Information Security

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Course Content

- **UNIT I**
- Introduction to Security, Security Basics – Confidentiality, Integrity, Availability; Introduction to types of attacks, Introduction to Security Threats: Viruses and Worms, Intruders, Insiders, Terrorists, Information warfare, Types of attack: Denial of service (DOS), backdoors and trapdoors, sniffing, spoofing, man in the middle, replay, TCP/IP Hacking, Phishing attacks, Distributed DOS, SQL Injection, Buffer Overflow, Brute Force.

Course Content

- **UNIT II:**
- Review of Number Theoretic Algorithms, Symmetric Encryption and Hash Function: Introduction to Symmetric encryption; Asymmetric encryption, Encryption algorithm / Cipher, Encryption and Decryption using: Caesar's cipher, play fair cipher, shift cipher, shift cipher, Vigenere cipher, one time pad (vermin cipher), hill cipher, Transposition techniques, Modern Block Ciphers, Symmetric Cryptographic Algorithms, Hashing function:SHA1

Course Content

- **UNIT III**
- Asymmetric encryption & Public Key Infrastructure: Diffie-Hellman, RSA, Digital Signatures, Public key infrastructures: basics, digital signatures, digital certificates, certificate authorities, registration authorities, Trust Models: Hierarchical, peer to peer.
- **Organizational Security:** Password selection, Piggybacking, Shoulder surfing, Dumpster diving, installing unauthorized software /hardware, Access by non-employees, Physical security: Access controls Biometrics: finger prints, hand prints, Retina, Patterns, voice patterns, signature and writing patterns, keystrokes, Physical barriers, Password Management, vulnerability of password, password protection, password selection strategies, components of a good password.

Course Content

- **UNIT IV**
- Network Security: Firewalls: working, design principles, trusted systems, Kerberos, IP security: overview, architecture, IPSec configurations, IPSec security, Security topologies, Email security.
- Web Security: Intruders: Intrusion detection systems (IDS): host based IDS, network based IDS, logical components of IDS, signature based IDS, anomaly based IDS, Intrusion detection systems, Web security threats, web traffic security approaches, Introduction to Secure Socket Layer (SSL); Transport Layer Security(TLS)

Reference Books

1. Principles Of Computer Security CompTIA Security And Beyond (Exam SY0-301), 3rd Edition, Conklin, Wm. Arthur Gregory White, Dwayne Williams, Mc Graw Hill
2. **Cryptography and Network Security Principles and Practices, Williams Stallings, Pearson Education, Third Edition**
3. **Cryptography and Network Security , B A Forouzen , TMH**
4. **Cryptography and Network Security Principal and Practices , Atul Kahathe, TMH**
5. Computer Security , Dieter Gollman , Wiley India Education, Second Edition

Introduction

- The art of war teaches us to rely not on the likelihood of the enemy's not coming, but on our own readiness to receive him/her; not on the chance of his/her not attacking, but rather on the fact that we have made our position unassailable.

  —The Art of War, Sun Tzu

Introduction

- We are living in the information age
- **Information: a meaningful data**

- We need to keep information about every aspect of our lives
  - Information is an asset that has a value like any other asset

- As an asset, information needs to be secured from attacks

Introduction

- To be secured,
  - Information needs to be hidden from unauthorized access
  - Protected from unauthorized change
  - And available to an authorized entity when it is needed

Introduction

- **Until a few decades ago,**
  - The information collected by an organization was stored on physical files
  - Confidentiality of files: achieved by restricting the access to a few authorized and trusted people in the organization
  - Integrity: Only a few authorized people were allowed to change the contents of the files
  - Availability: achieved by designating at least one person who would have access to the files at all times

Introduction

- With the advent of computers,
  - Information storage became electronic
    - Instead of being stored on physical media, it was stored in computers

- The files stored in computers require confidentiality, integrity, and availability.

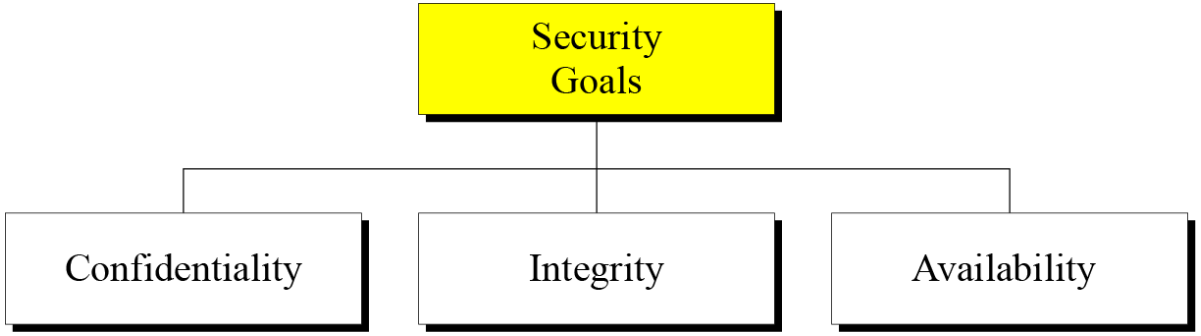
- The implementation of these requirements, however is different and more challenging

Introduction

- During the last few decades, computer networks created a revolution in the use of information
  - Information is now distributed
- Authorize people can send and retrieve information from a distance using computer networks
- Three security requirements – confidentiality, integrity, and availability have not changed, they have new dimensions

- Not only should information be confidential when it is stored in a computer,
  - There should also be a way to maintain its confidentiality when it is transmitted from one computer to another

Introduction



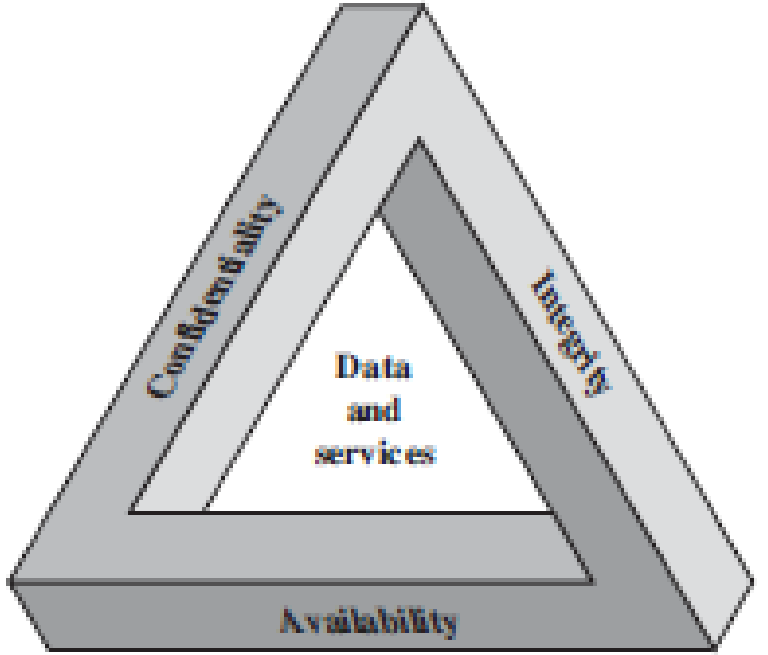


Figure 1.1 The Security Requirements Triad

Confidentiality

- Confidentiality is probably the most common aspect of information security.

