

# Asymmetric Cryptography and Key Management

## Key Distribution and Management

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# **Module: Key Distribution and Management**

Key distribution overview

Key hierarchy

Public-key authority

Public-key certificates



# **Key Distribution and Management**

Key distribution/management are complex

Alice and Bob establish:

- Shared secret key for symmetric cryptography
- Valid/authenticated public keys for asymmetric cryptography

## **Key Distribution Approaches**

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2. Third party can physically deliver the key to A and B
3. If they communicated previously, A and B can use a previous key to encrypt and communicate the new key
4. If A and B have secure communications w/ a trusted third party C, C can deliver key



## **Key Hierarchy**

Session key:

- Temporary; used for one or few sessions
- Used between users for data encryption

Master key:

- Encrypt session keys
- Shared between user and key distribution center

## Decentralized Key Distribution

Assume symmetric key ( $K_m$ ) distributed  
for both Alice and Bob

Use  $K_m$  to distribute and share  $K_s$

**Alice**

**Bob**

$|D_A| |N_1$  ----->

**Alice**

**Bob**

$|ID_A| |N_1$  ----->

<-----  $E(K_m, [K_s | | ID_A | | ID_B$   
 $| | f(N_1) | | N_2 ])$

**Alice**

**Bob**

$|ID_A| |N_1$  ----->

