Secure Programming - SECR4483

Session 4: Password Security

Session Learning Outcome

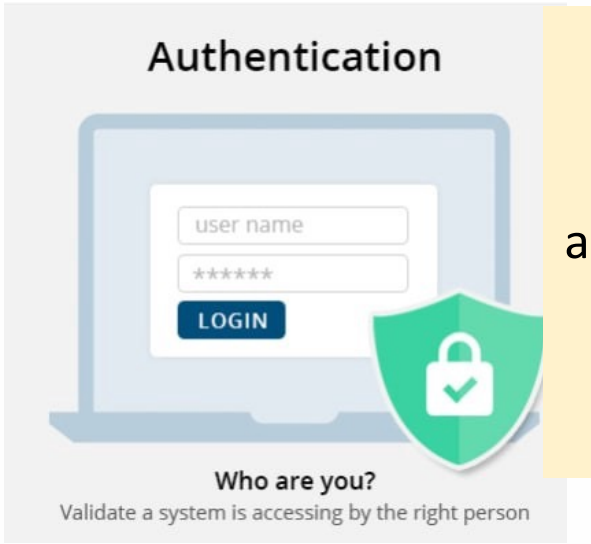
After finish this session you have to be able to:

1. Explaining Password Cracking Concepts, Methodology and Password Cracking Techniques
2. Performing different types of password attacks
3. Describing methods to protect the passwords.
4. Practicing Secure Password Programming

Authentication and Authorization

You can gain access to a system by following these two steps:

1. Authentication (who are you?):
2. Authorization (What can you do?):



In the authentication phase, you check a username or password against a database of **valid users**. If a match comes up, you move to the second phase.

In the authorization phase, you check the username or password if only passwords are used) against a database to **define how much access that user is granted.**

Authentication Techniques

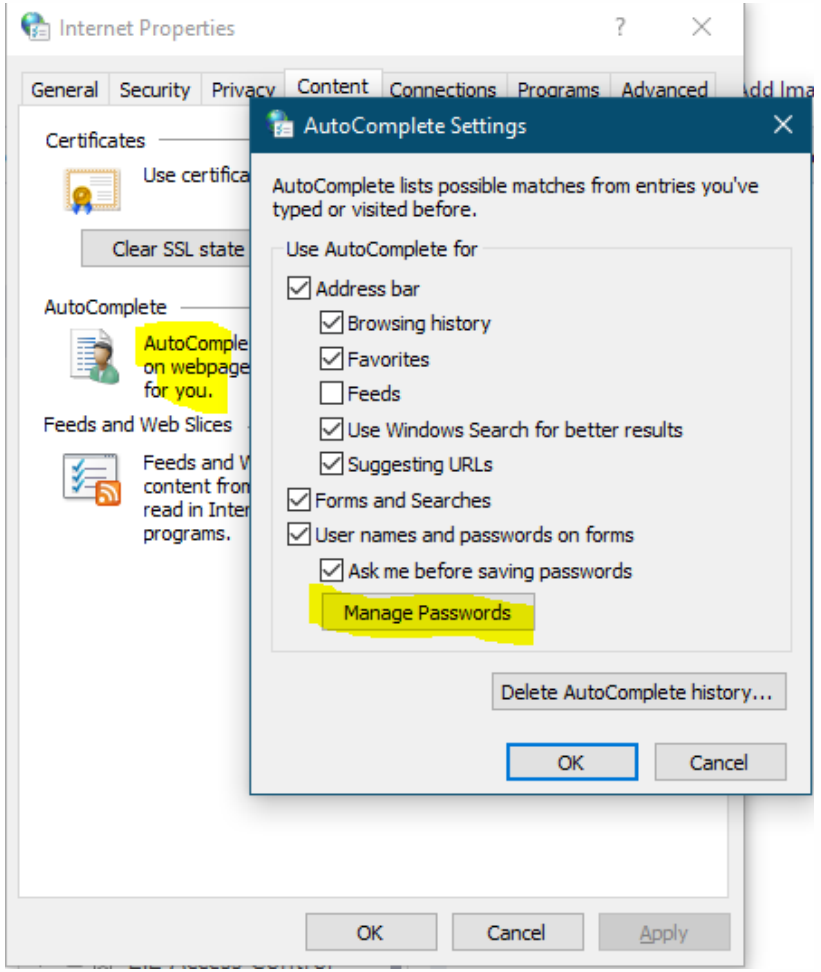
- Something you know
  - Password, PIN,…etc.
- Something you have
  - Card, Key,..
- Something you are
  - Biometric

Password Storage

- Local and Remote Authentication
- Storage: files and databases
- Storage:
  - Plain Text
  - Password Hash
- Unix-Based OS Password File **(Demo)**
  - /etc/passwd (for users info)
  - /etc/shadow (for passwords)
- Windows Based OS Password File (DB) **(Demo)**
  - C:/Windows/System32/config/SAM
  - C:/Windows/System32/config/SYSTEM

Lab Activity (1): Finding Windows Internet Password Storage

1. Press **Win + R** to open **Run**.
2. Type inetcpl.cpl, and then click **OK**.
3. Go to the **Content** tab.
4. Under **AutoComplete**, click on **Settings**.
5. Click on **Manage Passwords**. This will then open Credential Manager where you can view your saved passwords.



