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Data Encryption & Decryption - A Review

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Abstract*: The art of obtaining security by converting readable messages into non-readable is called Cryptography. It is the process of hiding secret information. The normal text also called plain text is visible and readable to all. To provide security to some important messages we need to encode the text called cipher text. The contents of cipher text are visible to everyone but they are not readable. Cryptography is a branch of computer science, information theory and mathematics whose main task is to codify the given information so that it is not easily understood by unauthorized users. It is used numerous applications for providing security for transmitted data. In this paper, we provide review of various types of cryptography techniques.
Keywords: Cryptography, plain text, cipher text, cryptanalyst

I. INTRODUCTION

Cryptography, then, not only protects data from theft or alteration, but can also be used for user authentication. Cryptography methods are divided into following techniques for providing security of data: secret key (or symmetric) cryptography, public key (or asymmetric) cryptography, and hash functions. Due to enhancement of public and private network there have been encouraged activities such as unauthorized access, illegal usage, disruption, alteration of transmitted and stored data.

There is vast use of digital media over the internet nowadays therefore security of these digital media is necessary. Security concerns with regards to such data transmission and storage has been a major concern of both the transmitters and receivers and hence the security of critical cyber and physical infrastructures as well as their underlying computing and communication architectures and systems becomes a very crucial priority of every institution.

Cryptography is the fundamental platform in which modern information security, which involves the use of advanced mathematical approaches in solving hard cryptographic issues, has gained its grounds in the digital world. This has evolved from classical symmetric, in which shifting keys are normally used as well as substitution methods, ciphers to modern public key exchange cryptosystems, which aims to make cryptanalysis a difficult approach to deciphering ciphers.

In cryptography there are some important terms and are given below (figure 1):

A. Plain Text

It is the original text which has to be encrypted.

B. Cipher Text

It is the encrypted text. The text obtain after encoding the data with the help of a key is known as cipher text.

C. Key

It is a word or value that is used to encrypt the plain text or decrypt the cipher text.

D. Encryption

The method of converting the data into coded form with the help of key is called encryption [4].

E. Decryption

The method of converting the encoded data to the original form is called decryption [37].

F. Crypto Analyst

A crypto analyst is a person who is an expert in analyzing and breaking codes [3].

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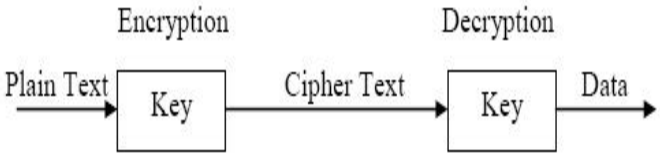

Figure 1: Cryptographic Model [2]

The work presented in this paper is to study the existing encryption algorithm used for data security.

II. LITERATURE SURVEY

There are huge amount of work done by the various researchers in the field of cryptographic algorithm for data security. Some of these work done by the researchers are explain in this chapter.

Laurent Eschenauer et al. [4] proposed a key management scheme for distributed sensor networks. Key management scheme designed to satisfy both operational and security requirements of distributed sensor networks. This scheme requires cryptographic protection of communications, sensor capture detection, key revocation and sensor disabling. So they present a key management scheme designed to satisfy both operational and security requirements of distributed sensor networks.

Jung.Wen Lo et al. [5] proposed an efficient key assignment scheme for access control in a large leaf class hierarchy. In which users were divided this into different security classes. They also proposed a new key assignment scheme for controlling the access right in a large partially ordered set hierarchy and reduce the required computation for key generation. Information retrieval and the number of leaf classes which were substantially larger than the number of non-leaf classes.

Bharat B. Madan et al. [6] worked on various methods used for modelling and quantifying the security attributes of intrusion tolerant systems**.** Various issues related to quantifying the security attributes of an intrusion tolerant system were also addressed. Response of a security intrusion tolerant system to an attack was modelled as a random process. They facilitate the use of stochastic modelling techniques to predict the attacker behaviour.