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$E(K_s | | f(N_2))$  ----->

**Alice**

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$E(K_s | | f(N_2))$  ----->

Need  $n(n-1)/2$  keys for  $n$  users



## **Public-Key Authority**

Builds on public directory securely  
registering {ID<sub>i</sub>,K<sub>i</sub>}

K<sub>i</sub> public key of user i  
and k<sub>i</sub> private key of user I

## **Public-Key Authority**

Builds on public directory securely  
registering  $\{ID_i, K_i\}$

Securely distribute keys from directory

Require users to know authority's  $K_{AU}$

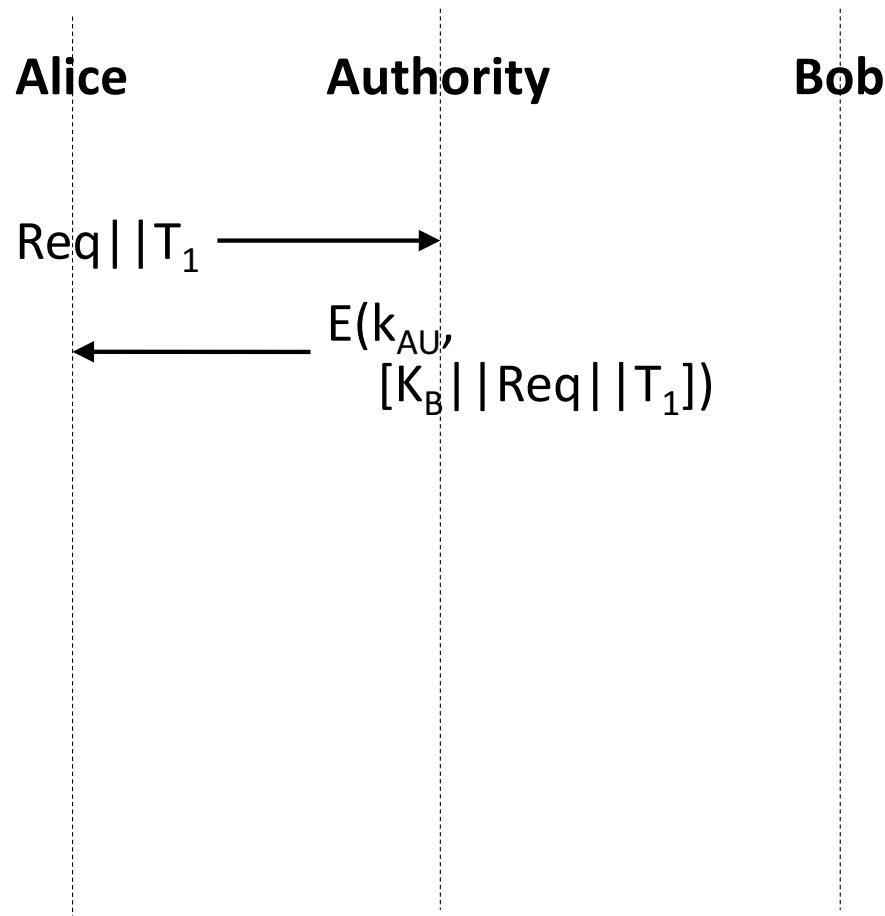
Require real-time access to authority

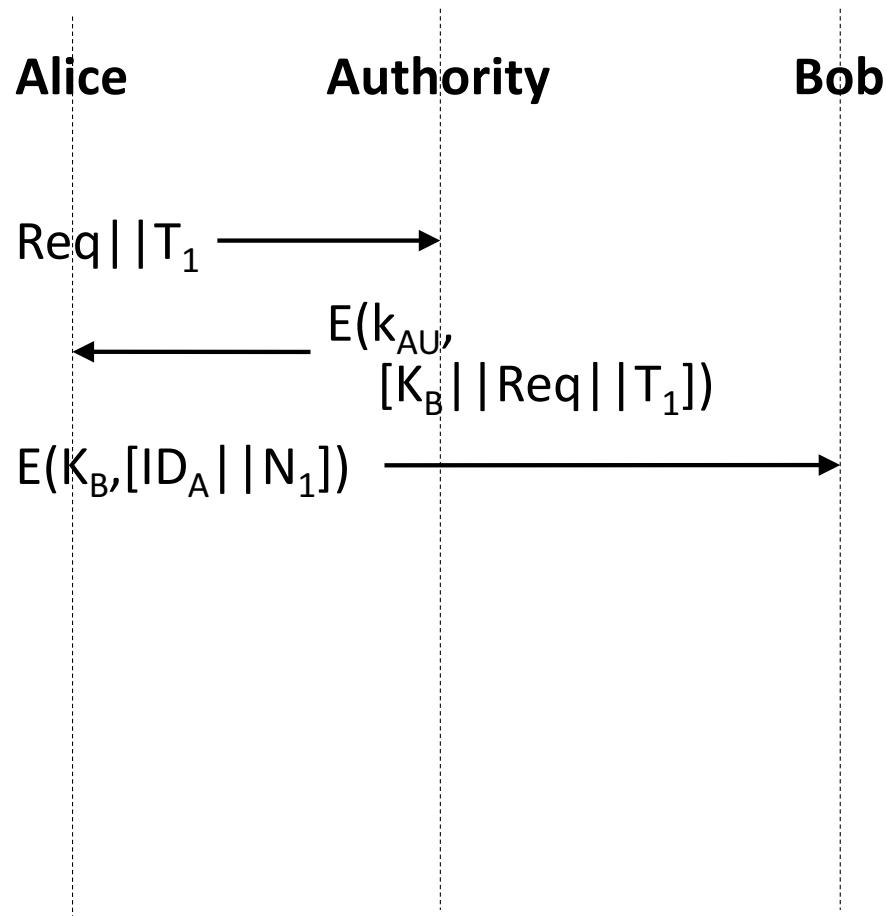
**Alice**

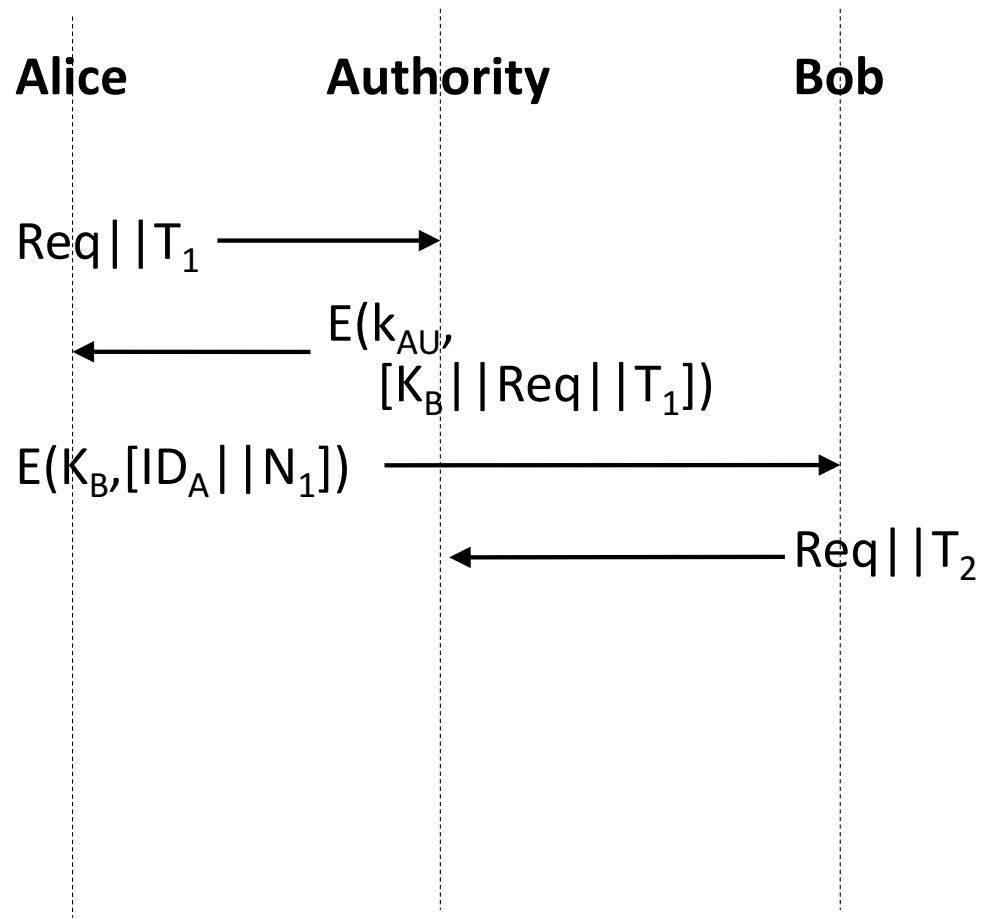
**Authority**

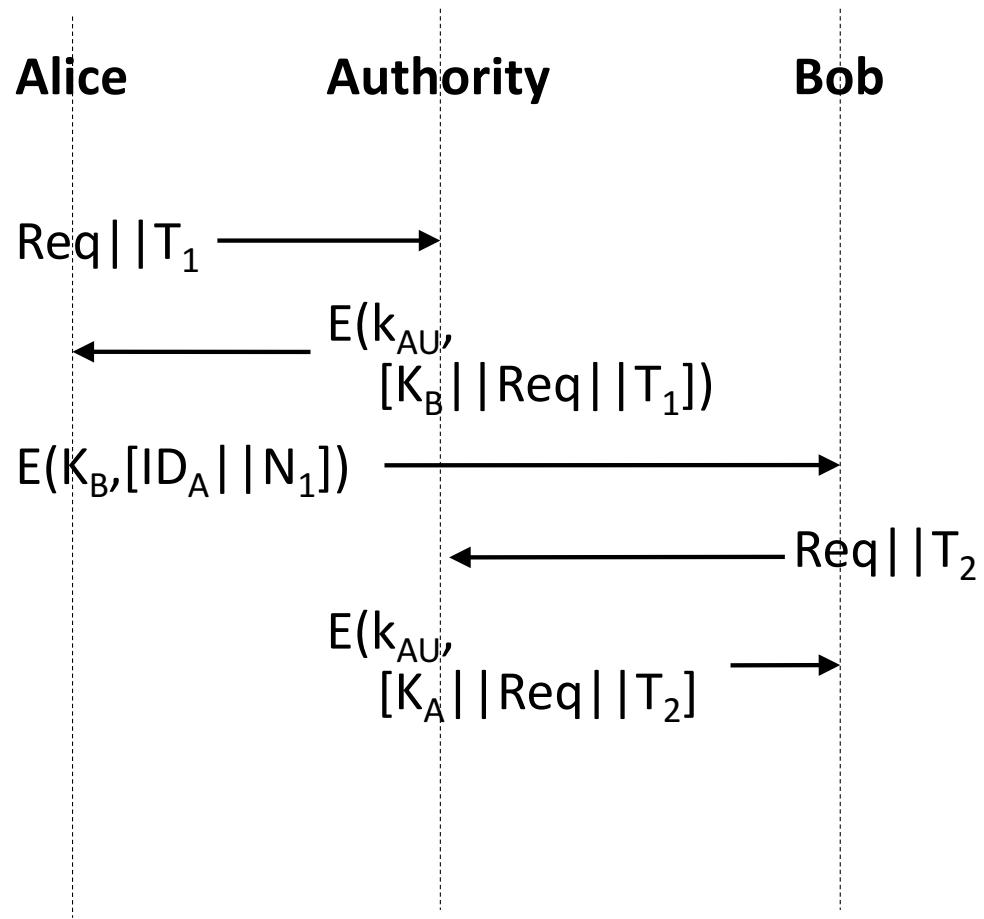
**Bob**

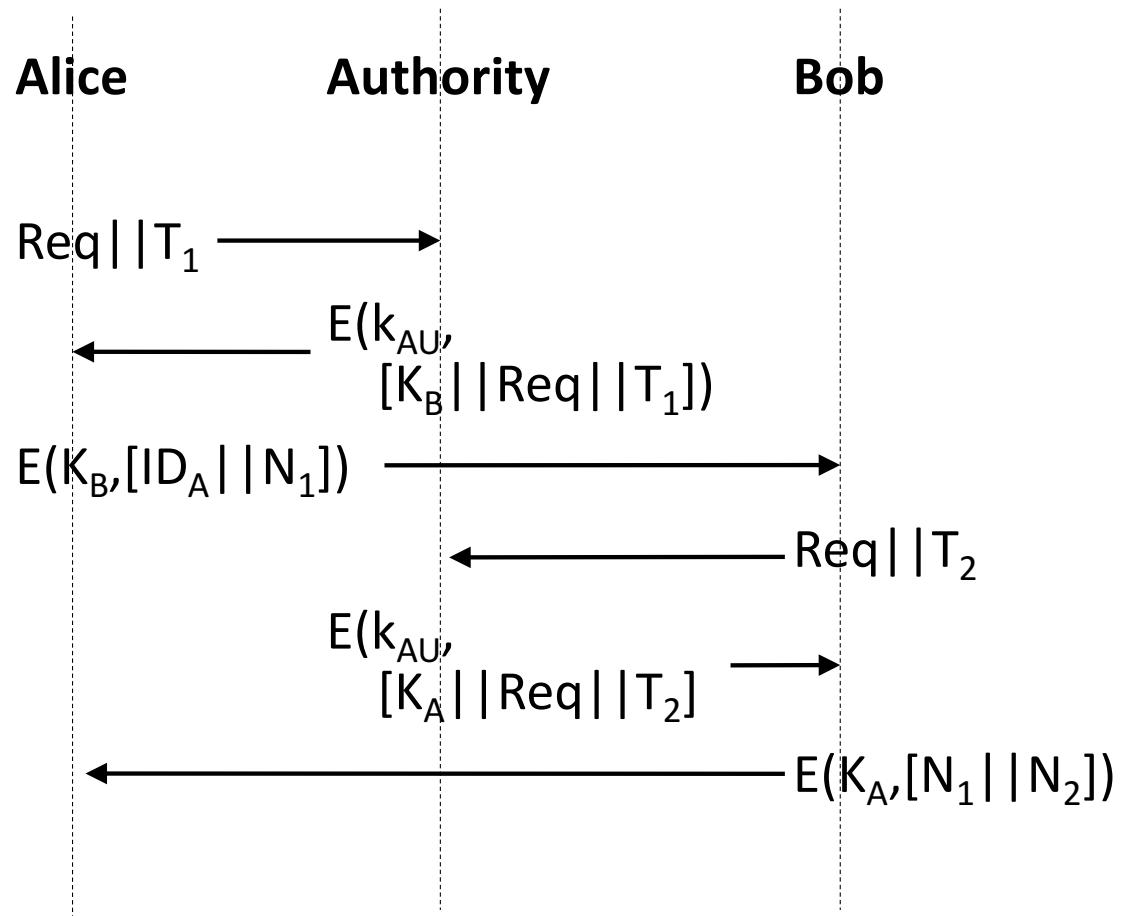
Req || T<sub>1</sub> —→

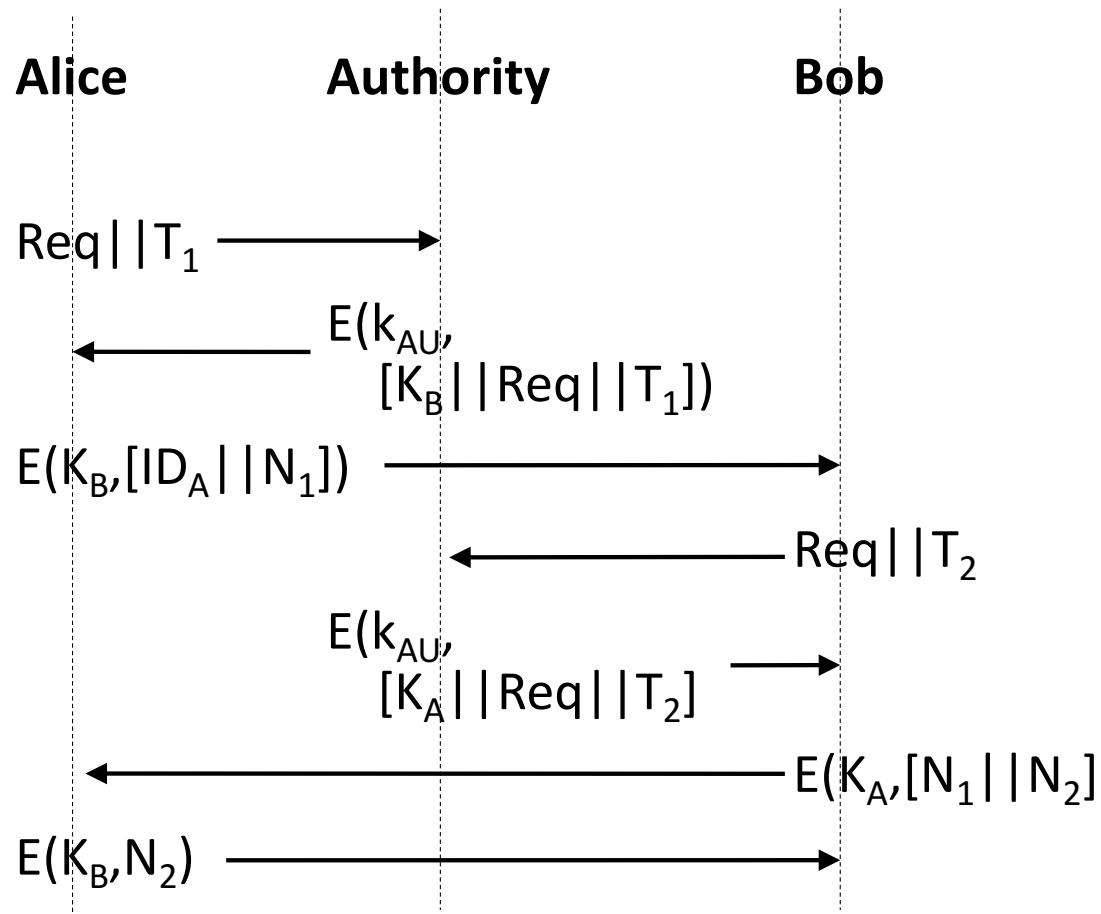


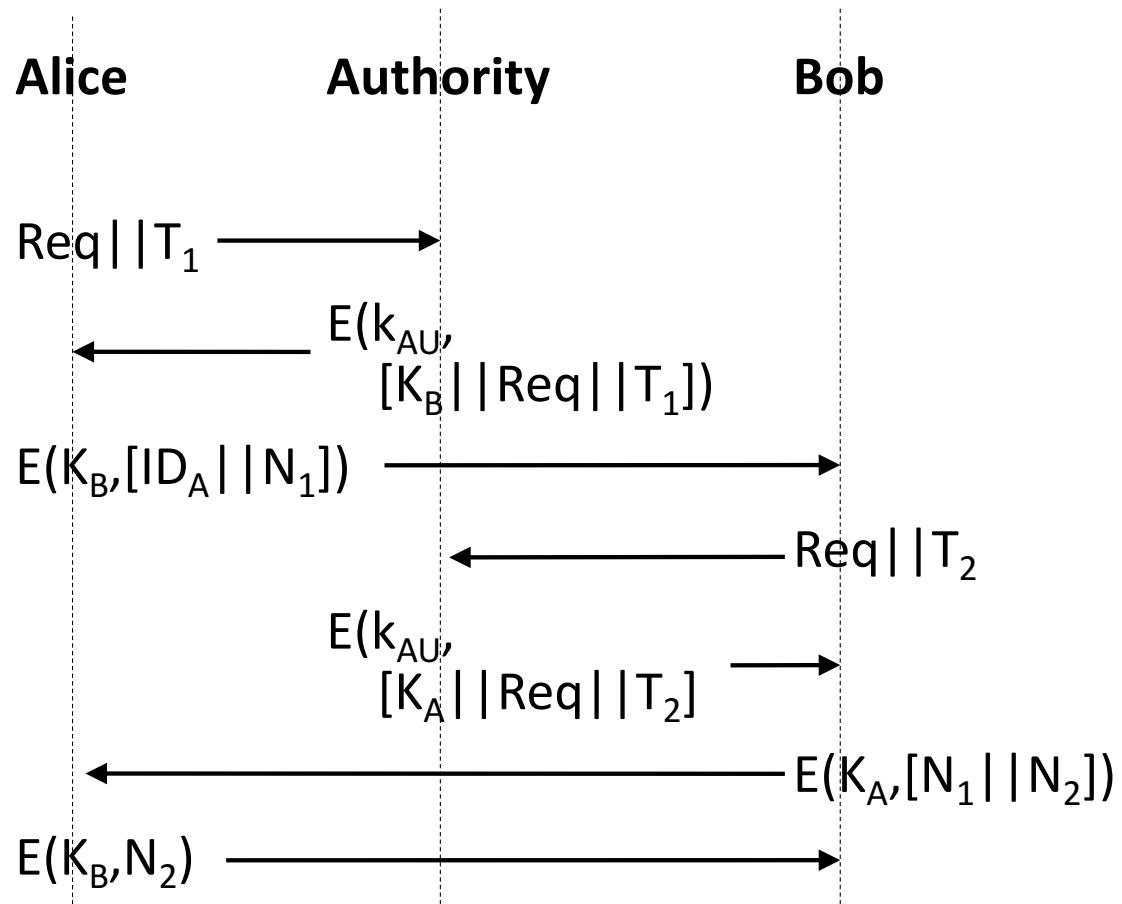