control panel > user accounts > credential manager

For Mac user: https://support.apple.com/en-my/HT211145

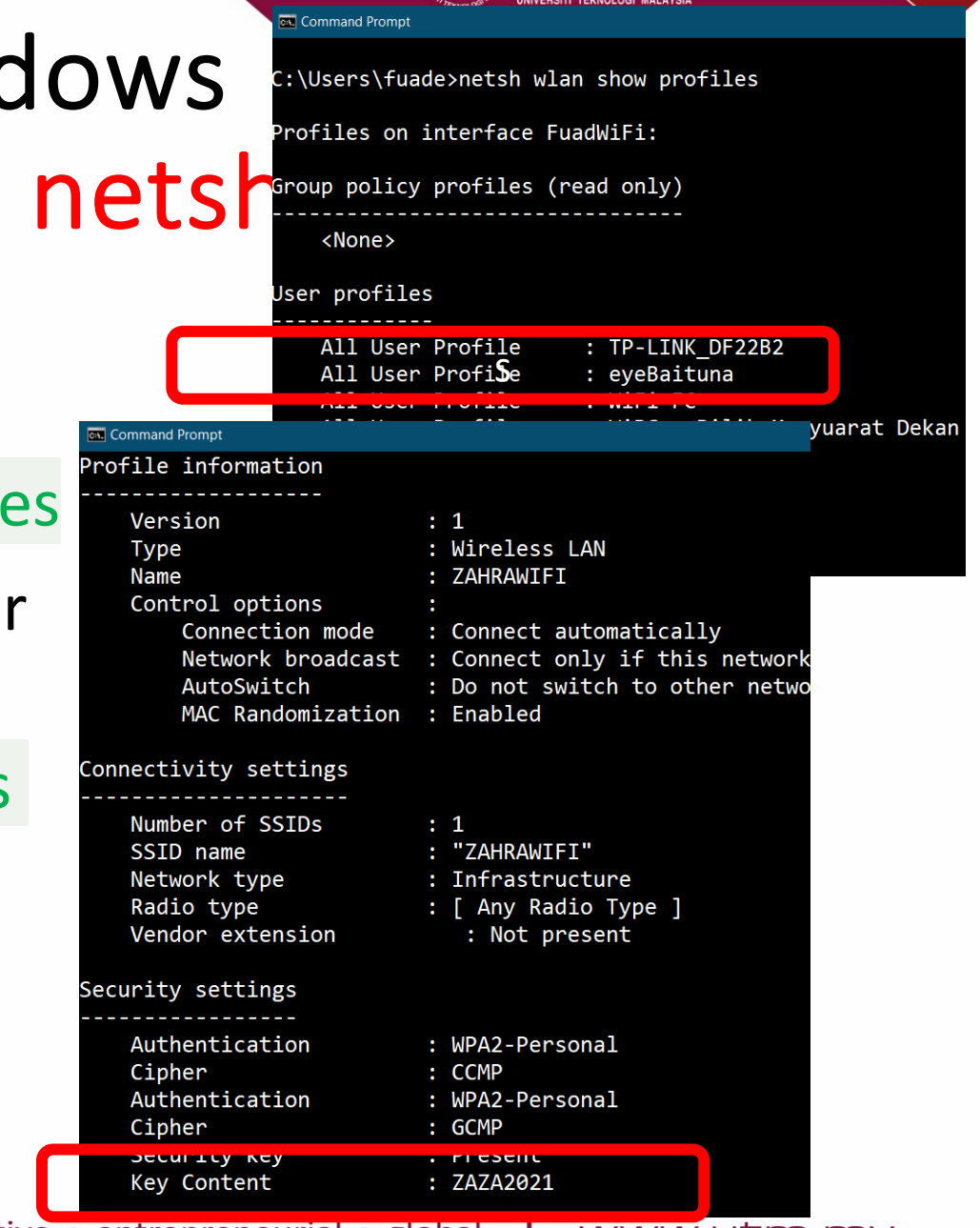
Lab Activity (2): Finding Windows WiFi Password Storage using netsh

- From command line, run the following command:

```
c:\users\fuad>netsh wlan show profiles
```

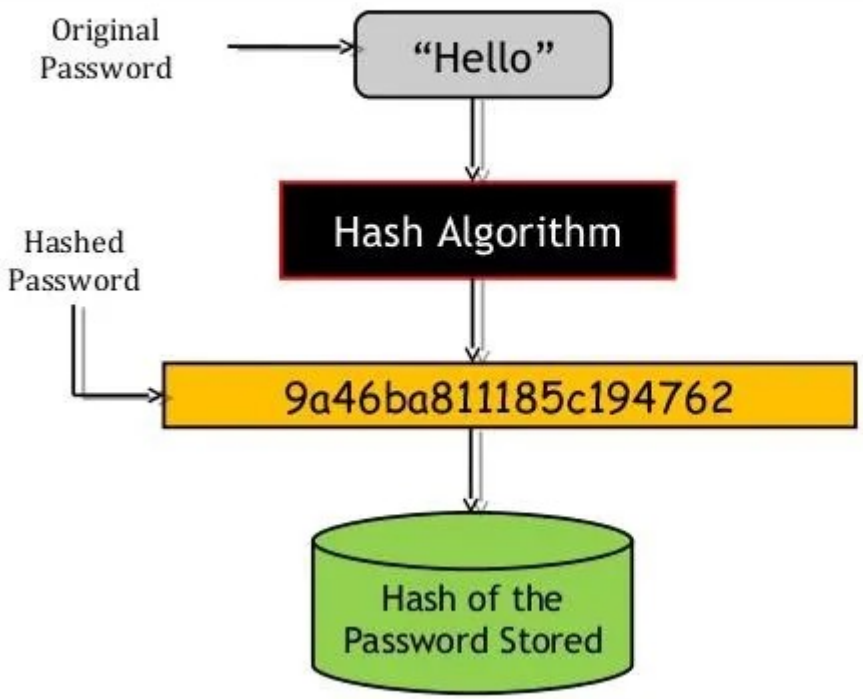
- To get the password of the specific user profile, run the following command:

```
c:\users\fuad>netsh wlan show profiles name=ZAHRAWIFI key=clear
```