- We need to protect our confidential information. An organization needs to guard against those malicious actions that endanger the confidentiality of its information.

- Example:
  - In military, concealment of sensitive information is the major concern,
  - In industry, hiding some information from competitors is crucial to the operation of the organization
  - In banking, customers' accounts need to be kept secret

Confidentiality

- **Example:** Confidentiality is the most important when the information is a record of people's personal activities, such as in cases involving personal and financial information of the customers of companies like Google, Amazon, Apple, and Walmart, etc.
- To guarantee confidentiality under the CIA triad, communication channels must be properly monitored and controlled to prevent unauthorized access.

Confidentiality

- **Data confidentiality:** Assures that private or confidential information is not made available or disclosed to unauthorized individuals.

- Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information.

- A loss of confidentiality is the unauthorized disclosure of information.

Integrity

- Information needs to be changed constantly.
  - In a bank, when a customer deposits or withdraws money, the balance of her account needs to be changed

- Integrity means that changes need to be done only by authorized entities and through authorized mechanisms.

Integrity

- **Data integrity:** Assures that information and programs are changed only in a specified and authorized manner.
- **System integrity:** Assures that a system performs its intended function in an unimpaired manner, free from deliberate or inadvertent unauthorized manipulation of the system.
- Integrity: Guarding against improper information modification or destruction, including ensuring information nonrepudiation and authenticity.
- A loss of integrity is the unauthorized modification or destruction of information.

Integrity

- **Example:** Any change in financial records leads to issues in the accuracy, consistency, and value of the information.
- For example, banks are more concerned about the integrity of financial records, with confidentiality having only second priority.
- Some bank account holders or depositors leave ATM receipts unchecked and hanging around after withdrawing cash.
- This shows that confidentiality does not have the highest priority. Instead, the goal of integrity is the most important in information security in the banking system.
- To guarantee integrity under the CIA triad, information must be protected from unauthorized modification.

Availability

- The information created and stored by an organization needs to be available to authorized entities.

- Information is useless if it is not available
- Information constantly changed, means it must be accessible to authorized entities
  - Imagine, what would happen to a bank, if customers could not access their accounts for transactions

Availability

- **Availability:** Assures that systems work promptly and service is not denied to authorized users.

- Ensuring timely and reliable access to and use of information.
- A loss of availability is the disruption of access to or use of information or an information system.

Availability

- **Example:** Press releases are generally for public consumption.
- For them to be effective, the information they contain should be available to the public.
- Thus, confidentiality is not of concern. Integrity has only second priority.
- In the CIA triad, to guarantee availability of information in press releases, governments ensure that their websites and systems have minimal or insignificant downtime.

Security Attacks

Security Attacks

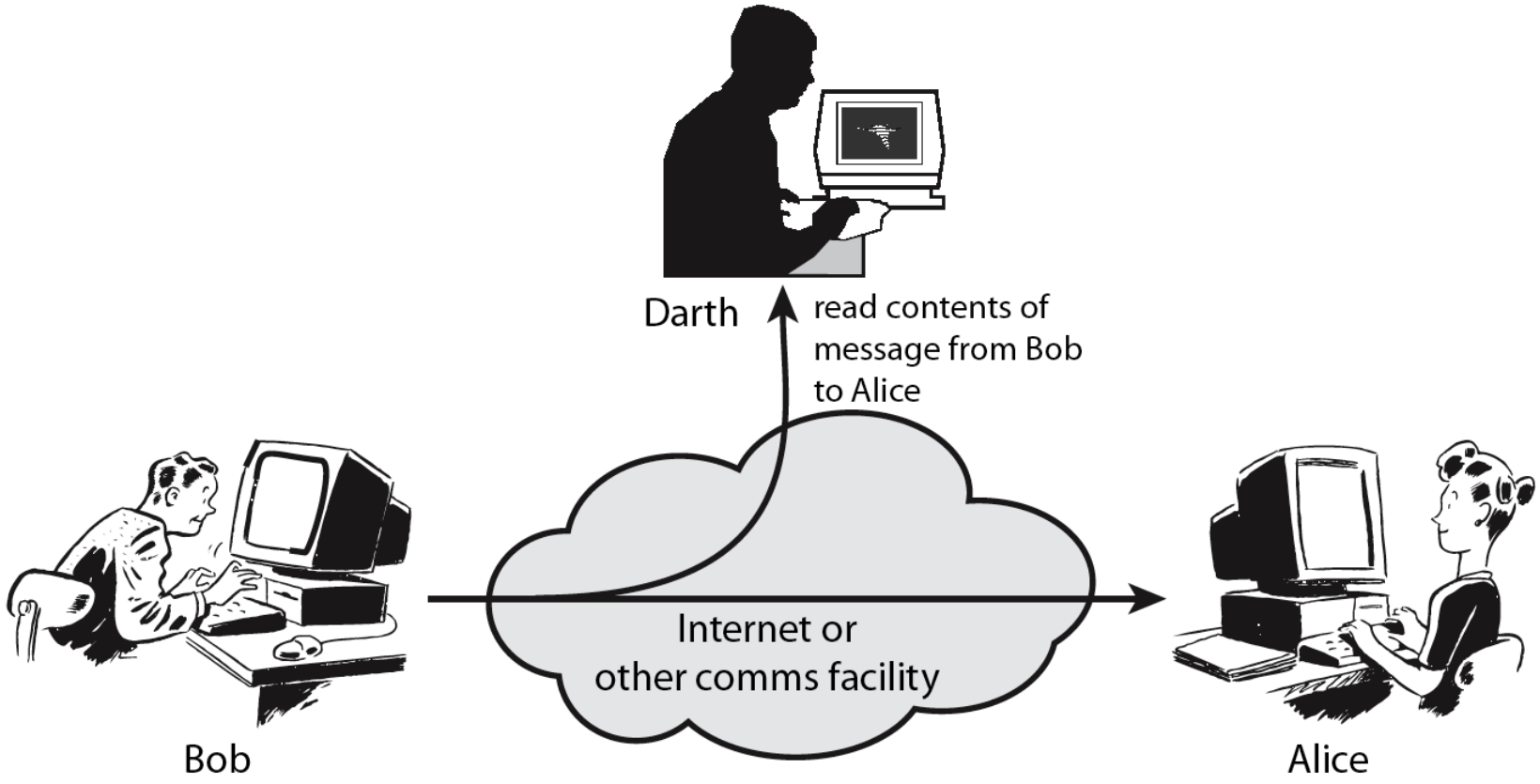
- The three goals of security : confidentiality, integrity, and availability can be threatened by security attacks.

