中山大學
SUN YAT-SEN UNIVERSITY

Module I. Fundamentals of Information Security

Chapter 3
Authentication Technologies

Information Security: Theory & Applications

School of Data & Computer Science, Sun Yat-sen University

Outline

- **3.1 Overview**
  - Introduction to Authentication Technologies
  - The Weak/Strong Authentication Scheme
  - The Application of Authentication Technologies
  - The Attack to Authentication
  - The Security Guidelines to Protect Authentication Schemes
- **3.2 Public Key Infrastructure**
  - Introduction to PKI
  - PKIX
  - The Management of PKIX
  - Public Key Certificate
  - Trust Hierarchy Model

Outline

- 3.3 Kerberos
  - Introduction
  - Description
  - Kerberos Process
  - Drawbacks & Limitations
- **3.4 X.509**
  - What is X.509
  - Certificate
  - Security problems
  - Application

3.4 X.509

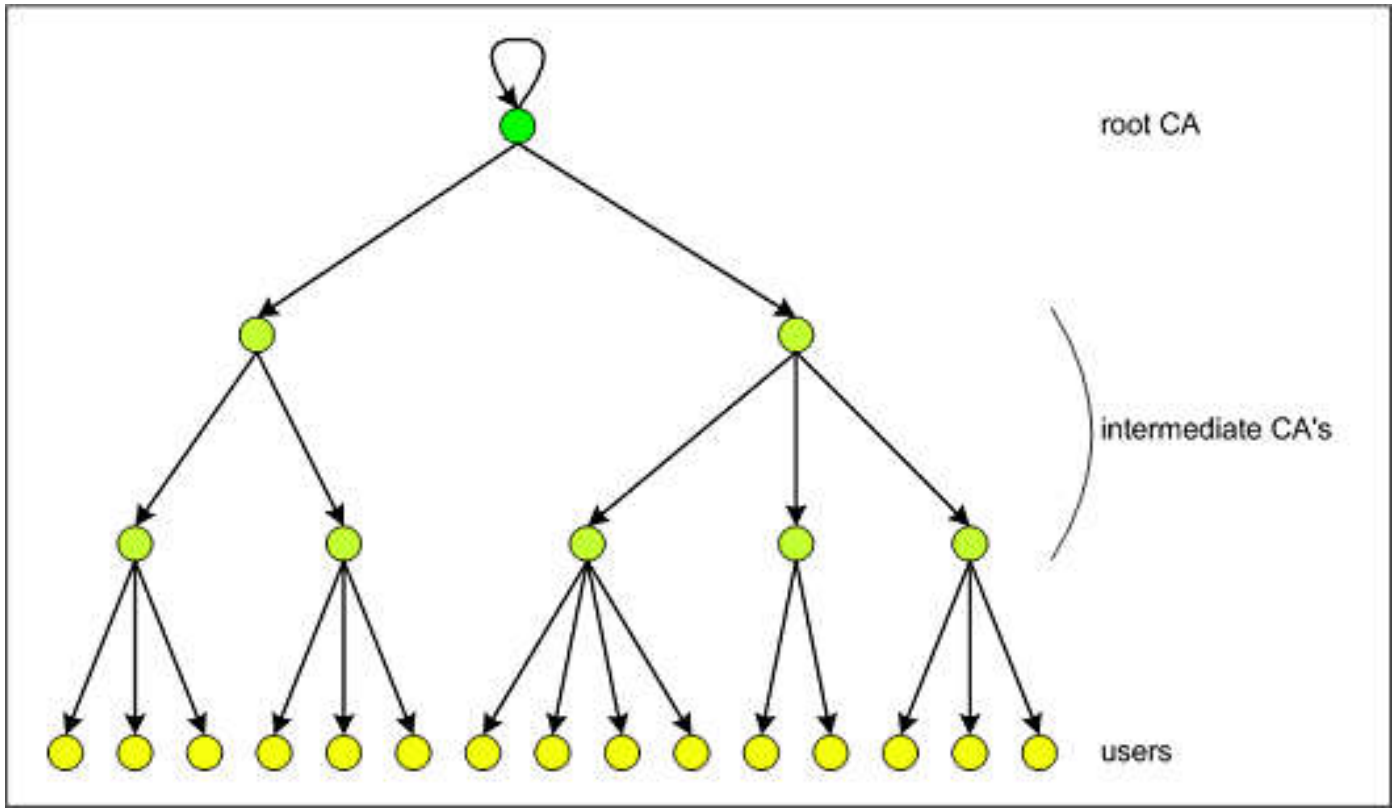
3.4.1 What is X.509

- **X.509**
  - X.509 is an ITU-T standard for a public key infrastructure (PKI) for single sign-on (SSO, 单点登录) and Privilege Management Infrastructure (PMI, 特权管理基础架构).
  - X.509 specifies, amongst other things, standard formats for public key certificates, certificate revocation lists, attribute certificates, and a certification path validation algorithm.
  - Key words
    - ✧ Certificate
    - ✧ CA (Certificate Authority)
    - ✧ Hierarchy