Real-time access of authority when key is needed



## **Public-Key Certificate**

Builds on p.-k. authority; binds i to  $K_i$

But allows key exchange without  
real-time access to the authority

Contains validity period, rights of use

Signed by Certificate Authority (CA)

## **Public-Key Certificate Requirements**

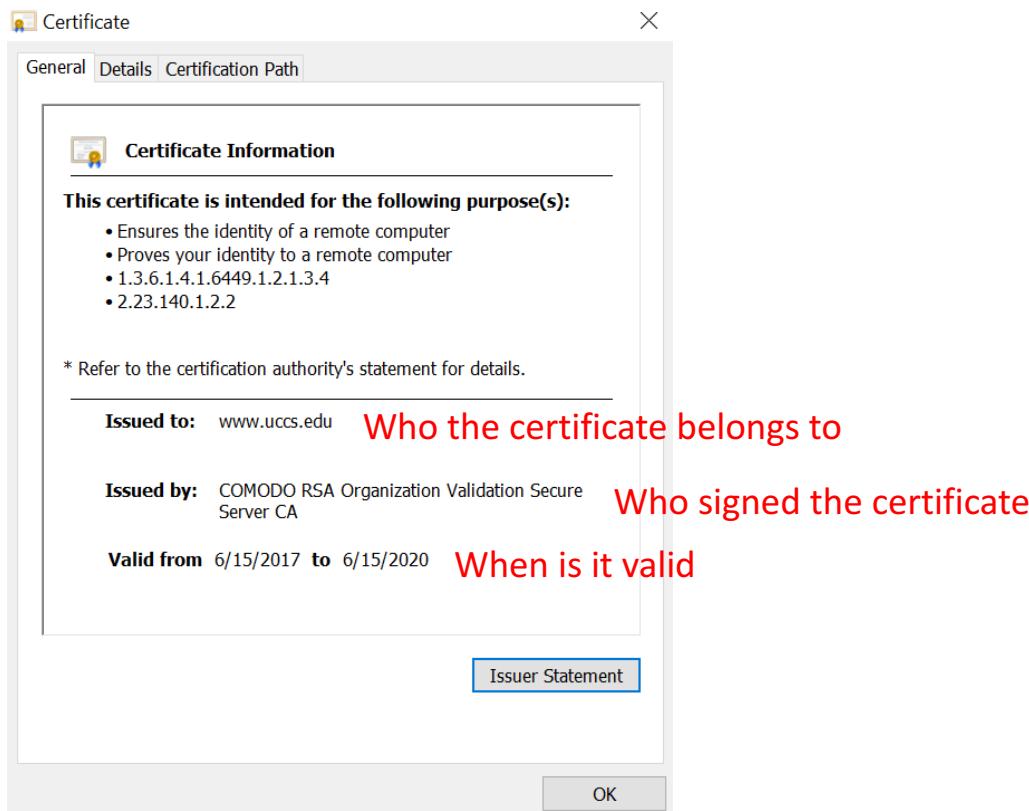
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E.g., X.509 certificate standard

