Distributed Information Processing

20th Lecture

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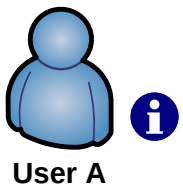
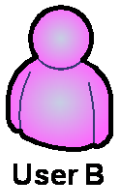
Outline

- DRM (Digital Rights Management)
  - Introduction
  - PKI and Certificate Chain
  - DRM for Content Distribution
  - OMA (Open Mobile Alliance) DRM
- Q&A

Secure Information Transfer





- How Can User A Send Information Securely to User B?
  - What does this mean?

Basic Security Concepts

- Identification (Against All Entities)
  - Process of Recognizing a Particular Individual Using Presented Information
- Authentication (Against a Previously Identified Entity)
  - Process of Verifying Certain Information
- Authorization
  - Process of Determining What You Are Allowed to Do

Basic Security Concepts (Cont'd)

- Integrity
  - Process of Ensuring That Information Is Unchanged
- Confidentiality
  - Keeping Information Secret
- Non-Repudiation
  - Not Being Able to Deny Something

Cryptography Basics

- Definition
  - Science of Applying Mathematics to Increase Security
- Symmetric Cryptographic Algorithms
  - Taking Clear Text as Input Outputting the Cipher Text Using a Symmetric Key, and Reversing This Process
    - DES (Data Encryption Standard)
    - 3-DES
    - RC2, RC5, RC6
    - Rijndael(or AES, Advanced Encryption Standard)

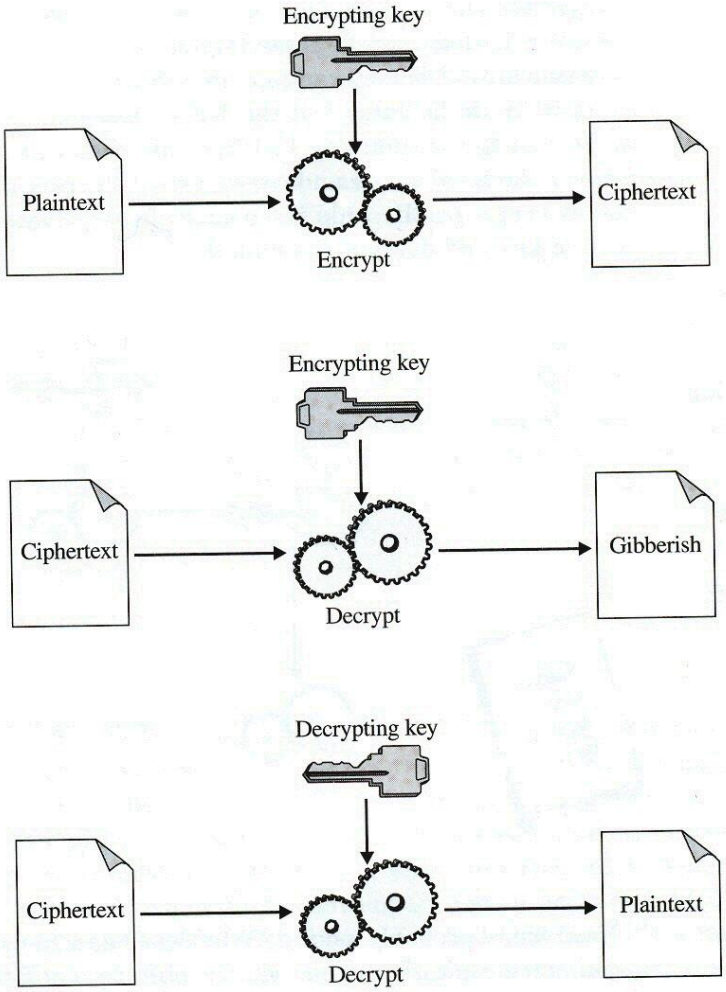
Cryptography Basics (Cont'd)

