The Anatomy of a Cyber Attack

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agenda

- Concepts and definitions
  - What is a cyber attack?
  - Motivation
  - Vulnerabilities and exploits
- Anatomy of a cyber attack
  - The four stages of attack
  - Types of attack
  - Active attacks
    - DDoS, Spoofing, MiTM, ARP attacks, Overflows
  - Passive attacks
    - Wiretapping, Scanning, Phishing and Spear-Phishing, Social Engineering, Worms, Viruses, Trojans, Crypto Attacks
  - Zero Day and Advanced Persistent Threats
- Case studies
  - Stuxnet (2009-2011)

*Further reading in the slide notes

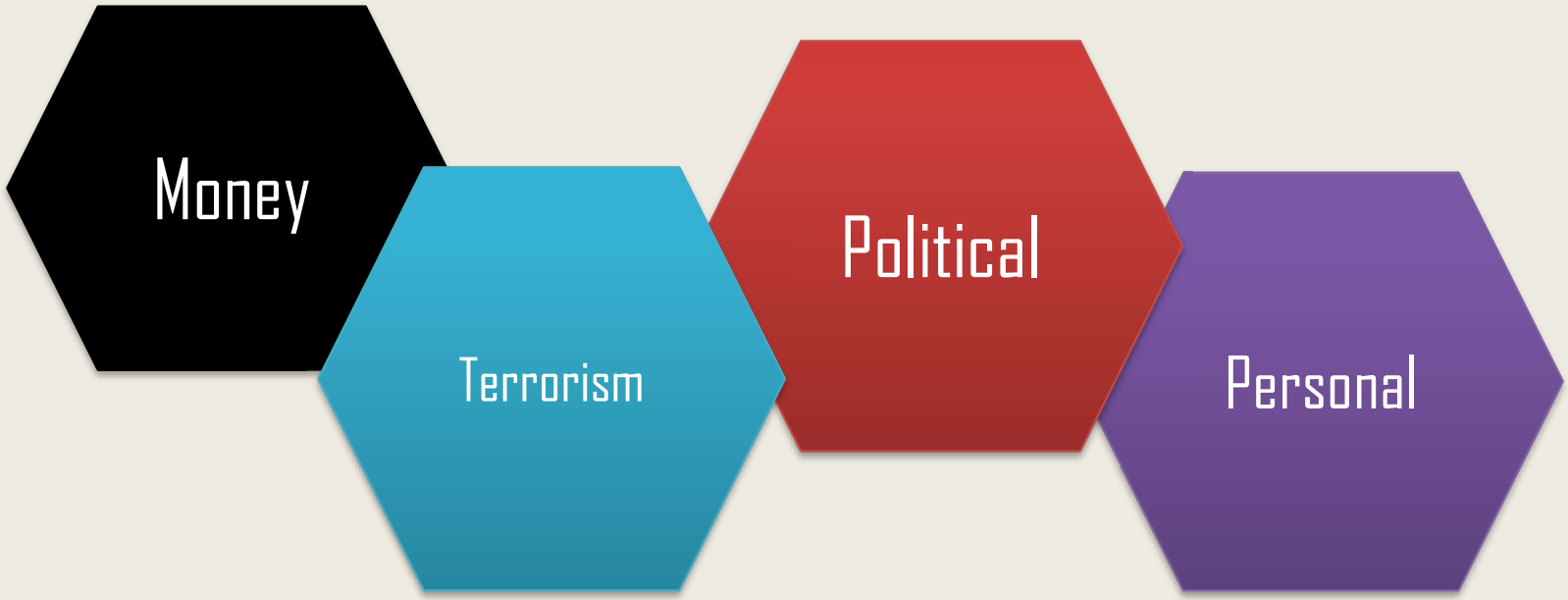
Concepts and definitions

What is a cyber attack?

