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CRYPTOGRAPHY AND ITS COMPONENTS

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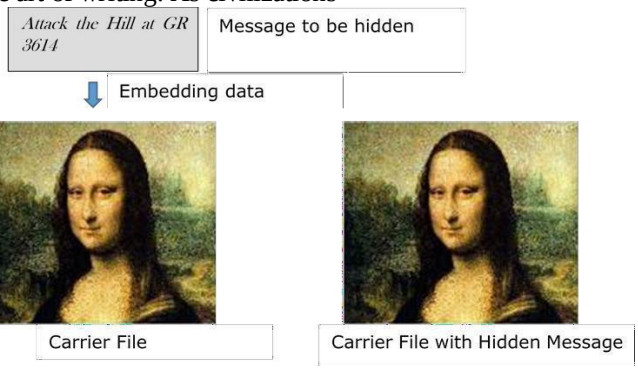
Abstract: Network security is a complicated subject, historically only tackled by well-trained and experienced experts. However, as more and more people become "wired", an increasing number of people need to understand the basis of security in a networked world. This document was written with basic computer user and information systems manager in mind, explaining the concepts needed to read through the hype in the marketplace and understand the risks and how to deal with them. So it is very important for all the users to get familiar with the various aspects of the network security. In the article basis of the network security are discussed. With the millions of the users able to pass information from the network, the security of business networks is a major concern. The very nature of the internet makes it vulnerable to attack the internet and computers connected to the internet. With the growth in the business use of the internet, network security rapidly becoming crucial to the development of the internet. Many business set up firewalls to control access to their networks by persons using the Internet.

I. INTRODUCTION

Human being from ages had two inherent needs: (a) to communicate and share information and (b)to communicate selectively. These two needs gave rise to the art of coding the messages in such a way that only the intended people could have access to the information. Unauthorized people could not extract any information, even if the scrambled messages fell in their hand. The art and science of concealing the messages to introduce secrecy in information security is recognized as cryptography. The word 'cryptography' was coined by combining two Greek words, 'Krypto' meaning hidden and 'Graphene' meaning writing.

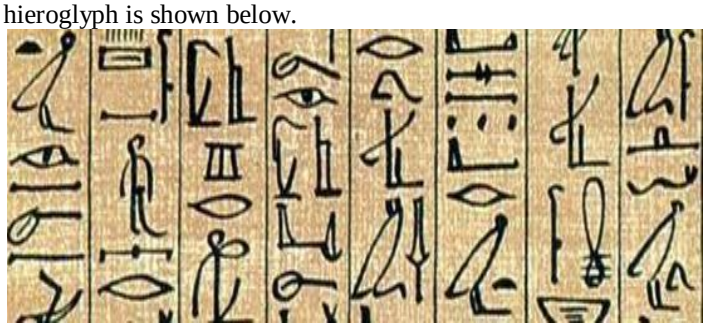
II. HISTORY OF CRYPTOGRAPH

The art of cryptography is considered to be born along with the art of writing. As civilizations evolved, human beings got organized in tribes, groups, and kingdoms. This led to the emergence of ideas such as power, battles, supremacy, and politics. These ideas further fueled the natural need of people to communicate secretly with selective recipient which in turn ensured the continuous evolution of cryptography as well. The roots of cryptography are found in Roman and Egyptian civilizations.



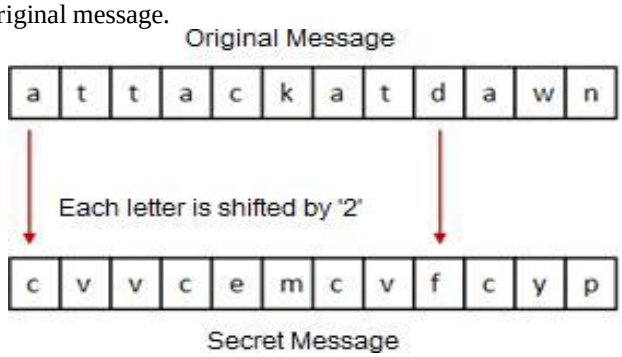
Hieroglyph – The Oldest Cryptographic Technique

The first known evidence of cryptography can be traced to the use of 'hieroglyph'. Some 4000 years ago, the Egyptians used to communicate by messages written in hieroglyph. This code was the secret known only to the scribes who used to transmit messages on behalf of the kings. One such hieroglyph is shown below.