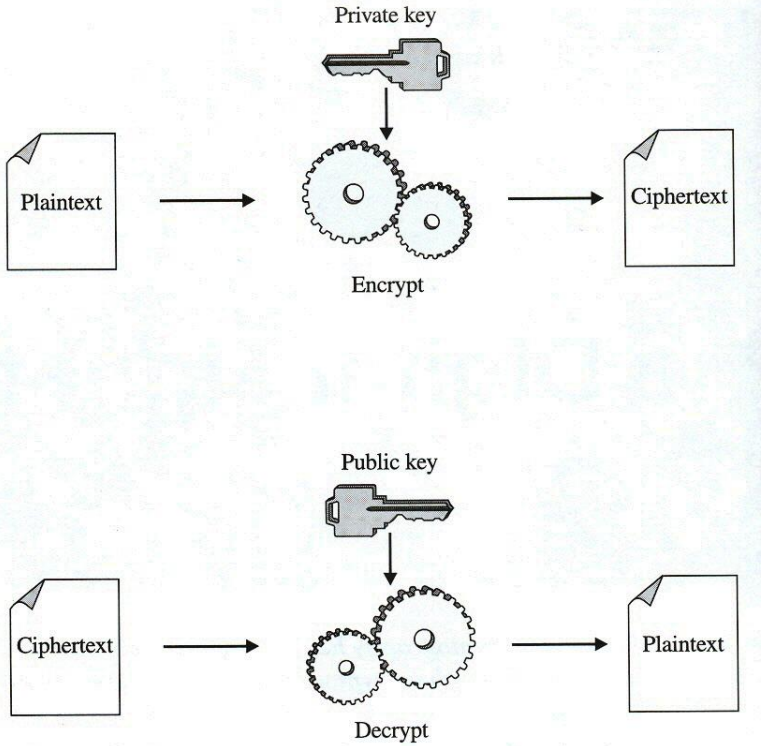
- Asymmetric Cryptographic Algorithms
  - Taking Clear Text as Input Outputting the Cipher Text Using a Public/Private Key, and Reversing this Process Using the Matching Private/Public (Respectively) Key
    - DH (Diffie-Hellman)
    - RSA (Rivest, Shamir, and Adleman at MIT)
    - ECC (Elliptic Curve Cryptography)

PKI (Public Key Infrastructure): the Public/Private Key-Based Encryption Framework That Permits Deploying Security Services

Cryptography Basics (Cont'd)

- Illustrations: Asymmetric Cryptography





Cryptography Basics (Cont'd)