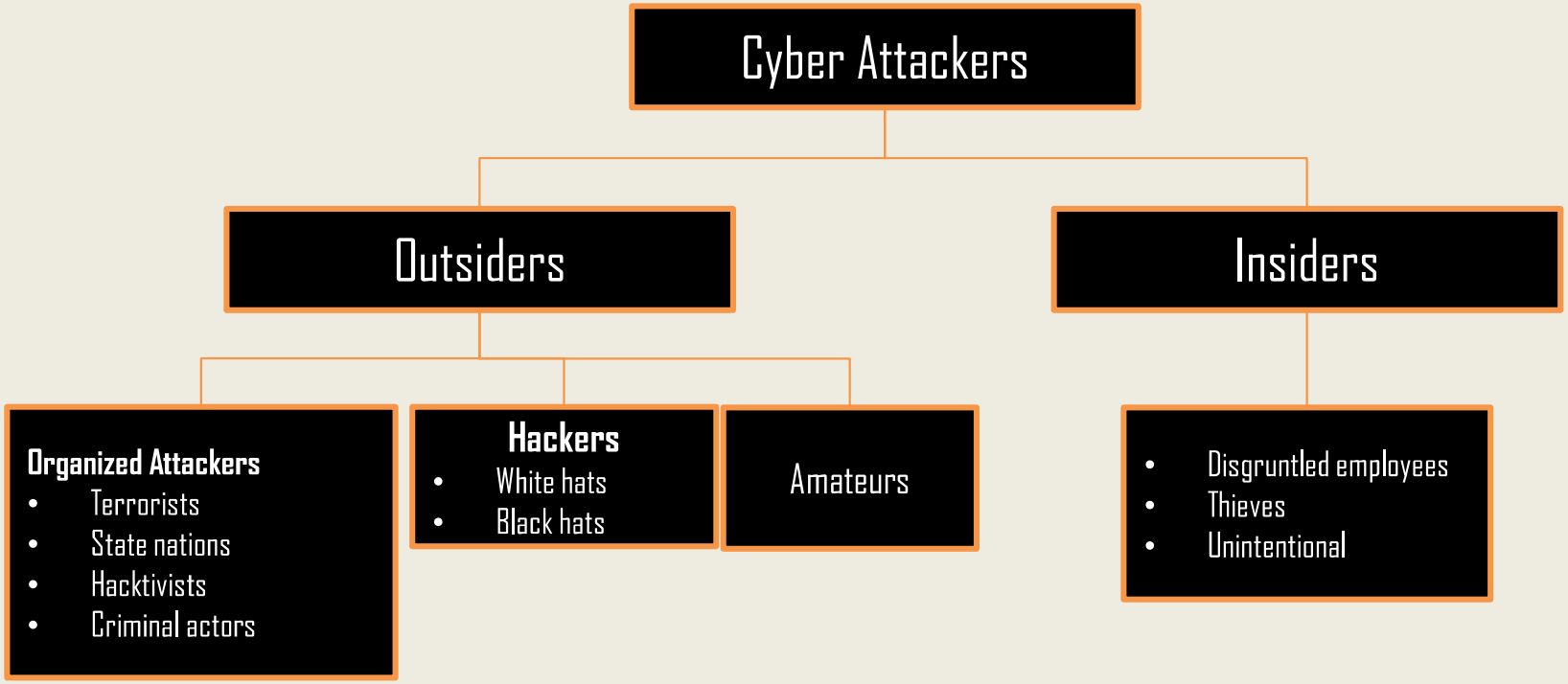
A **cyberattack** is any type of offensive maneuver that targets computer information systems, infrastructures, computer networks, or personal computer devices.

