中華電信股份有限公司
Chunghwa Telecom Co., Ltd.

SafGuard 200 Hardware Security Module and Key Management User Guide

Ver 1.1

Chunghwa Telecom Co., Ltd.
Telecommunication Lab

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Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Modifications not expressly approved by the manufacturer could void the user's authority to operated the equipment under FCC rules.

Table of Contents

1. Introduction

SafGuard 200 Hardware Security Module and Key management program transmit data each other via Internet, since a 10M/100Mbps network interface is used. In this way, we are able to transfer and receive information more efficiently.

There are 3 or 4 entities in SafGuard 200 environment; (1) SafGuard 200 hardware security Module; (2) a CA server which requests SafGuard 200 for cryptographic operations; (3) Smartcards; (4) whether provides a Audit Serve to record the events of cryptographic module。

For security consideration, the Initialization process for SafGuard200 has to meet the following purposes;

1. There must be a unique relationship between SafGuard 200 and CA server. SafGuard 200 can only provide services to the CA servers which have participated in the initialization process. This CA server can only request SafGuard 200 which has participated in this initialization process to provide cryptographic operation services。
2. SafGuard 200 provides the cryptographic service which depends on the identity of the smartcard; certain identity can only request certain services from SafGuard 200; this is decided while an smartcard is generated, SafGuard 200 will store the services which could be requested by this identity into the hardware.
3. This CA server requests that SafGuard 200 to insert an Smartcard while providing some cryptographic services; in such a way, this SafGuard 200 can ensure that the identity of this Smartcard having the authorization to execute this cryptographic service.

2. Instructions for SafGuard 200 Hardware Secure Module

In order to reach the above goals, we set the following SafGuard 200 Initialization process.

2.1. Initialization Process

2.1.1 Before left the Factory (before SafGuard 200

handed to customers)

While Customers obtain SafGuard 200, they will obtain several empty Smartcards and the files used for installing a CA server; at this moment SafGuard 200 firmware already exists without key stored in it.

2.1.2 After Left the Factory (Customers obtain SafGuard 200)

When SafGuard 200 is handed to a customer, all services related to cryptographic modules are disable. SafGuard 200 state is at Initialization state; customers can return it to the original factory, if it is not at the Initialization state.

Before initializing any service, customers have to execute initialization process (Key Management Program). After SafGuard 200 left the factory, Initialization process can be divided into the following two stages, customers have to execute these stages by order.

2.1.2.1. Generating Smartcards for different identities

The process is as follows: generating MK (Master Key) and storing it to the Smartcard marked as **SO** (Security Officer). The results that SafGuard 200 generates MK are stored in SafGuard 200 itself and also Smartcards, which are held by 4 Security Officer. Once generating MK, SafGuard 200 will store MK forever, until SO needs to restore a new MK or this SafGuard 200 is damaged. While changing MK, it is necessary to provide the old MK before installing a new one. If MK is changed, then all keys related to cryptographic modules have to be regenerated again by using this new MK.

There are 4 Security Officer Key Pair being generated, SafGuard 200 encrypts Private Key using MK, then stored it to the Smartcard marked as Security Officer. On the other hand, SafGuard 200 will store its Public Key in its interior.

While generating HK, Key Pair (RSA key pair with 1024-bit key length) will be stored in SafGuard 200, and the Public Key is transferred back for key management program to use.

After completion of the above activities, SafGuard 200 system state will be configured as Authentication State. Rebooting SafGuard 200 is necessary for entering the Authentication State for normal operations.

2.1.2.2. Generating Application Key

Generating an Application Key (APK) and stored it to Smartcards used by differently authorized personnel.

System administrators can generate User key pair by their needs and store them to the Smartcard marked as "user" (or "operator").

System administrators then use SafGuard 200 to generate APKs for different authorized users. The generated APK is a Public-key/Private-key key pair, 3DES or RC6, which is stored in the SafGuard 200 and held by different Smartcards. Then they configure the ACL of APK. System administrators may configure system state of SafGuard 200 as Initialization State; however, this activity will erase any key stored in SafGuard 200.

Every Application Key has its corresponding ACL and Status. While generating APK, Status is "0x00"; once ACL is set, Status is enabled.

2.2. Key Usage

The keys generated above and their usages are as figure 2-1.

Type of Key	**Role of Key holder**	**Methods of storing to Smartcard**	**Number of Smartcards**	**Merge of Smartcard**	**Methods of Storing to HSM**
Security Officer Key	Security Officer, System Officer	CA pvk plaintext (signature only)	4	With MK	CA public key
MK	Security Officer, System Administrator	Plaintext, split by 4 persons，2 out of 4 split		With SO Key	Key Splits
User Key	User1, System Operators	CA pvk Plaintext (signature only)	3	Independent	CA public key
AP Key (optional)	User2, Key Holders	3 out of 5 splits, no encryption before split	5	Independent	Plaintext
AP Key (optional)	User2, Key Holders	2 out of 3 splits, no encryption before split	3	Independent	Plaintext

Table 2-1: Key Usage

According to the above analysis, one SafGuard 200 needs at most twelve Smartcard holders, at least four holders, three combinations are as follows.

(1) 12 persons

(2) 9 person (if Security officer and User1 are in the same group)

(3) 4 persons (if Security officer and User1, User2 are in the same group)

Two types of Smartcards are as follows.

(1) First type is for Security officer and User1.

(2) Second type is for User2. Because SafGuard 200 may store more than one key, this type of Smartcard is for saving more memory, and satisfies the separation principle of operation Smartcards and backup Smartcards.

2.3. Environments for Smartcards Control

CA is under a 12-person control, and RA is suitable for a 9-person or 4-person control. Standard ID-based control is feasible.

3. Instructions for Key Management Program

This chapter is for more details about the Authentication State for the hardware SafGuard 200.

3.1. Service Types

When the system is at the Authentication State, there are three types of Authentication Services, namely, Security Officer Service, User Service and Normal Service.

3.1.1 Security Officer Service

When executing the Security Officer Service, security officers need to do **S**ecurity **O**fficer Logon (**SO**Logon). Two Smartcards, called SO Smartcards, are also needed in this activity. This will generate a SessionKey, using this SessionKey for MAC to ensure that one can execute this service. There is only one SessionKey for Security Officer at a time.

Backup Application keys to Smartcards

Restore application keys from Smartcards

Create Security Officers

Cerate Users

Generate Application Keys

Set AP Key ACL (Access Control Limit)

Set Real-time Clock

Set network configuration

Switch to Initialization/Maintenance State

Erase AP Key

Write CA Software version-info.

3.1.2 User Service

When executing the User Service, a User needs to do User Logon (UserLogon). User Logon is mainly for AP Keys; the key management program needs to transfer APK-keyType and APK-keyID to SafGuard 200. There are at least n different User Smartcards according to the Limit_auth_num “n” in ACL of AP Key. SafGuard 200 will also compare User ID in the Smartcard and that in the ACL.

Every UserLogon generates a SessionKey for MAC to ensure whether this service is executable. Every AP Key has only one SessionKey at a time.