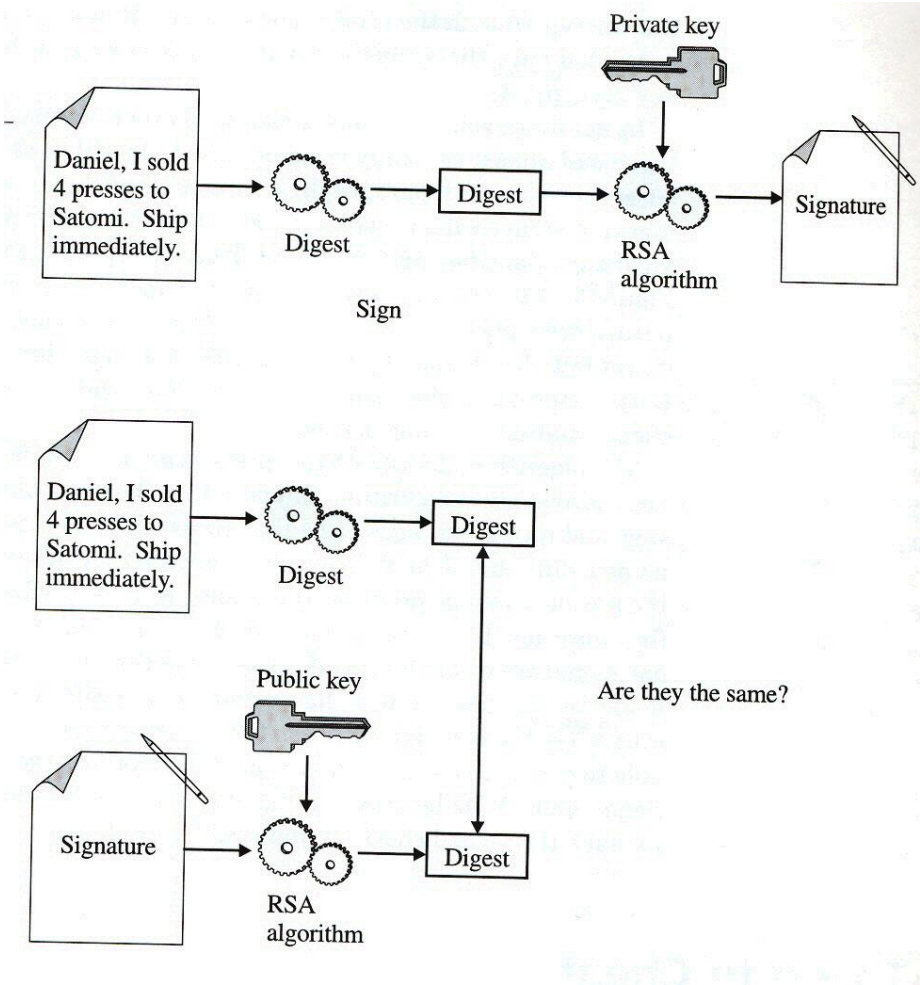
- Symmetric vs Asymmetric Cryptographic Algorithms
  - Advantages of Asymmetric Algorithms
    - Superior key management and scaling
    - Unnecessary prior relationship
    - Private-key-holder only operations (as a basis for digital signatures)
  - Disadvantages of Asymmetric Algorithms
    - Possibly 10 to 100 times slower execution
    - Expansion of the cipertext

Cryptography Basics (Cont'd)

- Hash Algorithms
  - Definition
    - Taking a chunk of data and compressing it into a digest (or fingerprint) of the data
  - Examples
    - MD2 (128-bit digest; best for 8-bit processors)
    - MD5 (128-bit digest; best for 32-bit processors)
    - SHA-1 (160-bit digest; best for high-end processors)
  - Properties
    - No backward recovery
    - No information about the initial clear text
    - No backward creation/discovery

Digital Signatures

- Data Encrypted with a Private Key
  - Technique for Authentication and Non-Repudiation
    - If a public key properly decrypts data, then it must have been encrypted with the private key



Verifying Integrity, too

Certificate

- Notarized Association between the Particular User with the Particular Public Key

