MODULE-1: Introduction & Number Theory

VIT | Vidyalankar Institute of Technology
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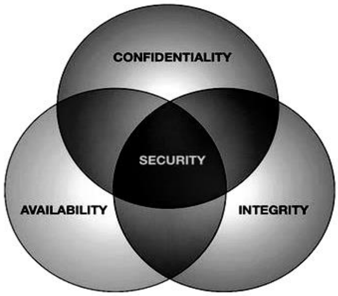
Module 1 Introduction

Goals of security
CIA focuses on three aspects of information protection that indeed are important.

Confidentiality is a set of rules that limits access to information, integrity is the Assurance that the information is trustworthy and accurate, and availability is guarantee of reliable access to the information by authorized people.

1. **Confidentiality :**
   Confidentiality is the ability to hide information from those people unauthorized to view it. It is perhaps the most obvious aspect of the CIA triad when it comes to security; but correspondingly, it is also the one which is attacked most often. Cryptography and Encryption methods are an example of an attempt to ensure confidentiality of data trasferred from one computer to another.



2. **Integrity :**
   The ability to ensure that data is an accurate and unchanged representation of the original secure information. One type of security attack is to intercept some important data and make changes to it before sending it on to the intended receiver.

3. **Availability :**
   It is important to ensure that the information concerned is readily accessible to the authorized viewer at all times. Some types of security attack attempt to deny access to the appropriate user, either for the sake of inconveniencing them, or because there is some secondary effect. For example, by breaking the web site for a particular search engine, a rival may become more popular.

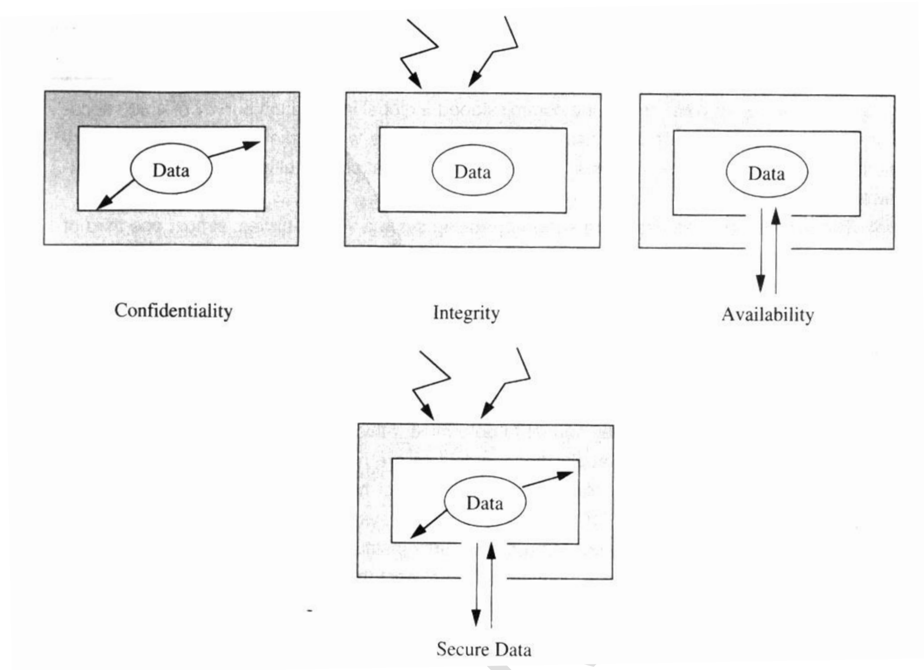


Fig. : Security of Data

Threat

A threat to a computing system is a set of circumstances that has the potential to cause loss or harm.

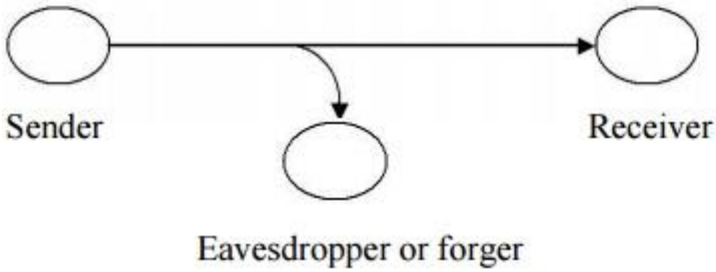
To devise controls, we must know as much about threats as possible. We can view any threat as being one of four kinds: interception, interruption, modification, and fabrication. Each threat exploits vulnerabilities of the assets in computing systems.