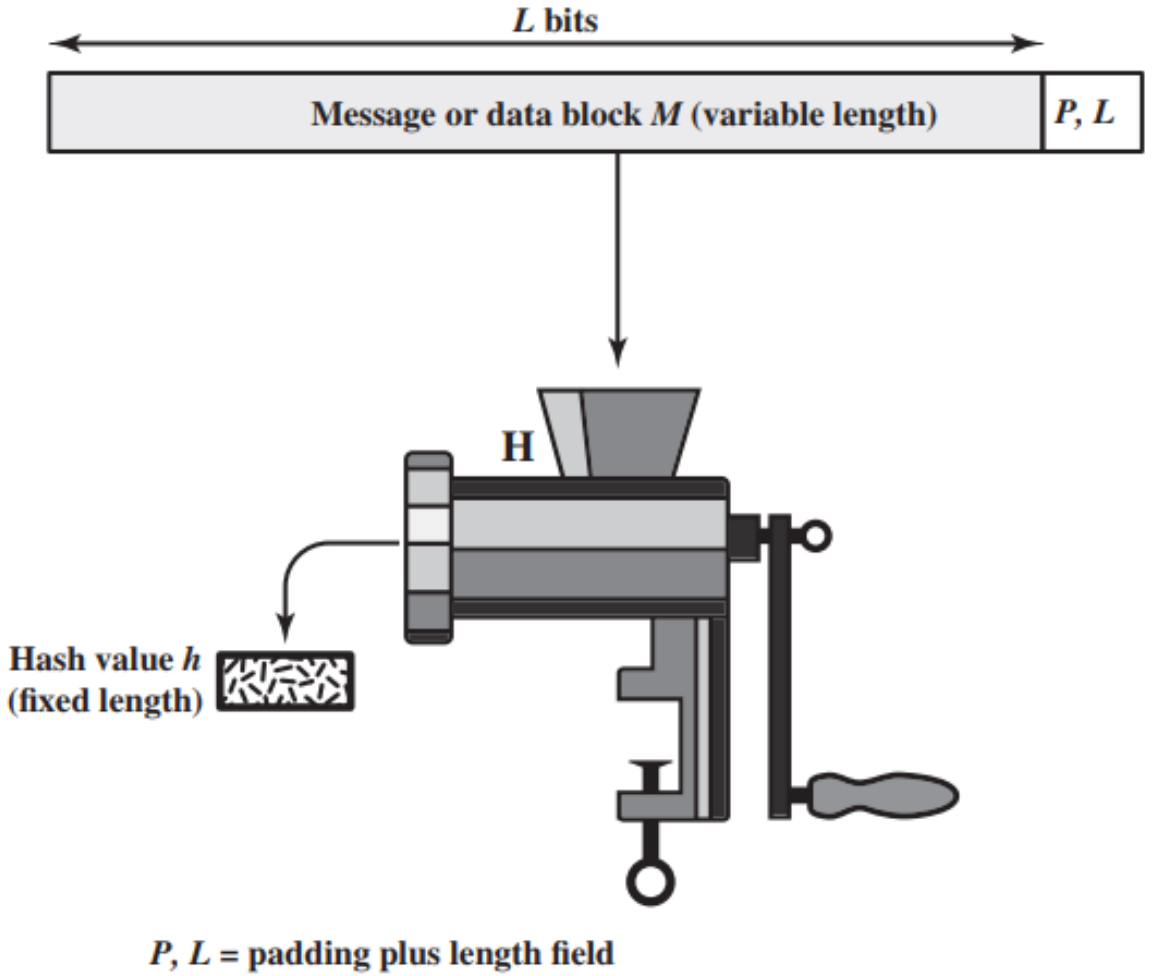
Password Hash

Operating systems store passwords in hidden (encrypted) form so that compromising the id–password list does not give immediate access to all user accounts.

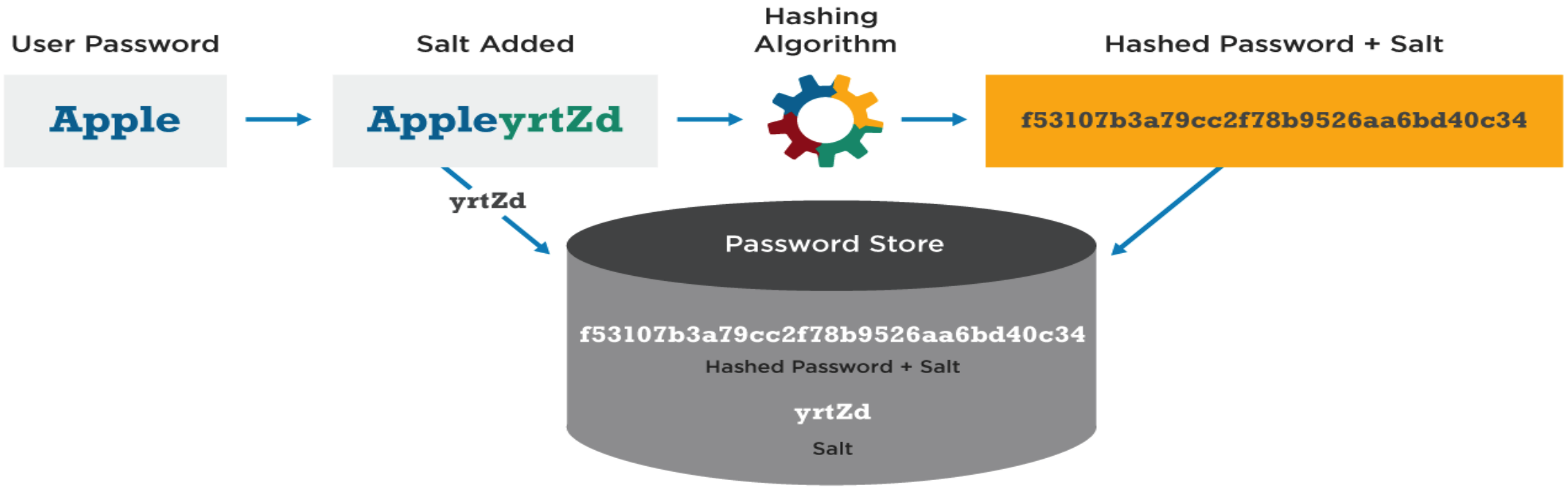


Password Hashing

- A hash function accepts a variable-size message M as input and produces a **fixed-size message** digest H(M) as output.
- Message Digest (MD)
  - MD5 was most popular and widely used hash function for quite some years.
  - The MD family comprises of hash functions MD2, MD4, MD5 and MD6.
  - It is a 128-bit hash function.
- Secure Hash Function (SHA), SHA-1 (160-bit), SHA-2 (SHA-256, SHA-384, SHA-512), and SHA-3 (1600-bit)



Password Hashing with Salt



The **salt serves three purposes**:

1. Prevents duplicate passwords
2. Increases the difficulty of offline dictionary attacks
3. Nearly impossible to tell if a person used the same password on multiple systems

Salted, hashed password check

What is your username and password?

My name is john. My password is automobile.

Does
h(automobile|1515)
=
ScF5GDhW...
???

Password File:

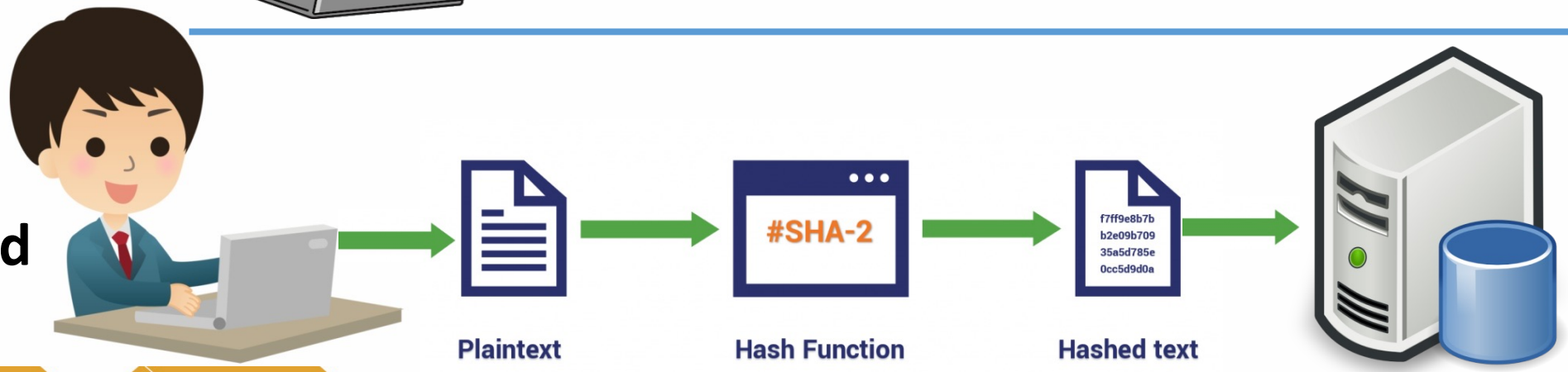
john	ScF5GDhW...	1515
mary	9+aPuu2I...	3044
joe	zjKO8IL+...	3885