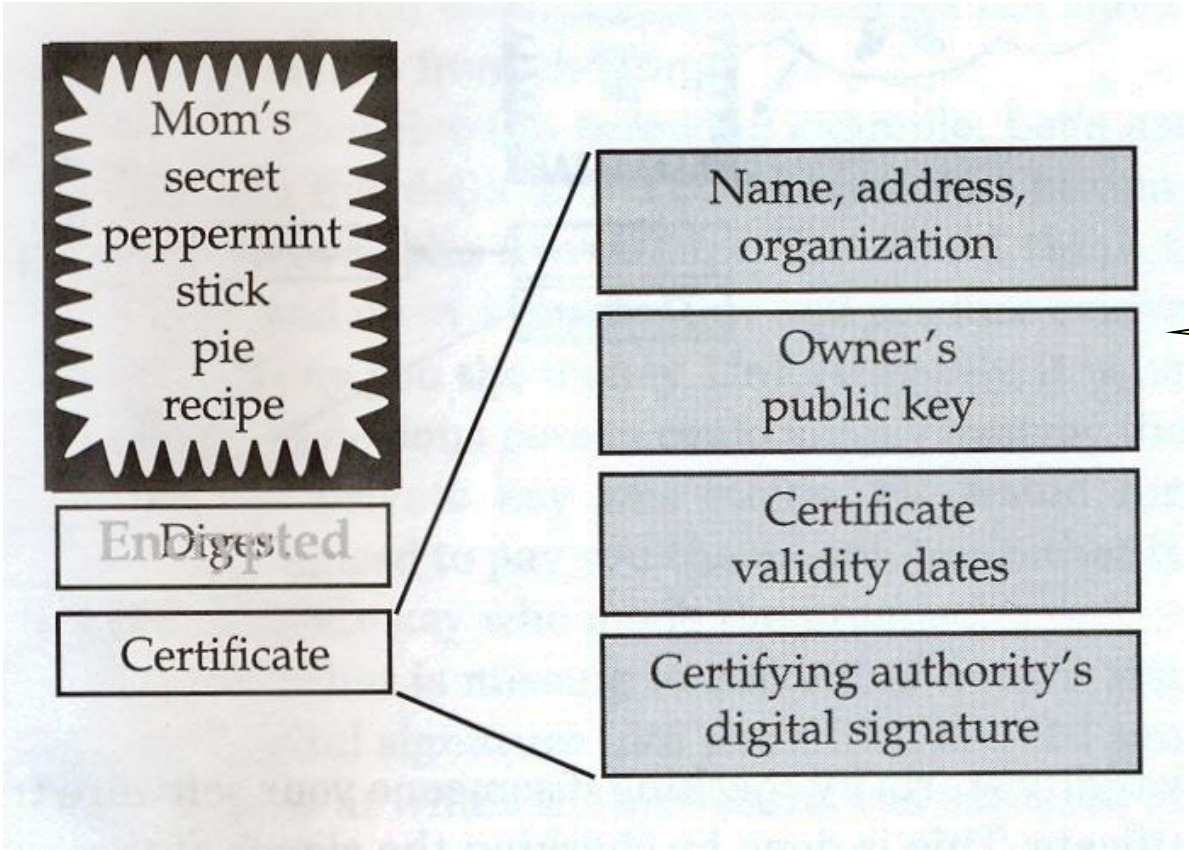
