

# Теория Информации

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*Лекция 1*

2015

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***E-Commerce security:*** E-commerce security standards. SET protocol.

***Internet Banking security:*** Online Banking Security. Password and PIN security:

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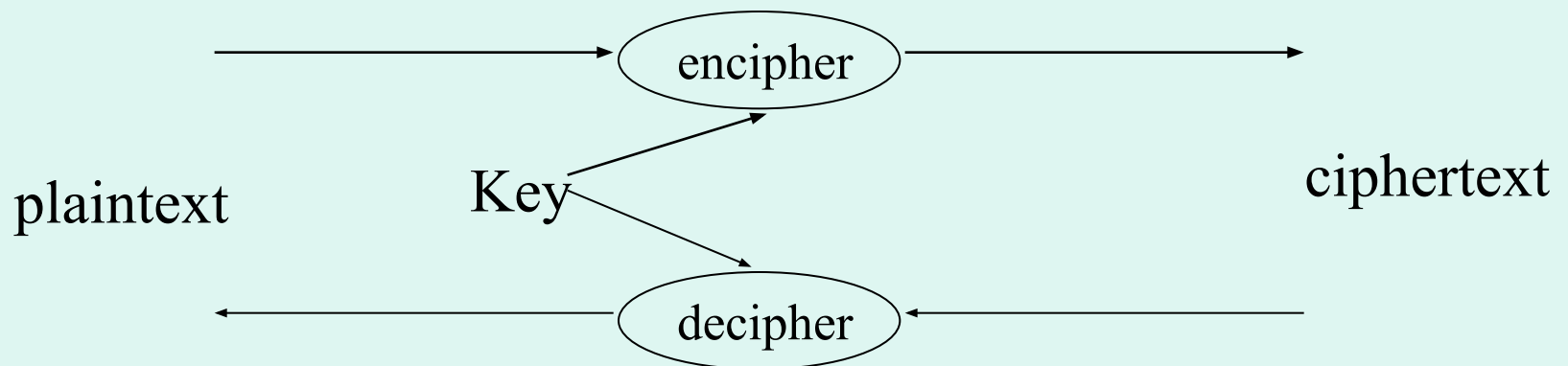
# Introduction

*Cryptography* is the science and study of secret writing.

A *cipher* is a secret method of writing, whereby *plaintext* (or *cleartext*) is transformed into *ciphertext* (*cryptogram*).

*Encipherment* (*encryption*) is the process of transforming plaintext into ciphertext.

*Decipherment* (*decryption*) is the reverse process of transforming ciphertext into plaintext. Both encipherment and decipherment are controlled by a cryptographic *key* or *keys*.



**Fig.1.1.** Secret writing

# Introduction

## *Transposition ciphers*

- There are two basic types of ciphers *transpositions* and *substitutions*.
- *Transposition ciphers* rearrange bits or characters.
- The following simple example of the “*rail-fence*” cipher illustrate this method.

C	R	Y	P	T	O	G	R	A	P	H	Y
				⇓							
C				T				A			
	R		P		O		R		P		Y
		Y				G				H	
				⇓							
C	T	A	R	P	O	R	P	Y	Y	G	H

**Fig.1.2.** Rail-fence transposition cipher



# Introduction

## *Substitutions ciphers*

*Substitution ciphers* replace bits, characters, or blocks of characters with substitutes.

A simplest type of substitution cipher shifts each letter in the English alphabet forward by  $k$  positions cyclically (shifts past Z cycle back to A).  $k$  is the key to the cipher. This type of cipher is often called a *Caesar* cipher.