Concepts and definitions

Understanding the motivation behind cyber attacks



Concepts and definitions

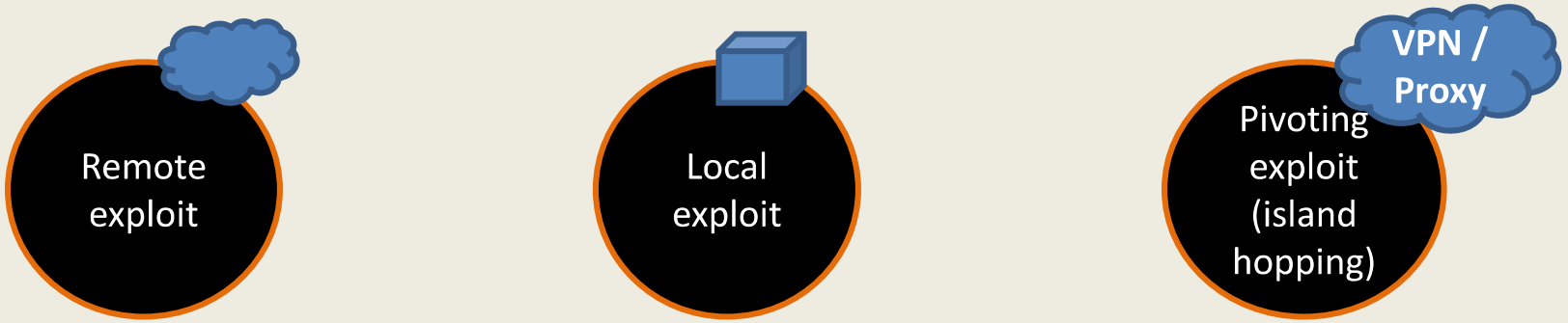


Concepts and definitions

Vulnerabilities and exploits

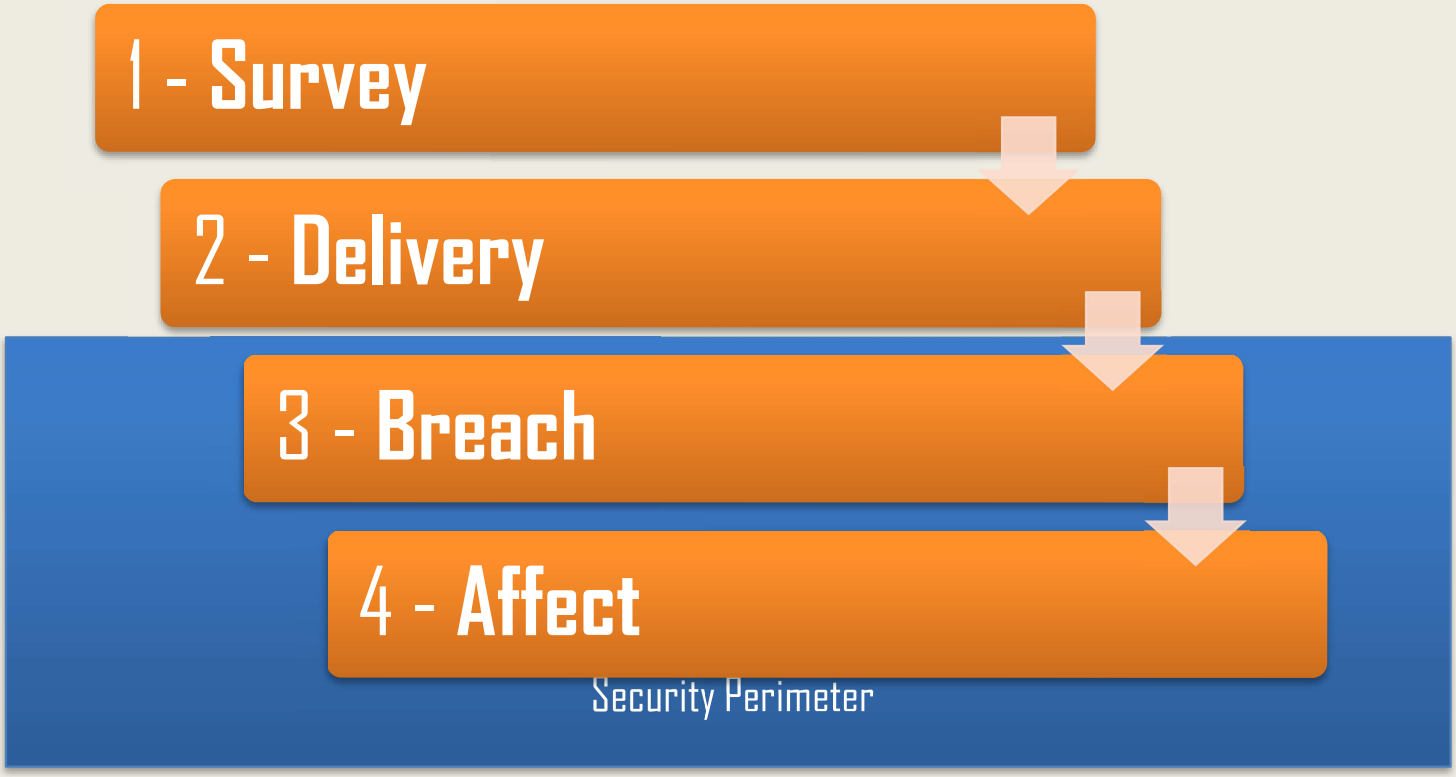
A **Vulnerability** is a weakness in a computer system that can be exploited by an Attacker to perform unauthorized or unintended actions

An **Exploit** is piece of software, chunk of data or sequence of commands that takes advantage of a vulnerability to cause unintended or unanticipated behavior in a computer system



Anatomy of a Cyber Attack

The four stages of an attack



Anatomy of a Cyber Attack

Types of attacks:

(dual taxonomy)

Outside
Attacker is outside the **security perimeter**

Inside
Attacker is 'inside' the **security perimeter**

Where is the attacker located?
Inside attackers – foot in the stronghold
Outside attackers – looking through the fence

Active
Alters system resources to affect operation

Passive
Gathers information from the systems but does not alter its state

How is the attacker acting?
Active – in the system, messing around
Passive– looking through the fence, gathering info

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Active Attacks

Distributed Denial of Service

Ever been to a music festival? Imagine how would the access gates look like if there weren't any security staff queuing people for ticket validation

