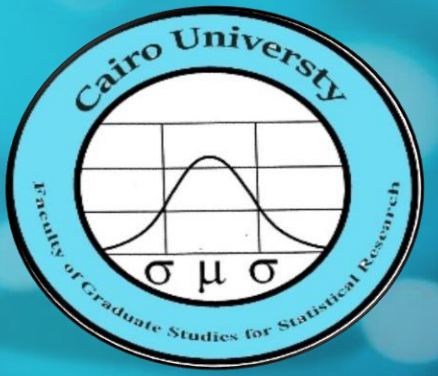
Cairo University



Information Security

(SE205)

Dr. Hany Mohamed

Course Objectives

- Explain the objectives of information security (Servers and Clients).
- Explain the importance of each of confidentiality, integrity, and availability.
- Understand the basic categories of threats to computers and networks.
- Understand various cryptographic algorithms.
- Describe public-key cryptosystem.
- Discuss the fundamental ideas of public-key cryptography.
- Describe the Secure Software design and programming techniques.
- Discuss Web security and Firewalls.
- Understand Intrusions and intrusion detection.
- Design Intrusion Detection System IDS (python).

Course Syllabus

- **Unit 1**: **attacks on computer and computer security**:

- Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.

- **Unit 2**: **Cryptography**: Concepts and Techniques: Introduction, **encryption** and **decryption**, plain text and cipher text, substitution techniques, transposition techniques.

Course Syllabus

Unit 3:

- **Symmetric key Ciphers**: Block Cipher principles & Algorithms(DES, AES, Blowfish), Differential and Linear Cryptanalysis, Block cipher modes of operation, Stream ciphers, RC4,Location and placement of encryption function, Key distribution.

- **Asymmetric key Ciphers**: Principles of public key cryptosystems, Algorithms(RSA, Diffie-Hellman, ECC), Key Distribution.

Course Syllabus

- **Unit 4**:

- Message Authentication Algorithms and Hash Functions: Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, Whirlpool, HMAC, CMAC, Digital signatures, knapsack algorithm

- Authentication Applications: Kerberos, X.509 Authentication Service, Public — Key Infrastructure, Biometric Authentication

Course Syllabus

Unit 5:

- Secure Software design and programming techniques, Web security and Firewalls, Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction.
- Intruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls.
- Case Studies on Cryptography and security: Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual Elections.

Course References and Outcomes

TEXT BOOKS:

1. Cryptography and Network Security: William Stallings, Pearson Education.

2. **Cryptography and Network Security: Atul Kahate, Mc Graw Hill.**

Outcomes:

- **Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues.**
- **Ability to identify information system requirements for both of them such as client and server.**
- **Ability to understand the current legal issues towards information security.**
- **Ability to understand the main principles during designing and development a secure system software.**

Information Security

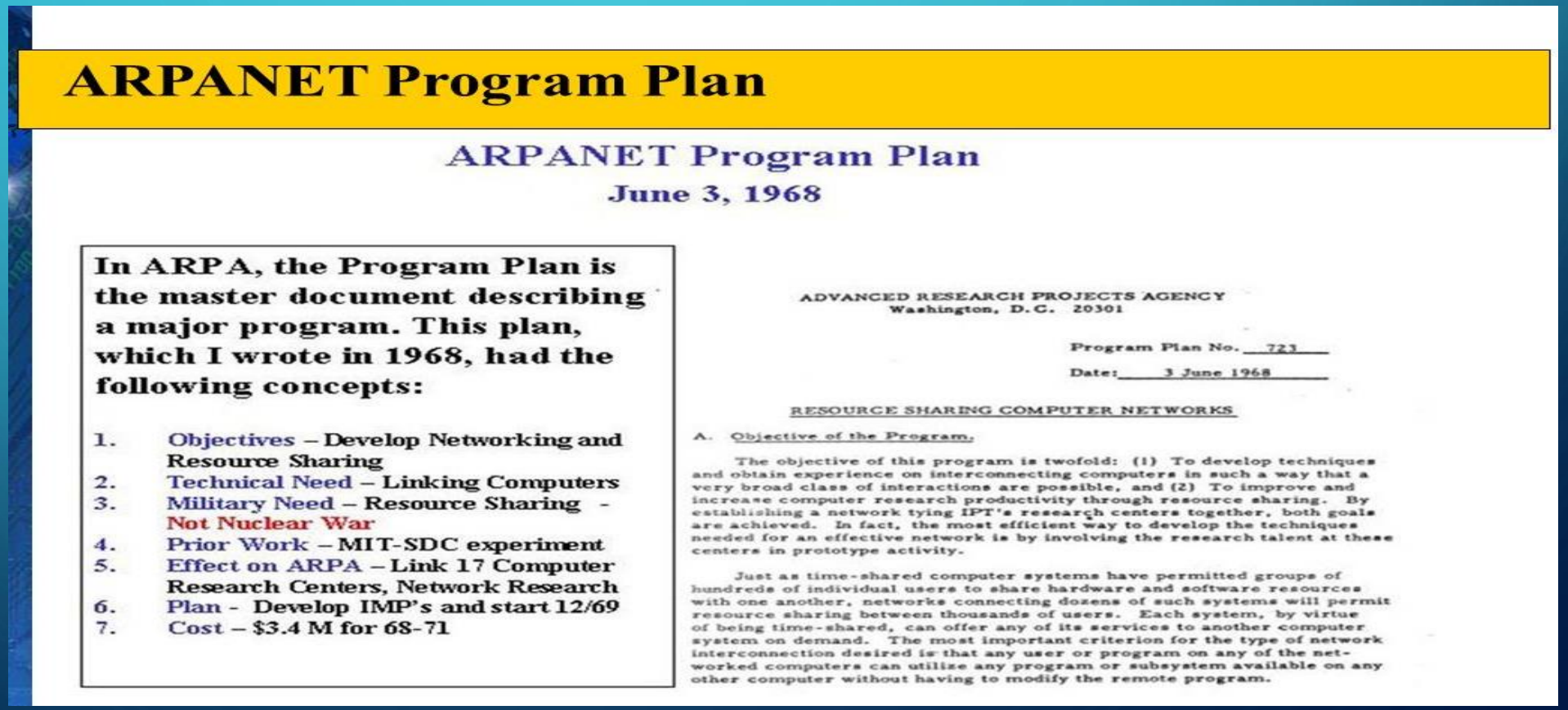
Unit 1: Attacks on Computers and Computer Security

