Security Tools

What is a CA ?

- *Certificate Authority* (認證中心)
- Trusted server which signs certificates
- One private key and relative public key
- Tree structure of X.509
  - Root CA

What is a CA ? (c.2)

- Root CA (最高層認證中心)
  - Micro$oft 翻譯成「根目錄授權憑證」
  - 通常 Root CA 不會直接用來簽發憑證，而是授權給一些中間的認證中心，讓這些中間的認證中心來簽發憑證
  - Root CA 自己幫自己簽名
    - 沒有再上層可以為他簽名
  - 認可最高層認證中心
    - 經由 secure channel 安裝 Root CA 的憑證
  - Root CA 只能由一些著名可靠的公司來擔任
    - 無法再向上查驗，所以不可隨便加進系統信任的 Root CA

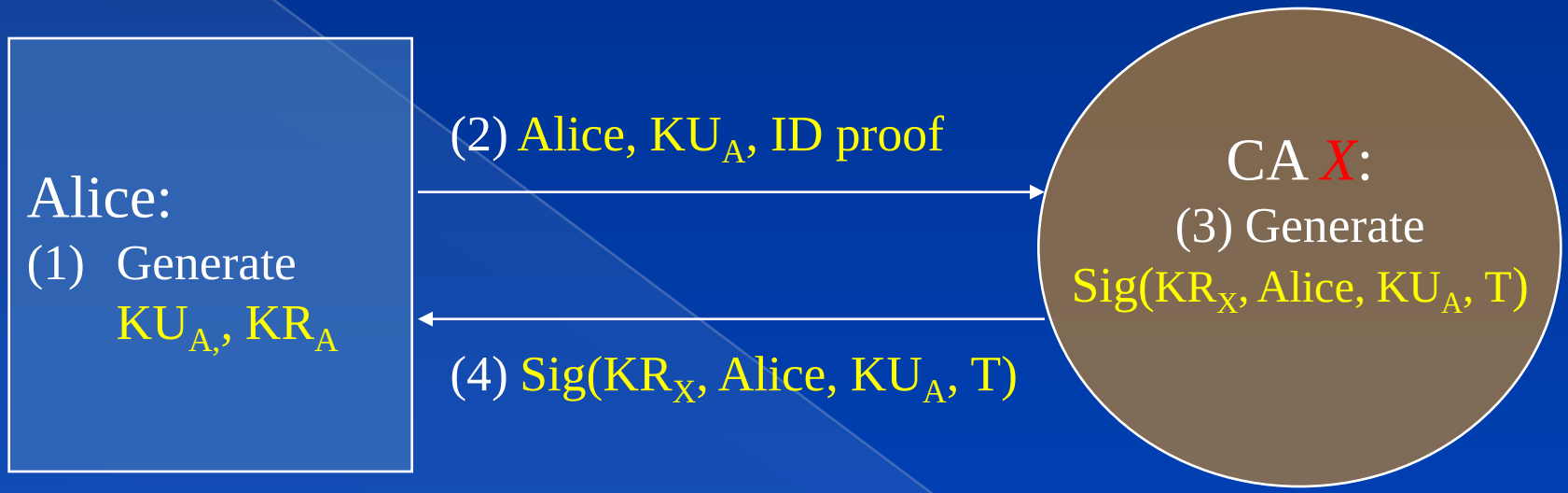
What is a CA ? (c.3)

- Tree structure of CA
  - 每個合格的 CA，都會有一個管轄它的最高層 CA 的簽名，表示 Root CA 授權給它，可以簽發別人的憑證
  - 當程式碰到沒見過的憑證，憑證上簽名的 CA 也沒見過時，只要檢查 Root CA 的簽名無誤，就接受這個憑證
- Cost of certificate
  - HiTrust : NT *$30,000* / per year / per host
  - Myself : NT *$0*

Certificate

- 電子憑證 / 公開金鑰憑證 / 網路身份證
- A certificate is issued by a CA *X*
- A certificate of a user A consists:
  - The name of the issuer CA *X*
  - His/her public key KU_A
  - The signature $Sig(KR_X, A, KU_A)$ by the CA *X*
  - The expiration date
  - Applications
    - Encryption / Signature

Certificate (c.1)



$Cert_{A,X}$=[Alice, KU_A, Sig(KR_X, Alice, KU_A)]