Later, the scholars moved on to using simple mono-alphabetic substitution ciphers during 500 to 600 BC. This involved replacing alphabets of message with other alphabets with some secret rule. This rule became a key to retrieve the message back from the garbled message.

The earlier Roman method of cryptography, popularly known as the Caesar Shift Cipher, relies on shifting the letters of a message by an agreed number (three was a common choice), the recipient of this message would then shift the letters back by the same number and obtain the original message.



Steganography

Steganography is similar but adds another dimension to Cryptography. In this method, people not only want to protect the secrecy of an information by concealing it, but they also want to make sure any unauthorized person gets no

evidence that the information even exists. For example, invisible watermarking.
In steganography, an unintended recipient or an intruder is unaware of the fact that observed data contains hidden information. In cryptography, an intruder is normally aware that data is being communicated, because they can see the coded/scrambled message.

III. CHARACTERISTICS OF MODERN CRYPTOGRAPHY

There are three major characteristics that separate modern cryptography from the classical approach.

Classic Cryptography	Modern Cryptography
It manipulates traditional characters, i.e., letters and digits directly.	It operates on binary bit sequences.
It is mainly based on 'security through obscurity'. The techniques employed for coding were kept secret and only the parties involved in communication knew about them.	It relies on publicly known mathematical algorithms for coding the information. Secrecy is obtained through a secrete key which is used as the seed for the algorithms. The computational difficulty of algorithms, absence of secret key, etc., make it impossible for an attacker to obtain the original information even if he knows the algorithm used for coding.
It requires the entire cryptosystem for communicating confidentially.	Modern cryptography requires parties interested in secure communication to possess the secret key only.

Context of Cryptography
Cryptology, the study of cryptosystems, can be subdivided into two branches:

- Cryptography
- Cryptanalysis

What is Cryptography?
Cryptography is the art and science of making a cryptosystem that is capable of providing information security. Cryptography deals with the actual securing of digital data. It refers to the design of mechanisms based on mathematical algorithms that provide fundamental information security services. You can think of cryptography as the establishment of a large toolkit containing different techniques in security applications.

What is Cryptanalysis?
The art and science of breaking the cipher text is known as cryptanalysis.Cryptanalysis is the sister branch of cryptography and they both co-exist. The cryptographic process results in the cipher text for transmission or storage. It involves the study of cryptographic mechanism with the intention to break them. Cryptanalysis is also used during the design of the new cryptographic techniques to test their security strengths.

Security Services of Cryptography
The primary objective of using cryptography is to provide the following four fundamental information security services. Let us now see the possible goals intended to be fulfilled by cryptography.

Confidentiality
Confidentiality is the fundamental security service provided by cryptography. It is a security service that keeps the information from an unauthorized person. It is sometimes referred to as privacy or secrecy.Confidentiality can be achieved through numerous means starting from physical securing to the use of mathematical algorithms for data encryption.

Data Integrity
It is security service that deals with identifying any alteration to the data. The data may get modified by an unauthorized entity intentionally or accidently. Integrity service confirms that whether data is intact or not since it was last created, transmitted, or stored by an authorized user.Data integrity cannot prevent the alteration of data, but provides a means for detecting whether data has been manipulated in an unauthorized manner.

Authentication
Authentication provides the identification of the originator. It confirms to the receiver that the data received has been sent only by an identified and verified sender.

Authentication service has two variants:
Message authentication identifies the originator of the message without any regard router or system that has sent the message.
Entity authentication is assurance that data has been received from a specific entity, say a particular website. Apart from the originator, authentication may also provide assurance about other parameters related to data such as the date and time of creation/transmission.

Non-repudiation
It is a security service that ensures that an entity cannot refuse the ownership of a previous commitment or an action. It is an assurance that the original creator of the data cannot deny the creation or transmission of the said data to a recipient or third party.
Non-repudiation is a property that is most desirable in situations where there are chances of a dispute over the exchange of data. For example, once an order is placed electronically, a purchaser cannot deny the purchase order, if non-repudiation service was enabled in this transaction.