Interruption

An asset of the system is destroyed or becomes unavailable or unusable. This is an attack on availability.
e.g., destruction of piece of hardware, cutting of a communication line or disabling of file management system.

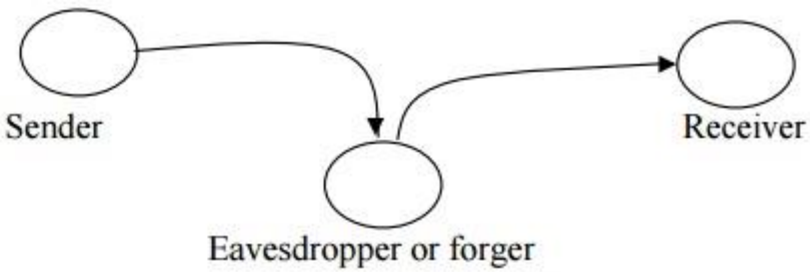
Interception

An unauthorized party gains access to an asset. This is an attack on confidentiality. Unauthorized party could be a person, a program or a computer.e.g., wire tapping to capture data in the network, illicit copying of files



Modification

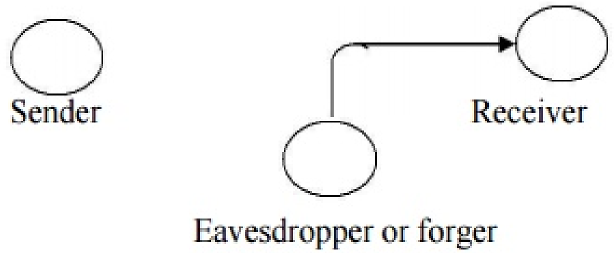
An unauthorized party not only gains access to but tampers with an asset. This is an attack on integrity.



e.g., changing values in data file, altering a program, modifying the contents of messages being transmitted in a network.

Fabrication

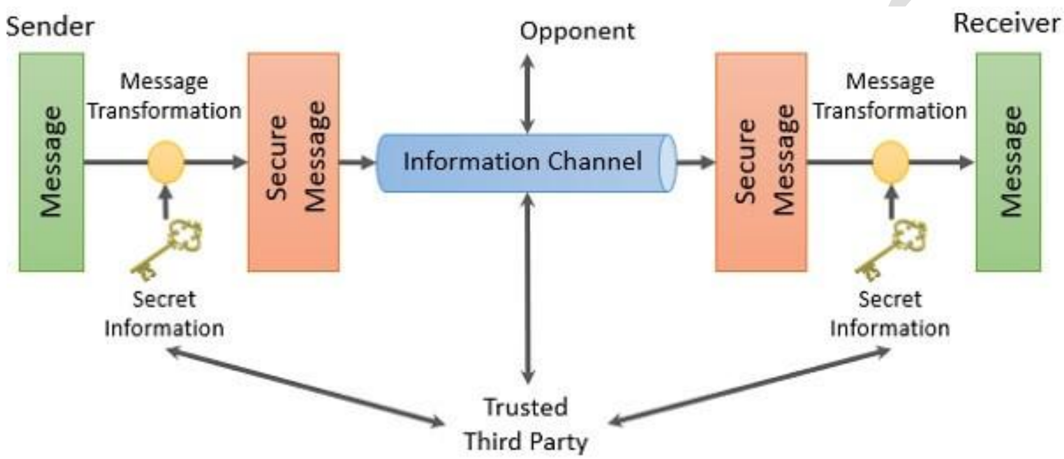
An unauthorized party inserts counterfeit objects into the system. This is an attack on authenticity.



e.g., insertion of spurious message in a network or addition of records to a file.

Network Security Model

A Network Security Model exhibits how the security service has been designed over the network to prevent the opponent from causing a threat to the confidentiality or authenticity of the information that is being transmitted through the network.



Network Security Model

So, considering this general model of network security, one must consider the following four tasks while designing the security model.

1. To transform a readable message at the sender side into an unreadable format, an appropriate algorithm should be designed such that it should be difficult for an opponent to crack that security algorithm.

2. Next, the network security model designer is concerned about the generation of the secret information which is known as a key.
This secret information is used in conjunction with the security algorithm in order to transform the message.