C R Y P T O G R A P H Y

↓

F U B S W R J U D S K B

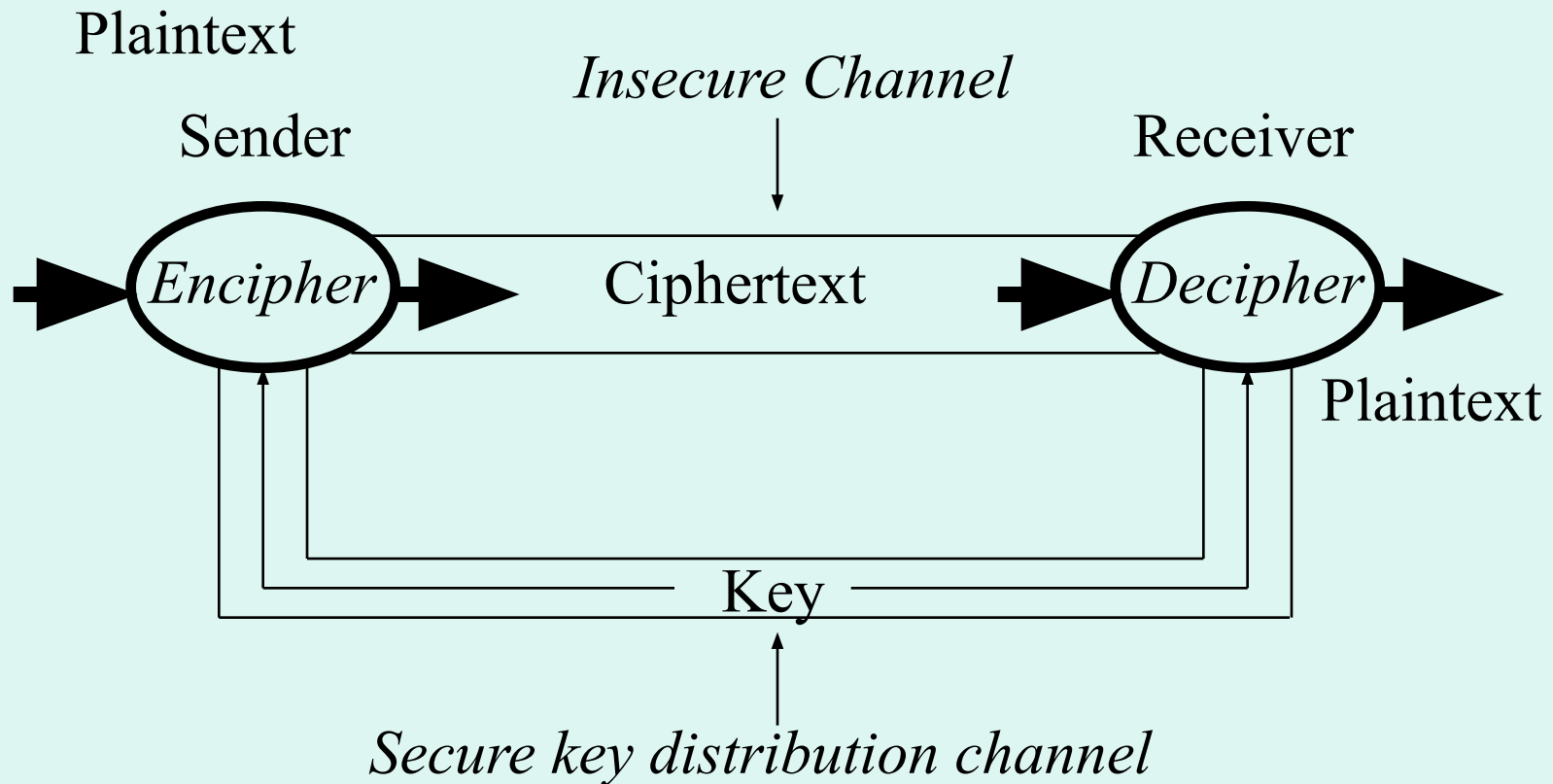
**Fig.1.3.** Caesar's substitution cipher

ABCDEFGHIJKLMNOPQRSTUVWXYZ

# Introduction

## *Data Security*

There are two principle objectives: *secrecy* (or *privacy*), to prevent the unauthorized disclosure of data; and *authenticity* (or *integrity*), to prevent the unauthorized modification of data.



**Fig.1.4.** Classical information channel

# Introduction

## *Cryptographic Systems*

A *cryptographic system* (or *cryptosystem* for short) has five components:

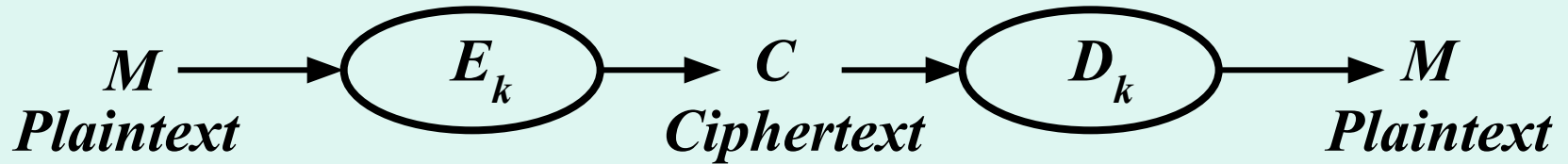
1. A *plaintext message space*,  $M$ .
2. A *cipher message space*,  $C$ .
3. A *key space*,  $k$ .
4. A family of *enciphering transform.*,  $E_k: M \rightarrow C$ .
5. A family of *deciphering transform.*,  $D_k: C \rightarrow M$ .

### *Cryptosystems General Requirements*

1. The system must be easy to use.
2. The enciphering and deciphering transformations must be efficient for all keys.
3. The security of the system should depend only on the secrecy of the keys and not on the secrecy of the algorithms  $E$  and  $D$ .