3.4 X.509

3.4.1 What is X.509

- **X.509**
  - Hierarchy



3.4 X.509

3.4.1 What is X.509

- **History and Versions**
  - Version 1 (1988): issued and associated with the X.500 Standard
  - Version 2 (not used widely): include Subject and Issuer identifier
  - Version 3 (1996): Extensions added
    - ✧ called PKIX for *Public Key Infrastructure*
  - RFC 5280

3.4 X.509

3.4.2 Certificate

- **Introduction**
  - In the X.509 system, a certification authority (CA) issues a **certificate** binding a public key to a particular distinguished name in the X.500 tradition, or to an alternative name such as an e-mail address or a DNS-entry.
  - An organization‘s trusted root certificates (根证书) can be distributed to all employees so that they can use the company PKI system.
  - Browsers such as IE, Netscape/Mozilla, Opera, Safari and Chrome come with root certificates pre-installed, so SSL certificates from larger vendors will work instantly; in effect the browsers' developers determine which CAs are trusted third parties for the browsers' users.

3.4 X.509

3.4.2 Certificate

- **Structure of Certificate**

Certificate
- Version
- Serial Number
- Algorithm ID
- Issuer (CA's name)
- Validity
  - Not Before
  - Not After
- Subject
- Subject Public Key Info
  - Public Key Algorithm
  - Subject Public Key
- Issuer Unique Identifier (Optional)
- Subject Unique Identifier (Optional)
- Extensions (Optional)
- Certificate Signature Algorithm
- Certificate Signature

3.4 X.509

3.4.2 Certificate

- **Example of Certificate**

Certificate:
Data:
Version: 1 (0x0)
Serial Number: 7829 (0x1e95)
Signature Algorithm: md5WithRSAEncryption
Issuer: C=ZA, ST=Western Cape, L=Cape Town, O=Thawte Consulting cc, OU=Certification Services Division, CN=Thawte Server, CA/emailAddress=server-certs@thawte.com
Validity:
Not Before: Jul 9 16:04:02 1998 GMT
Not After : Jul 9 16:04:02 1999 GMT
Subject: C=US, ST=Maryland, L=Pasadena, O=Brent Baccala, OU=FreeSoft, CN=www.freesoft.org/emailAddress=baccala@freesoft.org

3.4 X.509

3.4.2 Certificate

- **Example of Certificate**

Certificate:
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
RSA Public Key: (1024 bit)
Modulus (1024 bit):
00:b4:31:98:0a:c4:bc:62:c1:88:aa:dc:b0:c8:bb:
33:35:19:d5:0c:64:b9:3d:41:b2:96:fc:f3:31:e1:
66:36:d0:8e:56:12:44:ba:75:eb:e8:1c:9c:5b:66:
70:33:52:14:c9:ec:4f:91:51:70:39:de:53:85:17:
16:94:6e:ee:f4:d5:6f:d5:ca:b3:47:5e:1b:0c:7b:
c5:cc:2b:6b:c1:90:c3:16:31:0d:bf:7a:c7:47:77:
8f:a0:21:c7:4c:d0:16:65:00:c1:0f:d7:b8:80:e3:
d2:75:6b:c1:ea:9e:5c:5c:ea:7d:c1:a1:10:bc:b8:
e8:35:1c:9e:27:52:7e:41:8f
Exponent: 65537 (0x10001)

3.4 X.509

3.4.2 Certificate

- **Example of Certificate**

Certificate:

Signature Algorithm: md5WithRSAEncryption

93:5f:8f:5f:c5:af:bf:0a:ab:a5:6d:fb:24:5f:b6:59:5d:9d:
92:2e:4a:1b:8b:ac:7d:99:17:5d:cd:19:f6:ad:ef:63:2f:92:
ab:2f:4b:cf:0a:13:90:ee:2c:0e:43:03:be:f6:ea:8e:9c:67:
d0:a2:40:03:f7:ef:6a:15:09:79:a9:46:ed:b7:16:1b:41:72:
0d:19:aa:ad:dd:9a:df:ab:97:50:65:f5:5e:85:a6:ef:19:d1:
5a:de:9d:ea:63:cd:cb:cc:6d:5d:01:85:b5:6d:c8:f3:d9:f7:
8f:0e:fc:ba:1f:34:e9:96:6e:6c:cf:f2:ef:9b:bf:de:b5:22:
68:9f