There are three categories of DDoS attacks: volumetric, state exhaustion and application layer Attacks:

Volumetric

- Amplification attacks
- UDP, ICMP, TCPSYN attacks

Application Layer DDoS Attacks

Advanced Persistent DDoS

Exhaustion

- Lorises (Slowloris)
- Http floods

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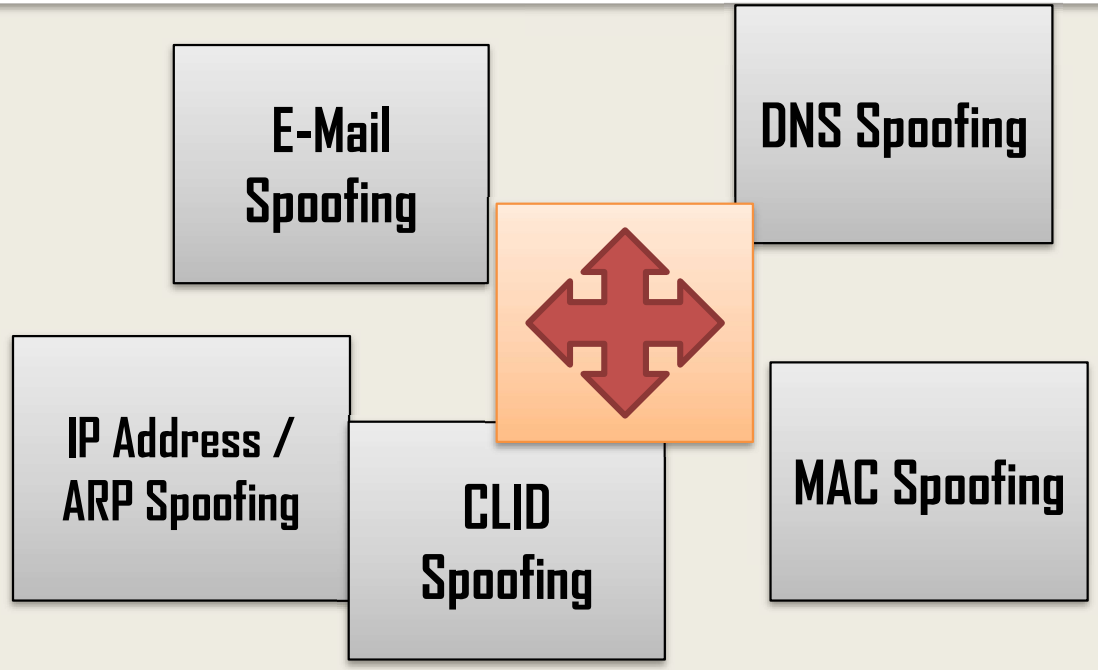
Active Attacks

Spoofing

The issue:
Many TCP/IP protocols do not provide mechanisms for authenticating the source and/or destination of a message



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Active Attacks — Man In The Middle (MiTM)

A MiTM attack usually implies one attacker secretly relaying the communication between two parties who believe they are directly communicating with each other.

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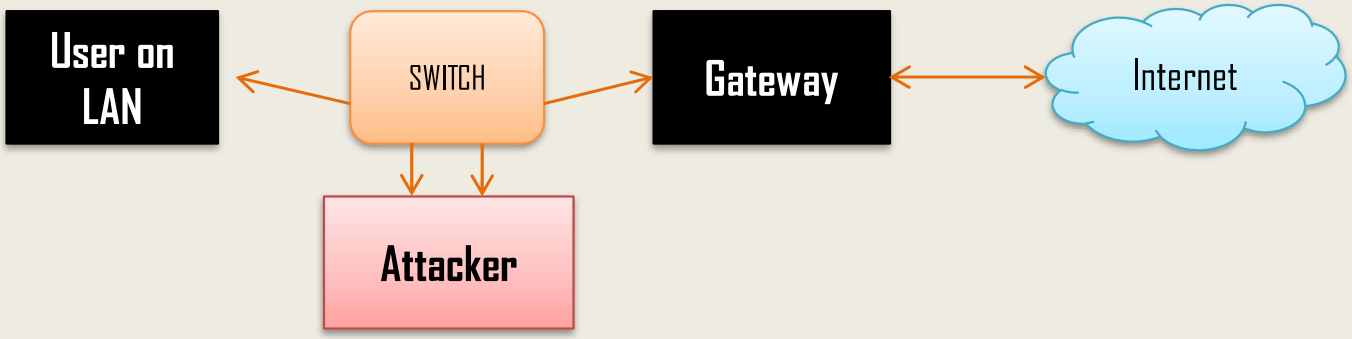
Active Attacks