Cryptography Primitives
Cryptography primitives are nothing but the tools and techniques in Cryptography that can be selectively used to provide a set of desired security services:

- Encryption
- Hash functions
- Message Authentication codes (MAC)
- Digital Signatures

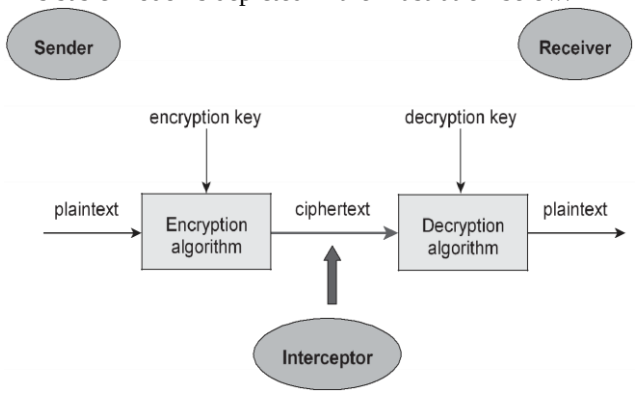
he following table shows the primitives that can achieve a particular security service on their own.

Primitives Service	Encryption	Hash Function	MAC	Digital Signature
Confidentiality	Yes	No	No	No
Integrity	No	Sometimes	Yes	Yes
Authentication	No	No	Yes	Yes
Non Reputation	No	No	Sometimes	Yes

Cryptosystems

A cryptosystem is an implementation of cryptographic techniques and their accompanying infrastructure to provide information security services. A cryptosystem is also referred to as a cipher system.

Let us discuss a simple model of a cryptosystem that provides confidentiality to the information being transmitted. This basic model is depicted in the illustration below:



The illustration shows a sender who wants to transfer some sensitive data to a receiver in such a way that any party intercepting or eavesdropping on the communication channel cannot extract the data.

The objective of this simple cryptosystem is that at the end of the process, only the sender and the receiver will know the plaintext.

Components of a Cryptosystem

The various components of a basic cryptosystem are as follows:

Plaintext. It is the data to be protected during transmission.

Encryption Algorithm. It is a mathematical process that produces a ciphertext for any given plaintext and encryption key. It is a cryptographic algorithm that takes plaintext and an encryption key as input and produces a ciphertext.

Ciphertext. It is the scrambled version of the plaintext produced by the encryption algorithm using a specific the encryption key. The ciphertext is not guarded. It flows on public channel. It can be intercepted or compromised by anyone who has access to communication channel.

Decryption Algorithm, It is a mathematical process, that produces a unique plaintext for any given cipher text and decryption key. It is a cryptographic algorithm that takes a cipher text and a decryption key as input, and outputs a plaintext. The decryption algorithm essentially reverses the encryption algorithm and is thus closely related to it.

Encryption Key. It is a value that is known to the sender. The sender inputs the encryption key into the encryption algorithm along with the plaintext in order to compute the cipher text.

Decryption Key. It is a value that is known to the receiver. The decryption key is related to the encryption key, but is not always identical to it. The receiver inputs the decryption key into the decryption algorithm along with the cipher text in order to compute the plaintext.

For a given cryptosystem, a collection of all possible decryption keys is called a key space.

An interceptor (an attacker) is an unauthorized entity who attempts to determine the plaintext. He can see the ciphertext and may know the decryption algorithm. He, however, must never know the decryption key

IV. CONCLUSION AND FUTURE WORK

With the explosive growth in the Internet, network and data security have become an inevitable concern for any organization whose internal private network is connected to the Internet. The security for the data has become highly important. User's data privacy is a central question over cloud. With more mathematical tools, cryptographic schemes are getting more versatile and often involve multiple keys for a single application.

The paper presented various schemes which are used in cryptography for Network security purpose. Encrypt message with strongly secure key which is known only by sending and recipient end, is a significant aspect to acquire robust security in cloud. The secure exchange of key between sender and receiver is an important task. The key management helps to maintain confidentiality of secret information from unauthorized users. It can also check the integrity of the exchanged message to verify the authenticity. Network security covers the use of cryptographic algorithms in network protocols and network applications. This paper briefly introduces the concept of computer security, focuses on the threats of computer network security

In the future, work can be done on key distribution and management as well as optimal cryptography algorithm for data security over clouds.

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