Tariq Jamil et al. [7] worked upon Rijndael algorithm for protecting sensitive unclassified government information. This algorithm was the new advanced encryption standard algorithms recommended by the US national institute of standards and technology. The performance of Rijndael algorithm based on speed of encryption, decryption process and keyset up time.

Ho Won Kim et al. [8] worked on Design and Implementation of a private and public key crypto processor and its application for security system. They present the design and implementation of a crypto processor. This special purpose microprocessor optimized for the execution of cryptography algorithms.

Prosanta Gopeet al. [9] proposed a new block cipher cryptographic symmetric key algorithm named TACIT encryption technique for secure routing. It used an independent approach with suitable mathematical which was assumed to be computationally secured. Key distribution system was being applied on a secure policy based routing. It was limited to conversion of text file.

Ismail .I.A et al. [10] worked on how to repair the hill cipher. This technique adjusts the encryption key to form a different key for each block encryption. This algorithm provides a method for adjusting the encryption key, thereby significantly increasing its resistance to various attacks such as a known plaintext attack and statistical attack. The proposed algorithm called HillMRIV cipher.

Yogesh Karandikar et al. [11] proposed on effective key management approach for differential access control in dynamic environment. In group communication each user accesses multiple resources and multiple users can access each resource. Each resource encryption key needs to be distributed to all subscribers of the resource and each subscriber must get the entire key. So they developed a new approach of keys management to enforce differential access control in highly dynamic environments for secure group communication framework.

Yanchao Zhang et al. [12] worked on Location-Based Compromise-Tolerant Security Mechanisms for Wireless Sensor Networks. They worked on the notion of location-based keys by binding private keys of individual nodes to both their IDs and geographic locations. They developed LBK-based neighbourhood authentication scheme to localize the impact of compromised nodes to their vicinity.

N. R. Potlapally et al. [13] worked on energy consumption characteristics of cryptographic algorithms and security protocols. They present a comprehensive analysis of the energy requirements of a wide range of cryptographic algorithms that form the building blocks of security mechanisms such as security protocols. They also discuss various opportunities for realizing energy efficient implementations of security protocols.

Darpan Anand et al. [14] explored identity based cryptography techniques and applications. They reviewed the identity based encryption applications in the field of various networks as ad-hoc networks. The scheme also used in mobile networks and other wireless networks. They also discussed that under what parameters identity based cryptography was used with its benefits and limitations. The main limitation was that the available methods were restricted to fixed output block, which was a trace for crackers.

III. CLASSICAL CRYPTOGRAPHY TECHNIQUES

The technique enables us to illustrate the basic approaches to conventional encryption today. The two basic components of classical ciphers are substitution and transposition [3]. Then other systems described that combines both substitution and transposition.

A. Substitution Techniques

In this technique letters of plaintext are replaced by or by numbers and symbols. If plaintext is viewed as a sequence of bits, then substitution involves replacing plaintext bit patterns with cipher text bit patterns.

1) *Caesar Cipher:* Caesar Cipher replaces each letter of the message by a fixed letter a fixed distance away e.g. uses the third letter on and repeatedly used by Julius Caesar.

For example:
Plaintext: I CAME I SAW I CONQUERED
Cipher text: L FDPH L VDZ L FRQTXHUHG
Mapping is:
ABCDEFGHIJKLMNOPQRSTUVWXYZ
DEFGHIJKLMNOPQRSTUVWXYZABC
Can describe the Cipher as:
Encryption: C = E (P) = (P + 3) mod 26
Decryption: P = D(C) = (C - 3) mod 26

2) *Mono Alphabetic Ciphers:* With only 25 possible keys, the Caesar cipher is far from secure. A dramatic increase in the key space can be achieved by allowing an arbitrary substitution. Recall the assignment for the Caesar cipher:

plain: 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
cipher: 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

If, instead, the "cipher" line can be any permutation of the 26 alphabetic characters, then there are 26! possible keys. This is 10 orders of magnitude greater than the key space for DES and would seem to eliminate brute-force techniques for cryptanalysis. Such an approach is referred to as a mono alphabetic substitution cipher, because a single cipher alphabet (mapping from plain alphabet to cipher alphabet) is used per message.

