IT Security

INTRODUCTION

 Version : 0.0.2 Update : 04/10/2021

Summary

1. Introduction to cybersecurity
2. Introduction to pentest
    a. Passive Reconnaissance : General tools
    b. Passive Reconnaissance : Dedicated to DNS and Zone Transfers
    c. Active Reconnaissance
    d. Exploitation : Directory Path Traversal
    e. Exploitation : SQL Injection

Introduction to cybersecurity

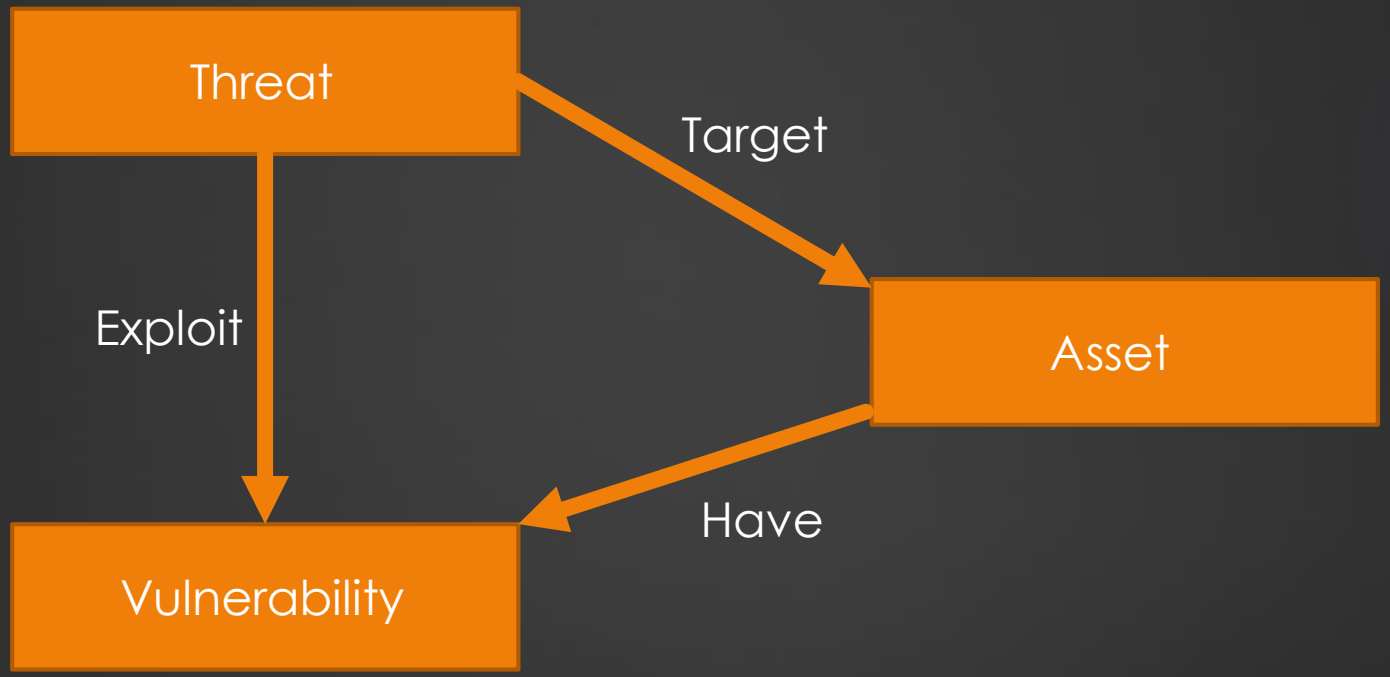
- Cybersecurity / IT security prevents unauthorized access to assets (computers, servers, networks, data, etc.).

- To maintain (CIA or DICP / DICPP in French)
  - **Confidentiality**:
    Cleartext or password stealing has an impact on confidentiality.
  - **Integrity**:
    Data tampering has an impact on integrity.
  - **Availability**:
    DoS attack has an impact on availability.
  - **Non repudiation**:
    Guarantee that the sender of a message cannot deny having sent the message and the recipient cannot deny having received it.

Terms

- **White Hats** is a good guys also called ethical hackers.
- **Black Hats** is a bad guys, malicious hackers.
- **Gray Hats** is a good and bad guys depends on the situation.
- **Threat** that could lead to a potential breach of security.
- **Exploit** takes advantage of a bug or vulnerability, leading to unauthorized access, privilege escalation, or Denial Of Service.
- **Vulnerability** is a software flaw or implementation error that can lead to an unexpected and undesirable event executing bad or damaging instructions to the system.
- **Risk analysis** aim to identify, assess and prioritize the risks associated with the activities of an organization.