3. Now, the secret information is required at both the ends, sender's end and receiver's end. At sender's end, it is used to encrypt or transform the message into unreadable form and at the receiver's end, it is used to decrypt or retransform the message into readable form.

So, there must be a trusted third party which will distribute the secret information to both sender and receiver. While designing the network security model designer must also concentrate on developing the methods to distribute the key to the sender and receiver.

An appropriate methodology must be used to deliver the secret information to the communicating parties without the interference of the opponent.

It is also taken care that the communication protocols that are used by the communicating parties should be supporting the security algorithm and the secret key in order to achieve the security service.

SECURITY SERVICES

The classification of security services are as follows:

Confidentiality: Ensures that the information in a computer system and transmitted information are accessible only for reading by authorized parties.
Eg., printing, displaying and other forms of disclosure.

Authentication: Ensures that the origin of a message or electronic document is correctly identified, with an assurance that the identity is not false.

Integrity: Ensures that only authorized parties are able to modify computer system assets and transmitted information. Modification includes writing, changing status, deleting, creating and delaying or replaying of transmitted messages.

Non repudiation: Requires that neither the sender nor the receiver of a message be able to deny the transmission.

Access control: Requires that access to information resources may be controlled by or the target system.

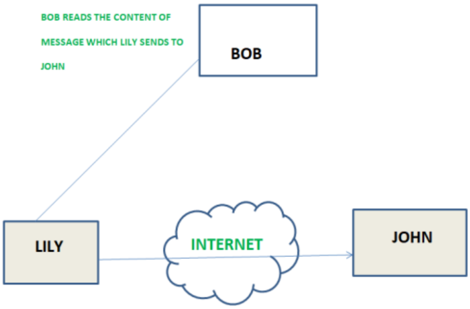
Availability: Requires that computer system assets be available to authorized parties when needed

Attack

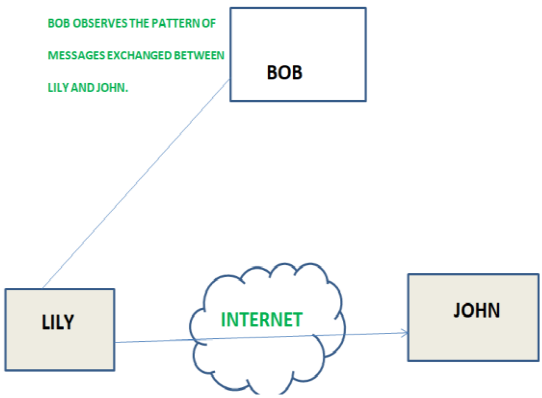
A cyber attack (or cyberattack) is any attempt to expose, alter, disable, destroy, steal or gain unauthorized access to a computer system

Passive attacks: A Passive attack attempts to learn or make use of information from the system but does not affect system resources. Passive Attacks are in the nature of eavesdropping on or monitoring of transmission. The goal of the opponent is to obtain information is being transmitted. Types of Passive attacks are as following:

1. **The release of message content –**
   Telephonic conversation, an electronic mail message or a transferred file may contain sensitive or confidential information. We would like to prevent an opponent from learning the contents of these transmissions.

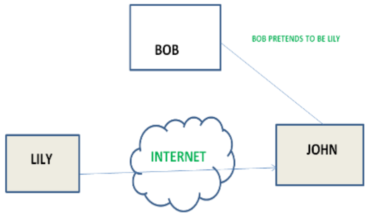


2. **Traffic analysis –**
   The opponent could determine the location and identity of communicating host and could observe the frequency and length of messages being exchanged. This information might be useful in guessing the nature of the communication that was taking place.

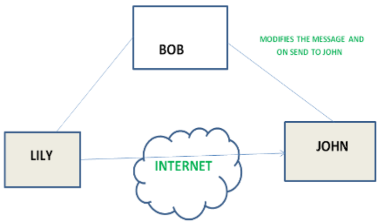


Active attacks: An Active attack attempts to alter system resources or effect their operations. Active attack involve some modification of the data stream or creation of false statement. Types of active attacks are as following:

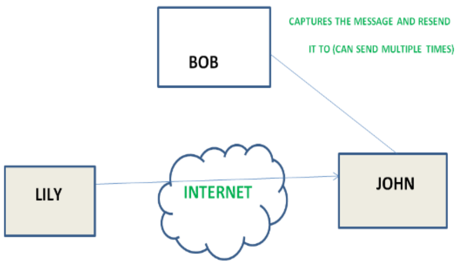
1. **Masquerade –**
   Masquerade attack takes place when one entity pretends to be different entity. A Masquerade attack involves one of the other form of active attacks.