ARP Attacks

ARP Spoofing (ARP Poisoning, ARP cache poisoning) is a type of attack by which an attacker sends spoofed (forged) Address Resolution Protocol (ARP) messages onto a local network, aiming to associate their MAC address with the IP address of another host in order to receive any traffic intended for that IP address

Normal operation



Operation with the ARP cache poisoned

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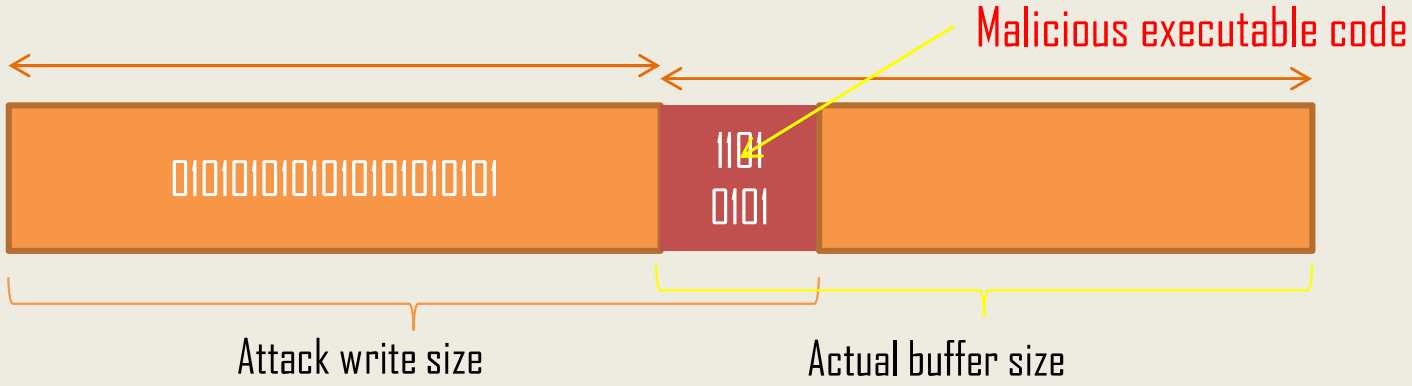
Active Attacks

Overflows – Buffer, Stack, Heap

A buffer overflow is an anomaly in the execution of a program where, while writing data to its buffer, it overruns the buffer boundaries effectively overwriting the adjacent buffer



1. Malformed (malicious) program overwrites this buffer (2) with one byte of malicious code
2. That byte of code overwrites executable code located in the next buffer
3. The malicious code gets executed instead.

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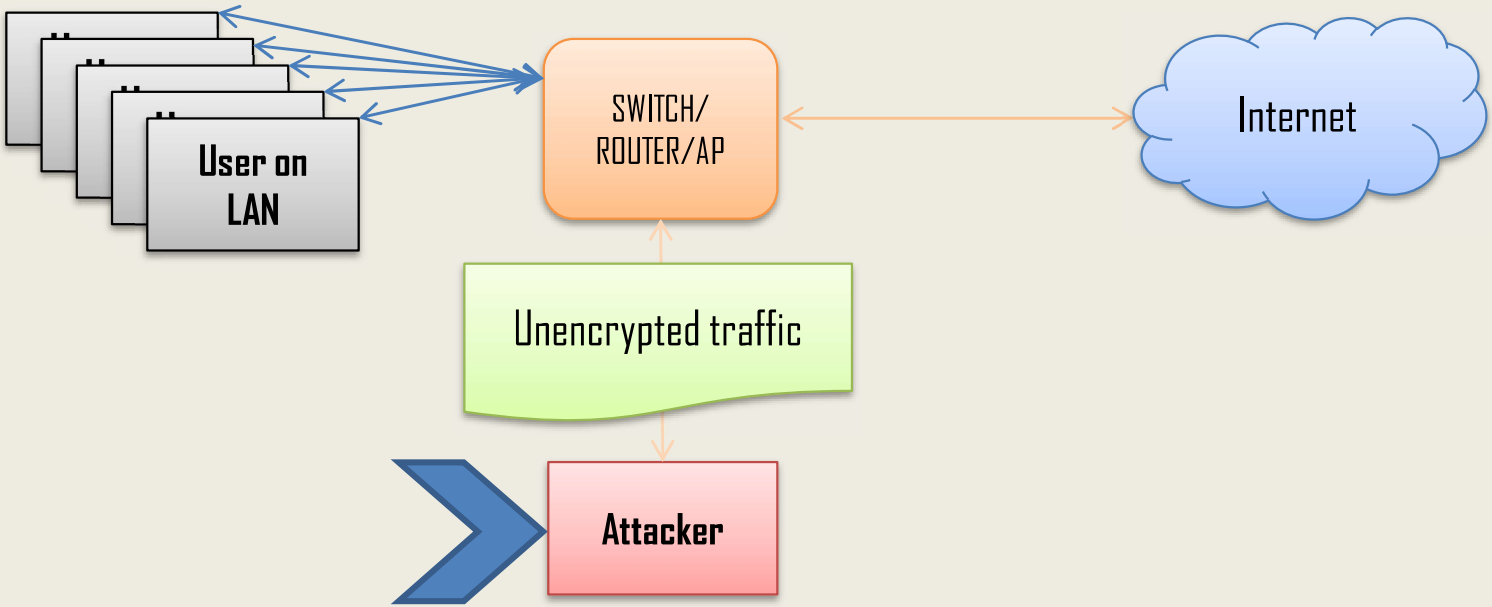
Passive Attacks