# Introduction

## *Requirement for secrecy and authenticity*



**Fig.1.5.** Cryptographic System.

### *Secrecy Requirements*

1. It should be computationally infeasible for a cryptanalyst to systematically determine the deciphering transformation  $D_k$  from intercepted ciphertext  $C$ , even if the corresponding plaintext  $M$  is known.
2. It should be computationally infeasible for a cryptanalyst to systematically determine plaintext  $M$  from intercepted ciphertext  $C$ .

### *Authenticity Requirements*

1. It should be computationally infeasible for a cryptanalyst to systematically determine the enciphering transformation  $E_k$  given  $C$  even if the corresponding plaintext  $M$  is known.
2. It should be computationally infeasible for a cryptanalyst to systematically find ciphertext  $C'$  such that  $D_k(C')$  is valid plaintext in the set  $M$ .

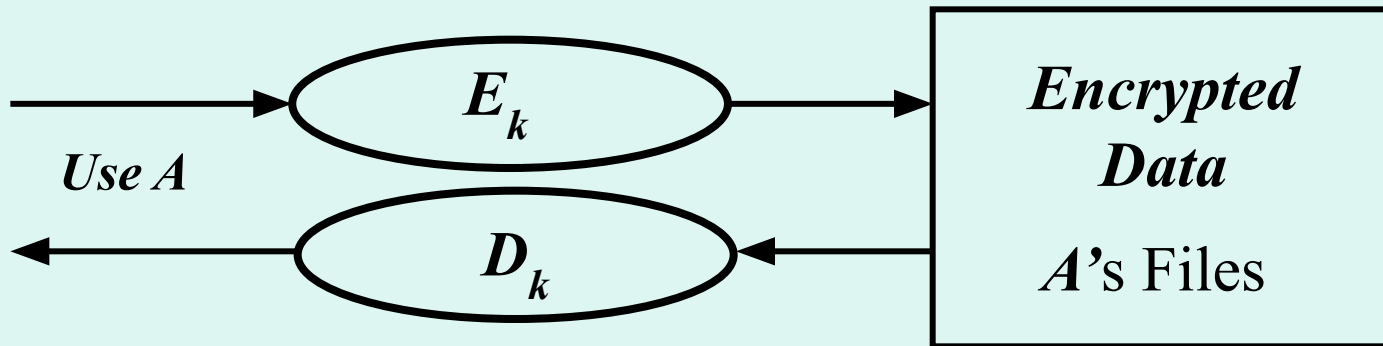
# Introduction

## *Simmons Cryptosystems Classifications*

*Simmons* classifies cryptosystems as *symmetric (one-key)* and *asymmetric (two-key)*.

In *symmetric* or *one-key* cryptosystems the enciphering and deciphering key are the same (or easily determined from each other). This means the transformations  $E_k$  and  $D_k$  are also easily derived from each other. Until recently, all cryptosystems were one-key systems only. There are also usually referred to as *conventional* (or *classical*) systems.

One-key systems provide an excellent way of enciphering user's private files. Each user A has private transformations  $E_k$  and  $D_k$  for enciphering and deciphering files.



**Fig.1.6.** Single-key encryption of private files

# Introduction

## *Public Key Cryptosystems*

In a public-key system, each user  $A$  has a *public transformation*  $E_A$ , which may be registered with a public directory, and a *private transformation*  $D_A$ , which is known only to that user.

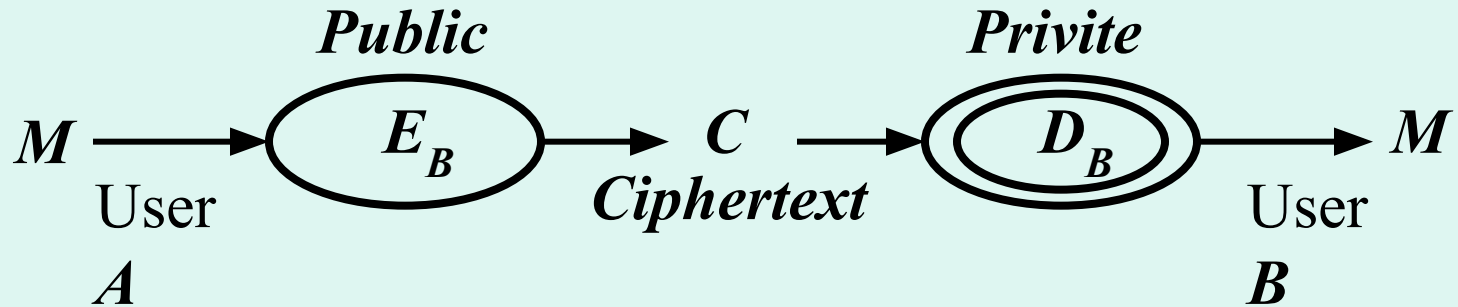
The private transformation  $D_A$  is described by a private key, and the public transformation  $E_A$  by a public key derived from the private key by one-way transformation. It must be computational infeasible to determine  $D_A$  from  $E_A$  (or even to find a transformation equivalent to  $D_A$ ).