Password Transmission

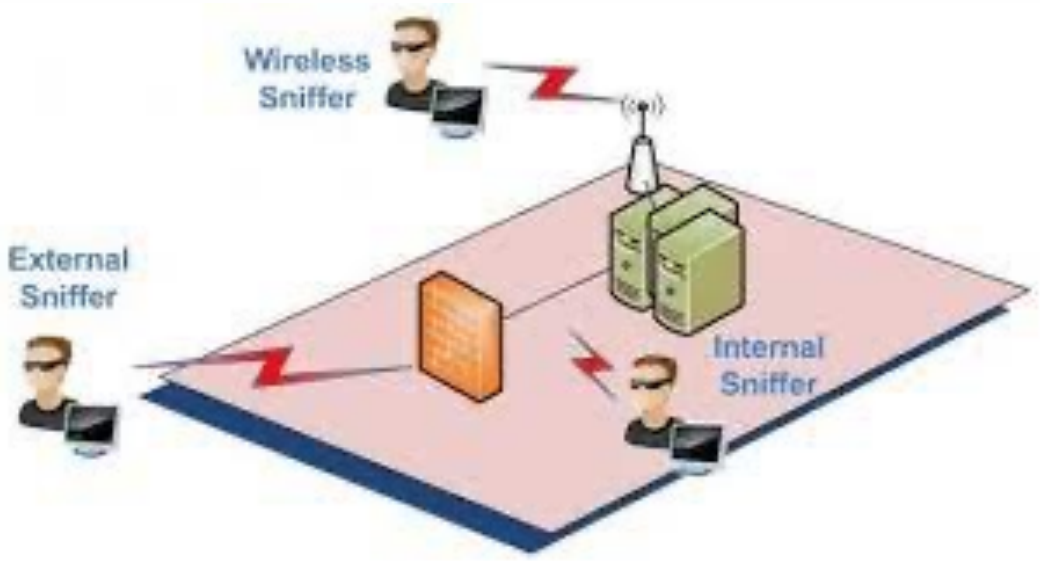
Passwords are **sent to a system** in one of two ways:

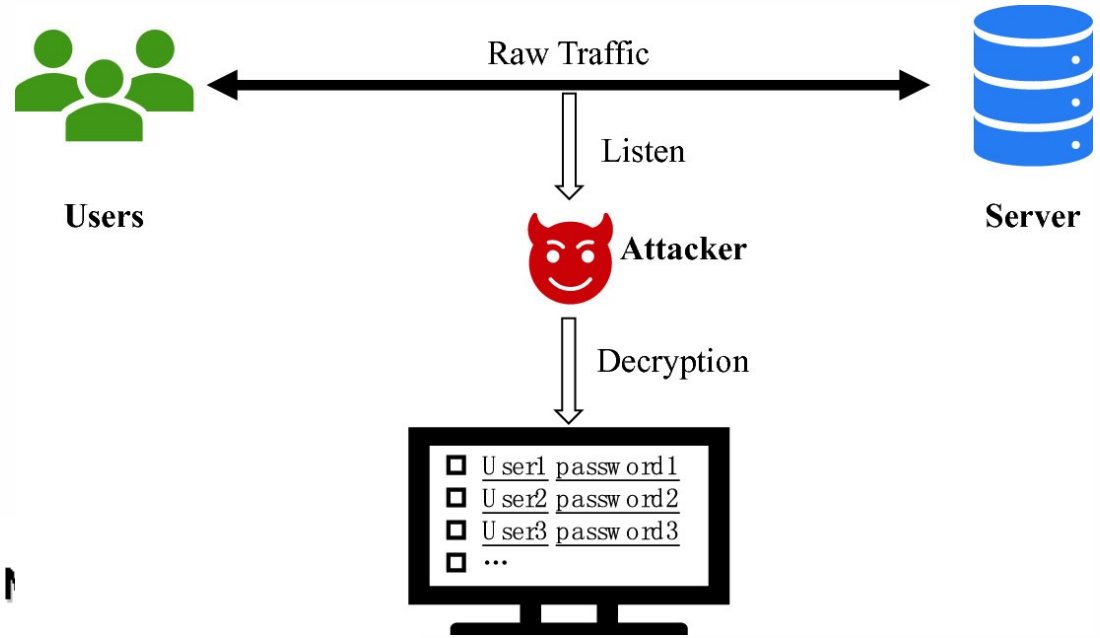
- **Clear-text**

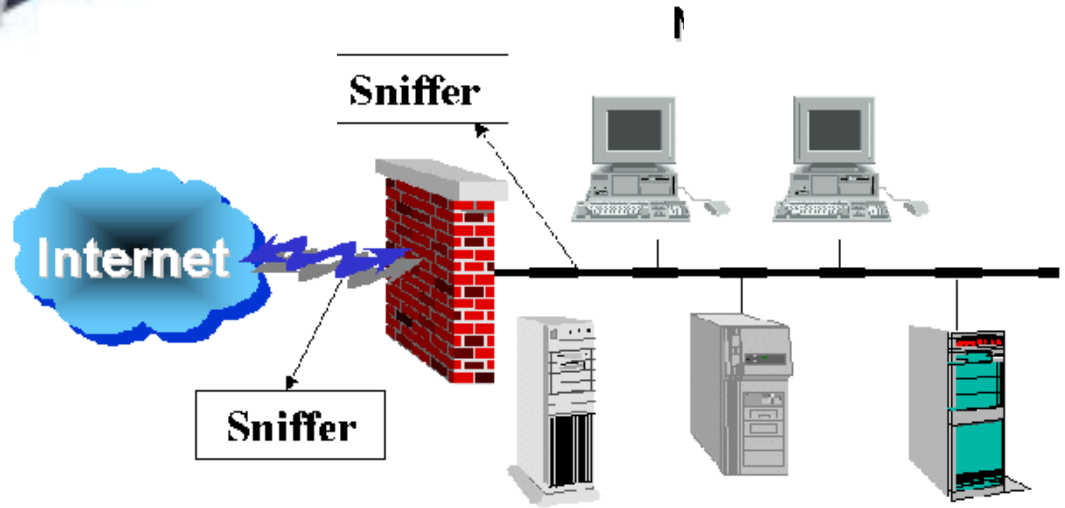
- **Encrypted**



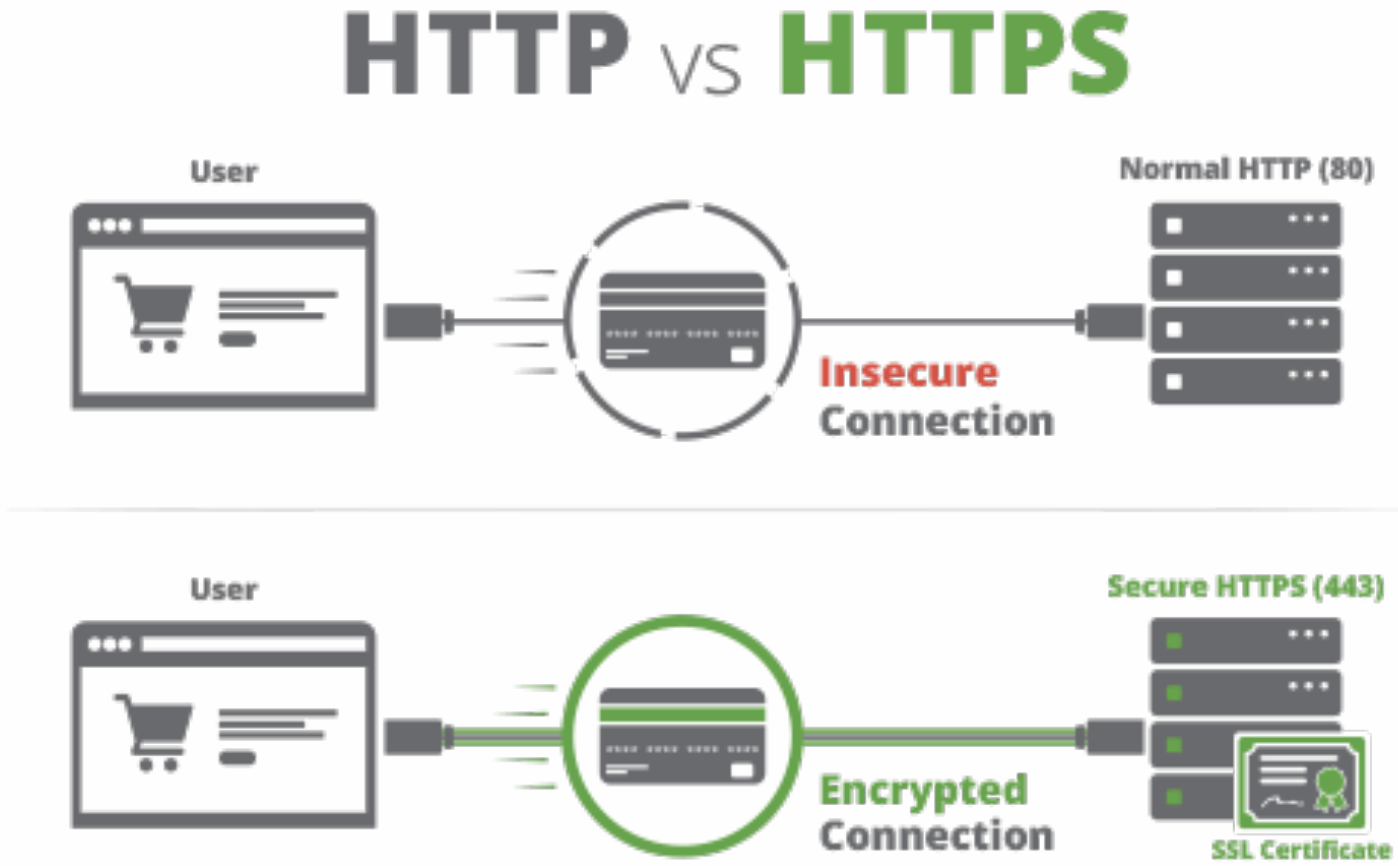
Password Sniffing







Secure Socket Layer (SSL) and Transport Layer Security (TLS)



Password Attacks and Defense Strategies

Type of Password Attacks

None-Electronic Attacks

- Need no Technical Knowledge

- ❖ Shoulder Surfing
- ❖ Social Engineering
- ❖ Dumpster Diving

Active Online Attacks:

- Need Direct Communication

- ❑ Password Guessing
- ❑ Dictionary Attack & Brute Forcing Attack
- ❑ Phishing
- ❑ Trojan /Spyware / Keyloggers

Passive Online Attacks:

- Without Direct Communication

- ➢ Sniffing
- ➢ Man-in- the middle attack
- ➢ Replay Attack

Offline Attacks

- Cracking the password in the attacker machine

- Rainbow Tables (Hashes)
- Distributed Network

None-Electronic Attacks

Shoulder Surfing

Attacker looks into users' keyboards or screens while the victim is logging

Social Engineering

Attackers convince victims to reveal the confidential information

Dumpster Diving

Attackers search for sensitive data in victims' trash-bins, printer trash-bins, and desks for sticky notes.

Defend Against None-Electronic Attacks

- Password Policy
- User Awareness's
- One Time Password
- Multi-Factor Authentication
- Image Authentication

Active Online Attacks

Password Guessing

Dictionary Attacks

Brute Forcing Attack

Phishing

Trojan /Spyware / Keyloggers

Password Guessing

The attacker creates list of **default Passwords** or possible passwords from information collected through social engineering or other means and tries them manually on the victim's machine

- **Low** Use Frequency
- **High** Failure rate

1. **Find** valid user
2. **Create** list of possible passwords
3. **Rank** those passwords from high to low
4. **Key in** each password, until correct password is obtained

Dictionary Attack

1. Most people use **real words (easy-to-remember)** passwords.
2. Attackers combine some **dictionary words** to create list of passwords.
3. Tools are used to **try login** using every password in the list. The list could be huge (Million+)

Easy to remember is **easy to guess**

Brute Forcing Attack

A brute-force attack is repeating login attempts using every possible letter, number, and character combination to guess a password.