Vocabularies



Testing types

- **Black box:** testing involves performing a security evaluation and testing with no prior knowledge of the infrastructure.
- **White box** testing involves performing a security evaluation and testing with complete knowledge of the infrastructure.
- **Gray box** testing involves a combination of white-box testing and black-box testing. The aim of this testing is to search for the defects if any due to improper structure or improper usage of applications.

All steps to execute a pentest

1. Talk to the client about the perimeter (IP, domain, etc.) and types of attacks that may create a risk for the customer (brute force, DoS, etc.).
2. Prepare and sign with the client the NDA (non-disclosure agreement)
3. Conduct the pentest and collect information in order to provide a report.
4. Write the report and have it proofread by a colleague.
5. Present the report findings to the client (report, documentation, etc.).

<u>Warning :</u> It is legally forbidden to scan / pentest / etc. if you haven't been commissioned for it or that the solution is not yours.

Kill chain : Attack phases

Kill chain is a term used to define the steps an enemy uses to attack a target.

Pre-attack

1. **Reconnaissance**: Information gathering and attempts to identify vulnerabilities.
2. **Weaponization**: Creates remote access (virus or worm).

Attack

3. **Delivery**: Transmits weapon to target (e-mail, websites or USB drives)
4. **Exploitation**: Malware weapon's program code triggers, which takes action on target network to exploit vulnerability (e.g., download code).
5. **Installation**: Malware weapon installs access point backdoor.
6. **Command and Control / Persistence**: Malware gives a hand on the keyboard.
7. **Actions on Objective**: Intruder takes action to achieve their goals (data exfiltration, data destruction, or encryption for ransomware).

Reconnaissance

- **Passive reconnaissance** there will be no traffic generated on the target's infrastructure, it is a matter of finding public data by conventional or specialized search engines (wireshark, shodan, etc.).

- **Active reconnaissance** it is a question of going directly to question the "target". For example, a server's ports can be purposely scanned to see which services they are responding to.

PASSIVE RECONNAISSANCE

DEDICATED TO DNS AND ZONE TRANSFERS

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DNS Basics

- DNS converts human readable domain names into IP-addresses. It's easier to remember than IP-addresses.
- This process may take place through a local cache or through a zone file that is present on the server. A zone file is a file on the server that contains entries for different Resource Records (RR). These records can provide us a bunch of information about the domain.
- Let's say the user opens up the browser and types in google.com. It is now the responsibility of the DNS resolver in the user's operating system to fetch the IP address.
  - First it checks his local cache.
  - If it can't find the IP address in it's cache it queries the DNS server.
  - If it still can't find the IP Address then it goes through a process or recursive DNS query in which it queries different nameservers (NS) to get the IP-address of the domain.

DNS Record Types

- Address Mapping record (A Record) : stores a hostname and its corresponding IPv4 address.
- IP Version 6 Address record (AAAA Record) : stores a hostname and its corresponding IPv6 address.
- Canonical Name record (CNAME Record) : alias a hostname to another hostname.
- Mail exchanger record (MX Record) : specifies an SMTP email server for the domain.
- Name Server records (NS Record) : specifies that a DNS Zone, such as "example.com" is delegated to a specific Authoritative Name Server, and provides the address of the name server.
- Reverse-lookup Pointer records (PTR Record) : allows a DNS resolver to provide an IP address and receive a hostname (reverse DNS lookup).
- Certificate record (CERT Record) : stores encryption certificates (PKIX, SPKI, PGP, and so on).
- Service Location (SRV Record) : a service location record, like MX but for other communication protocols.
- Text Record (TXT Record) : typically carries machine-readable data such as opportunistic encryption, sender policy framework, DKIM, DMARC, etc.
- Start of Authority (SOA Record) : this record appears at the beginning of a DNS zone file, and indicates the Authoritative Name Server for the current DNS zone, contact details for the domain administrator, domain serial number, and information on how frequently DNS information for this zone should be refreshed.