- Attacks Threatening Confidentiality
- Attacks Threatening Integrity
- Attacks Threatening Availability
- Passive versus Active Attacks

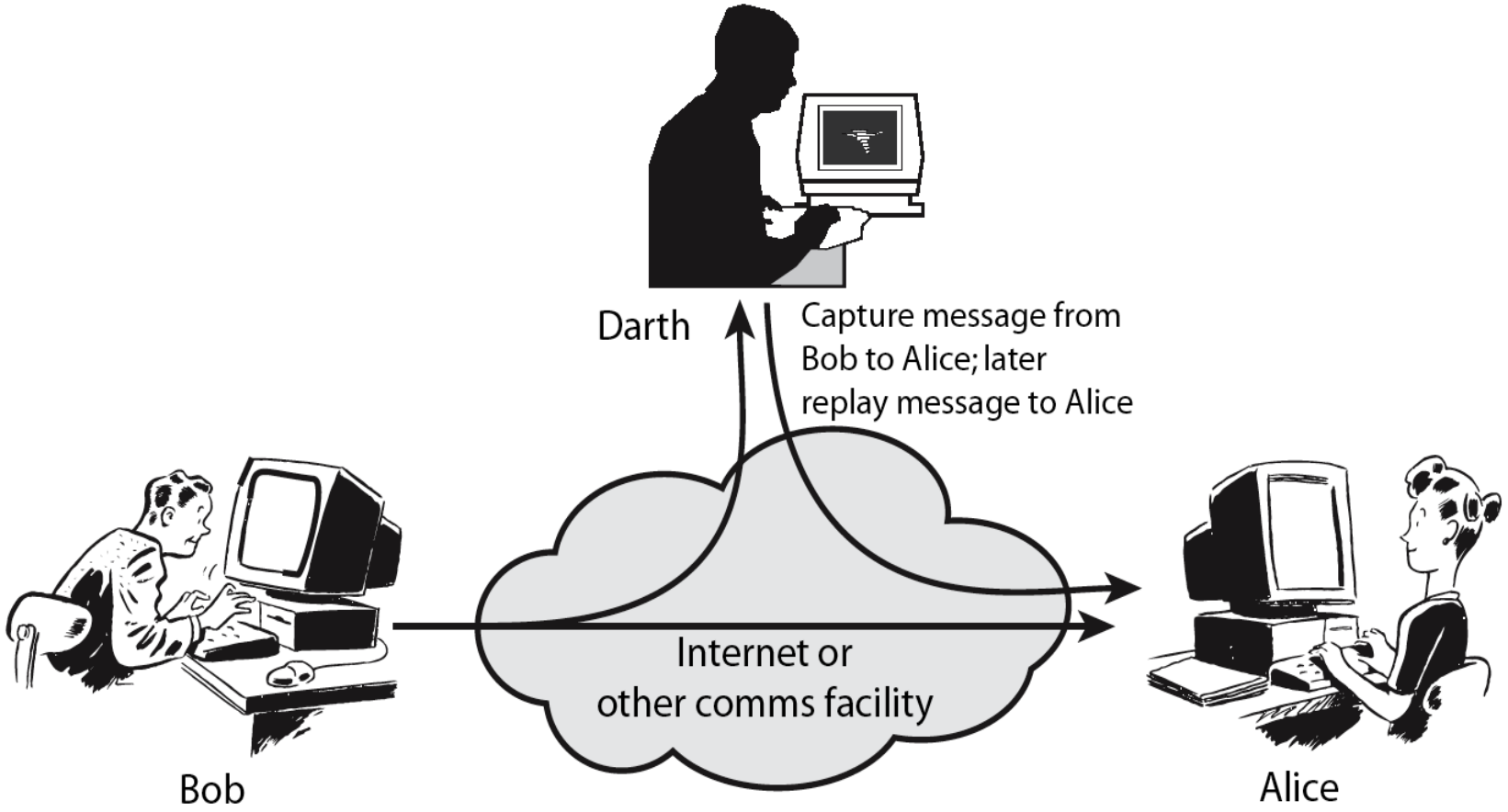
Security Attacks

- any action that compromises the security of information owned by an organization
- information security is about how to prevent attacks, or failing that, to detect attacks on information-based systems
- have a wide range of attacks
- can focus of generic types of attack
  - Passive
  - Active