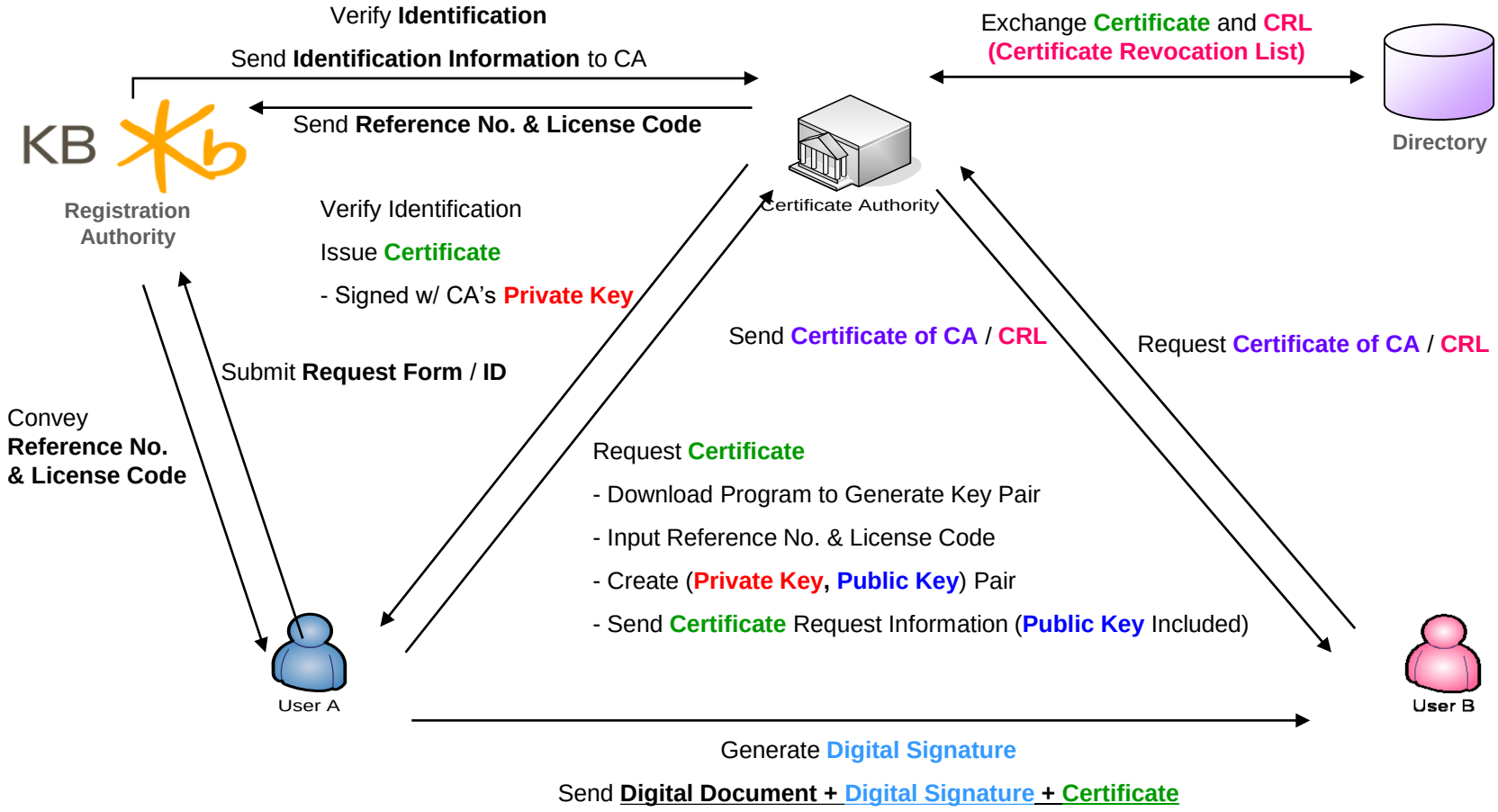