Use AP Key for cryptographic services

3.1.3 Normal Service

View SafGuard 200 information

Change Smartcard PIN

4. Setting Up the SafGuard200

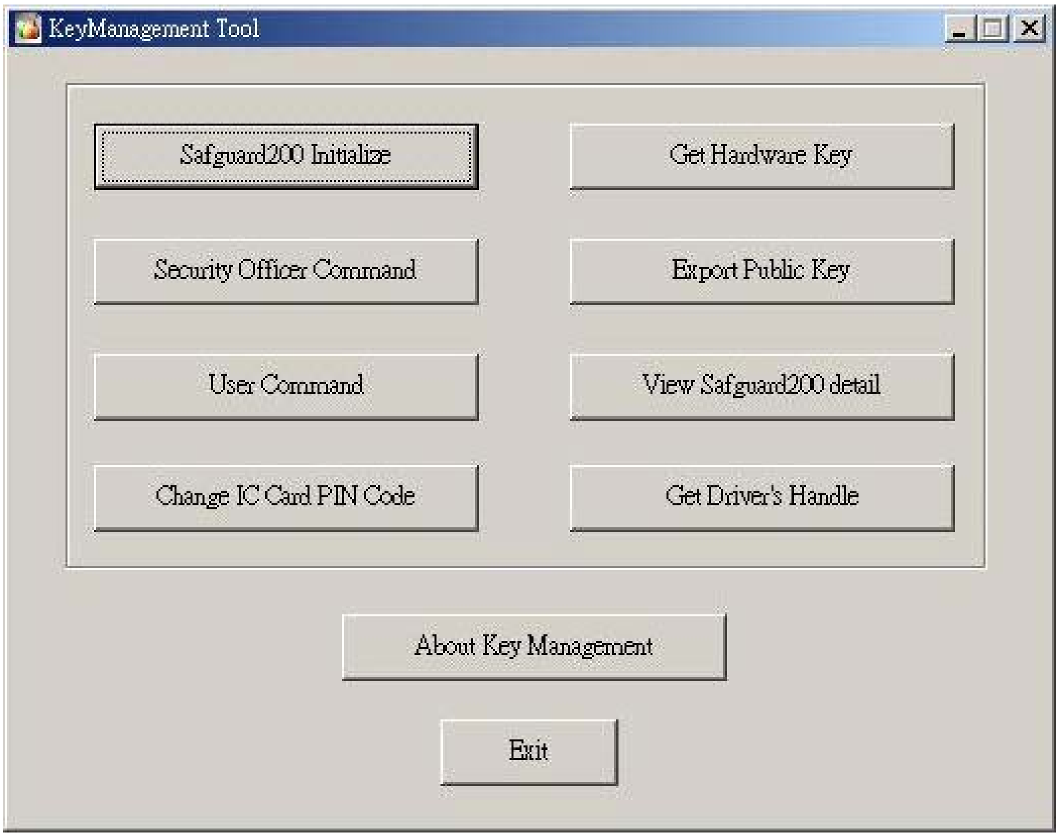


Fig. 4 -1 SafGuard200 setting up screen

4.1. Initialization of SafGuard 200

Selecting “Initialization” buttons to initialize the SafGuard200

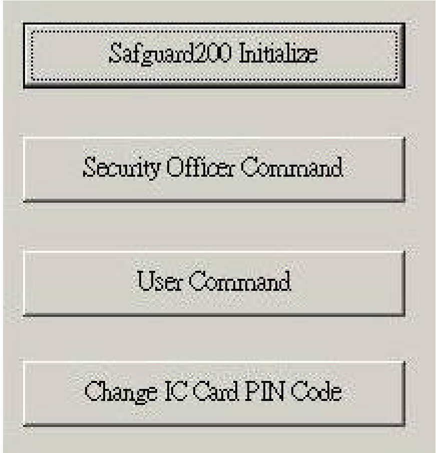
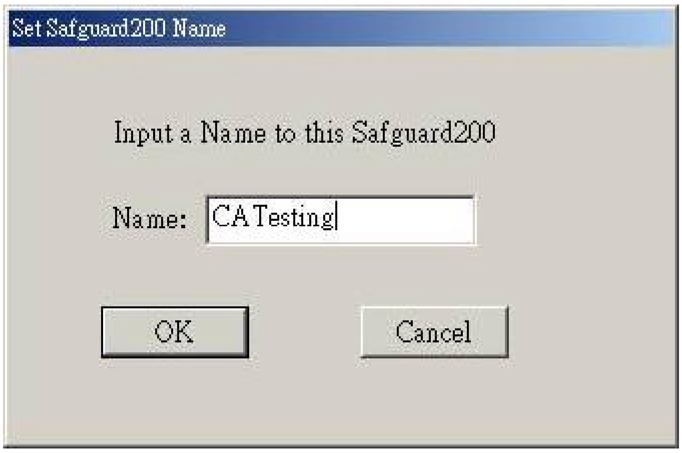


Fig. 4-2 Selecting the button of initialization

4.1.1. Setting the identification name of SafGuard200

Give an identification name for the safguard200.


Set Safguard200 Name

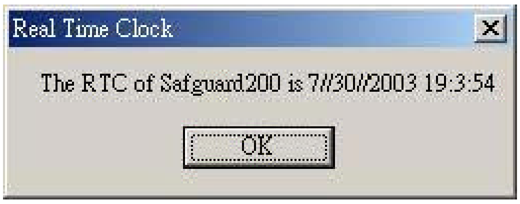
Input a Name to this Safguard200

Name: CA Testing

Fig. 4-3 Setting the identification name

4.1.2. Setting up the Real Time Clock of SafGuard200

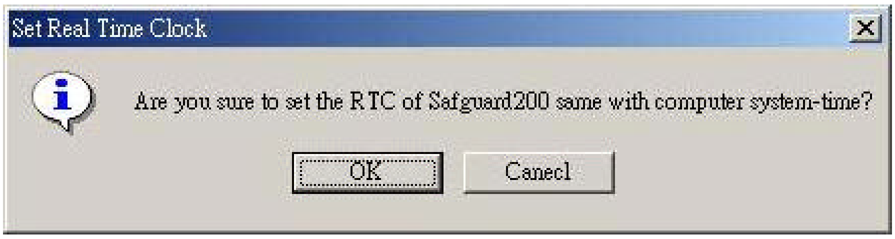
The program will show the time of SafGuard200 "Real Time Clock" on screen


Real Time Clock

The RTC of Safguard200 is 7//30//2003 19:3:54

Fig. 4-4 The time of SafGuard200

Setting up the SafGuard200 “Real Time Clock”.

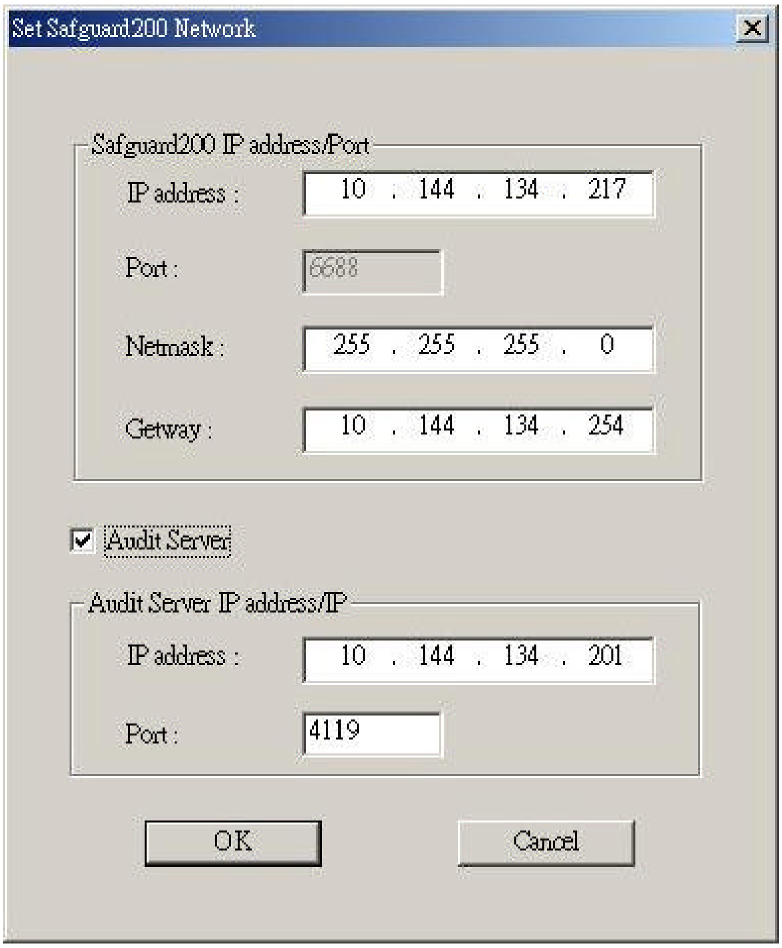

Set Real Time Clock

Are you sure to set the RTC of Safguard200 same with computer system-time?

Fig. 4-5 Setting upSafGuard200 Real Time Clock

4.1.3. Configuring SafGuard 200 Network Information

(1) The network information of SafGuard200 has default values, please modify the data according to the environment used.


Set Safguard200 Network

Safguard200 IP address/Port

IP address : 10 . 144 . 134 . 217

Port : 6688

Netmask : 255 . 255 . 255 . 0

Getway : 10 . 144 . 134 . 254

☑ Audit Server

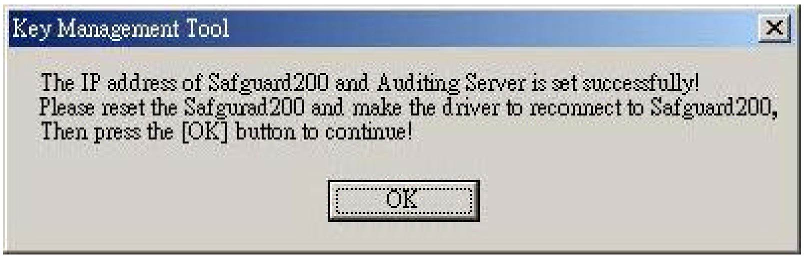
Audit Server IP address/IP

IP address : 10 . 144 . 134 . 201

Port : 4119

Fig. 4-6 Setting up SafGuard200 network information

(2) After configure the network information, please restart SafGuard200.



Key Management Tool

The IP address of Safguard200 and Auditing Server is set successfully!
Please reset the Safgurad200 and make the driver to reconnect to Safguard200,
Then press the [OK] button to continue!

Fig. 4-7 ReStart SafGuard200

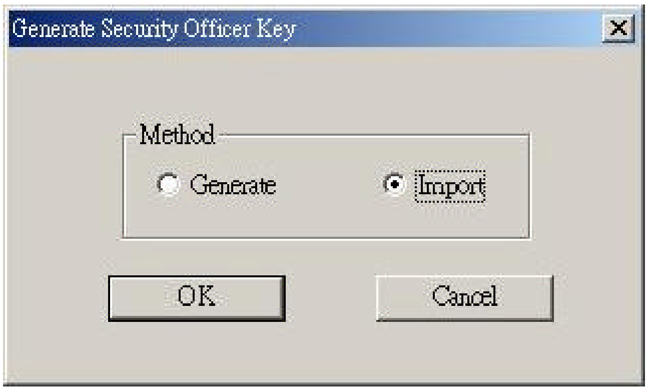
4.1.4. Instialitation of Master Key

4.1.4.1. Produce Master Key

Four Security Officers are required to produce Master Key.

4.1.4.2. Impose Master Key

Two SO are required to impose the Master Key， and these two SO needto have IC card with correct Master Key。



Generate Security Officer Key

Method: ○ Generate ● Import

Fig. 4-8 Produce、Impose Master Key

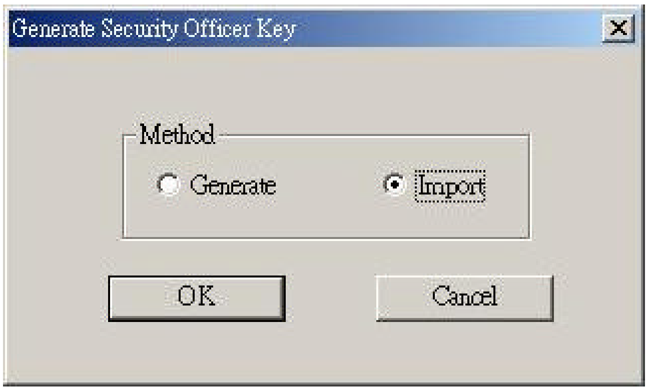
4.1.5. Installing Security Officer Ke y

4.1.5.1. Produce Security Officer Key

Four **S**ecurity **O**ffices are required to produce Security Officer Keys.

