Session 1. Introduction to Information Security

1.1 Introduction

Traditionally we think of Security as protecting the resources under the lock and key .

But in modern world today **Security** is a state of wellbeing (are you secure?)

Security is all about being prepared for the unexpected (challenge) .

And so Information Security is the collection of the following:

1.1.1 Policies

They tell you what to do.

Example: Real life

ID cards

Example: IT world

Password policies

A password must have mixture of numbers, characters, special characters - minimum 8 in length

1.1.2 Procedures

They tell you how to do.

Real life example:

Show the ID card to the guard before entering the premises.

IT world example:

*I. All user **passwords** must contain at least two (2) alphabetic and two-(2) non-alphabetic character. Non-alphabetic characters include numbers (0-9) and special characters.*

II. Procedure to install a package (WordPress), Linux or windows.

1.1.3 Practices

Patterns that are proven to get the desired output.

Real life example

I. Wearing your ID at all times while in premises.

II. Health practices - Washing your hands , covering your face with a mask , changing tooth brush.

IT world example:

Changing Passwords every 2 months, refrain from using easy password like birthdates.

1.1.4 Confidentiality

The state of keeping or being kept secret or private.

Confidentiality prevents the unauthorized use or disclosure of information, ensuring that only those who are authorized to access information can do so.

In other worlds it is restrictions on the accessibility (who can access the data) and dissemination of the information (if you have the data and you are authorized then you must keep it to yourself).

Real life example - generally , we do not publish our bank account balance on Facebook.

Example in IT world - Keep your password confidential.

1.1.5 Integrity

I. Protecting data from modification or deletion by unauthorized parties.

II. Ensuring that when authorized people make changes , that shouldn't been made, the damage can be undone.

Real life example:

Paying guest --> Room sharing --> Wallet outside --> and no money stolen - Integrity

Example if IT world:

Computer A --> (DATA - ABC) --> Computer B (DATA - ABC) - Integrity maintained

1.1.6 Availability

Ensuring that information is available when required.

Real life example

Your balance (You have money in your BSP account, you can withdraw it when you require cash).

IT World Example:

Sales report saved in the Sales Network folder can be accessed by the sales Managers at all times.

So in a nutshell, INFORMATION SECURITY is the collection of policies, standards, practices to ensure confidentiality, integrity and availability of information.

1.2 Why Information Security

We **need information security** to reduce the risk of unauthorized **information** access, use, disclosure, and disruption.

We **need information security** to reduce risk to a level that is acceptable to the business (management).

We **need information security** to improve the way we do business.

1.3 Security - the money factor involved

1.3.1 How Much Does an Information Security Analyst make?

In developed Countries where security is paramount like USA, Australia, Japan, China,

Information **Security Analysts made** a median salary of $99,730 in 2019 as per record.

The best-paid 25 percent **made** $128,640 that year, while the lowest-paid 25 percent **made** $75,450.

1.3.2 How much Does an Information Security Analyst make in PNG?

Average BSP offer: Base Salary K46 000 + Housing Allowance of K14 000.

Many other PNG companies would offer around the same amount.

1.4 Internet Statistics - Study from a security perspective

Check this out to see the real time internet usage in the world today:

https://www.internetlivestats.com

The following link below shows a real-time global *view* of DDoS *attacks*, hacking attempts, and bot assaults mitigated by Imperva security services.

https://www.imperva.com/cyber-threat-attack-map/

Session 2. Vulnerability, Threat and Risk

2.1 Vulnerability

It is the weakness in a mechanism that can threaten the wellbeing of an asset.

In other worlds, it is the lack of Countermeasures of a mechanism or a system.

Real life Example: When you are roaming around without a mask, you are vulnerable to any disease including covid-19.

IT world example: Running a system without a firewall, your system is vulnerable to any attack.

2.1.1 Types of Vulnerabilities

2.1.1.1 Design Vulnerability

When the Vulnerability is said to be inherent to the project or design.