3.4 X.509

3.4.2 Certificate

- **How to get a certificate**
  - CA distributing
  - Certificate transported by link
    - ✧ Feature
      - ◌ Everyone with CA's public key can get the public key in the CA's certificate
      - ◌ Only CA can modify the certificate
    - ✧ CA can exchange their PK safely

3.4 X.509

3.4.2 Certificate

- **Revoke a certificate**
  - Why revoking
    - ✧ Every certificate has a validity
    - ✧ User don’t think the key is secure
    - ✧ User don’t trust CA
    - ✧ CA think the certificate is unsecure
  - CRL (Certificate Revocation List)
    - ✧ the certificate revoked by not out of valid time

3.4 X.509

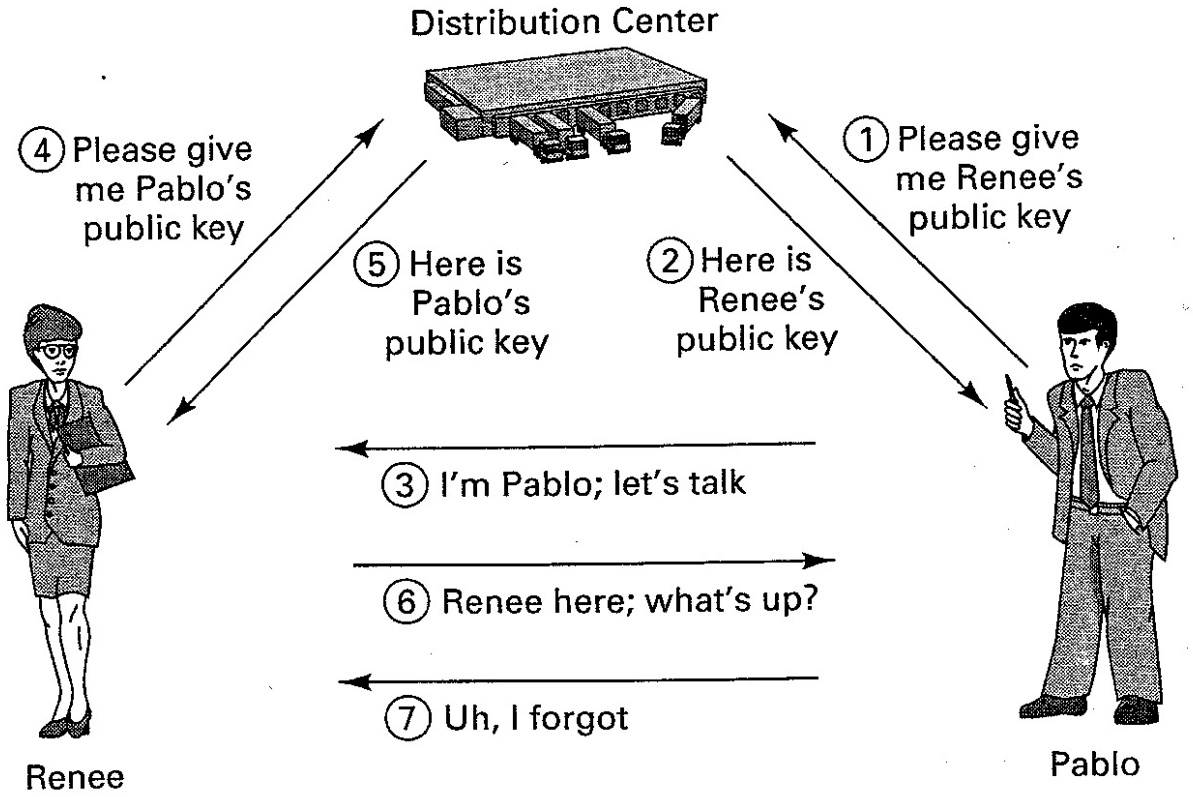
3.4.3 Security problems

- **Security Problems with X.509**
  - Specification
    - ✧ Complexity and lack of quality
  - Architectural flaw
  - Commercial certificate authorities
  - Implementation

3.4 X.509

3.4.3 Security problems

- **Security Problems with X.509**
  - Specification: Complexity and lack of quality



3.4 X.509

3.4.4 Applications

- **Applications with X.509**
  - S/MIME (Multipurpose Internet Mail Extensions)
  - SSL (Secure Socket Layer)
  - TLS (Transport Layer Security)
  - SET (Secure Electronic Trade)
  - PKI (Public Key Infrastructure)
  - ……

Referances

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End of Chapter 3