4.1.5.2. Impose Security Officer Key

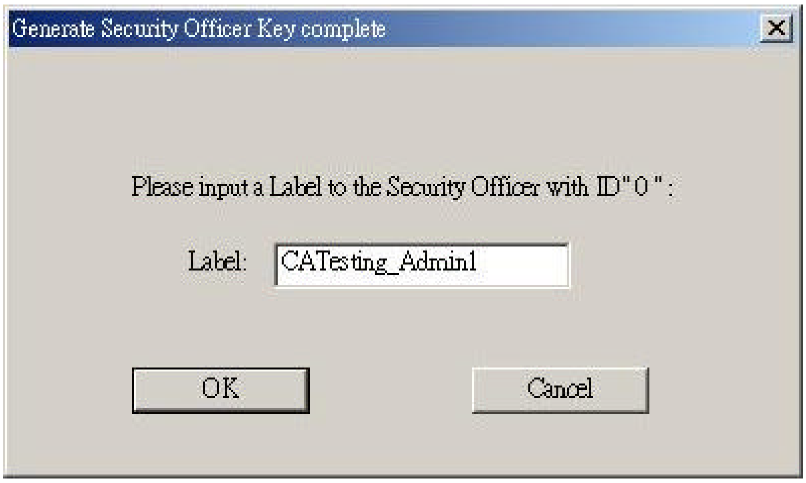
If selecting impose Security Officer Keys，the key-pair of SO IC card needed tobe encoded by the SafGuard 200 MK such that the SOLogon 可 can be used.



Method: ○ Generate ● Import

Fig. 4-9 Produce、Impose Security Officer Key

Please give this Security Officer an identification name such that the Security Officer can be identified in key management tool.


Generate Security Officer Key complete

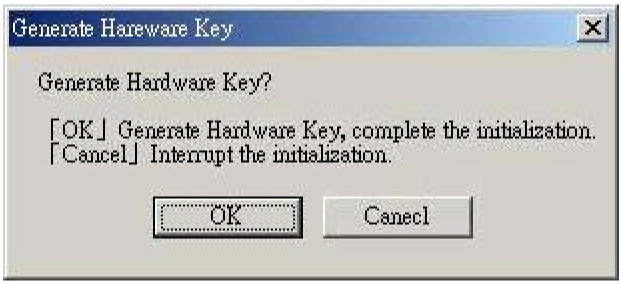
Please input a Label to the Security Officer with ID"0":

Label: CATesting_Admin1

Fig. 4-10 Setting the id name of SO

4.1.6. Produce the Key-Pair of SafGuard200

The Key-Pair of SafGuard 200 are required for the usage of UserLogon and SOLogon.


Generate Hareware Key

Generate Hardware Key?

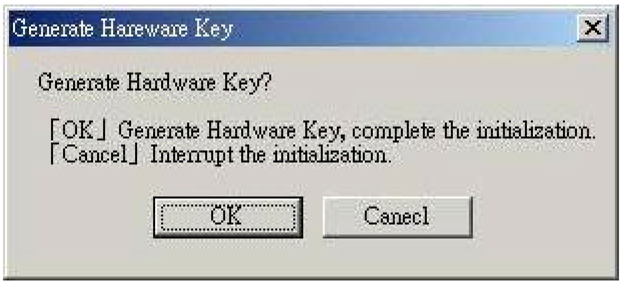
「OK」Generate Hardware Key, complete the initialization.
「Cancel」Interrupt the initialization.

Fig. 4-11 Produce SafGuard 200 Key-Pair

4.1.7. Complete SafGuard 200 initialization

(1) If previous steps all complete without any error, the initialization can be completed

Restart SafGuard200 and change the state to Authentication State。



Generate Hareware Key

Generate Hardware Key?

「OK」 Generate Hardware Key, complete the initialization.
「Cancel」 Interrupt the initialization.

Fig. 4-12 Initialization complete

If there is any error or the button “Cancle” was pressed, the initialization will be stop. If you want to initialiaze SafGuard200 again, you need to go step 1 .

4.2. Key Management functions

Two Security Officers are required to generate key pairs.

Selecting Security Officr command on the key management screen.

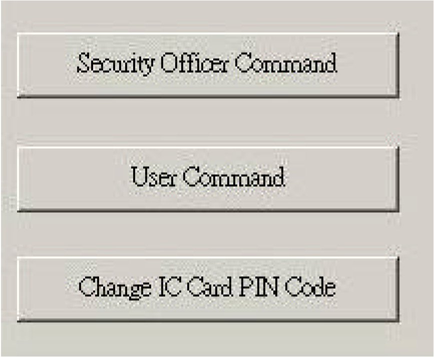
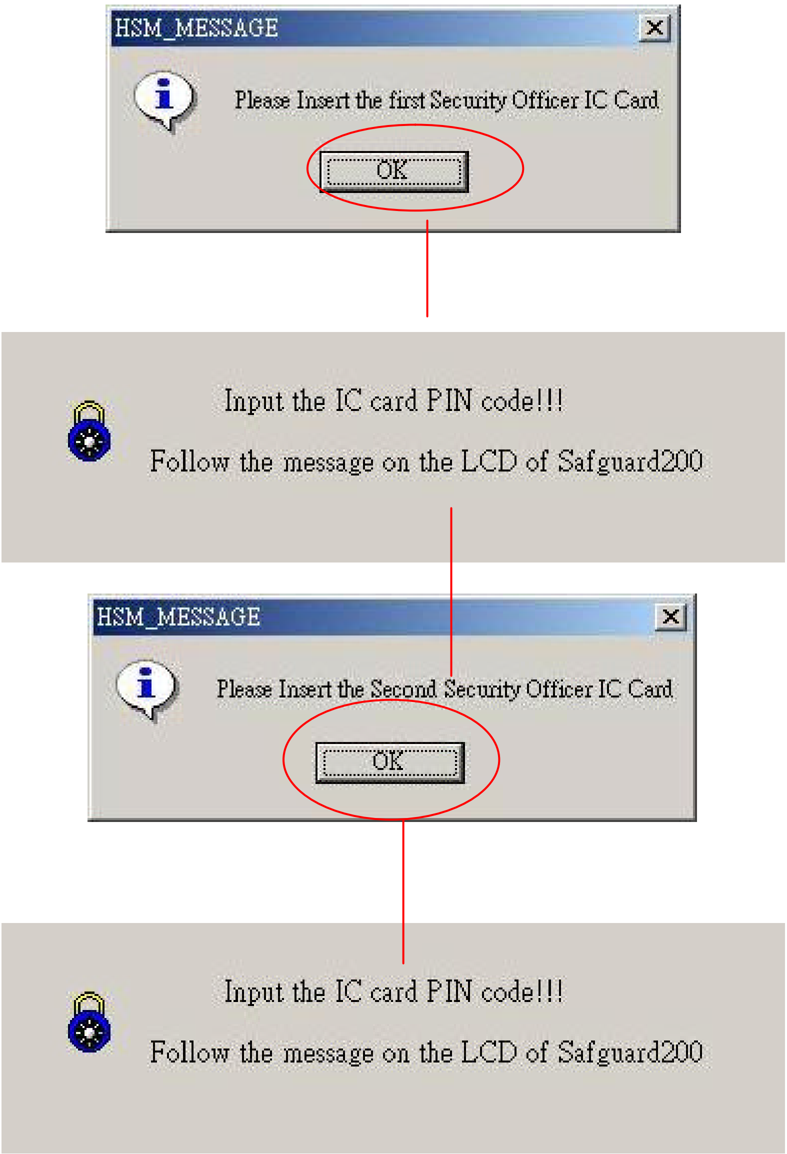


Fig. 4-13 Selecting Security Officer button

4.2.1. Security Officer Logon

(1) To Logon Security Officer, Security Office will be required to insert his/her IC card。



Please Insert the first Security Officer IC Card

Input the IC card PIN code!!!

Follow the message on the LCD of Safguard200

Please Insert the Second Security Officer IC Card

Input the IC card PIN code!!!