Wiretapping, Port Scanning



Common target: Unencrypted traffic such as e-mail, application data, application logins, files transferred with FTP etc.)

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Passive Attacks

Phishing and Spear-Phishing

Phishing: The attempt to obtain sensitive information such as usernames, password, credit card details, for malicious reasons, by disguising as a trusted or trustworthy entity

Spear phising

-directed to specific individuals;
-crafting and delivering of message in such a way as to cater to a specific person or company habits or needs

Clone phishing

-usually by e-mail;
-attacker modifies an existing, legitimate message;
-replaces links with their own;
-spoofs originating e-mail address

Whaling

A type of phishing targeting high-profile executives within business, hoping to gather extremely valuable information

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Passive Attacks

Phishing and Spear-Phishing

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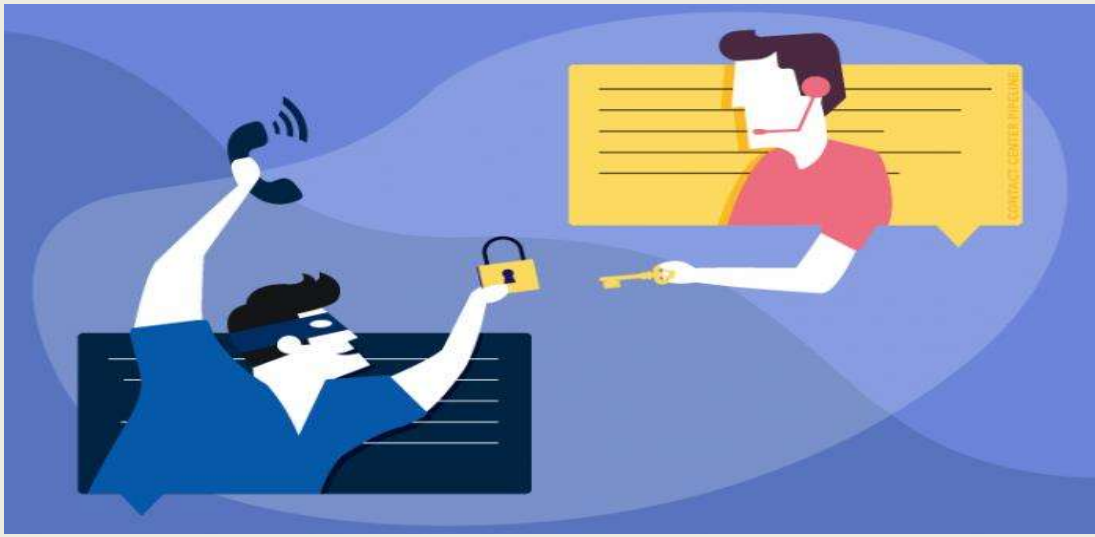
Passive Attacks

Social Engineering

Social engineering refers to psychological manipulation of people into performing actions or divulging confidential information. A type of confidence trick for the purpose of information gathering, fraud, or system access, it differs from a traditional "con" in that it is often one of many steps in a more complex fraud scheme.



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Passive Attacks — Worms, Viruses, Trojans

Worm

-stand alone malicious software
-replicates when executed
-spread itself by copying to other computers in a computer network

Virus

-malicious software
-it replicates when executed
-modifies other computer programs by inserting own malicious code

Trojan

-malicious software
-misleads users of its true intent
-deploys payload when executed

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Passive Attacks

Cryptomalware / Ransomware

Cryptomalware: type of malware that threatens to disclose or disable access to user's data by encrypting it with a public/private key pair.

Ransomware: a type of cryptomalware that will disable access to data unless a ransom is paid, usually in the form of untraceable crypto-currency.