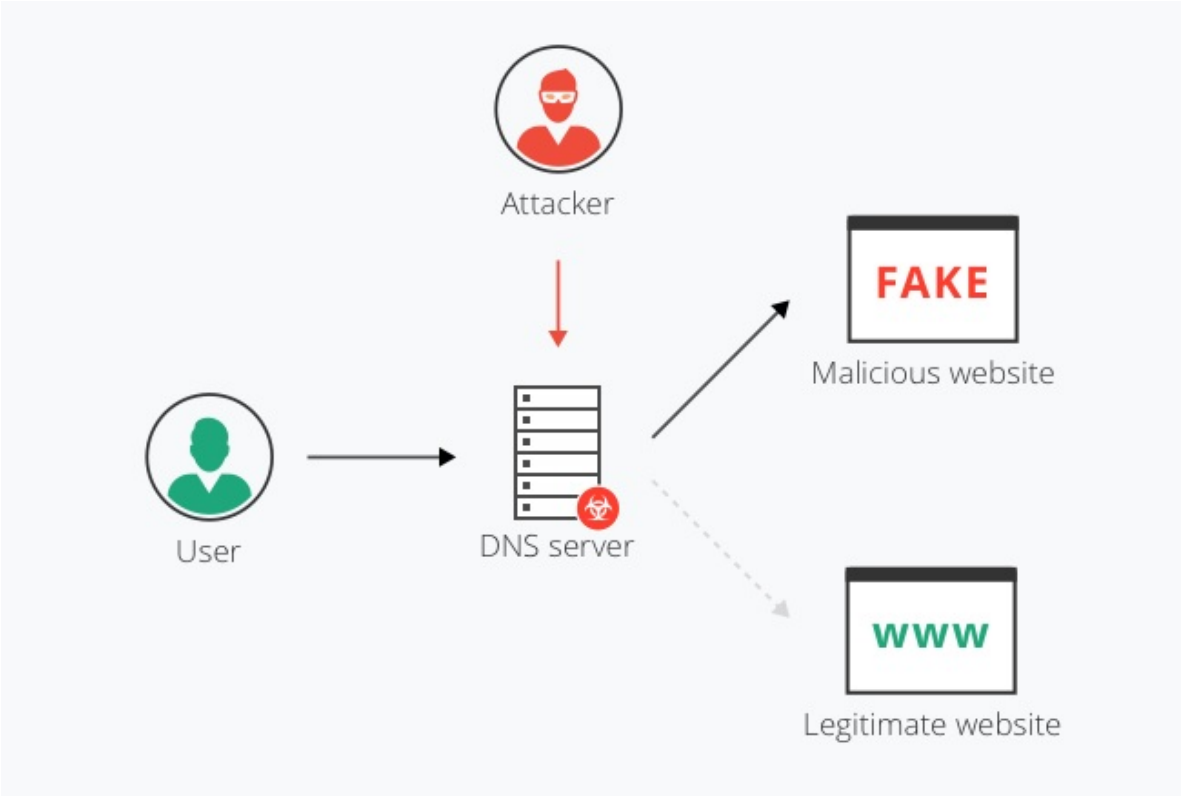
Example -

IP -->overtime IPSec was introduced to address the IP vulnerability.

DNS --> overtime DNSSec was introduced to address the DNS vulnerability.

HTTP --> overtime HTTPS was introduced to address the HTTP vulnerability.

Figure 1 below shows that the Attacker attacks the DNS and redirects the request from the user to a malicious website rather than to a legitimate website. Overtime that design was address with the introduction of the DNSSec (DNS Security Extension).



2.1.1.2 Implementation Vulnerability

Design is good.

Implementation vulnerabilities are also referred to as low-level flaws or technical flaws.

Implementation vulnerabilities encompass several well-publicized vulnerability classes you've probably heard of, such as buffer overflows and SQL injection.

2.1.1.3 Operational / Configurational Vulnerability

A flaw in your security settings, like failing to auto-encrypt your files, could leave your entire network and every device connected to it **vulnerable** to any attack.

One good example of this type of vulnerability is when System Admins fail to reset the default passwords of network devices, e.g. routers. You must change the default provided password of every devices purchased.