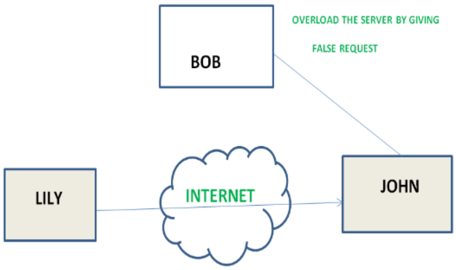
2. **Modification of messages –**
   It means that some portion of a message is altered or that message is delayed or reordered to produce an unauthorised effect. For example, a message meaning "Allow JOHN to read confidential file X" is modified as "Allow Smith to read confidential file X".



3. **Repudiation –**
   This attack is done by either sender or receiver. The sender or receiver can deny later that he/she has send or receive a message. For example, customer ask his Bank "To transfer an amount to someone" and later on the sender(customer) deny that he had made such a request. This is repudiation.
4. **Replay –**
   It involves the passive capture of a message and its subsequent the transmission to produce an authorized effect.



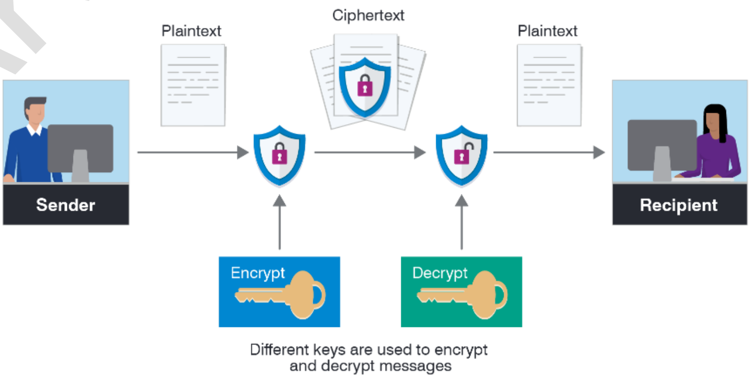
5. **Denial of Service –**
   It prevents normal use of communication facilities. This attack may have a specific target. For example, an entity may suppress all messages directed to a particular destination. Another form of service denial is the disruption of an entire network wither by disabling the network or by overloading it by messages so as to degrade performance.



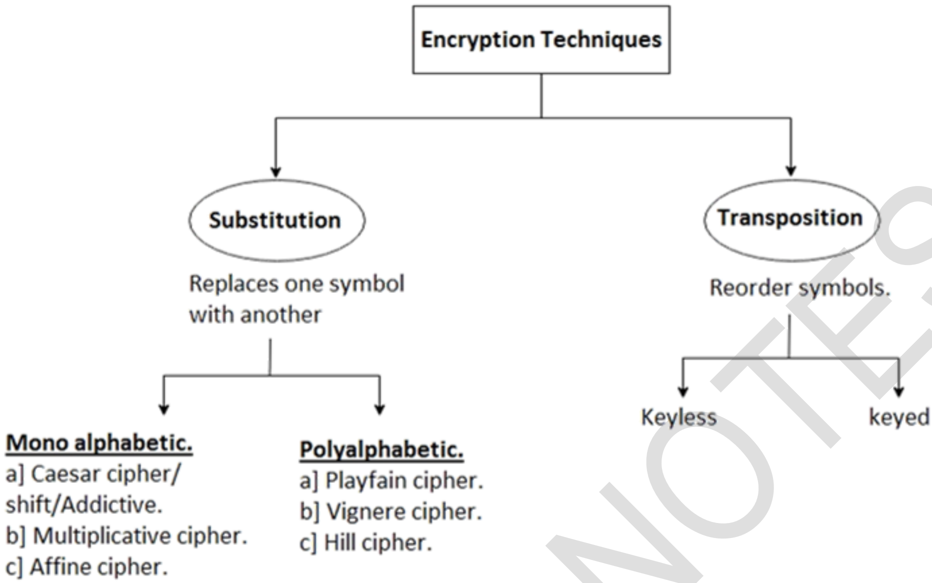
Encryption and Decryption

Encryption is a process which transforms the original information into an unrecognizable form.