Illustration: Public Key Infrastructure



Save **Certificate** on the Storage (HDD, USB, etc)

Encrypt / Save **Private Key** Using Password

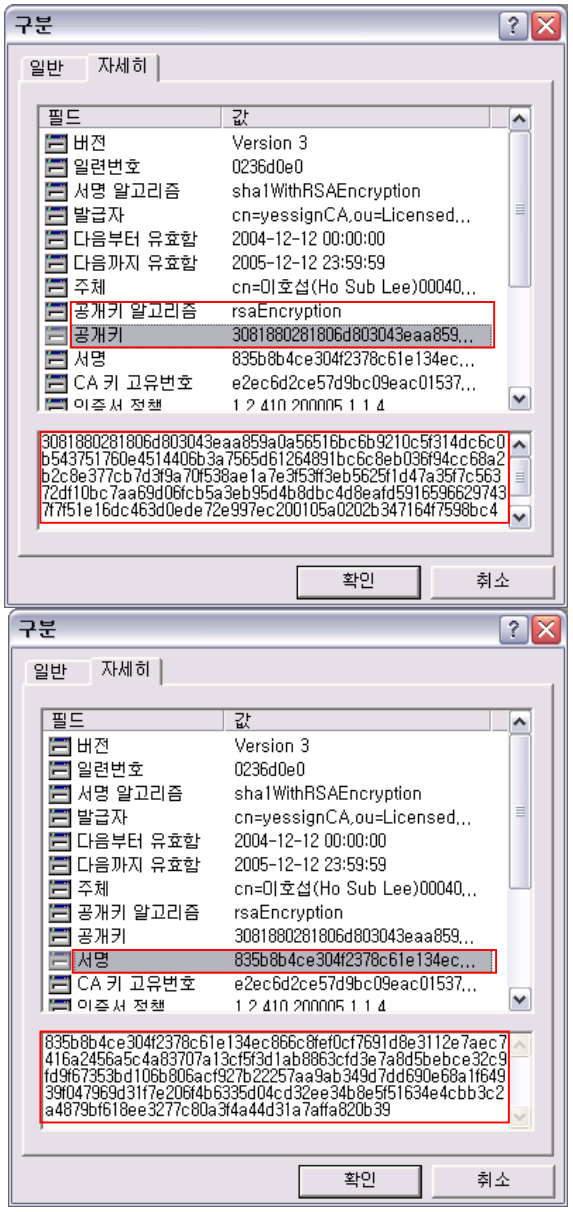
Verify **CRL**

Verify **Certificate** of User A

Verify **Digital Signature** of User A

X.509 Certificate

- X.509 Specification
  - Information Contained in a Certificate, and Its Format
- Components
  - Version
    - Indicator of Version 1,2, or 3
  - Serial Number
    - Unique Identifying Number for This Certificate
  - Signature
    - Algorithm Identifier of the Digital Signature Algorithm
  - Issuer
    - X.500 Name of the Issuing CA
  - Validity
    - Start and Expiration Dates and Times of the Certificate
  - Subject
    - X.500 Name of the Holder of the Private Key (Subscriber)
  - Subject Public-Key Information
    - Value of the Public-Key for the Subject Together with an Identifier of the Algorithm with Which This Public-Key to Be Used



Security Holes in PKI

- Fabricated Identification Card
- Illegal Copy of Certificate
- Hacking Program
  - E.g. Key Logger Program
    - Hacker can get id/password, account no, security card no, and password for encrypting **private key**
    - Hacker can disguise himself/herself as a user

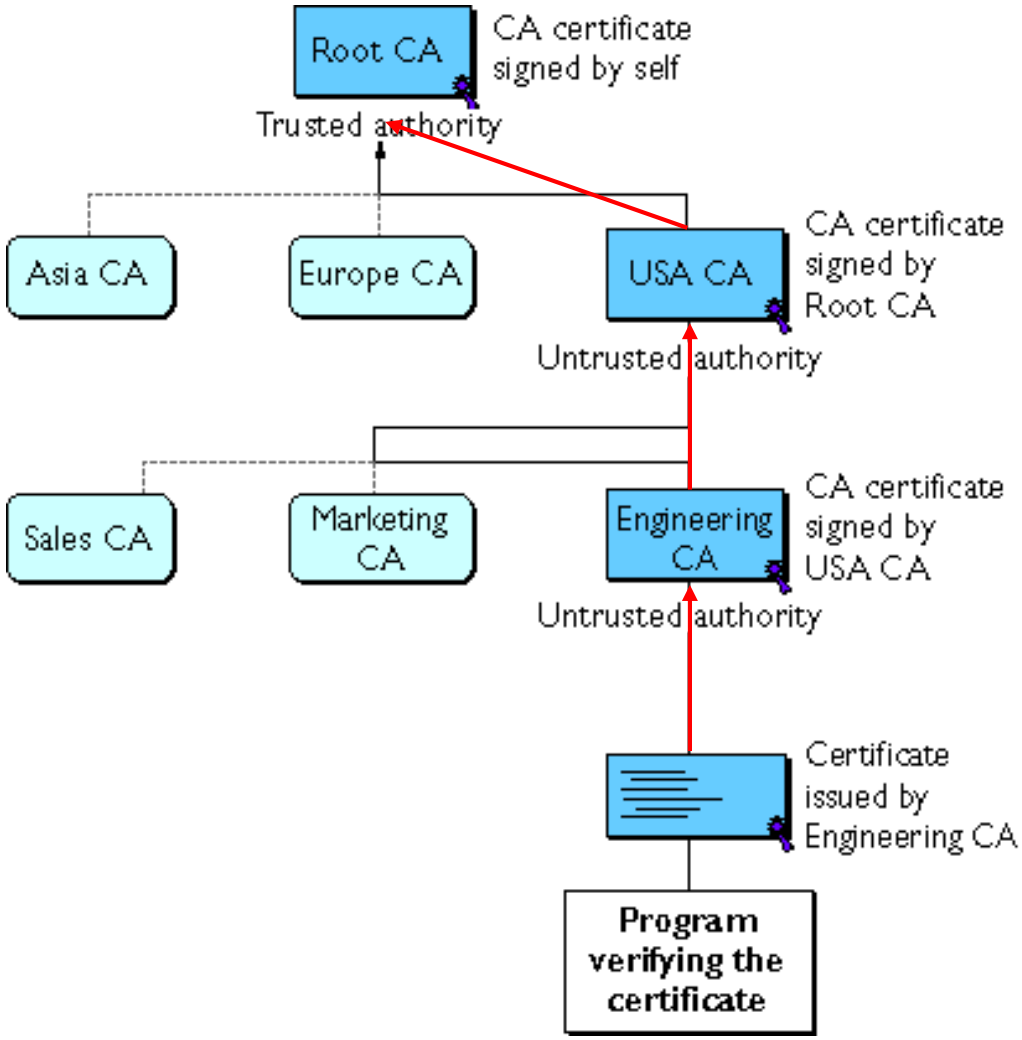
The Main Reasons for These Security Holes Are Unsafe Storage, Operating System, and Character-Based Protection Mechanism.