2.2 Threat

Threat is any potential danger to your information or system.

Someone uncovering a vulnerability and exploiting it. That person becomes the threat to your organization.

2.3 Risk

Business impact and the probability of a vulnerability being exploited.

For example if you are not carrying a backup regularly in your organization, you are at risk.

In the next section, we will discuss on how we manage risks.

2.3.1 Risk Management

You as the manager for the data center of your organization, one of your prime roles is to (a) identify the risks, (b) assess and prioritize them, (c) control the risks and (d) review the controls.

(A) Identify the Risk

The examples are as follows:

(1) Virus attack / hacking

(2) Power failure

(3) Hardware failure

(4) Flood / Earthquake

(5) The system admin - Christmas break to Home province - dies of sorcery/witchcraft

(B) Assess and prioritize the risk (what's important)

(C) Control the risk

(1) Defensive controls (Firewall, AV, IDS, IPS, Training our staff)

(2) UPS / Generator

(3) Use good systems, redundancy, RAID

(4) DR -Disaster Recovery Location - remotely saved backup to different location

(5) Junior system - policy - one person at a time

(D) Review the controls (are controls working fine?)

(1) Maintaining the firewall

Session 3: Exposure, Countermeasures and Firewall

Objective:

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1. Students should be able to understand the term exposure used in security
domain.
2. Students should be able to know and apply basic countermeasures to threats.
3. Students should be able to understand the use of firewall in a network.
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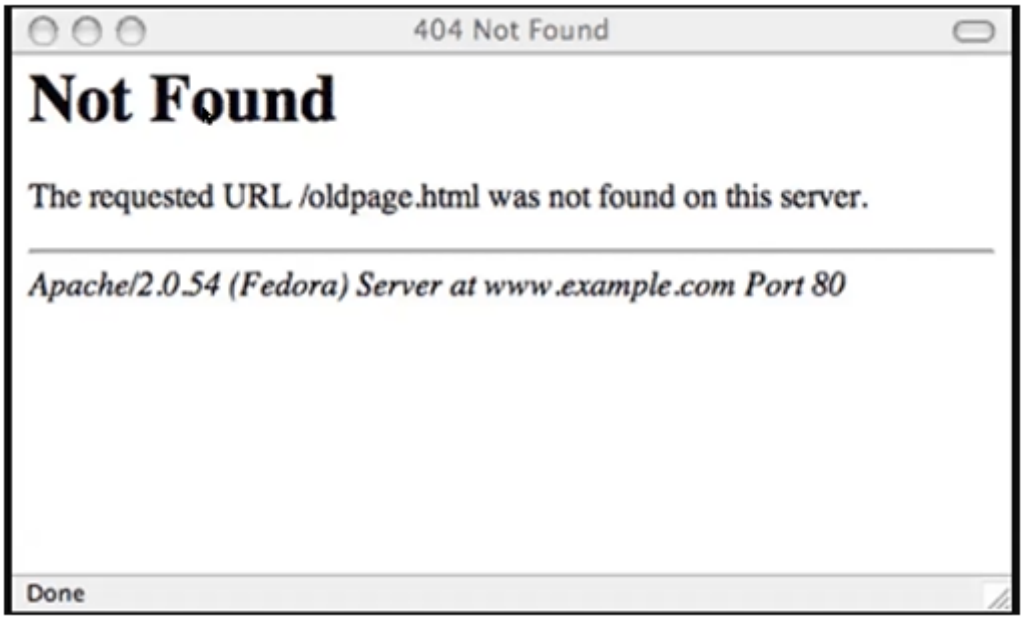
3.1 Exposure

Exposure is a state of having no protection against something harmful.

Take an example of a BSP user calling out his correct 4-digit bank PIN number at the ATM. This is a very good example of exposure.

Figure 2 below also shows how a certain website's URL and port number and other details are being exposed to public.



3.2 Countermeasures

Countermeasure is the deployment of a set of security to protect against a security threat.