Decryption is a process of converting encoded/**encrypted** data in a form that is readable and understood by a human or a computer.



Encryption Techniques



Substitution

A. Mono Alphabetic Substitution:

Monoalphabetic cipher is a substitution cipher in which for a given key, the cipher alphabet for each plain alphabet is fixed throughout the encryption process. For example, if 'A' is encrypted as 'D', for any number of occurrence in that plaintext, 'A' will always get encrypted to 'D'.

```
Plain:  abcdefghijklmnopqrstuvwxyz
Cipher: DKVQFIBJWPESCXHTMYAUOLRGZN
Plaintext:  ifwewishtoreplaceletters
Cipher text: WIRFRWAJUHYFTSDVFSFUUFYA
```

1. Ceaser Cipher:

The Caesar Cipher technique is one of the earliest and simplest method of encryption technique. It’s simply a type of substitution cipher, i.e., each letter of a given text is replaced by a letter some fixed number of positions down the alphabet. For example with a shift of 1, A would be replaced by B, B would become C, and so on. The method is apparently named after Julius Caesar, who apparently used it to communicate with his officials.

Thus to cipher a given text we need an integer value, known as shift which indicates the number of position each letter of the text has been moved down.

E_n(x)=(x+n)mod\ 26
(Encryption Phase with shift n)

D_n(x)=(x-n)mod\ 26
(Decryption Phase with shift n)

e.g
Text : ATTACKATONCE
Shift: 4
Cipher: EXXEGOEXSRGI

2. Multiplicative Cipher:

If multiplication is used to convert to cipher text, it is called a wrap-around situation. Consider the letters and the associated numbers to be used as shown below –

0	1	2	3	4	5	6	7	8	9	10	11	12
A	B	C	D	E	F	G	H	I	J	K	L	M
13	14	15	16	17	18	19	20	21	22	23	24	25
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

The numbers will be used for multiplication procedure and the associated key is 7. The basic formula to be used in such a scenario to generate a multiplicative cipher is as follows –

(Alphabet Number * key)mod(total number of alphabets)

The number fetched through output is mapped in the table mentioned above and the corresponding letter is taken as the encrypted letter.

Plaintext Symbol	Number	Encryption with Key 7	Ciphertext Symbol
A	0	(0 * 7) % 26 = 0	A
B	1	(1 * 7) % 26 = 7	H
C	2	(2 * 7) % 26 = 14	O
D	3	(3 * 7) % 26 = 21	V
E	4	(4 * 7) % 26 = 2	C
F	5	(5 * 7) % 26 = 9	J
G	6	(6 * 7) % 26 = 16	Q
H	7	(7 * 7) % 26 = 23	X
I	8	(8 * 7) % 26 = 4	E
J	9	(9 * 7) % 26 = 11	L
K	10	(10 * 7) % 26 = 18	S
L	11	(11 * 7) % 26 = 25	Z
M	12	(12 * 7) % 26 = 6	G
N	13	(13 * 7) % 26 = 13	N
O	14	(14 * 7) % 26 = 20	U
P	15	(15 * 7) % 26 = 1	B
Q	16	(16 * 7) % 26 = 8	I
R	17	(17 * 7) % 26 = 15	P
S	18	(18 * 7) % 26 = 22	W
T	19	(19 * 7) % 26 = 3	D
U	20	(20 * 7) % 26 = 10	K
V	21	(21 * 7) % 26 = 17	R
W	22	(22 * 7) % 26 = 24	Y
X	23	(23 * 7) % 26 = 5	F
Y	24	(24 * 7) % 26 = 12	M
Z	25	(25 * 7) % 26 = 19	T

3. Affine Cipher

The Affine cipher is a type of monoalphabetic substitution cipher, wherein each letter in an alphabet is mapped to its numeric equivalent, encrypted using a simple mathematical function, and converted back to a letter.

Encryption

It uses modular arithmetic to transform the integer that each plaintext letter corresponds to into another integer that correspond to a ciphertext letter. The encryption function for a single **letter is**

E (x) = (a x + b) mod m

modulus m: size of the alphabet

a and b: key of the cipher.

a must be chosen such that a and m are coprime.