In a public-key system, secrecy and authenticity are provided by the separate transformations. Suppose user  $A$  wishes to send a message  $M$  to another user  $B$ . If  $A$  knows  $B$ 's public transformation  $E_B$ ,  $A$  can transmit  $M$  to  $B$  in secrecy by sending the ciphertext  $C = E_B(M)$ . On receipt,  $B$  deciphers  $C$  using  $B$ 's private transformation, getting

$$D_B(C) = D_B(E_B(M)) = M.$$

# Introduction

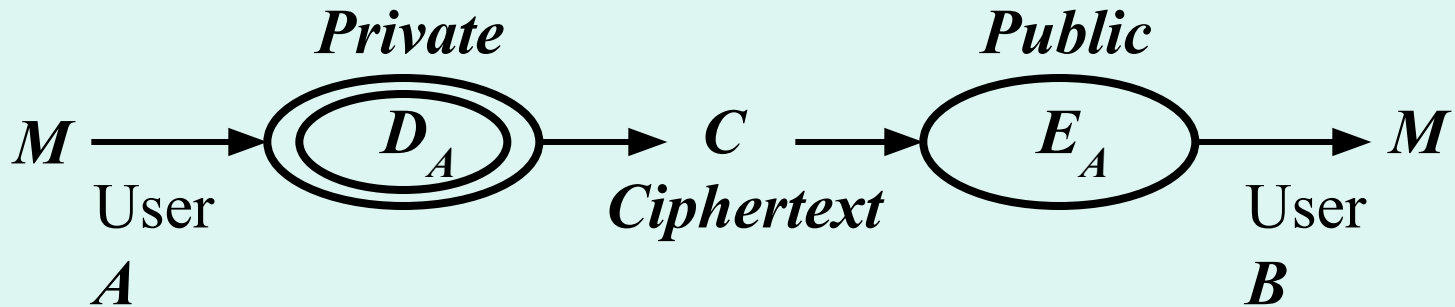
## *Public Key Cryptosystems*



**Fig.1.7.** Secrecy in public-key system

For authenticity,  $M$  must be transformed by  $A$ 's own private transformation  $D_A$ . Ignoring secrecy for the moment,  $A$  sends  $C=D_A(M)$  to  $B$ . On receipt,  $B$  uses  $A$ 's public transformation  $E_A$  to compute

$$E_A(C)=E_A(D_A(M))=M$$



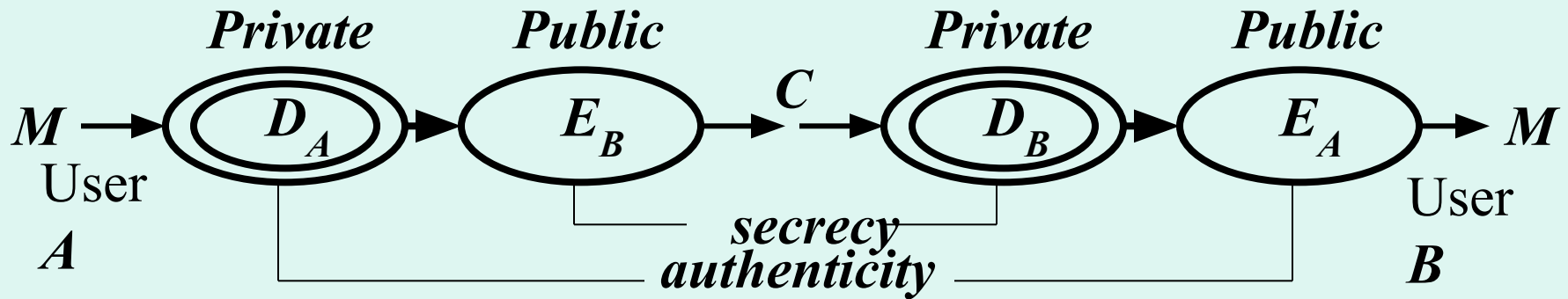
**Fig.1.8.** Authenticity in public-key system

# Introduction

## *Public Key Cryptosystems*

To achieve both secrecy and authenticity, the sender and receiver must each apply two sets of transformations. Sender  $A$  generates a ciphertext  $C = E_B(D_A(M))$ , and  $B$  recovers  $M$  according to

$$E_A(D_B(C)) = E_A(D_B(E_B(D_A(M)))) = E_A(D_A(M)) = M.$$



**Fig.1.9.** Secrecy and Authenticity in public-key system