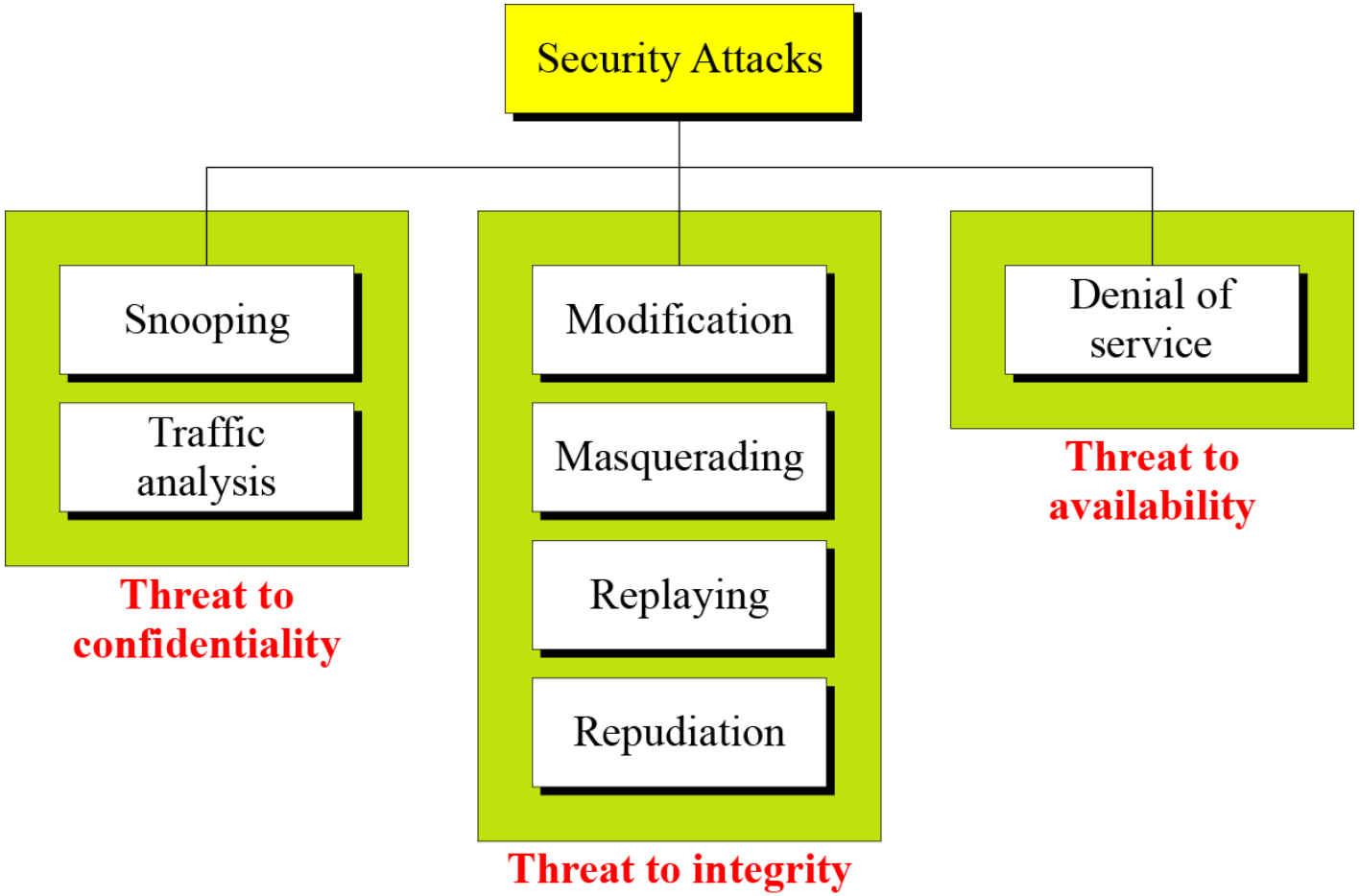
Passive Attack



Active Attack



Taxonomy of attacks with relation to security goals



Attacks Threatening Confidentiality

- **Snooping** refers to unauthorized access to or interception of data.

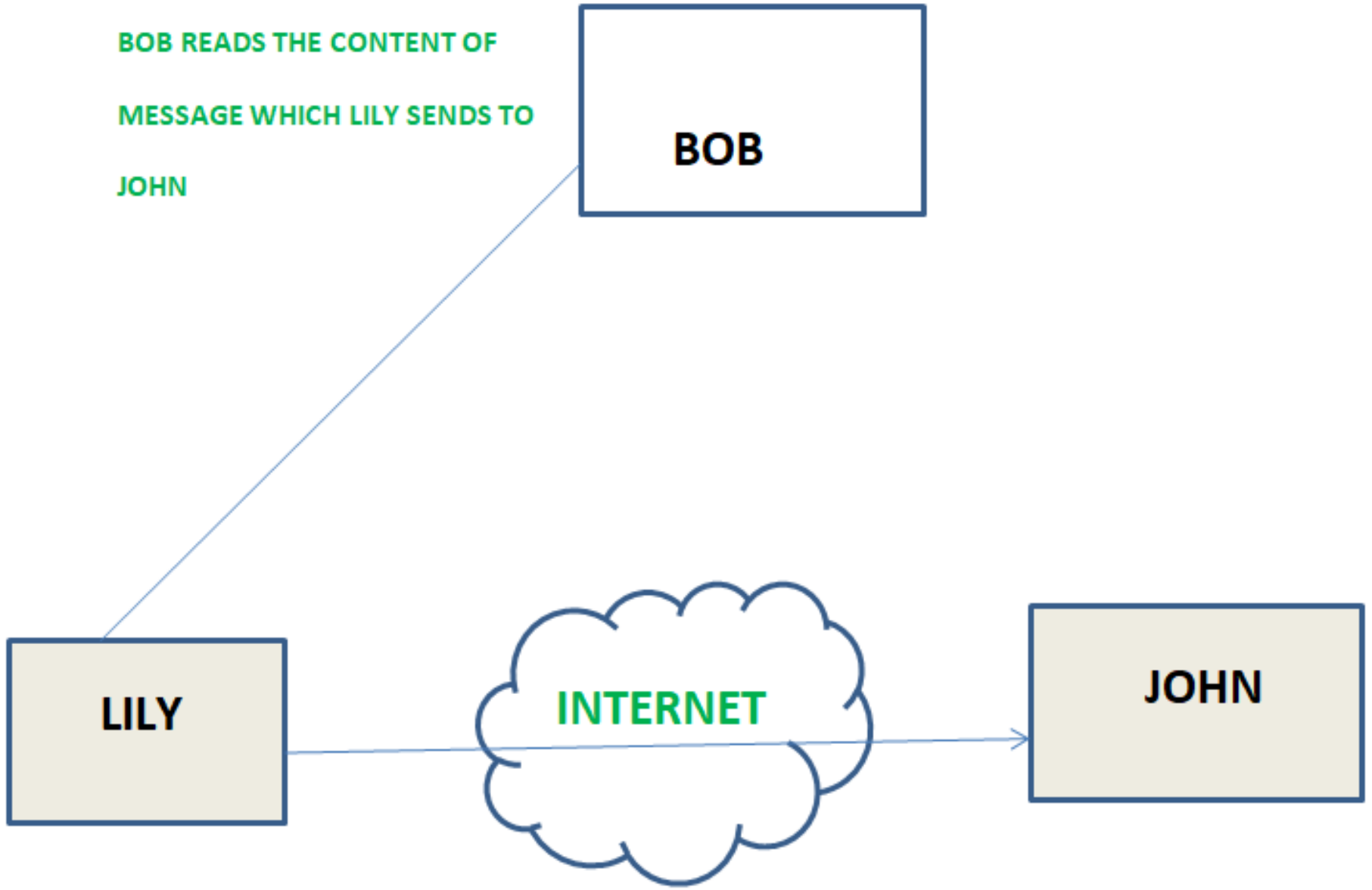
- **Traffic analysis** refers to obtaining some other type of information by monitoring online traffic.