Follow the message on the LCD of Safguard200

Fig.4-14 message of Security Officer Logon

(2) After SO Logon successfully, the window of selecting will show up as following

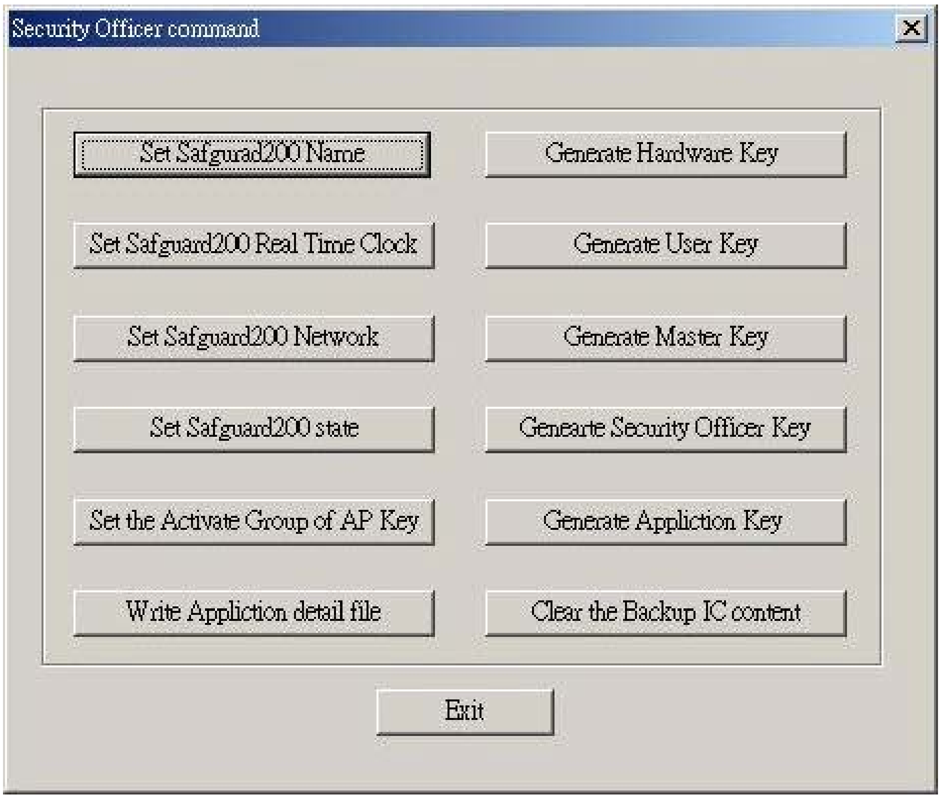


Fig. 4-15 the window of Security Officer function

4.2.2. Produce User Key

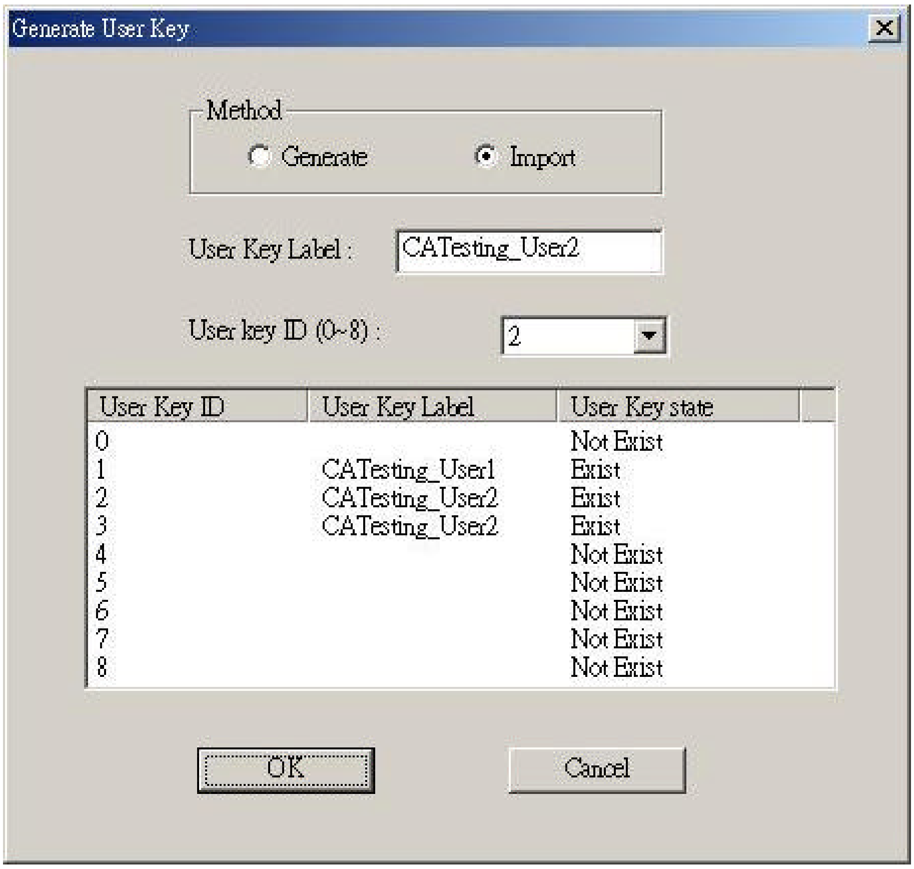
Ther are two ways to produce User Key』：

4.2.2.1. Produce User Key

【Produce】，a user(system operator) is required to generate a new key-pair.

4.2.2.2. Impose User Key

【Impose】 User Key， make sure that the key of IC card is encoded by the MK of SafGuard 200.



○ Generate ● Import

User Key Label : CATesting_User2

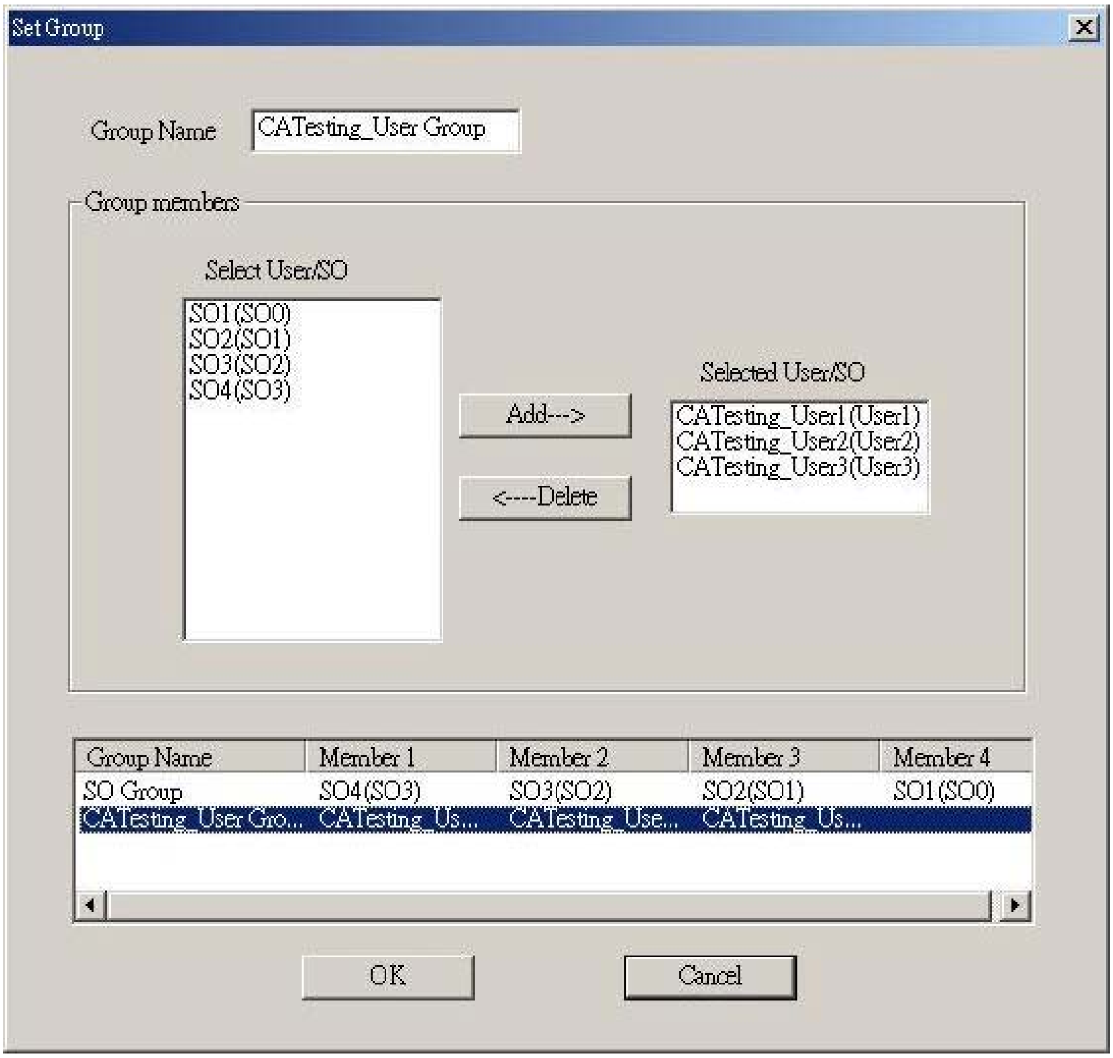
User key ID (0~8) : 2

User Key ID	User Key Label	User Key state
0		Not Exist
1	CATesting_User1	Exist
2	CATesting_User2	Exist
3	CATesting_User2	Exist
4		Not Exist
5		Not Exist
6		Not Exist
7		Not Exist
8		Not Exist

Fig. 4-16 the window of producing User Key

4.2.3. Setting up user group

After the User Key has been generated, please select 『set up Group』 on 【Security Officer function table】。 This function can classify Security Officer and User which can be used by Application Key(APK).