3) *Playfair Cipher:* The Playfair is a substitution cipher bearing the name of the man who popularized but not created it. The method was invented by Sir Charles Wheatstone, in around 1854; however he named it after his friend Baron Playfair. The Playfair Cipher was developed for telegraph secrecy and it was the first literal digraph substitution cipher.

The best-known multiple-letter encryption cipher is the Playfair, which treats digrams in the plaintext as single units and translates these units into ciphertext digrams. The Playfair algorithm is based on the use of a 5 * 5 matrix of letters constructed using a keyword. Here is an example:

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

In this case, the keyword is *monarchy*. The matrix is constructed by filling in the letters of the keyword (minus duplicates) from left to right and from top to bottom, and then filling in the remainder of the matrix with the remaining letters in alphabetic order. The letters I and J count as one letter. Plaintext is encrypted two letters at a time, according to the following rules:

a) Repeating plaintext letters that would fall in the same pair are separated with a filler letter, such as x, so that balloon would be enciphered as ba lx lo on.

b) Plaintext letters that fall in the same row of the matrix are each replaced by the letter to the right, with the first element of the row circularly following the last. For example, ar is encrypted as RM.

c) Plaintext letters that fall in the same column are each replaced by the letter beneath, with the top element of the row circularly following the last. For example, mu is encrypted as CM.

d) Otherwise, each plaintext letter is replaced by the letter that lies in its own row and the column occupied by the other plaintext letter. Thus, hs becomes BP and ea becomes IM (or JM, as the encipherer wishes).

The Playfair cipher is a great advance over simple monoalphabetic ciphers. For one thing, whereas there are only 26 letters, there are 26 * 26 = 676 diagrams, so that identification of individual diagrams is more difficult. Furthermore, the relative frequencies of individual letters exhibit a much greater range than that of diagrams, making frequency analysis much more difficult.

B. Transposition Techniques

All the techniques examined so far involve the substitution of a ciphertext symbol for a plaintext symbol. A very different kind of mapping is achieved by performing some sort of permutation on the plaintext letters. This technique is referred to as a transposition cipher.

The simplest such cipher is the rail fence technique, in which the plaintext is written down as a sequence of diagonals and then read off as a sequence of rows. For example, to encipher the message "meet me after the toga party" with a rail fence of depth 2, we write the following:

m e m a t r h t g p r y

e t e f e t e o a a t

The encrypted message is:

MEMATRHTGPRYETEFETEOAAT

This sort of thing would be trivial to crypt analyze. A more complex scheme is to write the message in a rectangle, row by row, and read the message off, column by column, but permute the order of the columns. The order of the columns then becomes the key to the algorithm. For example:

```
Key:          3 4 2 1 5 6 7
Plaintext:    a t t a c k p
              o s t p o n e
              d u n t i l t
              w o a m x y z

Ciphertext:   TTNAAPTMTSUOAODWCOIXKNLYPETZ
```

A pure transposition cipher is easily recognized because it has the same letter frequencies as the original plaintext. For the type of columnar transposition just shown, cryptanalysis is fairly straightforward and involves laying out the ciphertext in a matrix and playing around with column positions. Digram and trigram frequency tables can be useful.

The transposition cipher can be made significantly more secure by performing more than one stage of transposition. The result is a more complex permutation that is not easily reconstructed. Thus, if the foregoing message is re-encrypted using the same algorithm:

```
Key:          3 4 2 1 5 6 7
Input:        t t n a a p t
              m t s u o a o
              d w c o i x k
              n l y p e t z

Output:       NSCYAUOPTTWLTMDNAOIEPAXTTOKZ
```

IV. CONCLUSION

Data security is an essential component of an organization in order to keep the information safe from various competitors. It helps to ensure the privacy of a user's personal information from others. Secured and timely transmission of data is always an important aspect for an organization. Strong encryption algorithms and optimized key management techniques always help in achieving confidentiality, authentication and integrity of data and reduce the overheads of the system. Cryptography is a technique used to avoid unauthorized access of data. It has two main components: Encryption algorithm and Key. Sometime, multiple keys can also be used for encryption. In this paper we study the existing encryption algorithm used for data security.