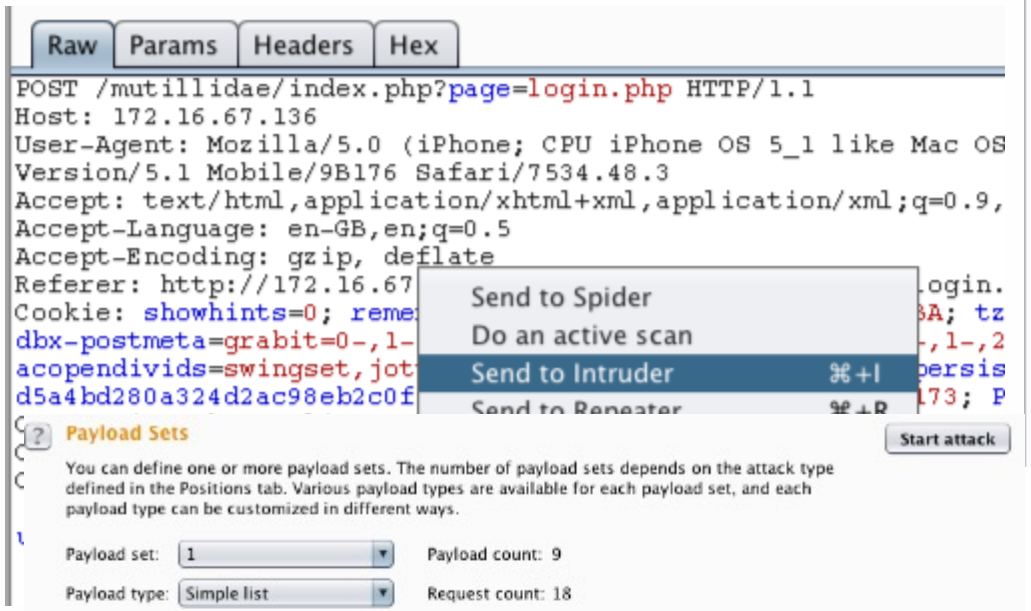
The most basic form of brute force attack is an exhaustive key search, which is exactly what it sounds like: Trying every single possible password solution (i.e., lowercase letters, capital letters, numbers, and special characters) character by character until a solution is found.

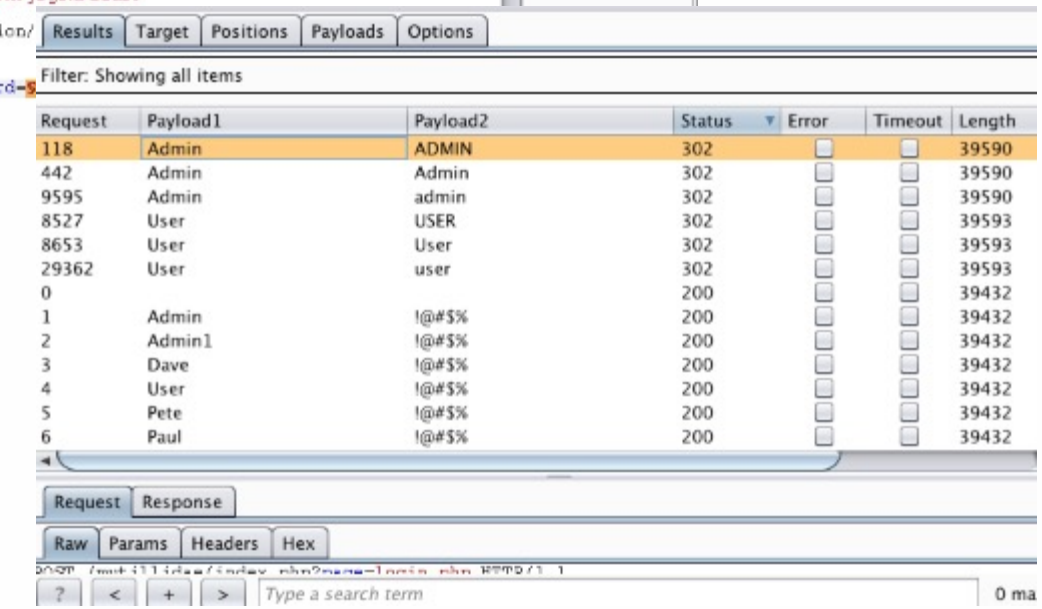
Exhaustive key searches are the solution to cracking any kind of cryptography, but they can take a very long time.

Lab Exercise 1: Online Password Cracking – Using Burp Suite

1. Download Burp Suite Community Edition.
2. Run the Burp suite and find the Proxy tab
3. Make sure that ”intercept is off” and use the embedded web browser to browse the target (victim) login page
4. Enable the intercept ”intercept is on” in the Burp Suite and supply any login id and password
5. Right click on the intercepted page and select “send to intruder”
6. In the intruder tab select the positions and click the clear button on the right
7. Select the username and password variables and click add button
8. In the Payloads tab set the first payload (username) example type admin in the simple list and set brute force for the second payload
9. Start the attack and monitor the change in the response from the server

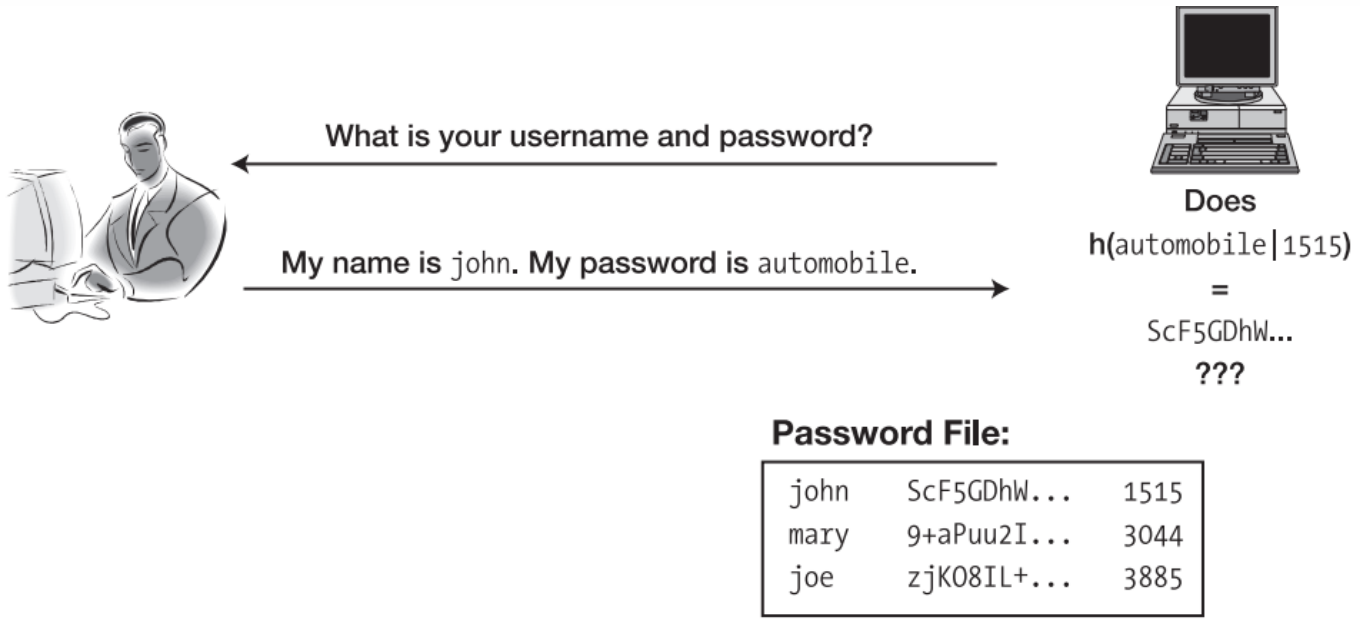
Lab Activity 1 : Online Password Cracking – Using Burp Suite