DNS Zone file example


```
$ORIGIN infosecinstitute.com.;This marks the beginning of the file
$TTL  86400 ; TTL is 24 hours , it could also be 1d or 1h
infosecinstitute.com  IN      SOA ns1.infosecinstitute.com.  webmaster.infosecinstitute.com. (
                      2002026801 ; serial number of this zone file
                      2d ; refresh time for slave
                      5h ; retry time for slave
                      2w ; expiration time for slave
                      1h ; maximum caching time
                                 )
      NS                    ns1.infosecinstitute.com.       ; ns1 is a nameserver for infosecinstitute.com
      NS                    ns2.infosecinstitute.com.       ; ns2 is a backup nameserver for infosecinstitute.com
      MX                    10 mail.infosecinstitute.com.   ; mail server
ns1     A                    192.168.1.1                    ; Ipv4 address for ns1.infosecinstitute.com
www   CNAME                 infosecinstitute.com            ; www.infosecinstitute.com is an alias for infosecinstitute.com
ftp   IN  CNAME             www.infosecinstitute.com.       ; CNAME for ftp
mail  A                     192.0.3.2                       ; Ipv4 address for mail.infosecinstitute.com
```

DNS Basics example


```
C:\Users>nslookup
Default Server:  UnKnown
Address:  192.168.0.254

> set type=A
> mapmyrun.com
Server:  UnKnown
Address:  192.168.0.254

Non-authoritative answer:
Name:    mapmyrun.com
Addresses:  13.249.13.101
          13.249.13.26
          13.249.13.107
          13.249.13.86
```

- **set type=A** . This means that we are querying for the A type records which will return IP-address for the domain we query. We will look more into records in the next section.
- As soon as we type in **mapmyrun.com** we get an output showing **Non-authoritative answer**. This basically means that our DNS server queried an external DNS server to fetch the IP-address. Below we can see 4 IP-addresses associated with **mapmyrun.com**. This is usually the case with large organizations. They use multiple servers to serve the request as one server is generally not capable of handling all the requests.

DNS Basics example


```
> set type=NS
> mapmyrun.com
Server:  UnKnown
Address:  192.168.0.254

Non-authoritative answer:
mapmyrun.com    nameserver = ns-748.awsdns-29.net
mapmyrun.com    nameserver = ns-1360.awsdns-42.org
mapmyrun.com    nameserver = ns-1621.awsdns-10.co.uk
mapmyrun.com    nameserver = ns-440.awsdns-55.com
```

- Now we have the four NS hostname.
  We can make resolutions to match IP and NS.

DNS Basics example


```
> set type=MX
> mapmyrun.com
Server:  ns-748.awsdns-29.net
Addresses:  2600:9000:5302:ec00::1
          205.251.194.236

mapmyrun.com    MX preference = 10, mail exchanger = inbound-smtp.us-east-1.amazonaws.com
mapmyrun.com    nameserver = ns-1360.awsdns-42.org
mapmyrun.com    nameserver = ns-1621.awsdns-10.co.uk
mapmyrun.com    nameserver = ns-440.awsdns-55.com
mapmyrun.com    nameserver = ns-748.awsdns-29.net
```

- I set the type to MX and again type in the domain name. What we get a mail server responsible for handling emails sent to that domain. The number before them denotes the priority with which to fetch mails. Lower the number, higher the priority.
- Note that querying from your own dns server may not give you the accurate information every time.

DNS Basics example


```
> fr.mapmyrun.com
Server:  UnKnown
Address:  192.168.0.254

Non-authoritative answer:
fr.mapmyrun.com canonical name = mapmyrun.com
```

- I set the type to CNAME and I search the subdomain **fr.mapmyrun.com.** I get a canonical name as **mapmyrun.com**. This means any request to the queried domain (in this case **fr.mapmyrun.com**) will be redirected to **mapmyrun.com**.

DNS Zone Transfers

- MX records indicate where mail should be sent, which tells us that GMail or Google is used. From this, you know that there is a minimum of spam and virus checking in place which helps when sending email for SE or client side attacks.