Introduction

- The Internet has become a real-world environment that has criminals and vandals.
- Security became a critical subject for computer systems because of the rapid growth of communications and the presence of Big Data.
- One of the most important fields of security is how to prevent intruders or attacks intending to break down any computer system.

Introduction

- 1969, Advanced Research Projects Agency Network (ARPANET) was the first operational computer network that became the foundation of the modern internet.



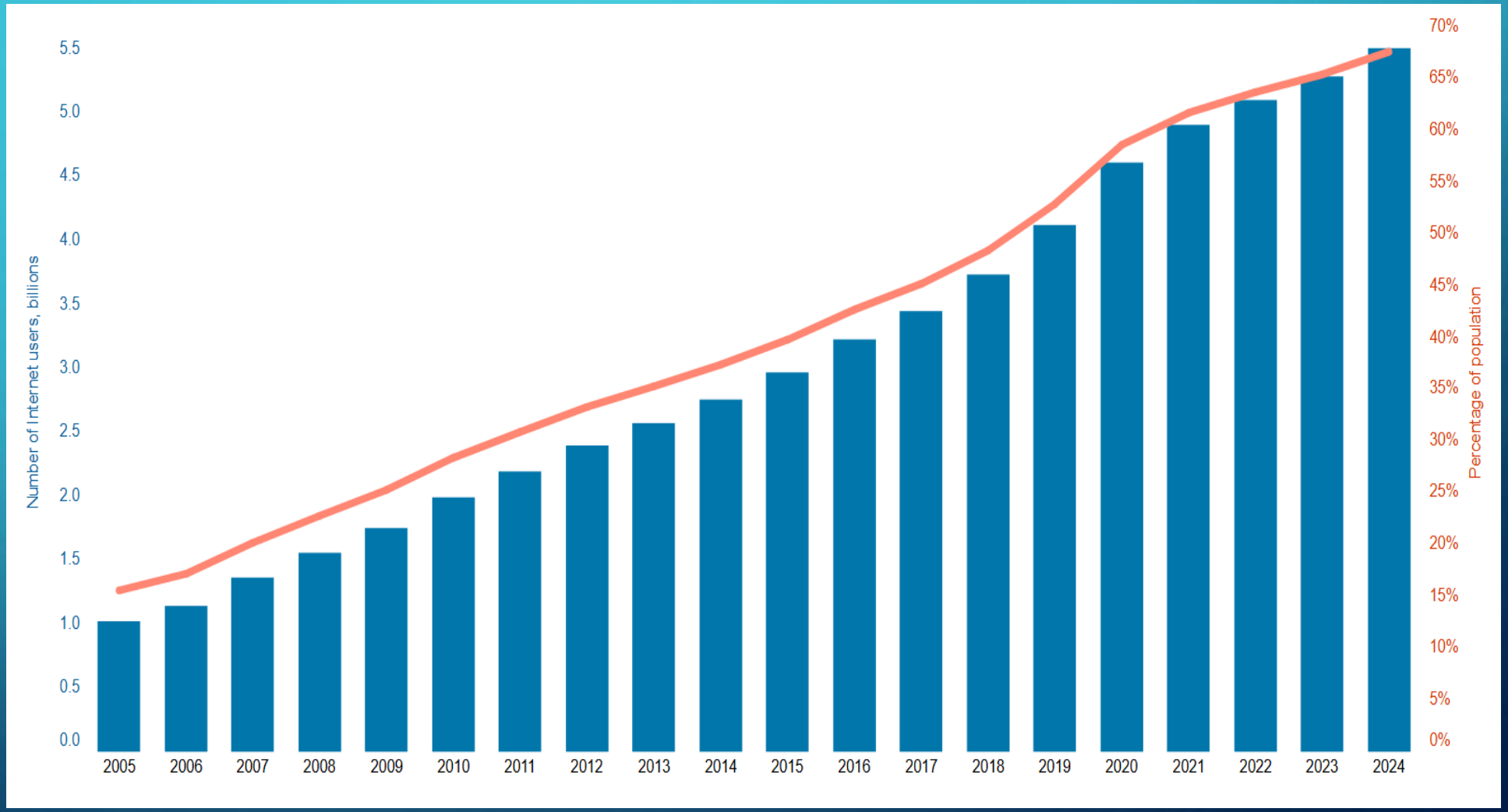
Introduction

- ARPANET grew in popularity as did its potential for misuse.
- Fundamental problems with ARPANET security were identified:
  - No safety procedures for dial-up connections to the ARPANET.
  - User identification and authorization to the system were non-existent.
- In the late 1970s the microprocessor expanded computing capabilities and security threats.

Introduction

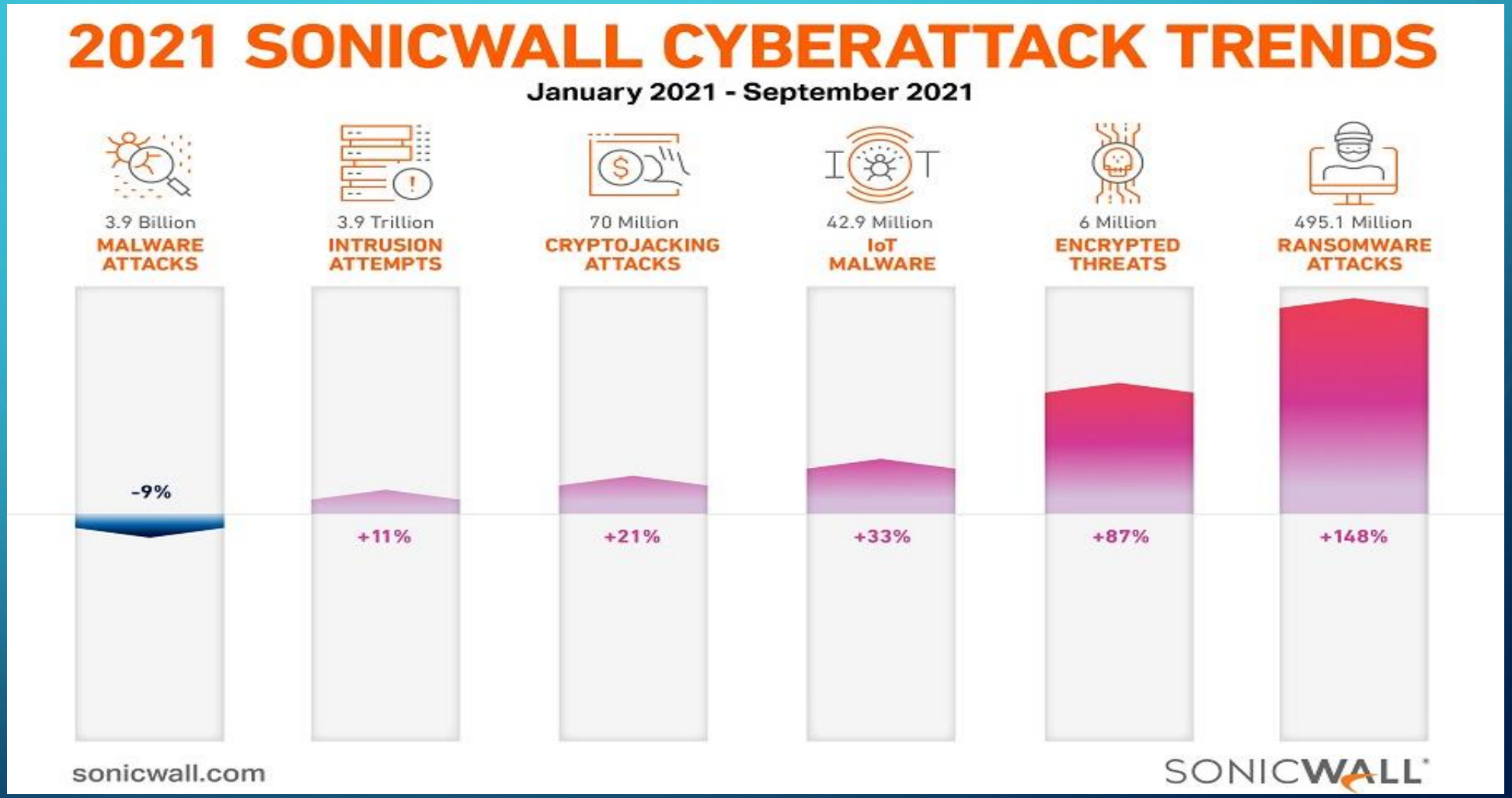
- In 1990s, network of computers became more common, so too did the need to interconnect the network.
- Resulted in the internet, the first manifestation of global network of networks.
- In early internet deployments, security was threated as low priority.
- Today, the internet has brought billion of computers and connected devices into communication with each other, many of them unsecured.
- Ability to secure each now influenced by security on every connected device.