Decryption

In deciphering the ciphertext, we must perform the opposite (or inverse) functions on the ciphertext to retrieve the plaintext. Once again, the first step is to convert each of the ciphertext letters into their integer values. The decryption function is

D (x) = a^-1 (x - b) mod m

a^-1 : modular multiplicative inverse of a modulo m. i.e., it satisfies the equation

1 = a a^-1 mod m

Encryption: Key Values a=17, b=20

Original Text	T	W	E	N	T	Y		F	I	F	T	E	E	N
x	19	22	4	13	19	24		5	8	5	19	4	4	13
ax+b % 26*	5	4	10	7	5	12		1	0	1	5	10	10	7
Encrypted Text	F	E	K	H	F	M		B	A	B	F	K	K	H

Decryption: a^-1 = 23

Encrypted Text	F	E	K	H	F	M		B	A	B	F	K	K	H
Encrypted Value	5	4	10	7	5	12		1	0	1	5	10	10	7
23 *(x-b) mod 26	19	22	4	13	19	24		5	8	5	19	4	4	13
Decrypted Text	T	W	E	N	T	Y		F	I	F	T	E	E	N

B. Polyalphabetic Cipher

A polyalphabetic cipher is any cipher based on substitution, using multiple substitution alphabets.

1. **Playfair cipher**

The **Playfair cipher** was the first practical digraph substitution cipher. The scheme was invented in **1854** by **Charles Wheatstone** but was named after Lord Playfair who promoted the use of the cipher. In playfair cipher unlike traditional cipher we encrypt a pair of alphabets(digraphs) instead of a single alphabet.

The Playfair Cipher Encryption Algorithm:
The Algorithm consists of 2 steps
Generate the key Square(5×5):

The key square is a 5×5 grid of alphabets that acts as the key for encrypting the plaintext. Each of the 25 alphabets must be unique and one letter of the alphabet (usually J) is omitted from the table (as the table can hold only 25 alphabets). If the plaintext contains J, then it is replaced by I.

For example:

The key is "**monarchy**"
Thus the initial entires are
'm', 'o', 'n', 'a', 'r', 'c', 'h', 'y'
followed by remaining characters of
a-z(except 'j') in that order.

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

Algorithm to encrypt the plain text: The plaintext is split into pairs of two letters (digraphs). If there is an odd number of letters, a Z is added to the last letter.

For example:

PlainText: "instruments"
After Split: 'in' 'st' 'ru' 'me' 'nt' 'sz'

Rules for Encryption:

1. **If both the letters are in the same column**: Take the letter below each one (going back to the top if at the bottom).

   For example:

   Diagraph: "me"
   Encrypted Text: cl
   Encryption:
   m -> c
   e -> l

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

2. **If both the letters are in the same row**: Take the letter to the right of each one (going back to the leftmost if at the rightmost position).
   For example:

Diagraph: "st"
Encrypted Text: tl
Encryption:
s -> t
t -> l

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

3. **If neither of the above rules is true**: Form a rectangle with the two letters and take the letters on the horizontal opposite corner of the rectangle.
   For example:

Diagraph: "nt"
Encrypted Text: rq
Encryption:
n -> r
t -> q

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

For example:

Plain Text: "instrumentsz"
Encrypted Text: gatlmzclrqtx
Encryption:
i -> g
n -> a
s -> t
t -> l
r -> m
u -> z
m -> c
e -> l

n -> r
t -> q
s -> t
z -> x

in:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

st:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

ru:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

me:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

nt:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

sz:

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

Decryption Technique

Decrypting the Playfair cipher is as simple as doing the same process in reverse. The receiver has the same key and can create the same key table, and then decrypt any messages made using that key.

Rules for Decryption:

1. **If both the letters are in the same column**: Take the letter above each one (going back to the bottom if at the top).
   For example:

Diagraph: "cl"
Decrypted Text: me
Decryption:
c -> m
l -> e

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

2. **If both the letters are in the same row**: Take the letter to the left of each one (going back to the rightmost if at the leftmost position).
   For example:

Diagraph: "tl"
Decrypted Text: st
Decryption:
t -> s
l -> t

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

3. **If neither of the above rules is true**: Form a rectangle with the two letters and take the letters on the horizontal opposite corner of the rectangle.