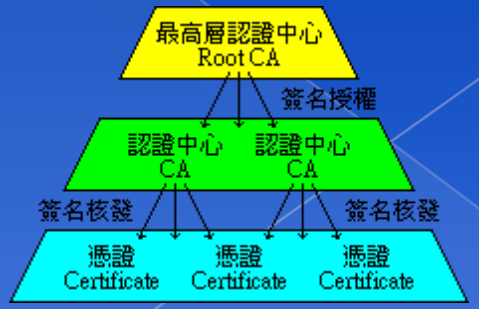
Note: CA does not know KR_A

Certificate (c.2)

- Guarantee of CA and certificate
  - Guarantee the public key is of *someone*
  - *Someone* is not guaranteed to be *safe*
- Security of transmitting DATA
  - Transmit *session key* first
    - *Public crypto system*
  - Transmit DATA by session key
    - *Symmetric crypto system*

Certificate Authority (1)

- Certificate
  - 憑證的原文是 Certificate ，是附上所有人 (owner) 的資料（公司名稱、伺服器名稱、個人真實姓名、連絡 E-mail 、通訊地址等資料），後面加上數位簽名的 Public Key 。憑證上會附有幾個數位簽名，代表這些簽名的人，確認過這個 Public Key 的所有人，和憑證上所載的資料相符，沒有假造。
  - 在 X.509 中，最下層每一個合格的憑證 (Certificate) 上，會有一個認證中心 (CA) 的簽名，表示這個認證中心 (CA) 檢查過，確認憑證上的所有者資料無誤。當程式碰到沒見過的憑證時，只要檢查憑證上認證中心 (CA) 的簽名無誤，即代表這個認證中心 (CA) 查核過這個憑證 (Certificate) ，憑證上的資料無誤。



Certificate Authority (2)

- Certificate Authority
  - 認證中心的原文是 CA ，是 Certificate Authority 的縮寫，在微軟繁體中文 WINDOWS 上翻譯成憑證授權。認證中心是 X.509 的一環。認證中心也是一種憑證，上面附有認證中心本身的資料，但不是用來加解密，而是用來簽發憑證，證明憑證所有人和憑證上所載的資料無誤。
  - 每一個合格的認證中心 (CA) 上，會有一個管轄它的最高層認證中心 (Root CA) 的簽名，表示最高層認證中心授權給它，可以簽發別人的憑證。當程式碰到沒見過的憑證，憑證上簽名的認證中心 (CA) 也沒見過時，只要檢查認證中心上附的最高層認證中心 (Root CA) 的簽名無誤，即代表這個最高層認證中心 (Root CA) ，認為這個認證中心 (CA) 的憑證簽發過程很仔細，檢查資料很詳實，所以授權給它，准許它可以簽發憑證 (Certificate) 。所以這個認證中心 (CA) 簽發的憑證 (Certificate) ，憑證上的資料也沒有問題。
  - Reference: http://www.imacat.idv.tw/tech/sslcerts.html

Apache configuration – Certificate Authority (1)

- Flow
  - Generate random seed
  - Generate RootCA
    - Generate private key of RootCA
    - Fill the Request of Certificate.
    - Sign the certificate itself.
  - Generate certificate of Web Server
    - Generate private key of Web Server
    - Fill the Request of certificate
    - Sign the certificate using RootCA
  - Modify apache configuration ➔ restart apache

Apache configuration – Certificate Authority (2)

- Generate random seed
  - openssl rand -out rnd-file num
    - Ex. openssl rand -out /etc/ssl/RootCA/private/.rnd 1024
  - chmod go-rwx rnd-file
    - Ex. chmod go-rwx /etc/ssl/RootCA/private/.rnd

Apache configuration – Certificate Authority (3)

- Generate RootCA
  - Generate private key of RootCA
    - openssl genrsa -des3 -rand rnd-file -out rootca-key-file num

```
% openssl genrsa -des3 -rand /etc/ssl/RootCA/private/.rnd \
  -out /etc/ssl/RootCA/private/rootca.key 2048
```

Note: phrase are asked (something like password)

    - chmod go-rwx rootca-key-file

```
% chmod go-rwx /etc/ssl/RootCA/private/rootca.key
```

Apache configuration – Certificate Authority (4)

- Generate RootCA
  - Generate private key of RootCA
  - Fill the Request of Certificate.
    - openssl req -new -key rootca-key-file -out rootca-req-file

      % openssl req -new -key /etc/ssl/RootCA/private/rootca.key \
        -out /etc/ssl/RootCA/private/rootca.req
    - chmod go-rwx rootca-req-file