Introduction



ITU estimates that approximately 5.5 billion people are using the Internet in 2024

Introduction

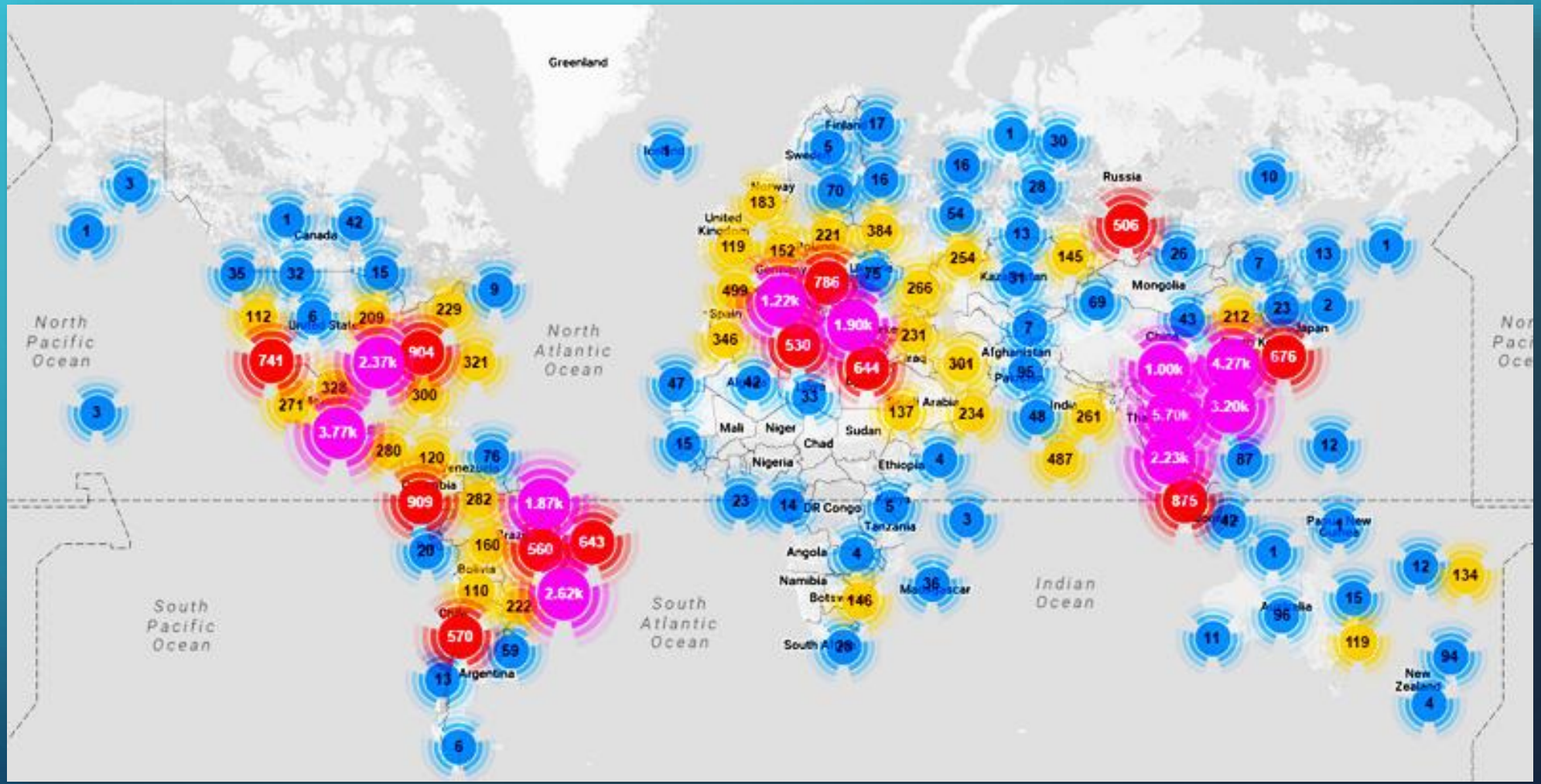


SONICWALL cyberattack trends and types in 2021

Computer security threats

- In 2016, the largest **DDoS attack** ever was launched on service provider **Dyn** using an **IoT botnet** "**Mirai**" led to huge portions of the internet going down, including Twitter, the Guardian, Netflix, Reddit, and CNN.
- Once infected with **Mirai**, computers continually search the internet for vulnerable IoT devices and then use known default **usernames** and **passwords** to log in, **infecting them with malware**.