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Anatomy of a Cyber Attack

Anatomy of a Cyber Attack

An **advanced persistent threat** is a set of stealthy and continuous computer hacking processes, often orchestrated by a person or persons targeting a specific entity.

The "**persistent**" process suggests that an external command and control system is continuously monitoring and extracting data from a specific target. The "threat" process indicates human involvement in orchestrating the attack

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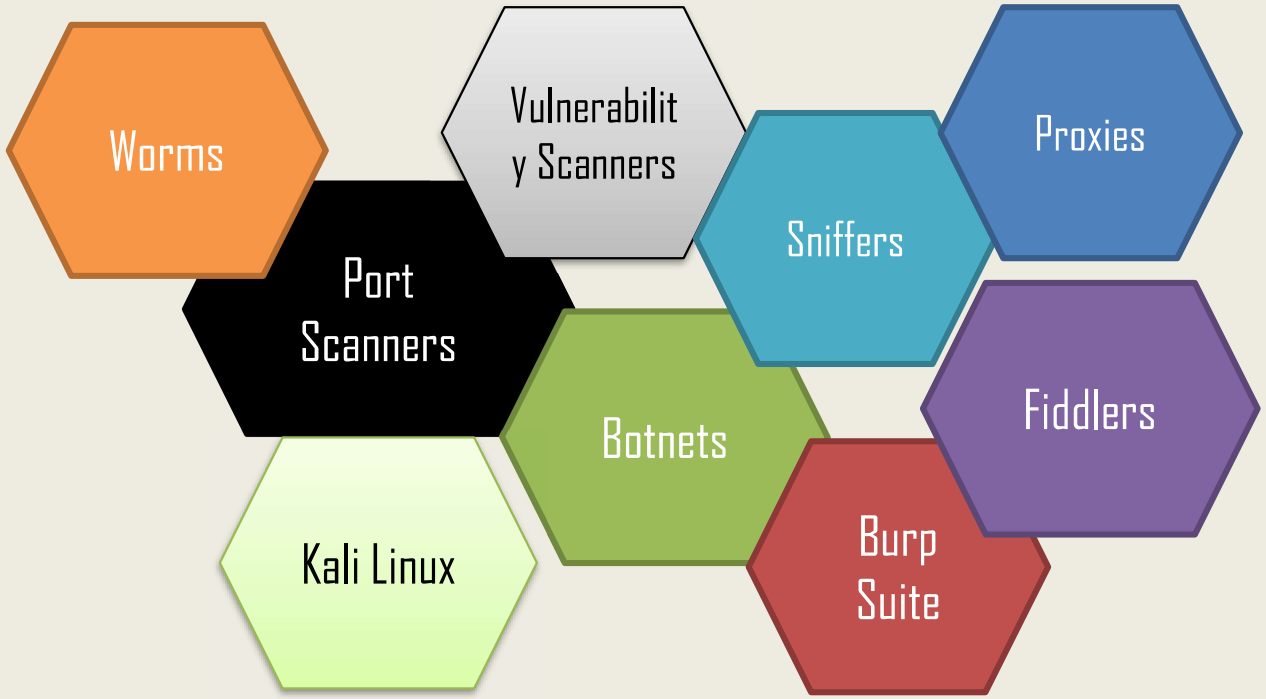
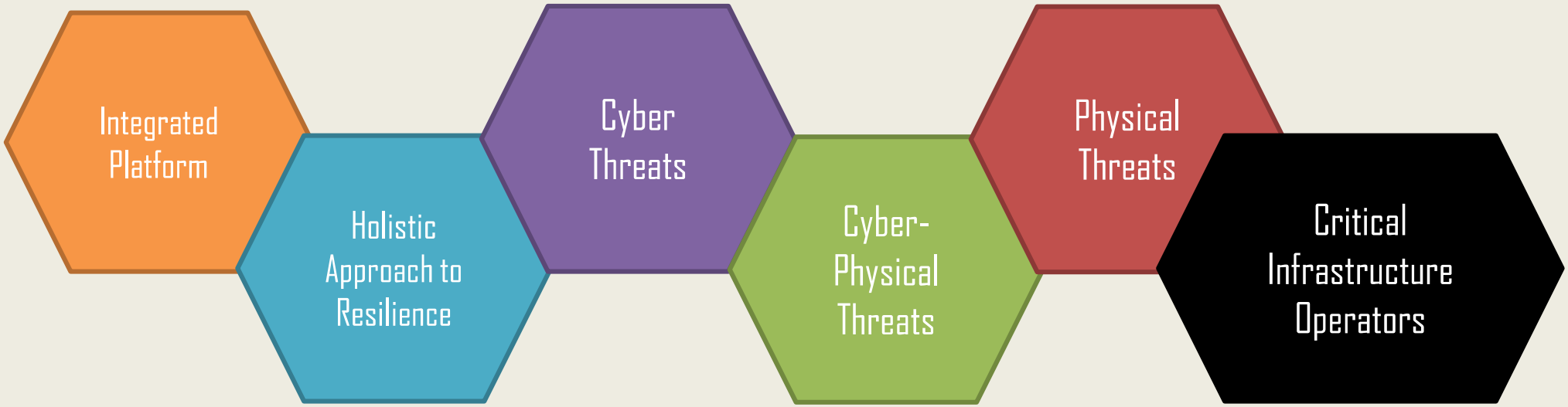


