can discuss your problems and find quick solutions from experts. Here is a compilation of some of the useful links that help expand your knowledge on the subject:

- **HackThisSite:** One of the best site that offers an excellent platform to learn, test and expand your hacking skills.

- **Hellbound Hackers:** Another website that gives in-depth information on various security related topics.

- **Astalavista:** This is a wonderful place to learn about latest security exploits, hacking techniques, code cracking and more.

- **Hack Forums:** Here you can discuss and interact with large group of likeminded people and experts to find information and solutions for various topics and problems about hacking.

- **Codecall:** This website provides all the programming resources needed for writing your own codes and exploits.

- **Go4Expert:** This is another community offering free help and resources on programming and web development.

## SUGGESTIONS AND FEEDBACK

I hope you found this book informative and are satisfied with the way things are presented. Should you have any questions, comments or feedback feel free to get in touch with my email address mentioned below:

**Email: info@gohacking.com**

best regards,

**Srikanth Ramesh**

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