Computer security threats



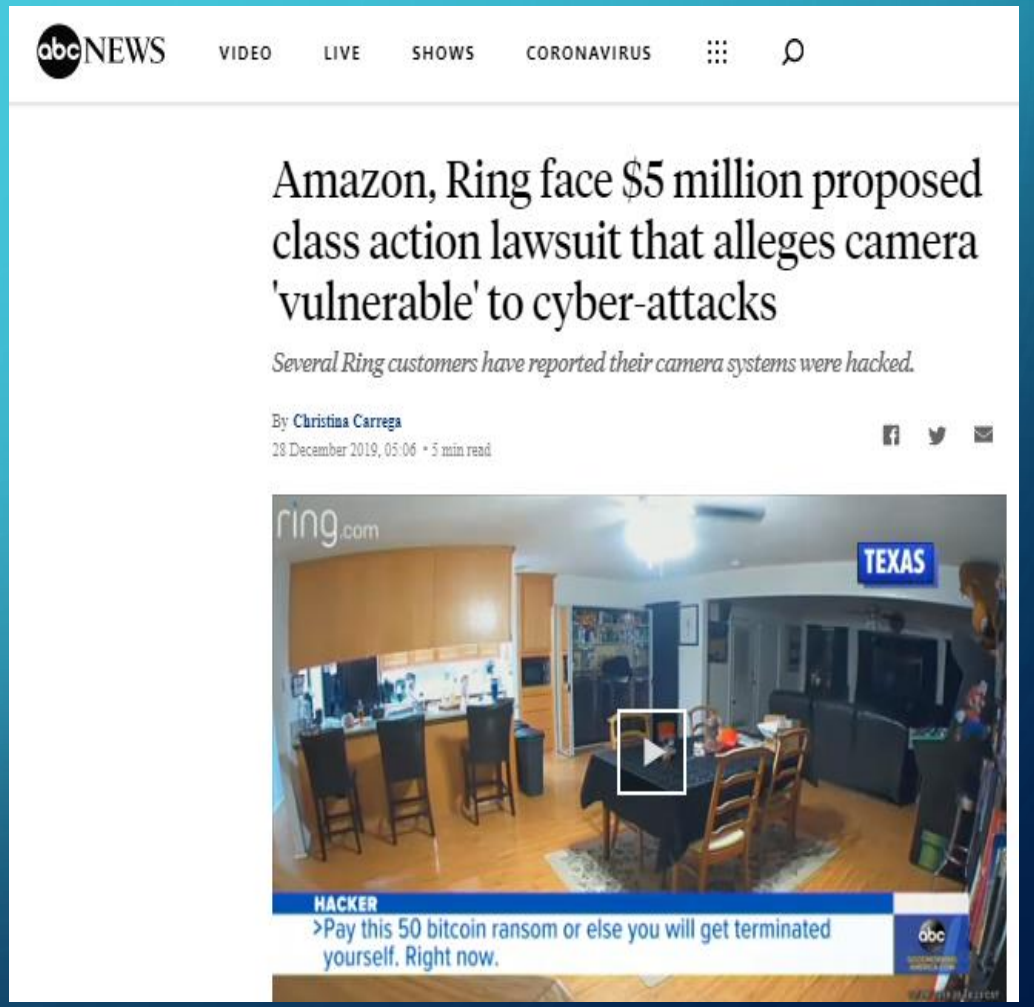
Spread of the "Mirai" Botnet attack around the world

Computer security threats

- In 2017, An **electrical power station** in **Ukraine's** Ivano-Frankivsk city was targeted for a cyberattack which affected a colossal impact on **1.4 million people** putting them in the **dark**.
- The attack was done using the **spear-phishing email** and **"Black Energy"** malware based on **"Mirai"** causing **deleting** the **data**, **destroying hard drives**, and taking **control** of **infected computers**.