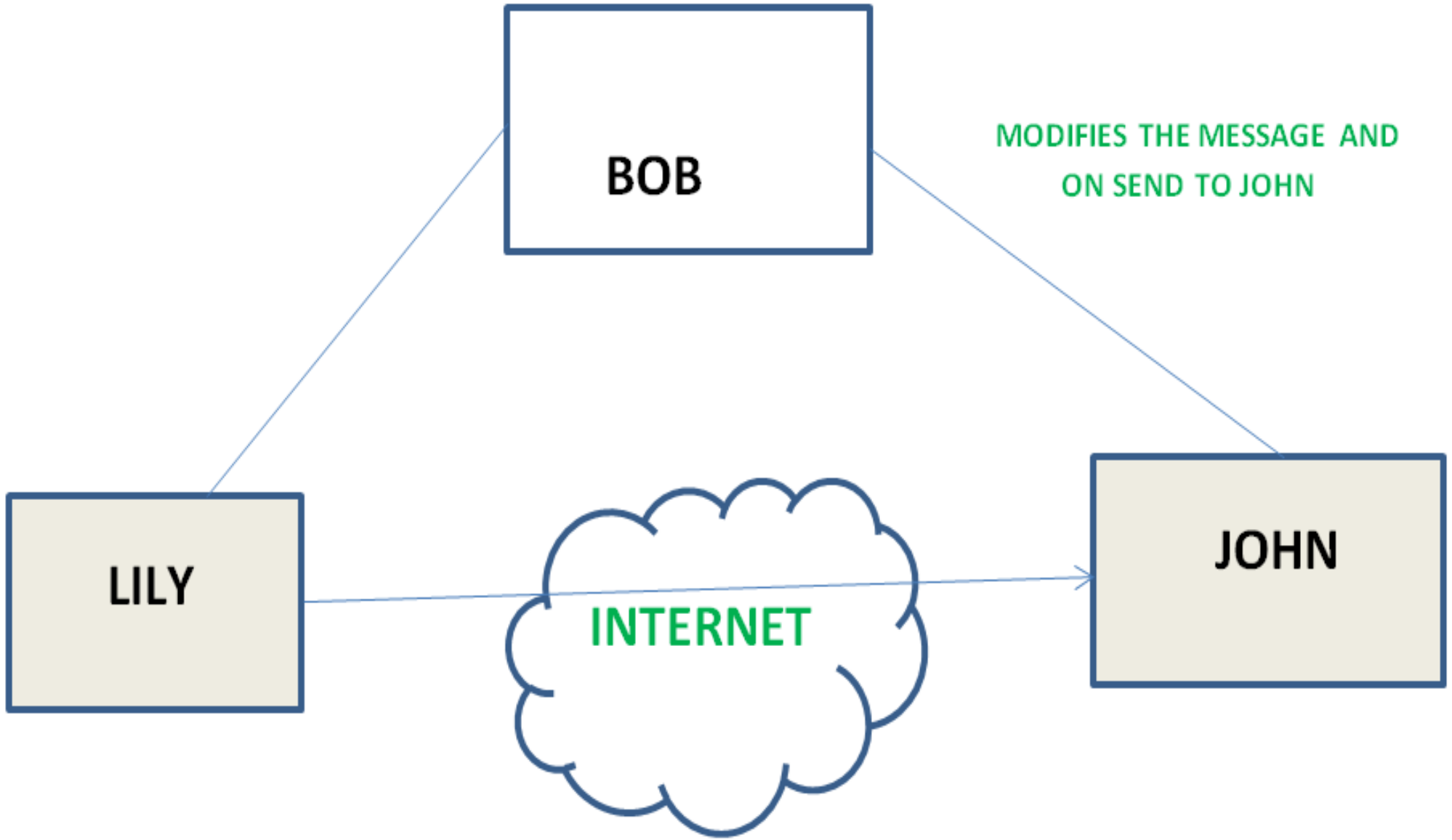
Attacks Threatening Integrity

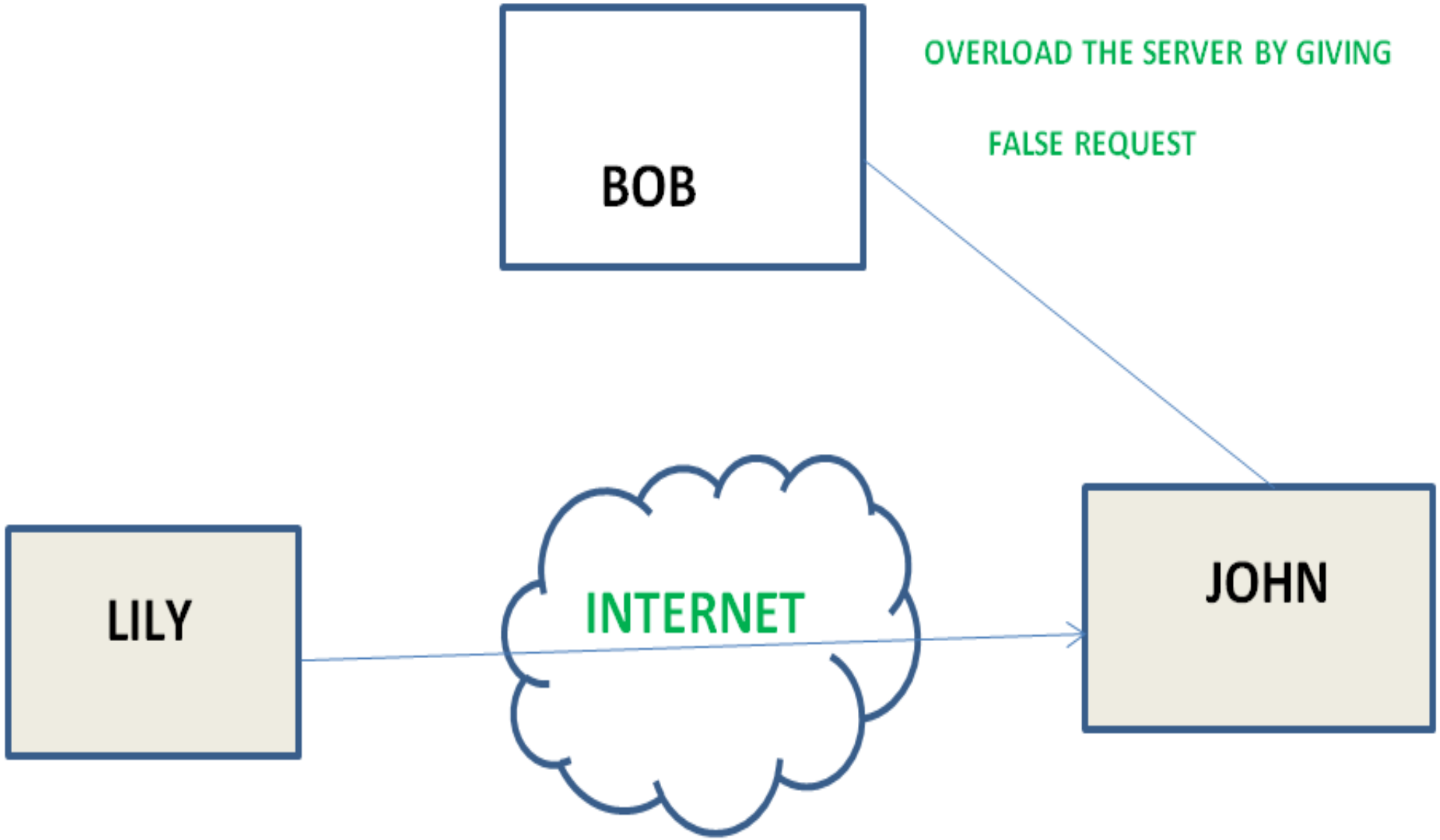
- **Modification** means that the attacker intercepts the message and changes it.
- **Masquerading** happens when the attacker impersonates somebody else.
- **Replaying** means the attacker obtains a copy of a message sent by a user and later tries to replay it.
- **Repudiation** means that sender of the message might later deny that she has sent the message; the receiver of the message might later deny that he has received the message.