Tools of the trade

Enhancing Resilience

RESIST



Horizon 2020 Project

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Anatomy of a Cyber Attack

- Cyber attacks are growing in number, complexity and impact
- Attackers have various motivations ranging from personal to political
- Attacks are becoming more difficult to mitigate as more advanced forms appears
- State-actors are increasingly using cyber-weapons for their geo-political agendas
- Prevention requires both awareness AND threat Intelligence

Key Take aways

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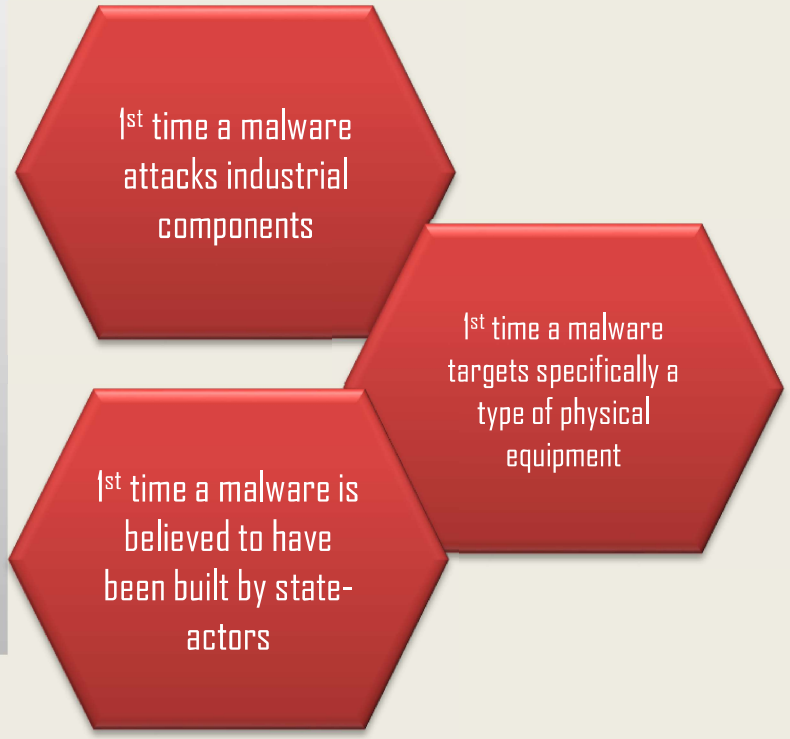
Case studies: STUXNET

Stuxnet is a malicious computer worm, first uncovered in 2010. Thought to have been in development since at least 2005, Stuxnet targets SCADA systems and is believed to be responsible for causing substantial damage to Iran's nuclear program. Although neither country has openly admitted responsibility, the worm is believed to be a jointly built American/Israeli cyberweapon

Timeline

2006 – First piece of code compiled specifically to target industrial PLCs
2007 – Conficker appears and starts spreading
2009 – Attackers begin deploying Stuxnet to Iran using Conficker as a infection vector
2010 – Security firm VirusBlokAda identifies Stuxnet as malware, after reviewing a sample from Iran
2010 – Iranian President Mahmoud Ahmadinejad admits that a cyber weapon had damaged gas centrifuges at a uranium enrichment facility



Case studies: STUXNET

Malware written to target a specific PLC model

Uses zero-day vulnerability to spread into systems

Actually uses 2 PRIVATE certificates from two large OEMs to deploy stealthy in MS Windows Systems

Spreads and mutates to other specific PLCs

Modifies PLC parameters in order to physically destroy centrifuges

Reports false data to monitoring system showing normal activity

Continuously monitors centrifuge data and slightly modifies parameters to make all damage permanent

Becomes inactive after a period of time and deletes most traces in the infected system

Is triggered (becomes active) remotely by pinging hardcoded URLs

Quick Recap

1. What is a cyber attack?
2. What drives the attacker?
3. What are the stages of attack?
4. What are the types of attack?
5. The usual suspects
6. The newcomers
7. When things go wrong (case study)

Thanks ☺

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