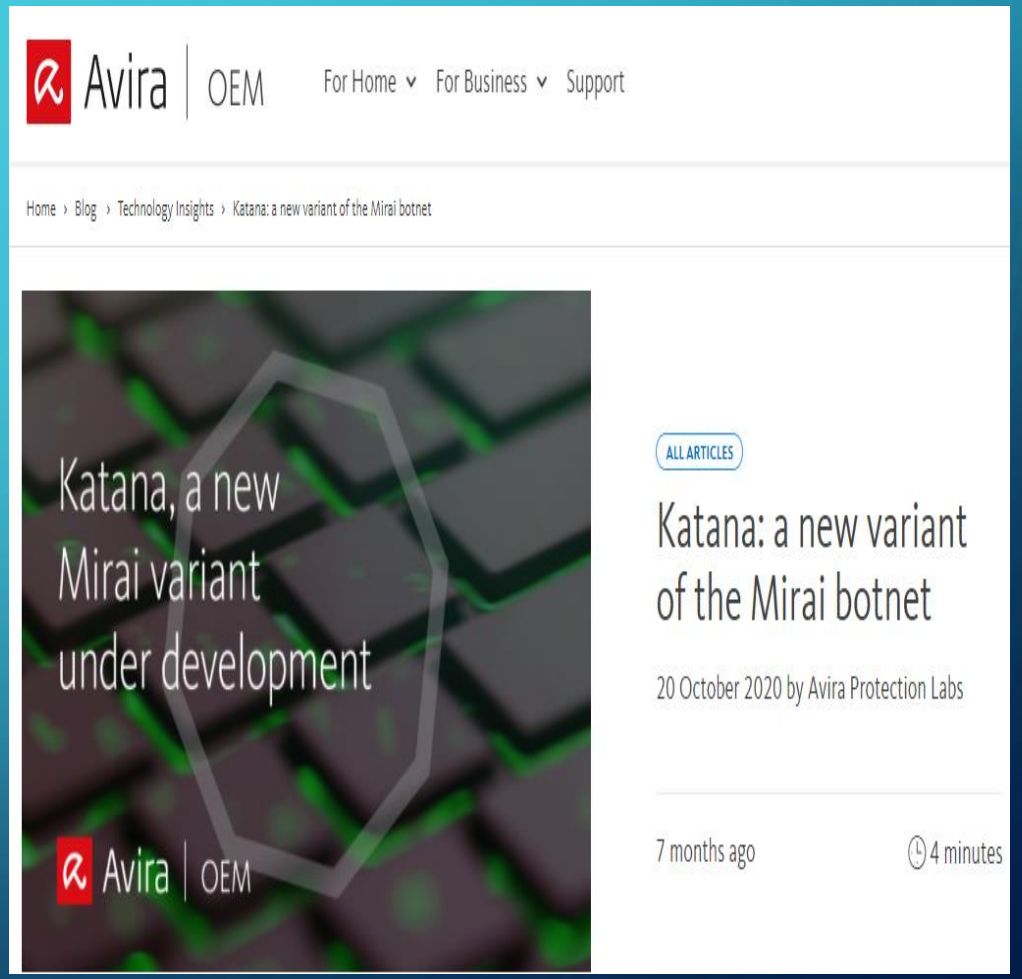
Computer security threats

- Another incident was the **Amazon Ring camera breach** In 2019, multiple families' security systems were compromised.
- Hackers used the hacked **cameras** to **invade** people's **privacy** and even **demand ransoms.**



Computer security threats

- In **2020**, researchers **discovered** a new **IoT virus**, named "**Katana**," that has been infecting **thousands** of **IoT devices daily**.
- According to **Avira Protection Lab**, this advanced virus, containing still **unknown** "**malware binaries**" has the **ability** to make your **device** inoperable or **deny** you **access** to your **own data** by **encrypting it**.



Computer security threats

- In **2021**, A **cyberattack** attempted to **poison** the **water supply** in Florida and managed by increasing the amount of **sodium hydroxide** to a potentially dangerous level.
- The cyber criminal was able to **breach Oldsmar's computer system** and briefly **increased** the amount of sodium hydroxide from 100 parts per million to 11,100 parts per million.