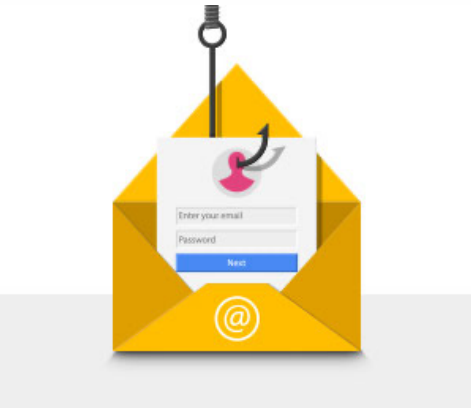
Defend Against Online Attacks: Brute Force-Attack , Dictionary Attack and Password Guessing Attack

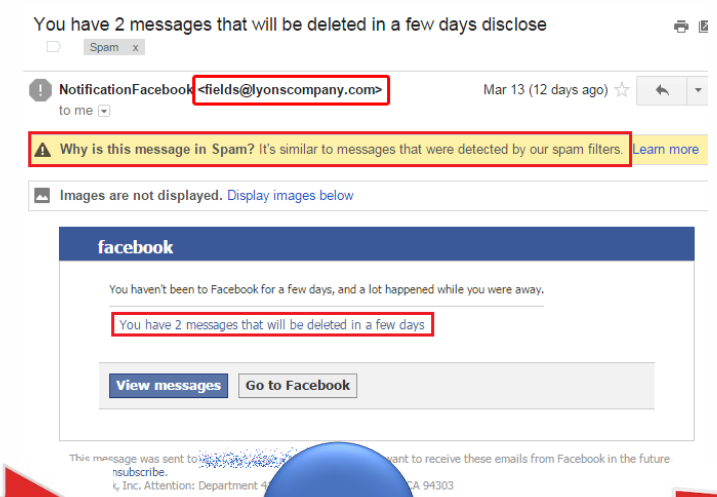
- Strong Passwords
- Enforce Password Complexity - Password Filtering
- Use Salting
  - What is the problem?
- "Honeypot" Passwords (IDS)
  - What is the problem?
- Limited Login Attempts
  - What is the problem?
- Artificial Delays
- Last Login
- Image Authentication
- Security Word
- One-Time Passwords

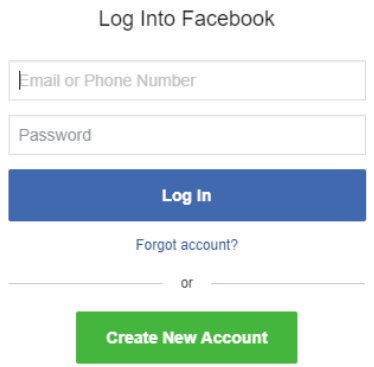


Phishing Attack

- Phishing is a form of social engineering in which you simply ask someone for a piece of information that you are missing by making it look as if it is a legitimate request.







1 → 2 → 3 → 4

Defense Against Phishing Attack

- Phishing Awareness
- Enforce Password Complexity
- Multi-factor authentication
- Image Authentication
- Certificate Authority
- One-Time Passwords

Trojan/Spyware/Keylogger

Spyware is a type of malware allows attackers to **secretly gather information** about a person or organization

Spyware

Trojan is a type of malware that allows the attacker to remotely gain access to victim machine **to steal stored passwords**

Trojan

Keylogger

A keylogger is a program that run in the background and allows remote attacker to **record every keystroke**

Trojan/Spyware/Keylogger

1. Attacker installs Trojan/Spyware/Keylogger on victim's machine to collect victim's **user names and passwords.**

2. Trojan/Spyware/Keylogger **runs in the background** and send back all user names and passwords to the attacker.

Defense Against Password Thefts

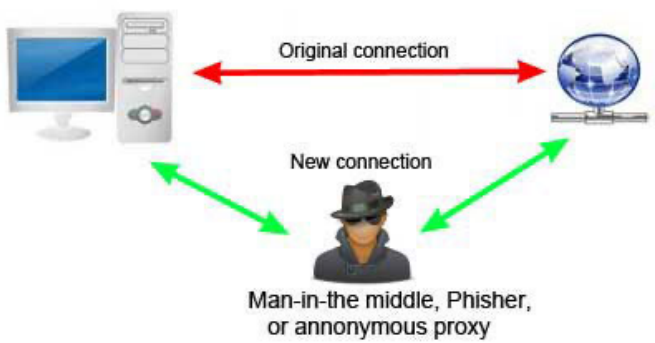
- Secure Storage (Encrypted Hash)
- Temporary Encryption Key
- Multi-factor authentication
- Change Password Regularly

Passive Online Attacks:

Attacker performs password cracking without direct interaction with the target system by **eavesdropping** on network **password** exchanges.

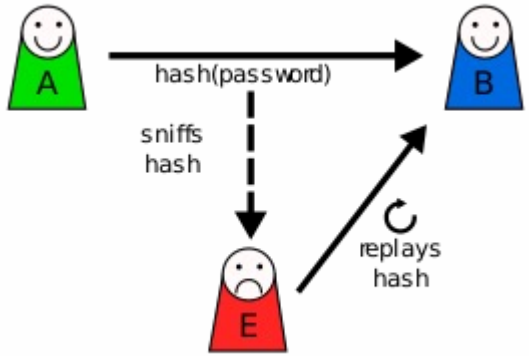
Sniffing

The password is captured during the authentication process.