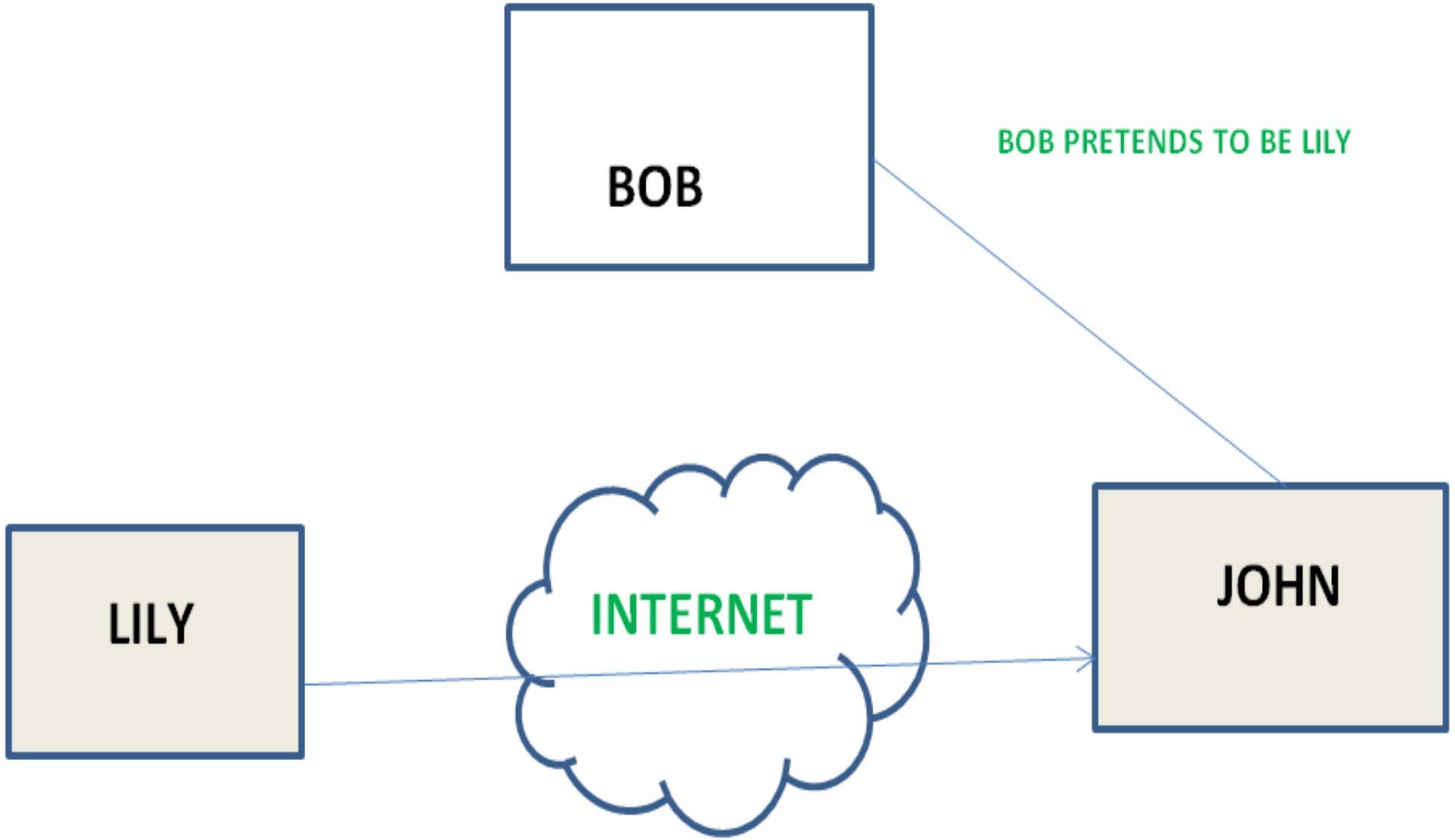
Attacks Threatening Availability

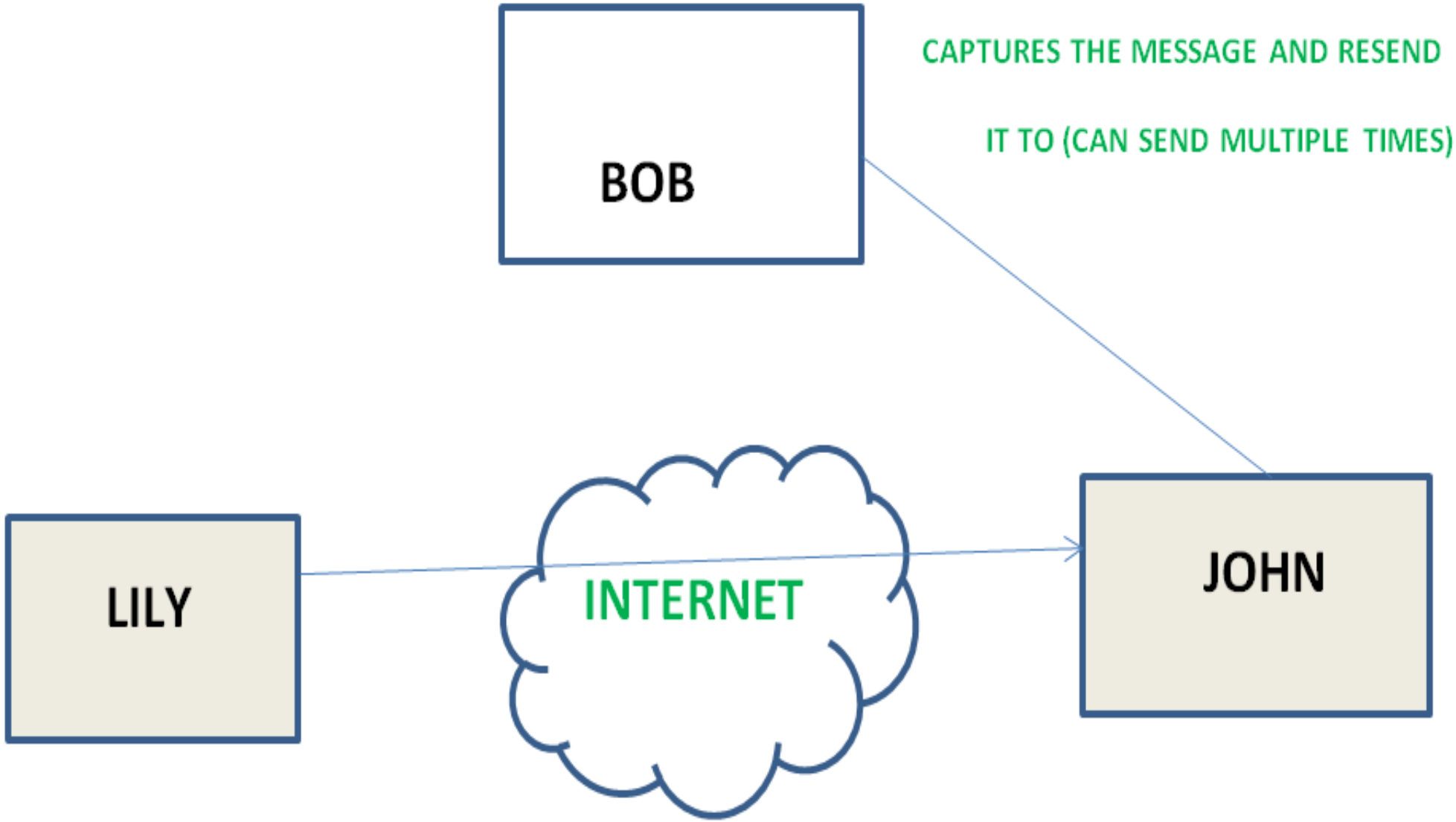
- **Denial of service (DoS)** is a very common attack. It may slow down or totally interrupt the service of a system.