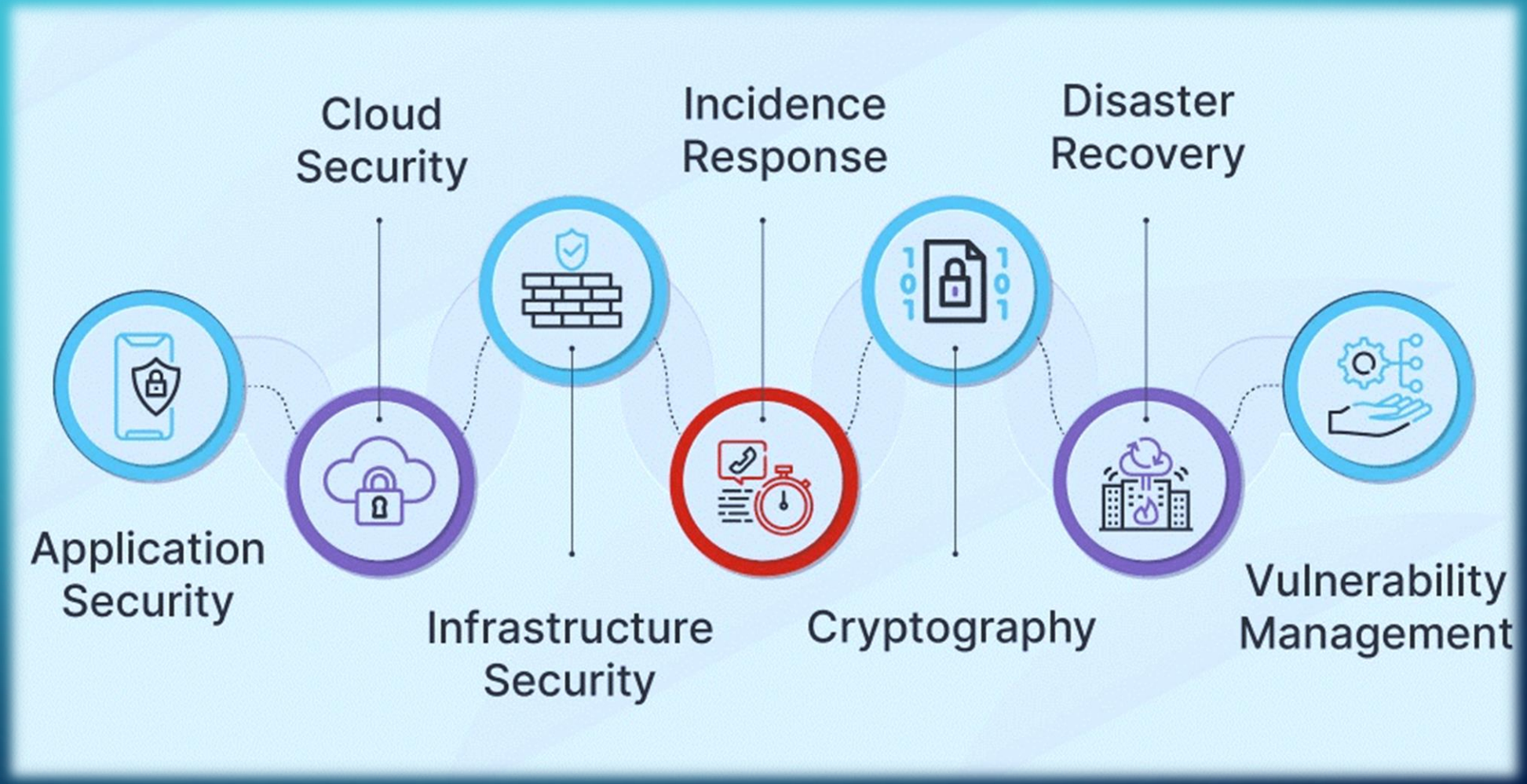
Computer security threats

- In 2023, The U.S. Cybersecurity and Infrastructure Security Agency (**CISA**) added a recently patched critical security flaw in **Zyxel gear** to its Known Exploited Vulnerabilities (KEV) catalog, citing evidence of active exploitation.
- The Shadow Server Foundation said the flaw is "being actively exploited to build a **Mirai-like botnet**" since May 26, 2023.
- Cybersecurity firm Rapid7 has also warned of "**widespread**" in-the-wild abuse of CVE-2023-28771.

Information Security

- The protection afforded to an automated information system in order to attain the applicable objectives of preserving the Integrity, Availability and Confidentiality of information system resources (includes hardware, software, firmware, information/data, and telecommunications).

Types of Information Security



Security Threats

- Security Threats, are any type of malicious activity or attack that could potentially cause harm or damage to an organization, its data or its personnel.
- Security threats may refer to physical threats, such as theft or vandalism, as well as digital threats, such as malware or ransomware.

Security Services

- The fundamental principles (services) of information security are Confidentiality, Integrity, and Availability.
- Every element of an information security program (and all three types of security controls put in place by an entity) should be designed to achieve one or more of these principles. Together, they are called the CIA Triad.

CIA Triad

Security Services

- Confidentiality measures are an essential component of data security, as they aim to safeguard sensitive information against any unauthorized access or disclosure.
- The primary goal of implementing confidentiality principles is to maintain the privacy and confidentiality of confidential information, ensuring that it remains accessible only to authorized individuals who require such information to carry out their job responsibilities.

CIA Triad

Security Services

- **Integrity** focuses on preventing any unauthorized modifications, deletions, or additions to the data.
- It is designed to ensure that data is accurate and trustworthy, and that it has not been tampered with or altered in any way without proper authorization.
- By upholding integrity principles, organizations can maintain the quality and reliability of their data, thereby enhancing their decision-making capabilities.