      % chmod go-rwx /etc/ssl/RootCA/private/rootca.req

```
Enter pass phrase for rootca-key-file:

Country Name (2 letter code) [AU]:TW
State or Province Name (full name) [Some-State]:Taiwan
Locality Name (eg, city) []:HsinChu
Organization Name (eg, company) [Internet Widgits Pty
Ltd]:NCTU
Organizational Unit Name (eg, section) []:CS
Common Name (eg, YOUR name) []:sysadm.cs.nctu.edu.tw
Email Address []:ta@sysadm.nctu.edu.tw

A challenge password []: (set if you wan to have a password)
An optional company name []: (depends on above setting)
```

Apache configuration – Certificate Authority (5)

- Generate RootCA
  - Generate private key of RootCA
  - Fill the Request of Certificate.
  - Sign the certificate itself.
    - openssl x509 -req -days number_of_days -sha1 \
      -extfile path_of_openssl.cnf -extensions v3_ca \
      -signkey rootca-key-file -in rootca-req-file -out rootca-crt-file

      % openssl x509 -req -days 5109 -sha1 -extfile /etc/ssl/openssl.cnf -extensions v3_ca \
      -signkey /etc/ssl/RootCA/private/rootca.key \
      -in /etc/ssl/RootCA/private/rootca.req \
      -out /etc/ssl/RootCA/private/rootca.crt \
    - rm -f rootca-req-file

      % rm -f /etc/ssl/RootCA/private/rootca.req
    - chmod go-rwx rootca-crt-file

      % chmod go-rwx /etc/ssl/RootCA/private/rootca.crt

Apache configuration – Certificate Authority (6)

- Generate certificate of Web Server
  - Generate private key of Web Server
    - openssl genrsa -out host-key-file num

      %openssl genrsa -out /etc/ssl/key/sysadm.key 1024
    - chmod go-rwx host-key-file

      %chmod go-rwx /etc/ssl/key/sysadm.key
  - Fill the Request of certificate
    - openssl req -new -key host-key-file -out host-req-file

      % openssl req -new -key /etc/ssl/key/sysadm.key \
      -out /etc/ssl/cert/sysadm.req
    - chmod go-rwx host-req-file

      % chmod go-rwx /etc/ssl/cert/sysadm.req

Apache configuration – Certificate Authority (7)

- Generate certificate of Web Server
  - Generate private key of Web Server
  - Fill the Request of certificate
  - Sign the certificate using RootCA
    - Tramsmit host-req-file to Root CA, and do following steps in RootCA
    - openssl x509 -req -days number_of_days -sha1 -extfile path_of_openssl.cnf \
      -extensions v3_ca -CA rootca-crt-file -CAkey rootca-key-file \
      -CAserial rootca-srl-file -CAcreateserial -in host-req-file -out host-crt-file

      % openssl x509 -req -days 361 -sha1 -extfile /etc/ssl/openssl.cnf -extensions v3_ca
      -CA /etc/ssl/RootCA/private/rootca.crt \
      -CAkey /etc/ssl/RootCA/private/rootca.key \
      -CAserial /etc/ssl/RootCA/private/rootca.srl \
      -CAcreateserial \
      -in /etc/ssl/cert/sysadm.req \
      -out /etc/ssl/cert/sysadm.crt
    - rm -f host-req-file (in both RootCA and Web Server)

      % rm -f /etc/ssl/cert/sysadm.req
    - Transmit host-crt-file back to Web Server

Apache configuration – Certificate Authority (8)

```
##
## SSL Virtual Host Context
##
<VirtualHost _default_:443>
#   General setup for the virtual host
DocumentRoot /www/data
<Directory "/www/data">
    Options Indexes FollowSymLinks
    AllowOverride All
    Order allow,deny
    Allow from all
</Directory>
ServerName sysadm.cs.nctu.edu.tw:443
ServerAdmin ta@sabsd.cs.nctu.edu.tw
ErrorLog /var/log/httpd/sabsd.cs-error.log
CustomLog /var/log/httpd/sabsd.cs-access.log common

SSLEngine on
SSLCipherSuite
ALL:!ADH:!EXPORT56:RC4+RSA:+HIGH:+MEDIUM:+LOW:!SSLv2:+EXP:+eNULL
SSLCertificateFile /etc/ssl/cert/sysadm.crt
SSLCertificateKeyFile /etc/ssl/key/sysadm.key
```

PGP

- Pretty Good Privacy
- Public key system
  - Encryption
  - Signature
- security/gnupg

- Will talk more in Network Administration