Set Group

Group Name: CATesting_User Group

Group members

Select User/SO

SO1(SO0)
SO2(SO1)
SO3(SO2)
SO4(SO3)

Selected User/SO

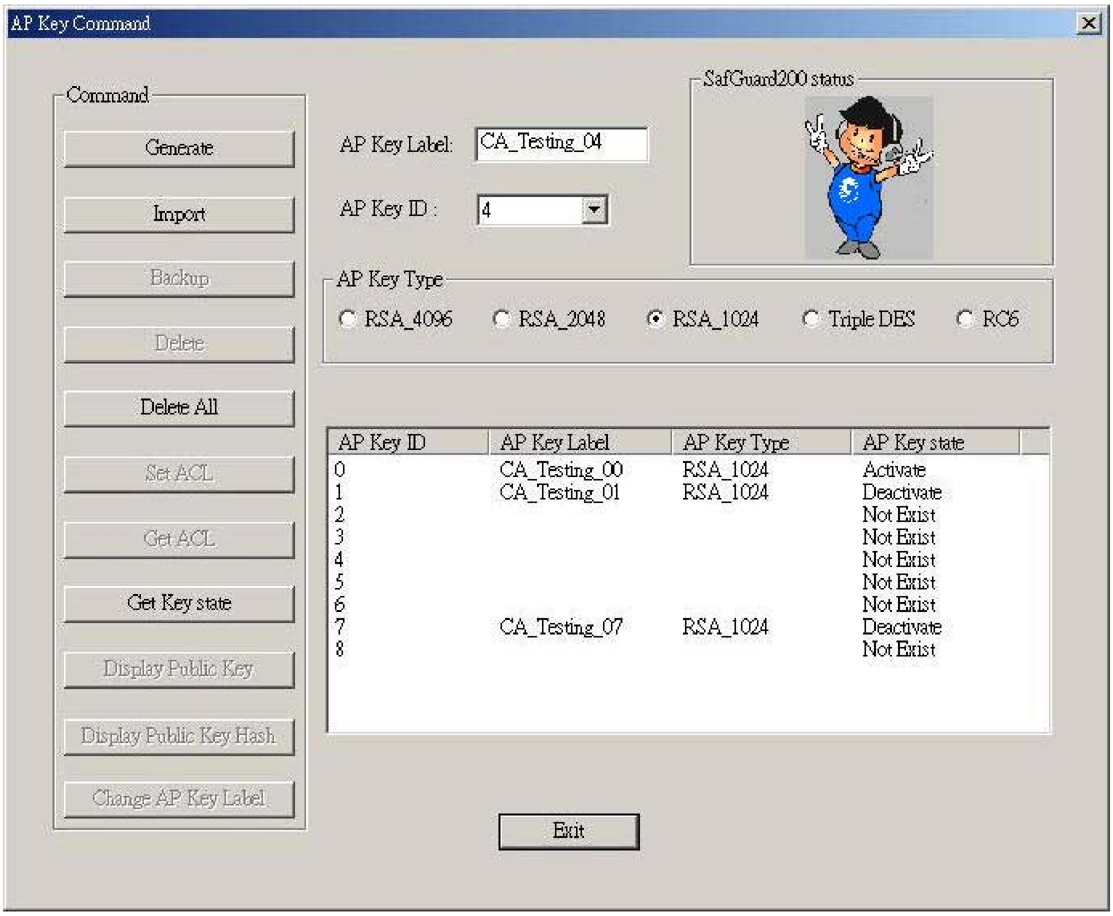
CATesting_User1(User1)
CATesting_User2(User2)
CATesting_User3(User3)

Group Name	Member 1	Member 2	Member 3	Member 4
SO Group	SO4(SO3)	SO3(SO2)	SO2(SO1)	SO1(SO0)
CATesting_User Gro...	CATesting_Us...	CATesting_Use...	CATesting_Us...	

Fig. 4-17 Setting User-Group

4.2.4 Produce AP Key

From Security Officer function window, click【Produce AP Key】 and go to the window of producing AP Key.



AP Key Label: CA_Testing_04

AP Key ID : 4

AP Key Type

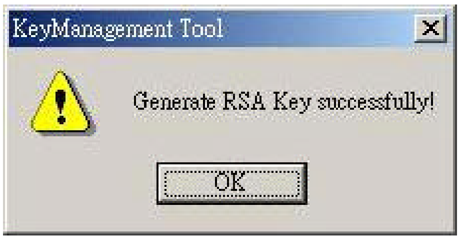
○ RSA_4096 ○ RSA_2048 ● RSA_1024 ○ Triple DES ○ RC6

AP Key ID	AP Key Label	AP Key Type	AP Key state
0	CA_Testing_00	RSA_1024	Activate
1	CA_Testing_01	RSA_1024	Deactivate
2			Not Exist
3			Not Exist
4			Not Exist
5			Not Exist
6			Not Exist
7	CA_Testing_07	RSA_1024	Deactivate
8			Not Exist

Fig. 4-18 the window of producing AP Key

4.2.4.1. Generating Keys

Click 『Generating key』 on 【producing AP Key】window。

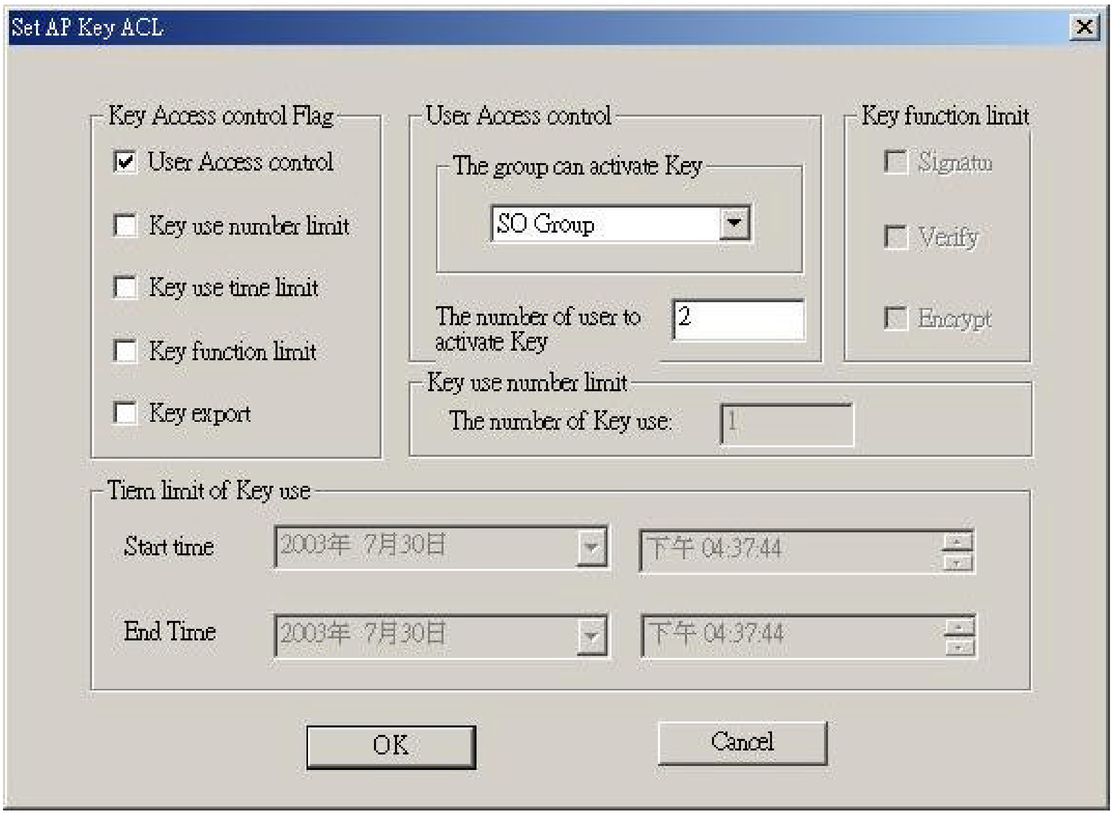


Generate RSA Key successfully!

Fig. 4-19 the complete of producing AP Key

Then you will be asked to set up the ACL(Access Control Limit) of the Application Key.