Man-in-the-middle

A hacker intercepts the authentication request and forward it to the server .



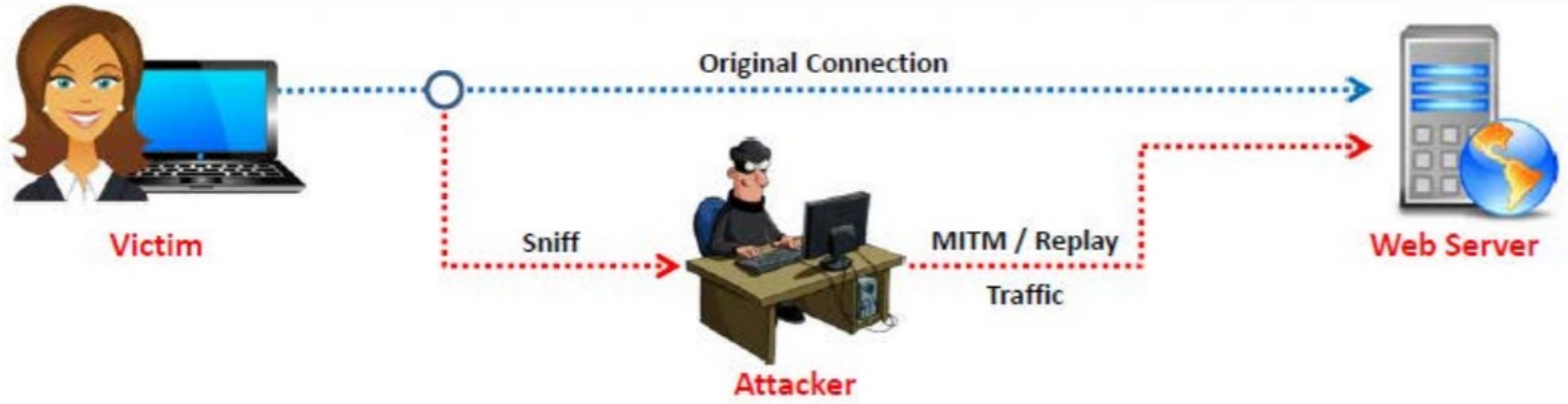
Reply Attack

An attacker intercepts the authentication packet and then resend it latter to gain access.

Sniffing

Attackers run packet sniffer tools on the LAN to access and record the raw network traffic

The captured data may include passwords sent to remote systems during Telnet, FTP, rlogin sessions, and electronic mail sent and received



(1) Password Plain Text – (2) Precomputed Hash – (3) Replay Attack

In a MITM attack, the attacker acquires **access** to the communication channels between victim and server to extract the information

In a replay attack, packets and authentication tokens are captured using a **sniffer**. After the relevant info is extracted, the tokens are placed back on the network to gain access

Considerations

- Relatively **hard to perpetrate**
- Must be **trusted** by one or both sides
- Can sometimes be broken by **invalidating traffic**

Defense Against Sniffing Attacks

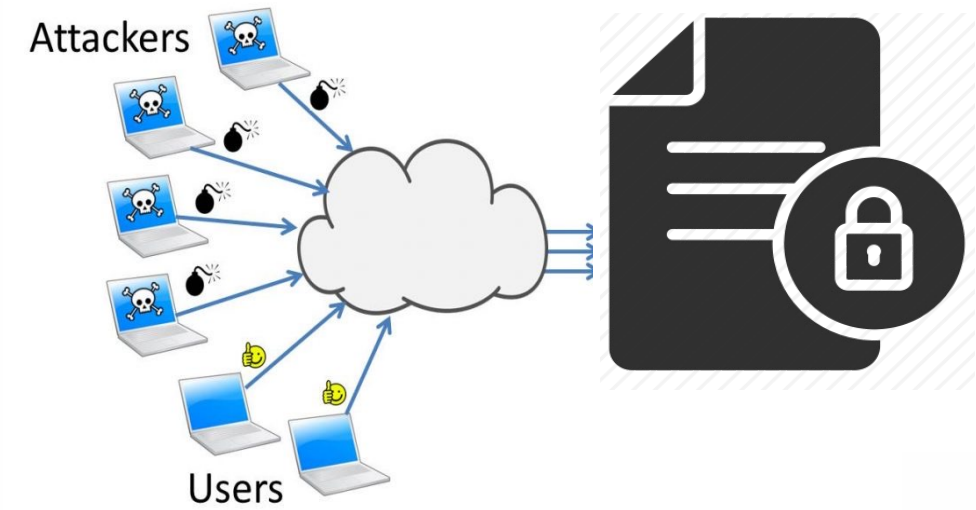
- Use Encrypted Wireless Communication
  - Wired Equivalent Privacy (WEP)
  - WiFi Protected Access (WPA), WPA2, WPA3
- SSL and TSL (TCP/IP)

Offline Attack

Offline Password Cracking is an attempt to recover one or more passwords from a password storage file that has been recovered from a target system.

Rainbow Table Attack

Attacker looks into users' keyboards or screens while the victim is logging



Distributed Network Attack (DNA)

DNA uses the power of machines across the network or across the world to decrypt passwords.

Lab Activity 2: Offline Password Cracking – Cracking Hashed Password using John Tool

1) **In Kali Linux create a user with name “pentest”**

```
root@kali:~/Desktop# useradd -r pentest
```

2) **Give the user password such as “Pentest123”**

```
root@kali:~/Desktop# passwd pentest
New password:
```

3) **Use John Tool to crack the passwords of the shadow file**

```
root@kali:~/Desktop# john /etc/shadow
Pentest123       (pentest)
1g 0:00:00:00 DONE 1/3 (2020-04-26 14:33) 1.612g/s 1058p/s 1058c/s 1058C/s pen
test123..pentest555
Use the "--show" option to display all of the cracked passwords reliably
Session completed
```

Defense Against Offline Attack

- Use Complex Password
- Use Secure Hash Function such as SHA 1,2,3 ..etc.
- Use Salting
  - With salting, an attacker has to hash 2^{k+n} strings where n is the password length and k is the salt length. Where it store the salt?

Third-Party Authentication

- Web-Based Authentication vs password-based authentication
- Password-based authentication
  - Security issues and the vulnerabilities of password-based methods in untrusted environments
  - usability aspects of remembering passwords
- Web-Based Authentication
  - A single point of failure
  - Privacy Issue: Third-parties give access to a large set of sites, which share and store a large set of potentially sensitive information

Next Session

- Preventing SQL Injection Attacks