CIA Triad

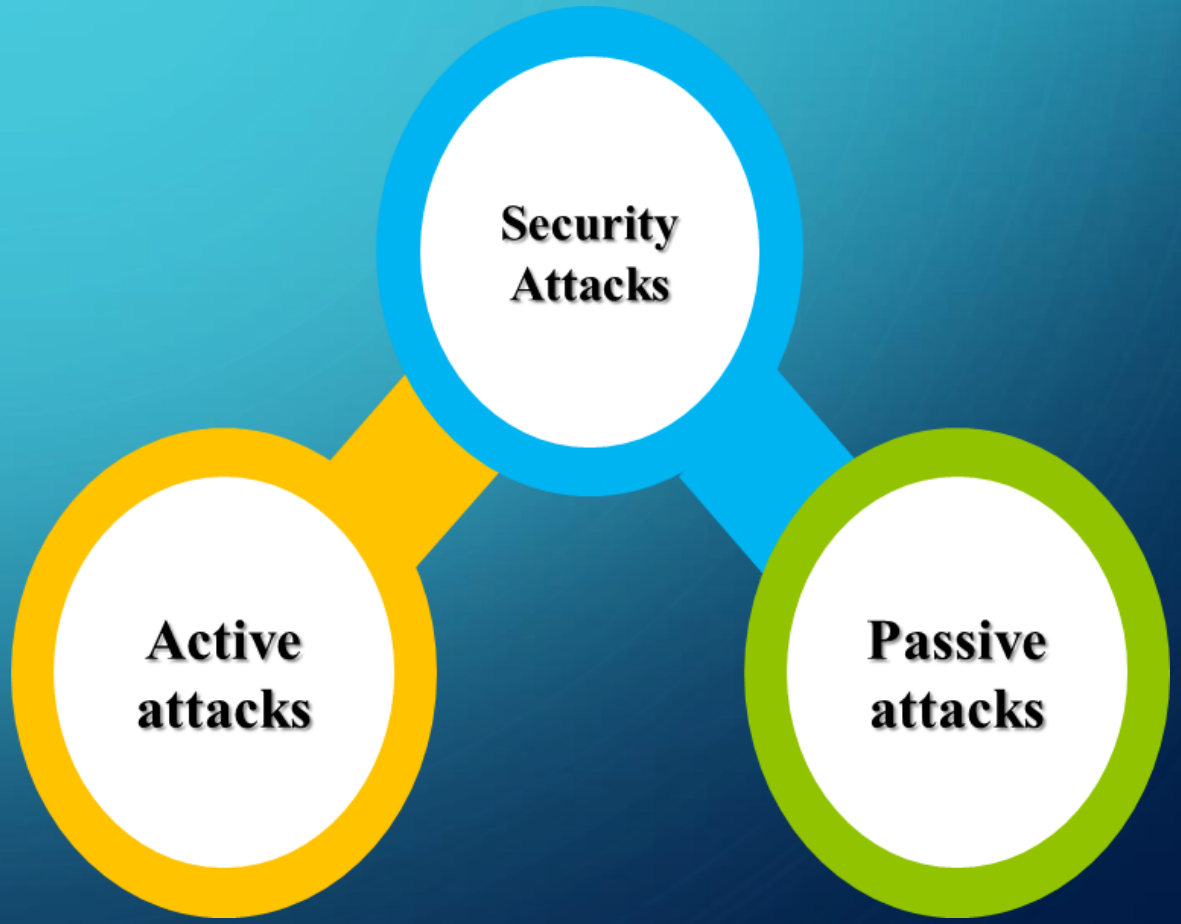
Security Services

- **Availability** involves ensuring that data is accessible to its users at all times, whenever they require it.
- This principle is concerned with the functionality of support systems, including hardware, software, and network infrastructure, and ensuring that they remain operational and responsive to user needs.
- By maintaining availability principles, organizations can ensure that their users can access the data they need to make informed decisions, thereby enhancing their productivity and efficiency.

CIA Triad

Security Attacks

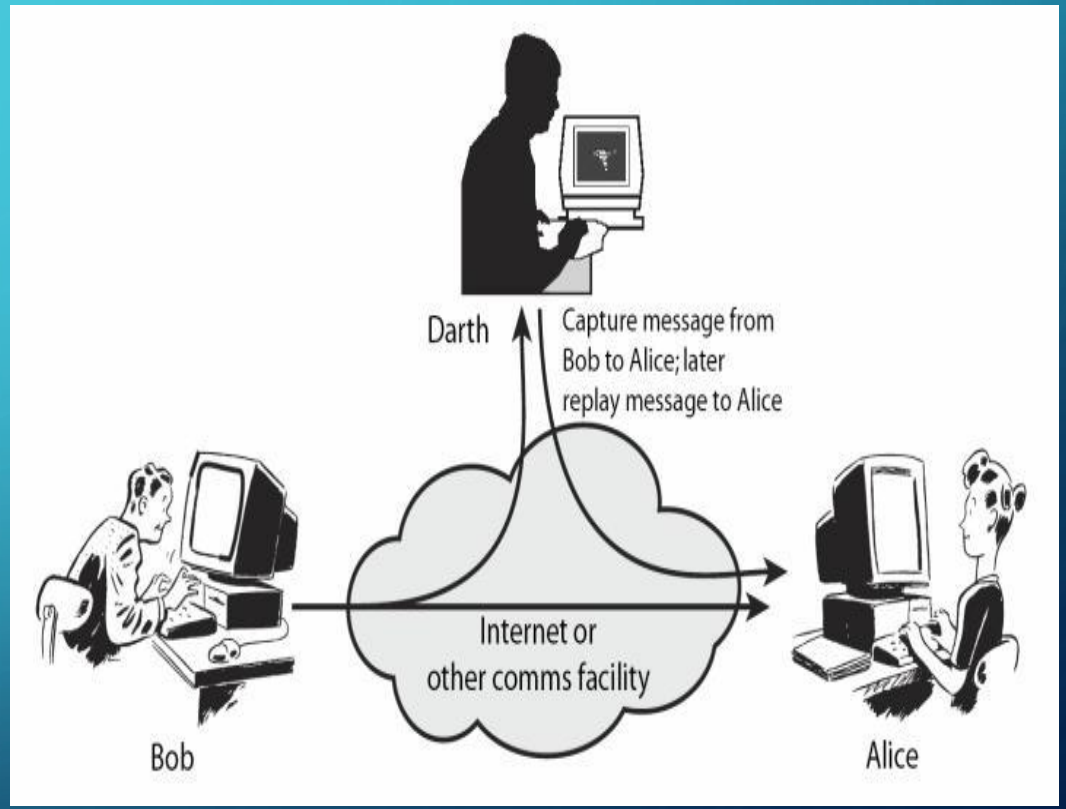
- here are basically two forms of threats:
- active attacks.
- passive attacks.



Security Attacks

- **An active attack** is an attack in which attackers directly harm your computer systems.

- They can create several problems, such as:
  - Crashing files.
  - Encrypting data for ransom.
  - Stealing data, etc.



Security Attacks

- **A passive attack** refers to an attack in which the attackers quietly watch and collect the information without your knowledge.
- Passive Attacks are in the nature of eavesdropping on or monitoring transmission. The goal of the opponent is to obtain information that is being transmitted.