Examples:

a. Firewall

b. AV (Anti-Virus)

3.2.1 Firewall

A **firewall** is a **network** security device that monitors incoming and outgoing traffic and decides whether to allow or block specific traffic based on a defined set of security rules. A **firewall** can be hardware, software, or both.

It is a part of an Operating System or Network to :

Block Unauthorized Access,

Implementing policies like blocking social media,

Permit Authorized Access,

Allow only FTP traffic, etc.....

3.2.1.1 Methods of implementing a Firewall

- Permit All (By default)
    - And explicitly denying
- Deny all
    - And explicitly Permit

Session 4: Types of Firewall

4.1 Packet Filtering firewall

The **packet filtering firewall filters** IP **packets** based on source and destination IP address, and source and destination port. The **packet filter** may lack logging facilities, which **would** make it impractical for an organization that has compliance and reporting requirements to which they must adhere.

4.2 Screened Host Firewall

A firewall which is implemented using a firewall router and a proxy server, with the router acting as a front end to the server. The firewall router first screens off any accesses which are disallowed to a closed network, apart from Web page accesses and secure accesses to services such as email. The Web accesses are then passed to the proxy server which acts as a front end to the Web server that actually dispenses the Web pages. There are thus two layers of security that a cracker has to circumnavigate before accessing the Web server inside the closed network.

4.3 Bastion host

A **bastion host** is a special-purpose computer on a network specifically designed and configured to withstand attacks. The computer generally hosts a single application, for example a proxy server, and all other services are removed or limited to reduce the threat to the computer. It is hardened in this manner primarily due to its location and purpose, which is either on the outside of a firewall or in a demilitarized zone (DMZ) and usually involves access from untrusted networks or computers.

4.4 Stateful Inspection Firewall

The term **stateful inspection** (also known as the dynamic packet filtering) refers to a **distinguished firewall technology**. It aims to monitor the active connections on a network. Moreover, the process of stateful inspection determines which network packets should be allowed through the firewall by utilizing the information regarding active connections.

4.5 iptables

Iptables is a Linux command line **firewall** that allows system administrators to manage incoming and outgoing traffic via a set of configurable table rules. **Iptables** uses a set of tables which have chains that contain set of built-in or user defined rules.

4.6 Threat Mangement Gateway (TMG)

Microsoft Forefront Threat Management Gateway (Forefront **TMG**), formerly known as Microsoft Internet Security and Acceleration Server (ISA Server), is a **network** router, firewall, antivirus program, VPN server and web cache from Microsoft Corporation.

Session 5: Defense in Depth

Also known as Elastic Defense / Castle Approach)

5.1 Defense in depth Layers

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Defense in Depth layers
   |_
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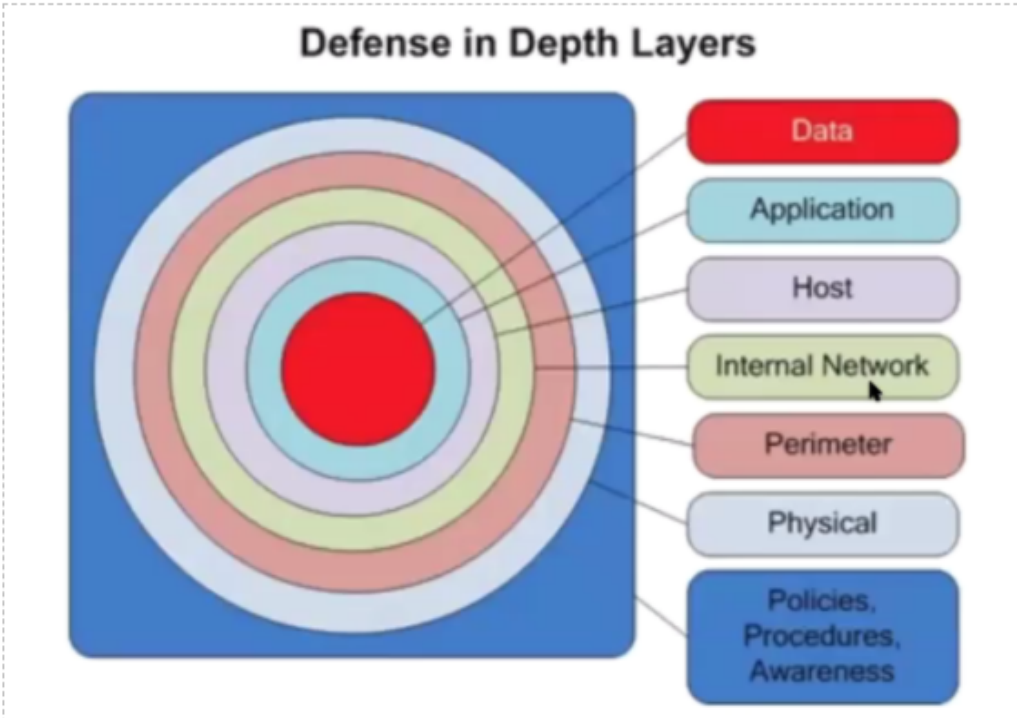