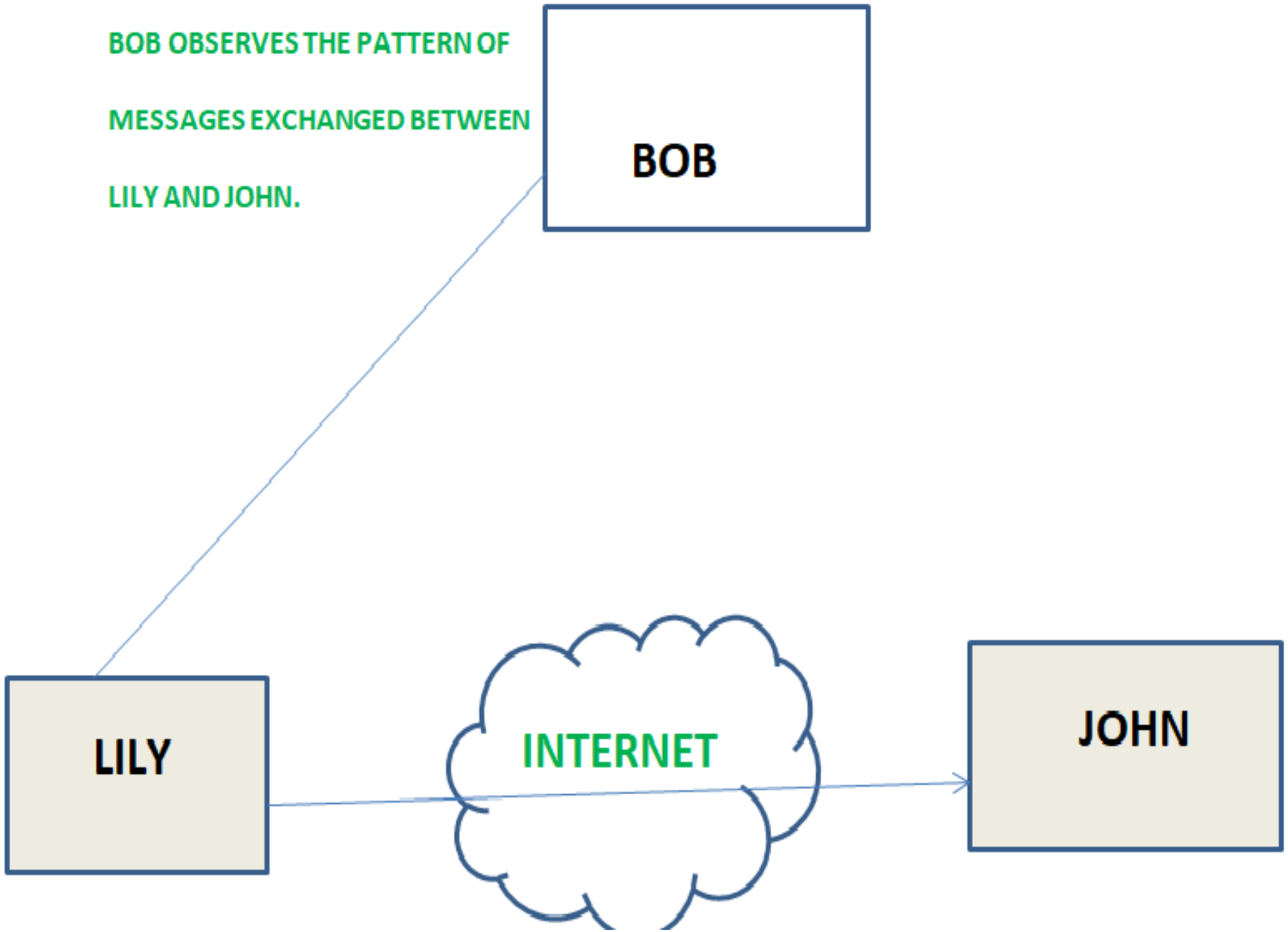

BOB READS THE CONTENT OF
MESSAGE WHICH LILY SENDS TO
JOHN
BOB
LILY
INTERNET
JOHN


BOB
MODIFIES THE MESSAGE AND
ON SEND TO JOHN
LILY
INTERNET
JOHN

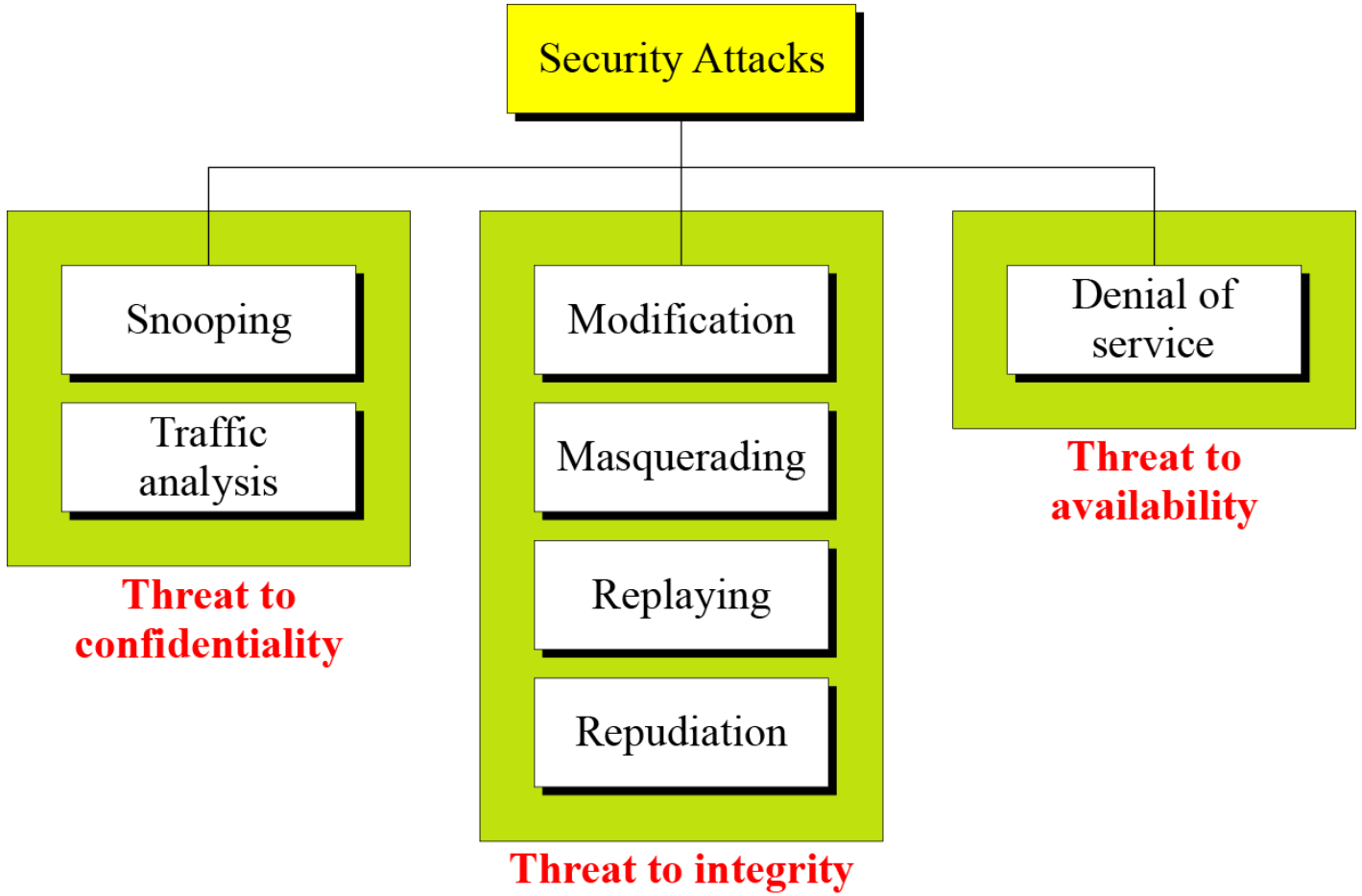

BOB
OVERLOAD THE SERVER BY GIVING
FALSE REQUEST
LILY
INTERNET
JOHN


BOB
BOB PRETENDS TO BE LILY
LILY
INTERNET
JOHN


BOB
CAPTURES THE MESSAGE AND RESEND
IT TO (CAN SEND MULTIPLE TIMES)
LILY
INTERNET
JOHN


BOB OBSERVES THE PATTERN OF
MESSAGES EXCHANGED BETWEEN
LILY AND JOHN.
BOB
LILY
INTERNET
JOHN

Taxonomy of attacks with relation to security goals



Passive Versus Active Attacks

Attacks	*Passive/Active*	*Threatening*
Snooping Traffic analysis	Passive	Confidentiality
Modification Masquerading Replaying Repudiation	Active	Integrity
Denial of service	Active	Availability

Difference between Active Attack and Passive Attack

Sr. No	ACTIVE ATTACK	PASSIVE ATTACK
1	In Active Attack, information is modified.	In Passive Attack, information remain unchanged.
2	Active Attack is dangerous for Integrity as well as Availability.	Passive Attack is dangerous for Confidentiality.
3	Attention is to be paid on detection.	Attention is to be paid on prevention.
4	In Active Attack, system is damaged.	In Passive Attack, system has no impact.
5	Victim gets informed in active attack.	Victim does not get informed in passive attack.
6	System Resources can be changed in active attack.	System Resources are not changed in passive attack.
7	Active attack influence the services of the system.	While in passive attack, information and messages in the system or network are acquired

Difference between Active Attack and Passive Attack