4.2.4.2. Setting up the ACL of Key



Set AP Key ACL

Key Access control Flag

☑ User Access control

☐ Key use number limit

☐ Key use time limit

☐ Key function limit

☐ Key export

User Access control

The group can activate Key: SO Group

The number of user to activate Key: 2

Key function limit

☐ Signatu

☐ Verify

☐ Encrypt

Key use number limit

The number of Key use: 1

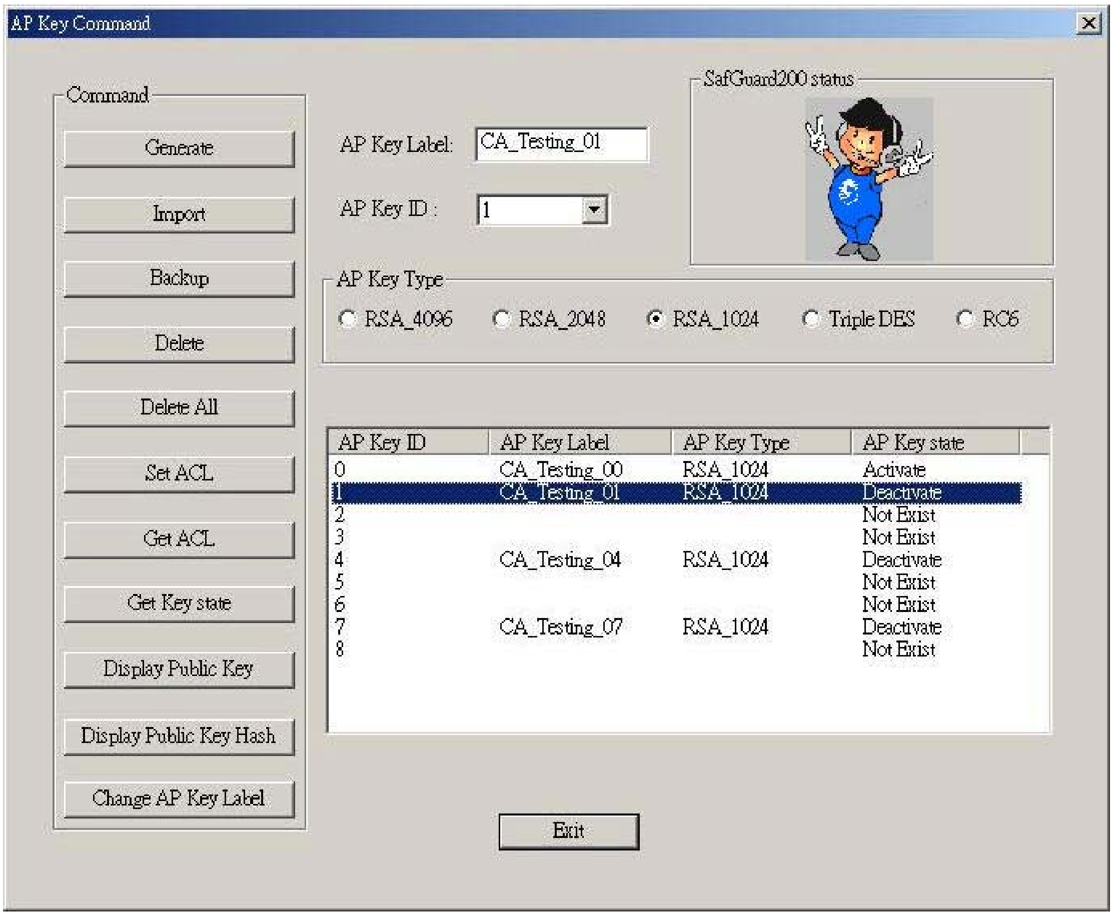
Tiem limit of Key use

Start time: 2003年 7月30日 下午 04:37:44

End Time: 2003年 7月30日 下午 04:37:44

Fig. 4-20 Setting up the ACL of AP Key

4.2.5 Key Recovery and Key Backup



AP Key Label: CA_Testing_01

AP Key ID : 1

AP Key Type

○ RSA_4096 ○ RSA_2048 ● RSA_1024 ○ Triple DES ○ RC6

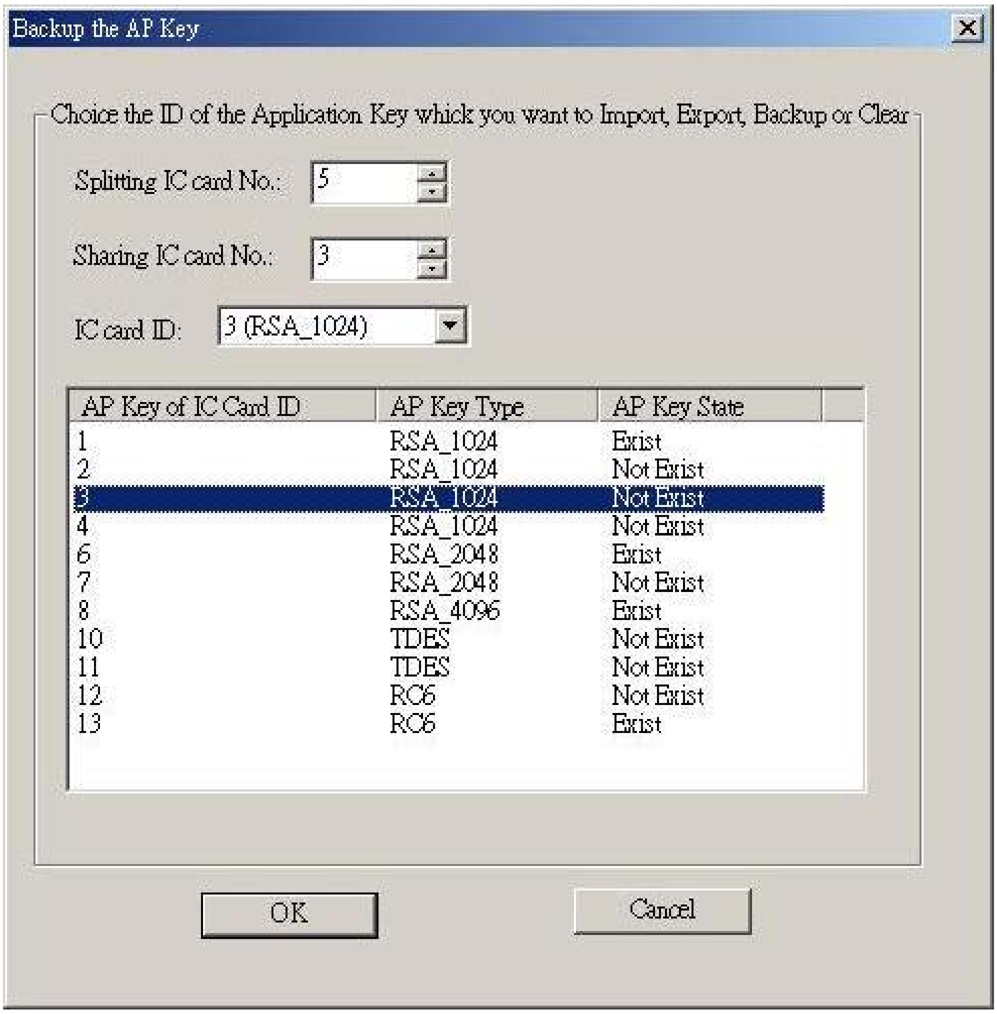
AP Key ID	AP Key Label	AP Key Type	AP Key state
0	CA_Testing_00	RSA_1024	Activate
1	CA_Testing_01	RSA_1024	Deactivate
2			Not Exist
3			Not Exist
4	CA_Testing_04	RSA_1024	Deactivate
5			Not Exist
6			Not Exist
7	CA_Testing_07	RSA_1024	Deactivate
8			Not Exist

Fig. 4-21 the screen of AP Key Backup and Recovery

4.2.5.1. Key BackUp

Click on『BackUp』 of 【producing AP Key screen】. Make sure the APK has been generated and SafGuard200 already has the key-pair of AP Key.

上圖中的 **AP Key狀態** 非〔尚未寫入〕即可。之後進入備份 AP Key 的設定畫面。



Backup the AP Key

Choice the ID of the Application Key whick you want to Import, Export, Backup or Clear

Splitting IC card No.: 5

Sharing IC card No.: 3

IC card ID: 3 (RSA_1024)

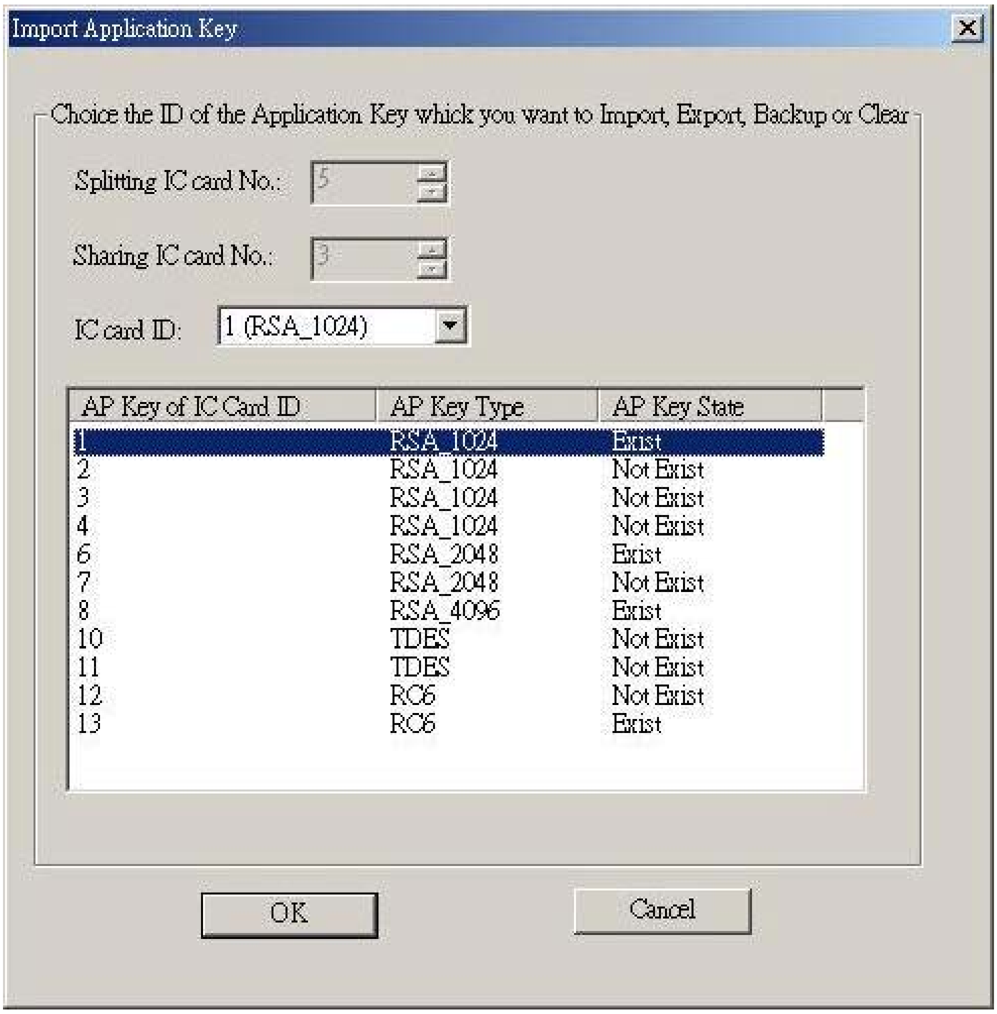
AP Key of IC Card ID	AP Key Type	AP Key State
1	RSA_1024	Exist
2	RSA_1024	Not Exist
3	RSA_1024	Not Exist
4	RSA_1024	Not Exist
6	RSA_2048	Exist
7	RSA_2048	Not Exist
8	RSA_4096	Exist
10	TDES	Not Exist
11	TDES	Not Exist
12	RC6	Not Exist
13	RC6	Exist