1. **Data**
   |_ Encryption
2. **Application**

|_ Username and password (ACL)

3. **Host**

   |_ Anti-viruses

   Host based Intrusion Detection System (HIDS)

4. **Internal Network**

   |_

   Network Intrusion Detection System (NIDS)

5. **Perimeter Network**

   |_

   Firewall

6. **Physical**

|_

Locks and Keys, Bio metric access control Tools

7. **Policies, Procedures, Awareness (Infrastructure**)

|_ Pre-defined protocols

Like - No Pen drives are allowed in the company

So in a nutshell, the objective of implementing the **Defense in Depth**:

- Each Layer is equipped with a Defense Mechanism
- Attacker has to bypass each layer to get the data
- Delay the attacker to perform the attack, by implementing outer / inner layers .
- If attacks are detected at those layers the inner layers are informed will be ready to take actions or block the attacker .

Lab Segment: Continue lab on iptables:

Adding some more rules:

Task 1 :

Allow incoming connection only from one IP (when INPUT is drop)

iptables -A INPUT -s 192.168.106.127 -j ACCEPT

(-s) source IP (cannot be used for ports)

Task 2:

Trust packets from a network (instead of single IP)

iptables -A INPUT -s 192.168.100.0/24 -j ACCEPT

or

instead of 24 --> 255.255.255.0

Task 3:

Trust packages from defined iprange

iptables -A INPUT -m iprange --src-range 192.168.10.10-192.168.10.20 -j ACCEPT

(iprange) --> Specifying the range

Task 4:

Drop the outgoing packets to specified iprange ,

iptables -A OUTPUT -m iprange --dst-range 192.168.125.100-192.168.125.110 -j DROP

Task 5:

Accept the packets from specified IP and MAC,

iptables -A INPUT -s 192.16.120.121 -m mac --mac 00:20:20:20:20:20 -j ACCEPT

(-m mac) mac address module

(--mac) mac as an input

NOTE : you cannot use more than one module in a single command

Task 6:

Accept/Allow packets with specific destination port ,

iptables -A INPUT -p tcp --dport 6881 -j ACCEPT

or

iptables -A INPUT -p tcp --destination-port 6882 -j ACCEPT

(-p) --> protocol

(--dport) --> going to port no

Task 7:

Accpet/Allow packets with specific destination port range

iptables -A INPUT -p tcp --dport 6881:6890 -j ACCEPT

Task 8:

Accept/Allow packets with specified source port/portrange

iptables -A INPUT -p tcp --sport 6881 -j ACCEPT

or

iptables -A INPUT -p tcp --source-port 6882 -j ACCEPT

or

iptables -A INPUT -p tcp --sport 6883:6890 -j ACCEPT

or

iptables -A INPUT -p tcp--source-port 5883:5890 -j ACCEPT

Session 6: Making permanent changes to iptables

SCENE :

Make a permanent change to the iptables so that it won't change if machine is restarted.