Sr. No	ACTIVE ATTACK	PASSIVE ATTACK
8	In active attack, information collected through passive attacks are used during executing.	While passive attack are performed by collecting the information such as passwords, messages by itself.
9	Active attack is tough to restrict from entering systems or networks.	Passive Attack is easy to prohibited in comparison to active attack.

Policy and Mechanism

- A *security policy* is a statement of what is, and what is not allowed.
- A *security mechanism* is a method, tool, or procedure for enforcing a security policy

- Mechanisms can be nontechnical, such as requiring proof of identity before changing a password;
- Policies often require some procedural mechanisms that technology cannot enforce.

Policy and Mechanism

- Example:
- Suppose a university's computer science laboratory has a policy that **prohibits any student from copying another student's assignment files.**
- The computer system provides mechanisms for preventing others from reading a user's files.
- Anna fails to use these mechanisms to protect her assignment files, and Bill copies them.
- A breach of security has occurred, because Bill has violated the security policy.
- Anna's failure to protect her files does not authorize Bill to copy them.

Policy and Mechanism

- Policies may be presented mathematically, as a list of allowed (secure) and disallowed (nonsecure) states.
- For our purposes, we will assume that any given policy provides an axiomatic description of secure states and nonsecure states.
- In practice, policies are rarely so precise; they normally describe in English, or some other natural language, what users and staff are allowed to do.