Fig. 4-22 the screen of setting up the AP Keybackup information

4.2.5.2. Key Recovery

Click 『impose』on 【Producing AP Keyscreen】

User need to have the backup data in order to excute thekey recovery operation.The screen of setting up the AP Key



Import Application Key

Choice the ID of the Application Key which you want to Import, Export, Backup or Clear

Splitting IC card No.: 5

Sharing IC card No.: 3

IC card ID: 1 (RSA_1024)

AP Key of IC Card ID	AP Key Type	AP Key State
1	RSA_1024	Exist
2	RSA_1024	Not Exist
3	RSA_1024	Not Exist
4	RSA_1024	Not Exist
6	RSA_2048	Exist
7	RSA_2048	Not Exist
8	RSA_4096	Exist
10	TDES	Not Exist
11	TDES	Not Exist
12	RC6	Not Exist
13	RC6	Exist

Fig. 4-23 the operation window of Impose AP Key

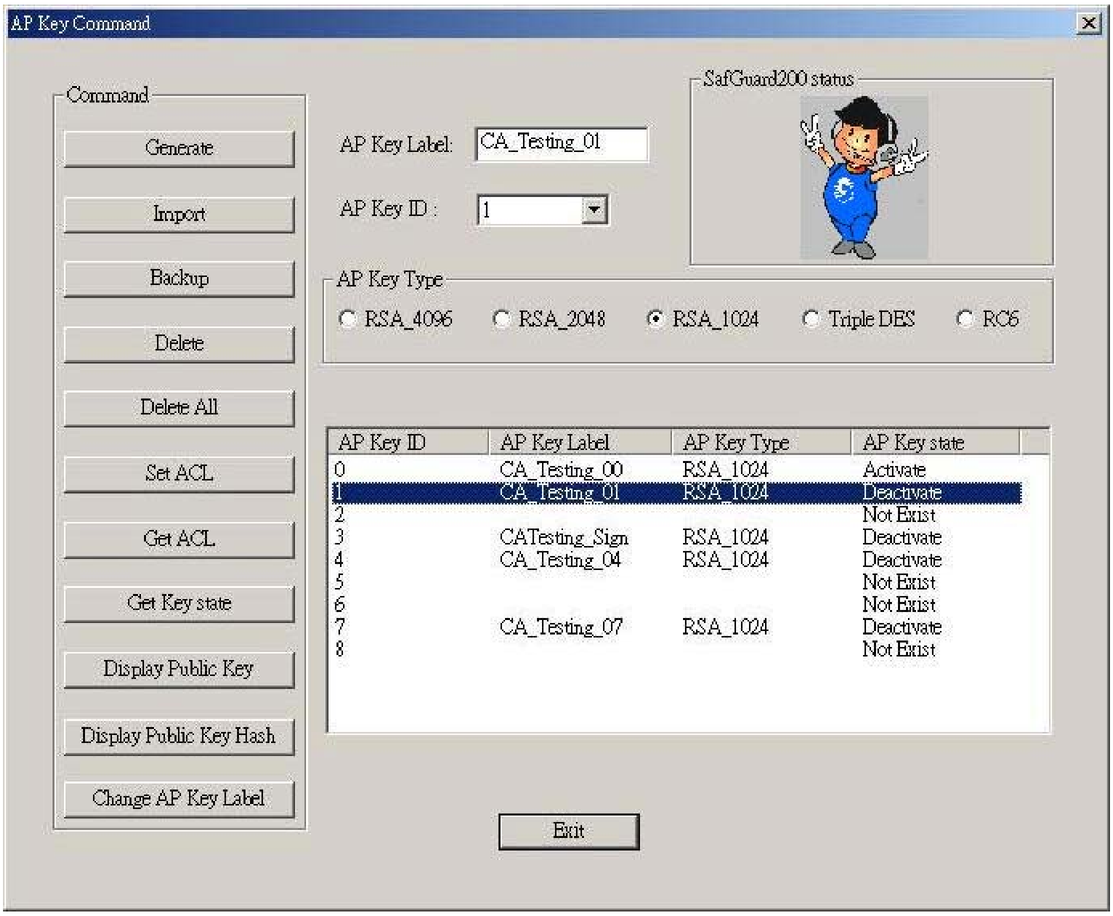
After Key Recovery, you will be asked to set up the ACL of AP Key.

Please reference 〈Figure 4-20 Setting up the ACL of AP Key〉。

4.2.6 Key Destroy

4.2.6.1. SafGuard200 Key Destroy

Selecting 『Delete』or『Delete All』 on the 【AP Keywindow】.



AP Key Label: CA_Testing_01

AP Key ID : 1

AP Key Type

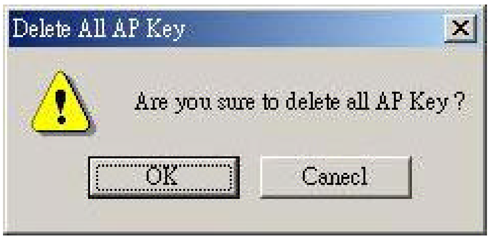
○ RSA_4096 ○ RSA_2048 ● RSA_1024 ○ Triple DES ○ RC6

AP Key ID	AP Key Label	AP Key Type	AP Key state
0	CA_Testing_00	RSA_1024	Activate
1	CA_Testing_01	RSA_1024	Deactivate
2			Not Exist
3	CATesting_Sign	RSA_1024	Deactivate
4	CA_Testing_04	RSA_1024	Deactivate
5			Not Exist
6			Not Exist
7	CA_Testing_07	RSA_1024	Deactivate
8			Not Exist

Fig .4-24 The screen of SafGuard Destroy

(1) 『Delete』 the selected AP Key .

(2) or『Delete All』 to delete all AP Key。



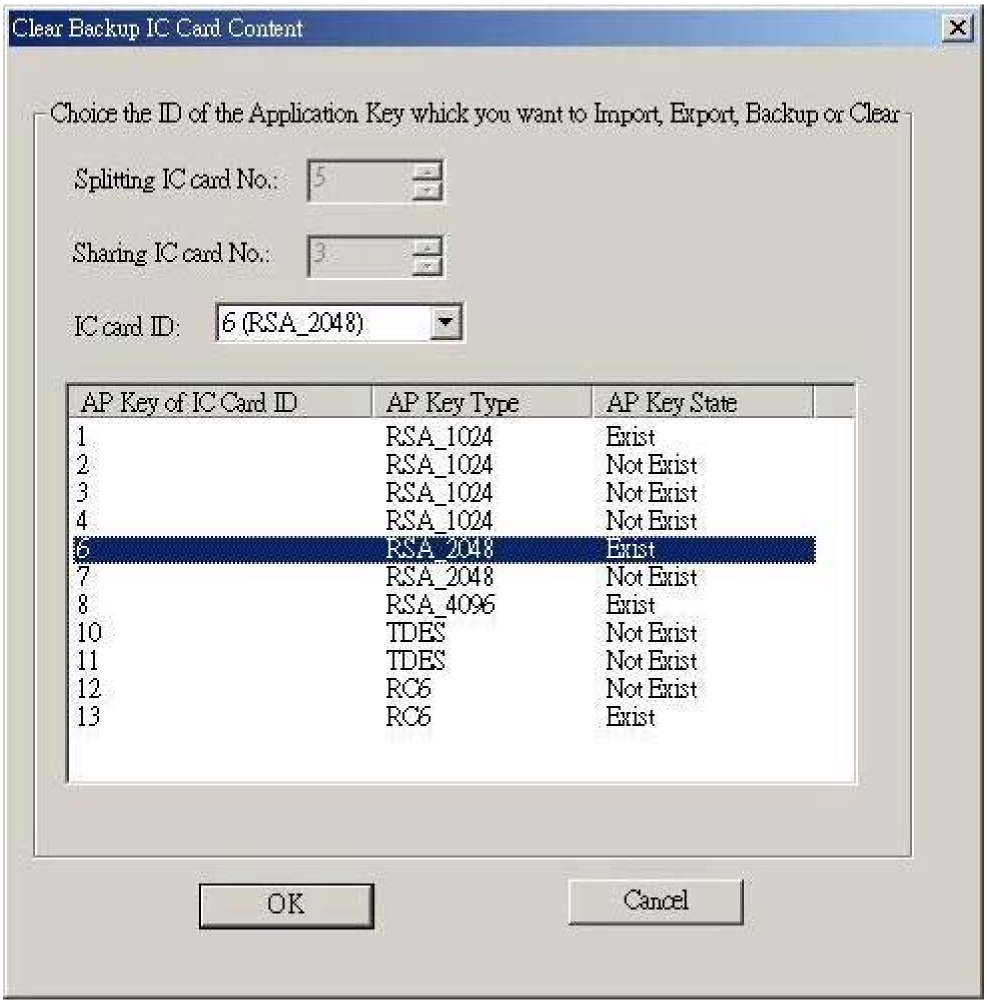
Are you sure to delete all AP Key ?

Fig. 4-25 key destroy

4.2.6.2. IC Card Backup Key Destroy

Selecting 【Delete the context of Backup ICcard】 on the Security Officer selecting window.

Delete the key on Backup IC Card.