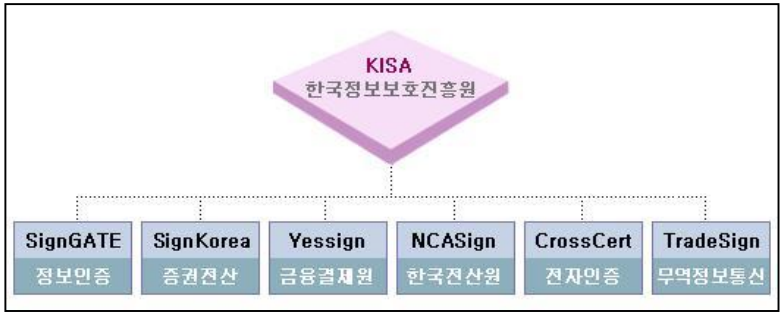
☞ **Security-Enabled Storage Medium, OS Security Patch, and Biometrics**

Certificate Chain

- X.509 Standard Model for Setting Up a Hierarchy of CAs
  - In Large Organizations, It May Be Appropriate to Delegate the Responsibility for Issuing Certificates to Several Different Certificate Authorities
- Ordered List of Certificates Containing an End-User or Subscriber Certificate and Its Certificate Authority Certificates
  - Each Certificate Is Followed by the Certificate of Its Issuer
  - Each Certificate Contains the Name (DN) of That Certificate's Issuer
    - Same as the subject name of the next certificate in the chain
  - Each Certificate Is Signed with the Private Key of Its Issuer
    - Signature verifiable with the public key in the issuer's certificate, which is the next certificate in the chain