(1) write a script --> includes all the lines

#!/bi/bash

iptables -F

iptables -P INPUT DROP

iptables -P FORWARD DROP

iptables -P OUTPUT ACCEPT

iptables -A INPUT -i lo -j ACCEPT

iptables -A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT

iptables -L

Yes this will also result in restoring the rules/iptables if rebooted, the main moto is to run it every-time when the machine boots up (automated the script to boot)(startup)

(2) Using save and restore command

How to use it

(1) Write a script/step wise commands

#!/bi/bash

iptables -F

iptables -P FORWARD DROP

iptables -A INPUT -i lo -j ACCEPT

iptables -L

Run the script

./script-name

(2) Exporting and Importing settings

(1) Create a dir to export/save the settings

mkdir /etc/iptables

(2) Export current settings/ip configuration

iptables-save > /etc/iptables/rules.v4

(3) Import/restore the saved file

iptables-restore < /etc/iptables/rules.v4

or

iptables-restore < /etc/iptables/rules.v6

Will still restore the settings if restarted, but restore command saves time to jump to previous seen state.

(3) Using Package iptables-persistent (kali --> netfilter-persistent)

apt-get install iptables-persistent

(persistent) --> runs # iptables-restore < /etc/iptables/rules.v4 on the startup

Session 7: Wireshark (Lab session)

Wireshark is the world's foremost and widely-used network protocol analyzer. It lets you see what's happening on your network at a microscopic level and is the standard across many commercial and non-profit enterprises, government agencies, and educational institutions.

Wireshark has a rich feature set which includes the following:

- Deep inspection of hundreds of protocols, with more being added all the time

- Live capture and offline analysis
- Standard three-pane packet browser
- Multi-platform: Runs on Windows, Linux, macOS, Solaris, FreeBSD, NetBSD, and many others
- Captured network data can be browsed via a GUI, or via the TTY-mode TShark utility
- The most powerful display filters in the industry
- Capture files compressed with gzip can be decompressed on the fly
- Coloring rules can be applied to the packet list for quick, intuitive analysis and many more.

So in simple terms, Wireshark is simply a Network Packet Capturing Tool (to analyze the packet) .

It is a Open Source Tool and can be installed on Windows OS, Mac OS or Linux OS.

Tasks:

1. Downloading and Installation of Wireshark
2. Installation steps to be guided by the Trainer.
3. Create a filter for data collection and display
4. Examine real world Packet Capture:

   a. Ping Windows machine from Linux machine. Capture IP packets (specifically ICMP packets) on Wireshark.

   b. ssh to Linux machine on Windows machine and capture ssh packets on Wireshark

   nb: ssh uses default port of 22

Observation:

There are three windows that are separated

1. Packet List
2. Packet Details
3. Packet Bytes

Session 8: tcpdump - Linux based packet capturing tool

It is the first generation IDS (Intrusion Detection System).

Lab Segment:

1. Is tcpdump already installed?

which tcpdump

If not installed :

apt-get update

apt-get install tcpdump

which tcpdump (Verify)

2. Getting Started

a. To start packet capturing just run:

tcpdump

To stop Ctrl + C | Ctrl + Z

b. To display all the available interfaces for tcpdump

tcpdump -D

Selecting the interface (If you do not select anything it'll grab the first one listed)

tcpdump -i ens33

(-i)--> interface

(ens33) --> interface name

Filters & commands

It only supports a single filter unlike wireshark

tcpdump udp

(udp) --> acts as a filter

Mentioning the interface with the filter type

tcpdump -i ens33 udp

limiting the no of outputs

tcpdump -i ens33 udp -c 2

(-c 2) --> this will limit the output to 2 packets , where c is count

Limiting the time

timeout 2 tcpdump

(2) --> 2 sec

Output in strictly numerical output

tcpdump -i ens33 udp -c 4 -n

(-n) --> no name resolution (no only)

Writing to a file

tcpdump -i ens33 icmp -c 4 -n -w file1.pcap

(-w) --> used to write output to the file

Reading the file

tcpdump -r file1.pcap

(-r) --> reading the file

tcpdump for a specific ip address and port number:

tcpdump -i eth0 host 192.168.56.101 and port 5060 -n -s 0 -vvv -w /usr/src/dump