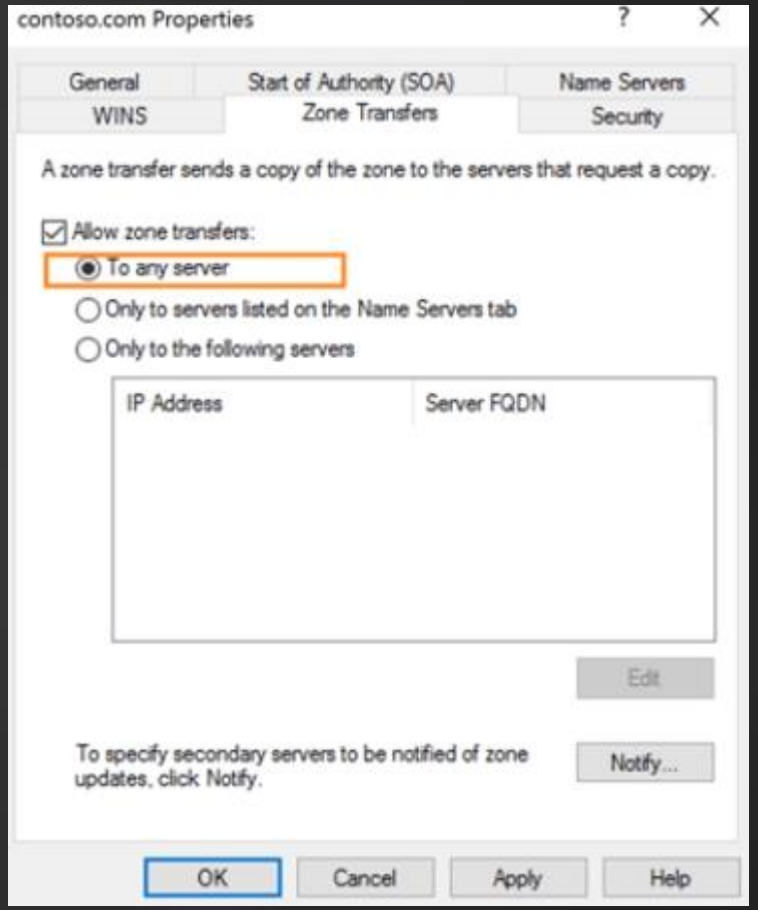
```
dig axfr @nsztm1.digi.ninja zonetransfer.me


; <<>> DiG 9.9.5-3ubuntu0.6-Ubuntu <<>> axfr @nsztm1.digi.ninja zonetransfer.me
; (1 server found)
;; global options: +cmd
zonetransfer.me.        7200    IN      SOA     nsztm1.digi.ninja. robin.digi.ninja. 2014101601 172800 900 1209600 3600
zonetransfer.me.        300     IN      HINFO   "Casio fx-700G" "Windows XP"
zonetransfer.me.        301     IN      TXT     "google-site-verification=tyP28J7JAUHA9fw2sHXMgcCC0I6XBmmoVi04VlMewxA"
zonetransfer.me.        7200    IN      MX      0 ASPMX.L.GOOGLE.COM.
zonetransfer.me.        7200    IN      MX      10 ALT1.ASPMX.L.GOOGLE.COM.
zonetransfer.me.        7200    IN      MX      10 ALT2.ASPMX.L.GOOGLE.COM.
zonetransfer.me.        7200    IN      MX      20 ASPMX2.GOOGLEMAIL.COM.
zonetransfer.me.        7200    IN      MX      20 ASPMX3.GOOGLEMAIL.COM.
zonetransfer.me.        7200    IN      MX      20 ASPMX4.GOOGLEMAIL.COM.
zonetransfer.me.        7200    IN      MX      20 ASPMX5.GOOGLEMAIL.COM.
```

DNS Zone Transfers : Security issue

- Microsoft DNS example on bad DNS admin side with the following screenshot:

- On pentest side with an enumeration it's easy to detect all DNS lookup zones on domain controllers running DNS in a forest and it's necessary to get all information if any of the zones on any DNS server has the following settings enabled.



DNS Zone Transfers : Reconnaissance before attacks

Attack Sophistication

Attack operators exploit any weakness

Target information on any device or service

Target AD & Identities

Active Directory controls access to business assets

Attackers commonly target AD and IT Admins

Attacks not detected

Current detection tools miss most attacks

You may be under attack (or compromised)

Response and Recovery

Response requires advanced expertise and tools

Expensive and challenging to successfully recover

DNS Zone Transfers : Why this matters

- DNS server contains a map of all the computers, IP addresses, services in your network and maybe a lot of other sensitive information.
- This information is used by attackers to map your network structure and target interesting computers in their attack.
- Many tools can be used to perform such activities:
  - nslookup
  - dig
  - dnsrecon
  - dnsenum
  - nmap
  - fierce
- Secure an Internal DNS server to prevent reconnaissance using DNS from occurring can be accomplished by disabling or restricting zone transfers only to specified IP addresses.

DNS Zone Transfers Security

- Only allow zone transfer to the trusted DNS servers (which host the secondary zones).
- Zone transfer settings are server specific and restrictions should be applied to all affected DNS servers.
- Create a process to document DNS Primary zone and secondary zone relationships: such should be reflected by the zone transfer settings on the upstream primary zone.
- Create a process to document all DNS server changes: remove unwanted IP addresses from the zone transfer allowed IP addresses if the downstream secondary servers have been retired.