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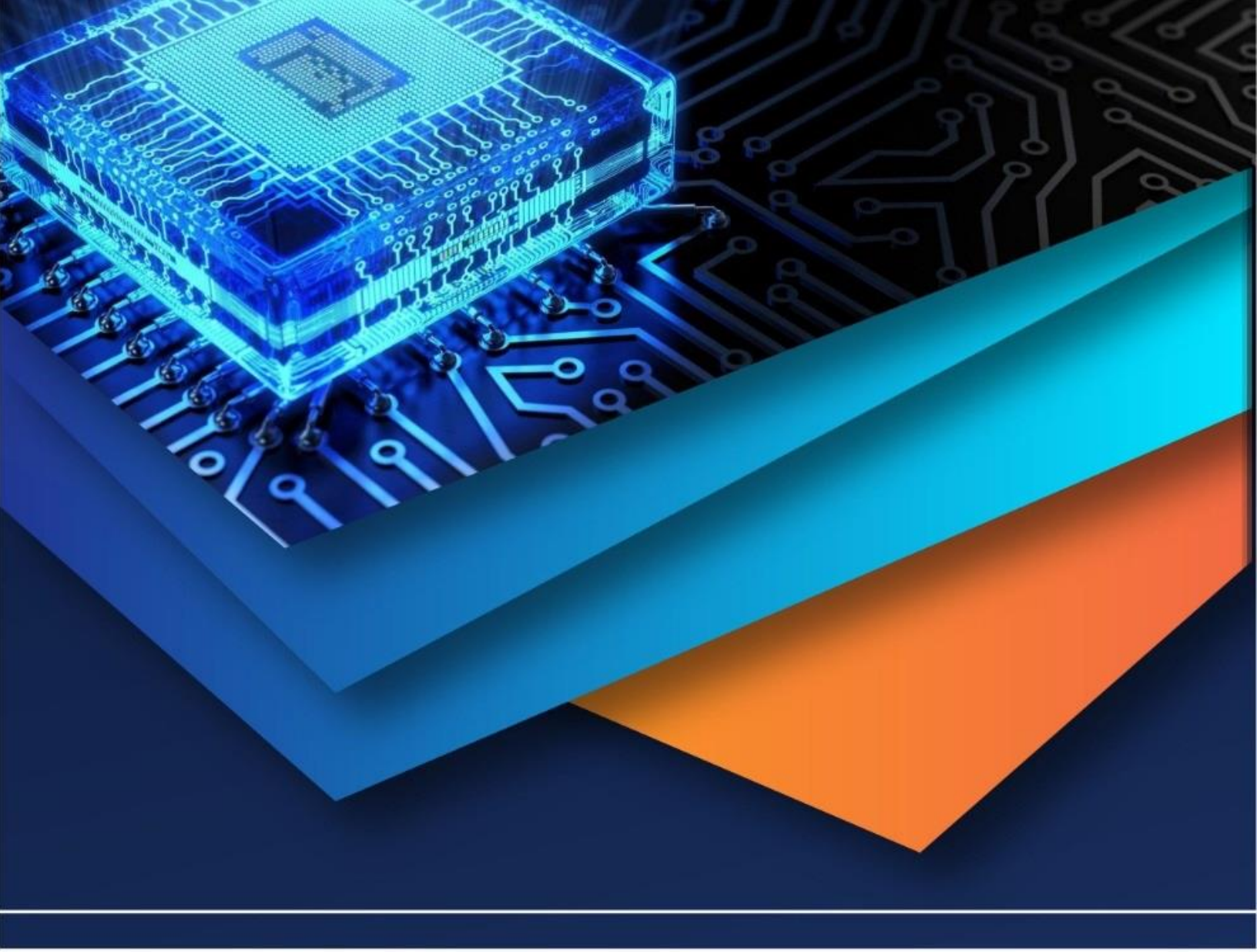

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