   For example:

Diagraph: "rq"
Decrypted Text: nt
Decryption:
r -> n
q -> t

M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

For example:

Plain Text: "gatlmzclrqtx"
Decrypted Text: instrumentsz
Decryption:
(red)-> (green)
ga -> in
tl -> st
mz -> ru
cl -> me
rq -> nt
tx -> sz

in:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

st:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

ru:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

me:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

nt:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

sz:				
M	O	N	A	R
C	H	Y	B	D
E	F	G	I	K
L	P	Q	S	T
U	V	W	X	Z

2. Vigenère cipher

Vigenère cipher, type of substitution cipher invented by the 16th-century French cryptographer Blaise de Vigenère and used for data encryption in which the original plaintext structure is somewhat concealed in the ciphertext by using several different monoalphabetic substitution ciphers rather than just one.

When the vigenere table is given, the encryption and decryption are done using the vigenere table (26 * 26 matrix) in this method.

Plaintext

Key	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Example: The plaintext is "NETWORK", and the key is "VIT".

To generate a new key, the given key is repeated in a circular manner, as long as the length of the plain text does not equal to the new key.

N	E	T	W	O	R	K
V	I	T	V	I	T	V

Encryption

The first letter of the plaintext is combined with the first letter of the key. The column of plain text "N" and row of key "V" intersects the alphabet of "I" in the vigenere table, so the first letter of ciphertext is "I".

Similarly, the second letter of the plaintext is combined with the second letter of the key. This process continues continuously until the plaintext is finished.

Ciphertext = IMMSWTF

Decryption

Decryption is done by the row of keys in the vigenere table. First, select the row of the key letter, find the ciphertext letter's position in that row, and then select the column label of the corresponding ciphertext as the plaintext.

I	M	M	S	W	T	F
V	I	T	V	I	T	V

For example, in the row of the key is "B" and the ciphertext is "I" and this ciphertext letter appears in the column "N", that means the first plaintext letter is "N".

Plaintext= NETWORK

3. Hill Cipher

Hill cipher is a polygraphic substitution cipher based on linear algebra. Each letter is represented by a number modulo 26.

Encryption

We have to encrypt the message 'ACT' (n=3).The key is 'GYBNQKURP' which can be written as the nxn matrix:

$$\begin{bmatrix} 6 & 24 & 1 \\ 13 & 16 & 10 \\ 20 & 17 & 15 \end{bmatrix}$$

The message 'ACT' is written as vector:

$$\begin{bmatrix} 0 \\ 2 \\ 19 \end{bmatrix}$$

The enciphered vector is given as:

$$\begin{bmatrix} 6 & 24 & 1 \\ 13 & 16 & 10 \\ 20 & 17 & 15 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ 19 \end{bmatrix} = \begin{bmatrix} 67 \\ 222 \\ 319 \end{bmatrix} \equiv \begin{bmatrix} 15 \\ 14 \\ 7 \end{bmatrix} \pmod{26}$$

which corresponds to ciphertext of 'POH'

Decryption

To decrypt the message, we turn the ciphertext back into a vector, then simply multiply by the inverse matrix of the key matrix (IFKVIVVMI in letters).The inverse of the matrix used in the previous example is:

$$\begin{bmatrix} 6 & 24 & 1 \\ 13 & 16 & 10 \\ 20 & 17 & 15 \end{bmatrix}^{-1} \equiv \begin{bmatrix} 8 & 5 & 10 \\ 21 & 8 & 21 \\ 21 & 12 & 8 \end{bmatrix} \pmod{26}$$

For the previous Ciphertext ‘POH’:

$$\begin{bmatrix} 8 & 5 & 10 \\ 21 & 8 & 21 \\ 21 & 12 & 8 \end{bmatrix} \begin{bmatrix} 15 \\ 14 \\ 7 \end{bmatrix} \equiv \begin{bmatrix} 260 \\ 574 \\ 539 \end{bmatrix} \equiv \begin{bmatrix} 0 \\ 2 \\ 19 \end{bmatrix} \pmod{26}$$

which gives us back ‘ACT’.

Transposition:

Keyed Transposition

Keyed transposition cipher uses keys to encrypt and decrypt the messages. It shares the same secret key among the senders and the receivers. Key is used as position finder for the cipher text. We can illustrate this by giving a nice example as-

Suppose given plaintext is- “Four Five”. And lets the key is=2401. Then the cipher text will be

Plain text	F	O	U	R		F	I	V	E
Key	2	4	0	1		2	4	0	1
Positions	0	1	2	4		0	1	2	4
Cipher Text	U	R	F	O		V	E	F	I
Positions	0	1	2	4		0	1	2	4
Key	2	4	0	1		2	4	0	1
Plain text	F	O	U	R		F	I	V	E

Keyless Transposition

Rail Fence algorithm.