Certificate Chain Example





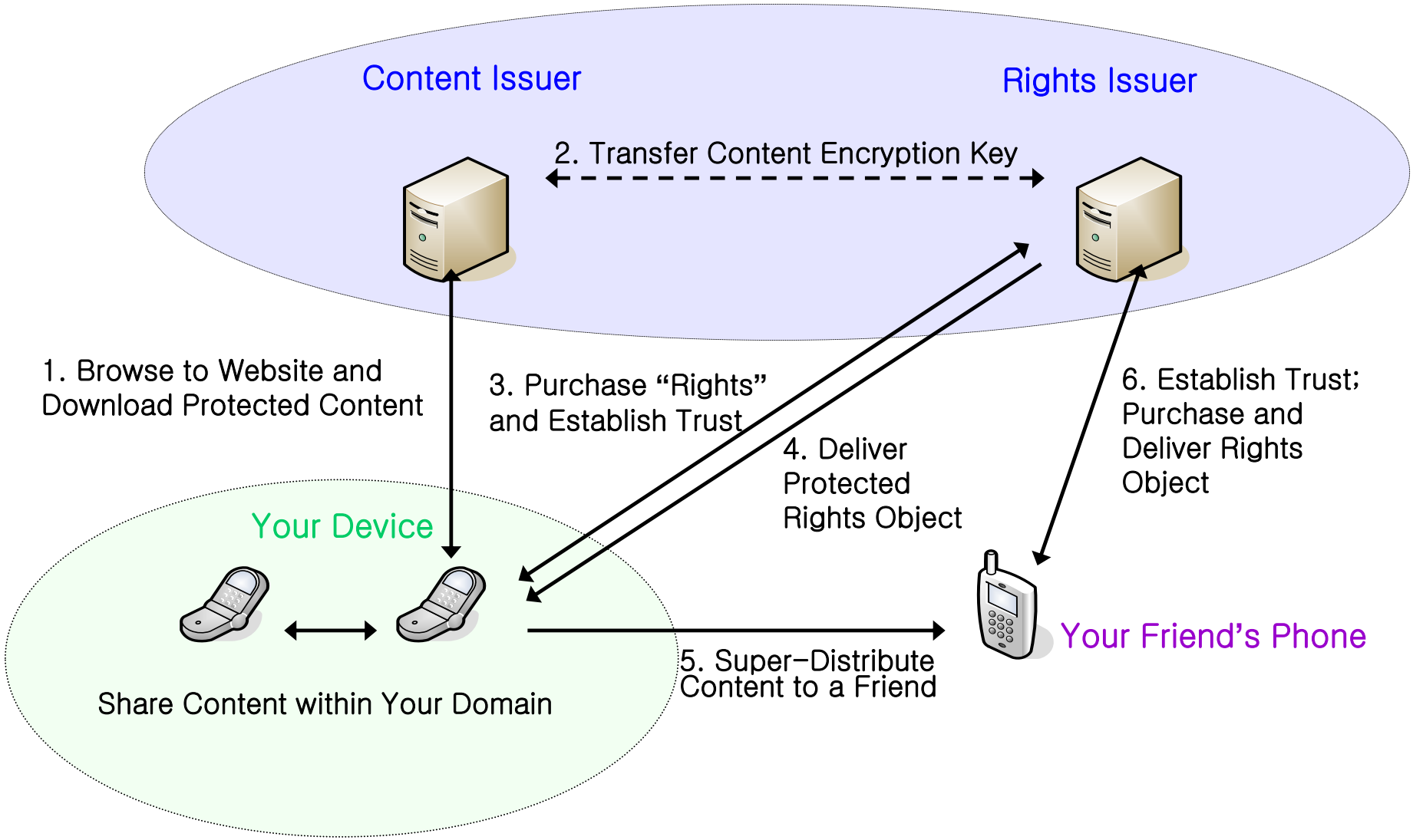
Korea

- Check Validity Period
- Verify That This Is Signed by Engineering CA
- Since Engineering CA Is Not Trusted,
  Check the Next Certificate

Applying DRM to Protect Content

- Distributing DRM Protected Content
  - Content Issuer's Encrypting the Content and Packaging in DRM Content Format
  - Rights Issuer's Assigning Permissions and Constraints for Content
  - User's Receiving Content and Rights
  - User's Sending the Protected Content to a Friend with OMA DRM Enabled Devices
  - Friend's Purchasing the Permission to Consume the Content

Example of OMA DRM Deployment



References

- [Burnett01] S. Burnett and S. Paine, *RSA Security's Official Guide to Cryptography*, Osborne/McGraw-Hill, March 2001
- [Nash01] A. Nash, *et al.*, *PKI: Implementing and Managing E-Security*, Osborne/McGraw-Hill, March2001
- [OMA] Open Mobile Alliance, www.openmobilealliance.org