# TLS Digital Certificate Example



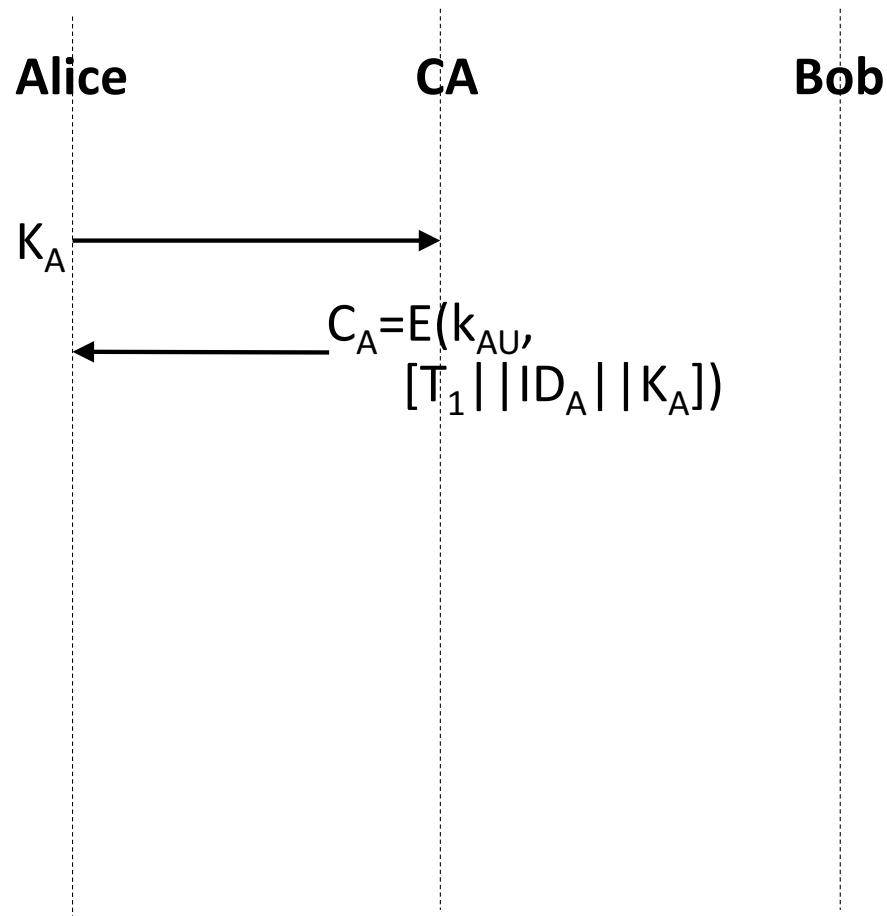
**Alice**

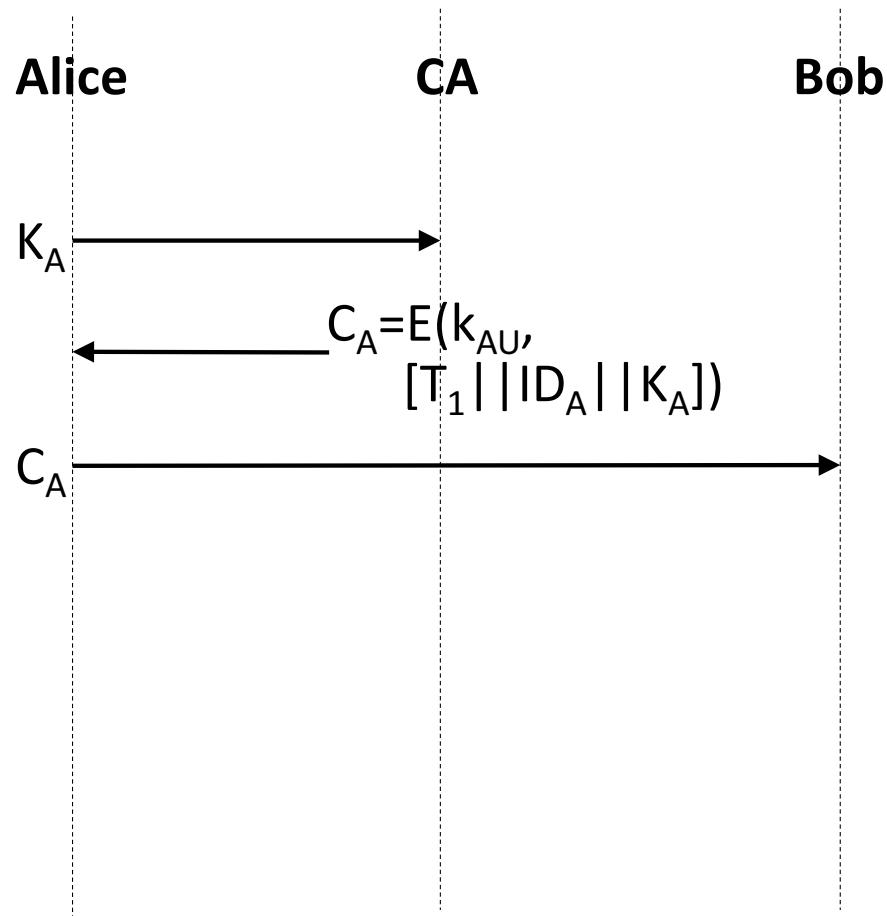
**CA**

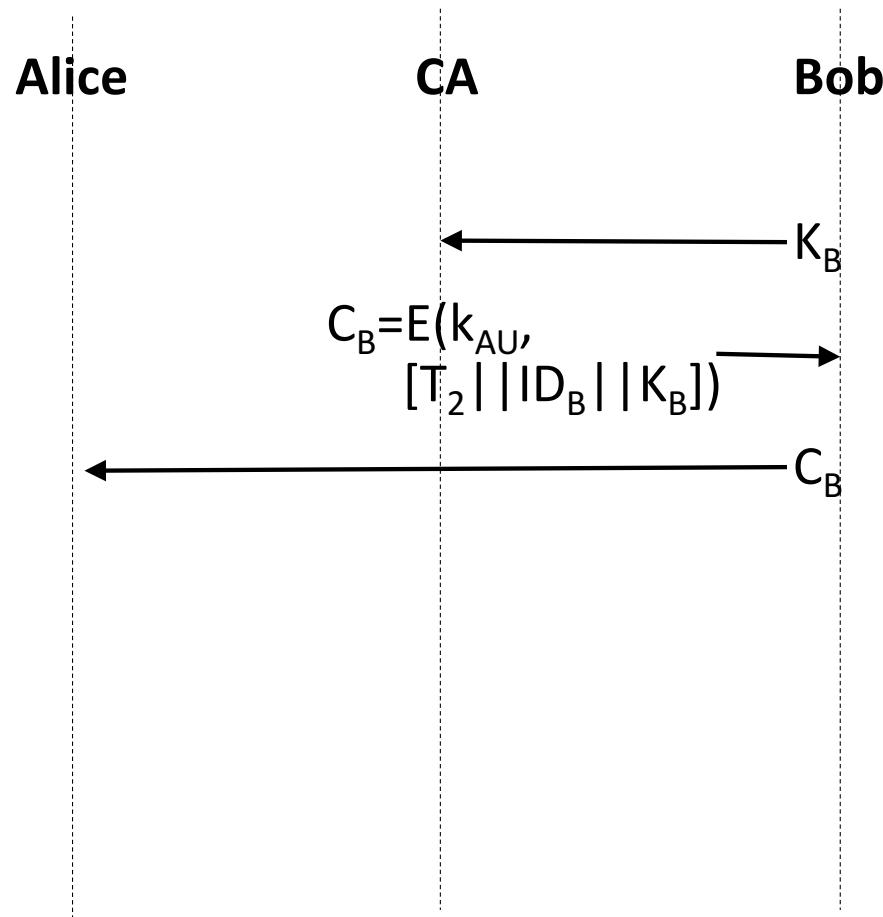
$K_A$

**Bob**









## **Public Key Infrastructure**

PKI is the system comprised of hardware, software, people policies, and procedures needed to create, manage, store, distribute, and revoke digital certificates

Enable secure, convenient, and efficient acquisition of public keys