The rail fence cipher (also called a zigzag cipher) is a form of transposition cipher. It derives its name from the way in which it is encoded.
In a transposition cipher, the order of the alphabets is re-arranged to obtain the cipher-text.

- In the rail fence cipher, the plain-text is written downwards and diagonally on successive rails of an imaginary fence.
- When we reach the bottom rail, we traverse upwards moving diagonally, after reaching the top rail, the direction is changed again. Thus the alphabets of the message are written in a zig-zag manner.
- After each alphabet has been written, the individual rows are combined to obtain the cipher-text.

Plaintext T H I S I S A S E C R E T M E S S A G E

Rail Fence Encoding key = 3

T				I				E				T				S			
	H		S		S		S		C		E		M		S		A		E
		I				A				R				E				G	

Ciphertext T I E T S H S S S C E M S A E I A R E G

Decryption

The decryption process for the Rail Fence Cipher involves reconstructing the diagonal grid used to encrypt the message. We start writing the message, but leaving a dash in place of the spaces yet to be occupied. Gradually, you can replace all the dashes with the corresponding letters, and read off the plaintext from the table.
We start by making a grid with as many rows as the key is, and as many columns as the length of the ciphertext. We then place the first letter in the top left square, and dashes diagonally downwards where the letters will be. When we get back to the top row, we place the next letter in the ciphertext. Continue like this across the row, and start the next row when you reach the end.

Cipher	T				I				E				T				S			
		-		-		-		-		-		-		-		-		-		-
			-				-				-				-				-	

Cipher	**T**				**I**				**E**				**T**				**S**			
		H		S		S		S		C		E		M		S		A		E
			-				-				-				-				-	

Cipher	**T**				**I**				**E**				**T**				**S**			
		H		**S**		**S**		**S**		**C**		**E**		**M**		**S**		**A**		**E**
			I				A				R				E				G	

Plain text: THISISASECRETMESSAGE

Steganography

Steganography is the technique of hiding secret data within an ordinary, non-secret, file or message in order to avoid detection; the secret data is then extracted at its destination. The use of steganography can be combined with encryption as an extra step for hiding or protecting data.

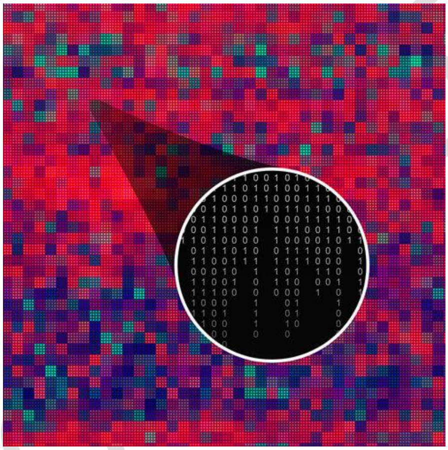


Fig: Steganography

Steganography Techniques

Depending on the nature of the cover object(actual object in which secret data is embedded), steganography can be divided into five types:

Text Steganography

Text Steganography is hiding information inside the text files.

Image Steganography

Hiding the data by taking the cover object as the image is known as image steganography

Video Steganography

In audio steganography, the secret message is embedded into an audio signal which alters the binary sequence of the corresponding audio file.

Audio Steganography

In Video Steganography you can hide kind of data into digital video format.

Network Steganography

You can use steganography in some covert channels that you can find in the OSI model. For Example, you can hide information in the header of a TCP/IP packet in some fields that are either optional.

	STEGANOGRAPHY	CRYPTOGRAPHY
Definition	It is a technique to hide the existence of communication	It's a technique to convert data into an incomprehensible form
Purpose	Keep communication secure	Provide data protection
Data Visibility	Never	Always
Data Structure	Doesn't alter the overall structure of data	Alters the overall structure of data
Key	Optional, but offers more security if used	Necessary requirement
Failure	Once the presence of a secret message is discovered, anyone can use the secret data	If you possess the decryption key, then you can figure out original message from the ciphertext

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