Clear Backup IC Card Content

Choice the ID of the Application Key whick you want to Import, Export, Backup or Clear

Splitting IC card No.: 5

Sharing IC card No.: 3

IC card ID: 6 (RSA_2048)

AP Key of IC Card ID	AP Key Type	AP Key State
1	RSA_1024	Exist
2	RSA_1024	Not Exist
3	RSA_1024	Not Exist
4	RSA_1024	Not Exist
6	RSA_2048	Exist
7	RSA_2048	Not Exist
8	RSA_4096	Exist
10	TDES	Not Exist
11	TDES	Not Exist
12	RC6	Not Exist
13	RC6	Exist

Fig. 4-26 Delete the context of Backup IC Card

4.2.7 Enable or Disable Key(WINDOWS)

Click 『User commands』 on the SafGuard200 setting up screen

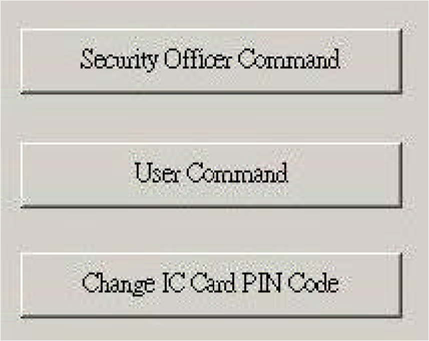
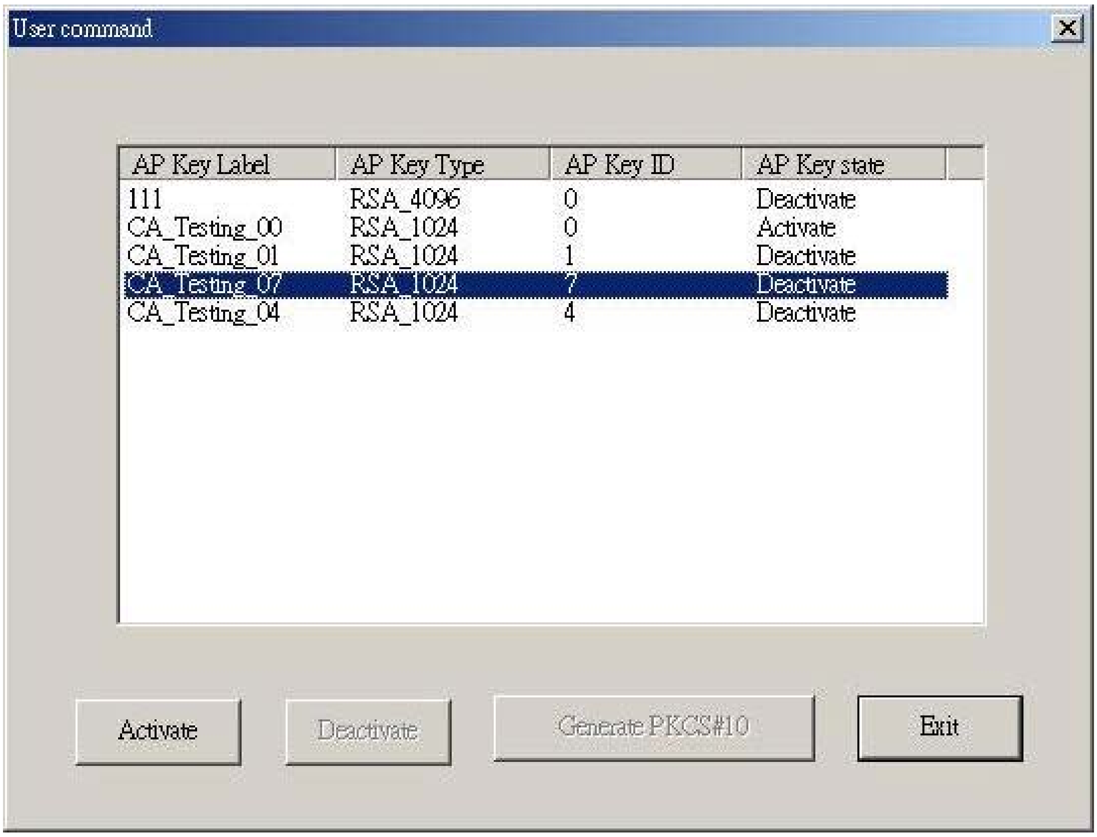


Fig. 4-27 Selecting the button of User commands

4.2.7.1. Enable Key

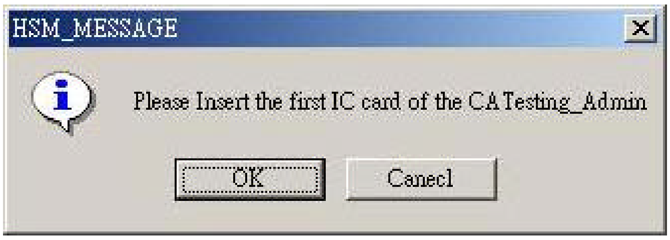
(1) Selecting the AP Key that you want to be enabledon on the List, than press 【Enable】。



AP Key Label	AP Key Type	AP Key ID	AP Key state
111	RSA_4096	0	Deactivate
CA_Testing_00	RSA_1024	0	Activate
CA_Testing_01	RSA_1024	1	Deactivate
CA_Testing_07	RSA_1024	7	Deactivate
CA_Testing_04	RSA_1024	4	Deactivate

Fig. 4-28 The screen of key enable(User Logon)

(2) You will be asked to insert at least one User IC Card, according to Limist_auth_num of the ACL of eack AP Key(Reference Figure 4-20 Setting up the ACL of AP Key)。



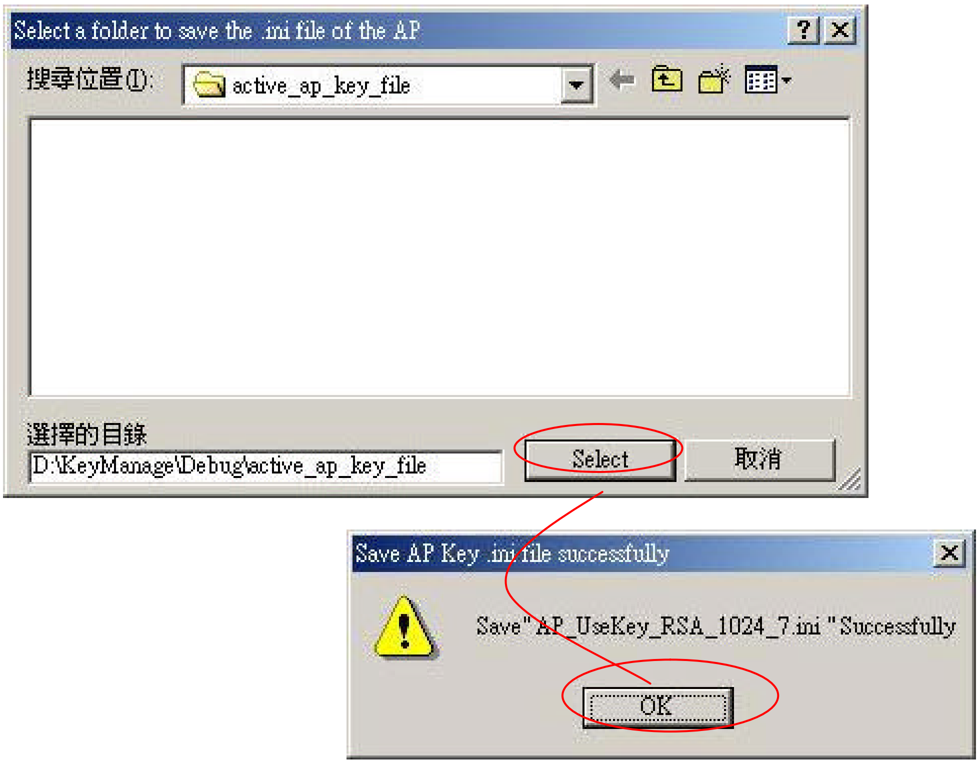
HSM_MESSAGE

Please Insert the first IC card of the CA Testing_Admin

Fig. 4-29 Enable AP Key。The message of inserting User IC Card

(3) After enable the key, set up the information about the AP Key

a. Selecting the directory to save



Select a folder to save the .ini file of the AP

搜尋位置(I): active_ap_key_file

選擇的目錄

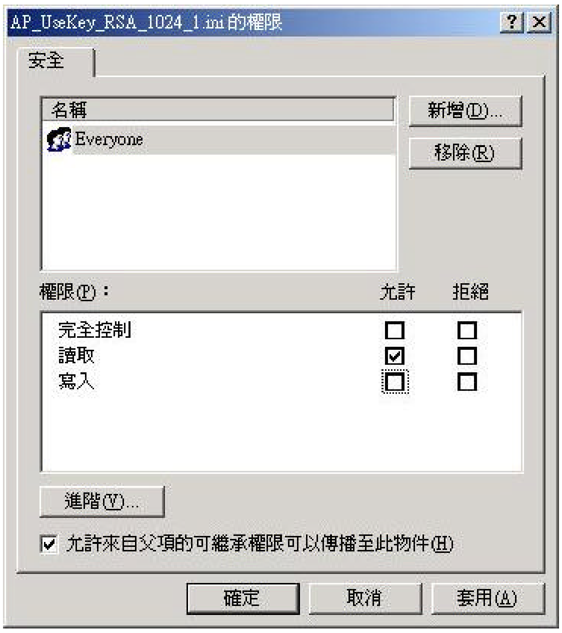
D:\KeyManage\Debug\active_ap_key_file

Save AP Key .ini file successfully

Save" AP_UseKey_RSA_1024_7.ini "Successfully

Fig. 4-30 Selecting the location of AP Key

b. Setting up the privilege



AP_UseKey_RSA_1024_1.ini 的權限

安全

名稱

Everyone

權限(P)：

權限(P)：	允許	拒絕
完全控制	□	□
讀取	☑	□
寫入	□	□

☑ 允許來自父項的可繼承權限可以傳播至此物件(H)

Fig. 4-31 AP Key configure file, setting up the privilege

4.2.7.2. Disable a using Key

Selecting the AP key you want to be disabled on the List, then press【Deactivate】。