



IBM System z – WAVV 2008

z/VSE Security Exploitation with Crypto Hardware

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Security requirements

§ Security requirements are increasing in today's world

- Data security
- Data integrity
- Keep long-term data audit-save

§ The number of attacks increase daily

- Industrial spying
- Security exploits, Denial-of-Service attacks
- Spam, Phishing, ...

§ Not paying attention to security requirements can be very expensive

- Your data is the heart of your company
- Loosing your customer data is a disaster
- You can loose customers

§ IT Security gets more and more important

- You need to consider the whole IT Environment not only single systems



BBC NEWS | UK | UK Politics | Q&A: Child benefit records lost - Mozilla Firefox

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Last Updated: Thursday, 22 November 2007, 16:30 GMT

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Q&A: Child benefit records lost

How worried should people be by the loss of discs containing child benefit recipients' personal details?

What has happened?

HM Revenue and Customs has lost computer discs containing the entire child benefit records, including the personal details of 25 million people - covering 7.25 million families overall. The two discs contain the names, addresses, dates of birth and bank account details of people who received child benefit. They also include National Insurance numbers.

How were the discs lost?

They were sent via internal mail from HMRC in Washington, in the North East of England, to the National Audit Office in London on 18 October, by a junior official, and never arrived. That broke data protection laws and is the reason Revenue and Customs chairman Paul Gray resigned.

BENEFIT RECORDS LOST

Queries answered
BBC personal finance reporter Jennifer Clarke answers your questions on the crisis

KEY STORIES

- ▶ Six more data discs 'are missing'
- ▶ Disc search moves to courier firm
- ▶ Private data 'also given to firm'
- ▶ E-mails reveal data warning
- ▶ Government challenges claims
- ▶ Cameron calls for ID cards halt
- ▶ Threat of fraud 'looms for years'
- ▶ Brown orders data spot checks
- ▶ Brown apologises for records loss
- ▶ UK's families put on fraud alert
- ▶ Government letter: full text

SKETCH

Done



BBC NEWS | UK | UK Politics | Q&A: Child benefit records lost - Mozilla Firefox

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What is the government saying?

Prime Minister Gordon Brown told MPs: "I profoundly regret and apologise for the inconvenience and worries that have been caused to millions of families who receive child benefits. When mistakes happen in enforcing procedures, we have a duty to do everything we can to protect the public." He denied the data was lost because of "systemic" failures at the HMRC saying it had been due to procedures not being followed. He ordered security checks on all government departments to ensure data is properly protected.

What is being done to find the discs?

The Metropolitan Police, National Audit Office, Revenue and Customs staff and courier firm TNT have all been searching for the discs.

How worried should people be?

The details on the lost discs would be sought after by fraudsters. Mr Darling says the information was password protected, but that was not good enough. He said there was no suggestion that anything untoward had happened as a result of the discs' loss to date. Experts say such data should normally be sent in encrypted form.

▶ **Analysis: How worried should we be?**

SKETCH

 **'Profound regret'**
How Brown dealt with data crisis in weekly Commons grilling

FEATURES AND BACKGROUND

- ▶ Q&A: Child benefit records lost
- ▶ Taking cover from ID theft
- ▶ Point-by-point: Darling statement
- ▶ The dealers in data
- ▶ Life inside the beleaguered HMRC
- ▶ Timeline: Benefits records loss
- ▶ Revenue's previous data failings

HAVE YOUR SAY

- ▶ Your reaction to lost records
- ▶ 'Our data was put at risk'

WATCH/LISTEN

- ▶ **WATCH** Brown's apology
- ▶ **WATCH** Alistair Darling

RELATED INTERNET LINKS

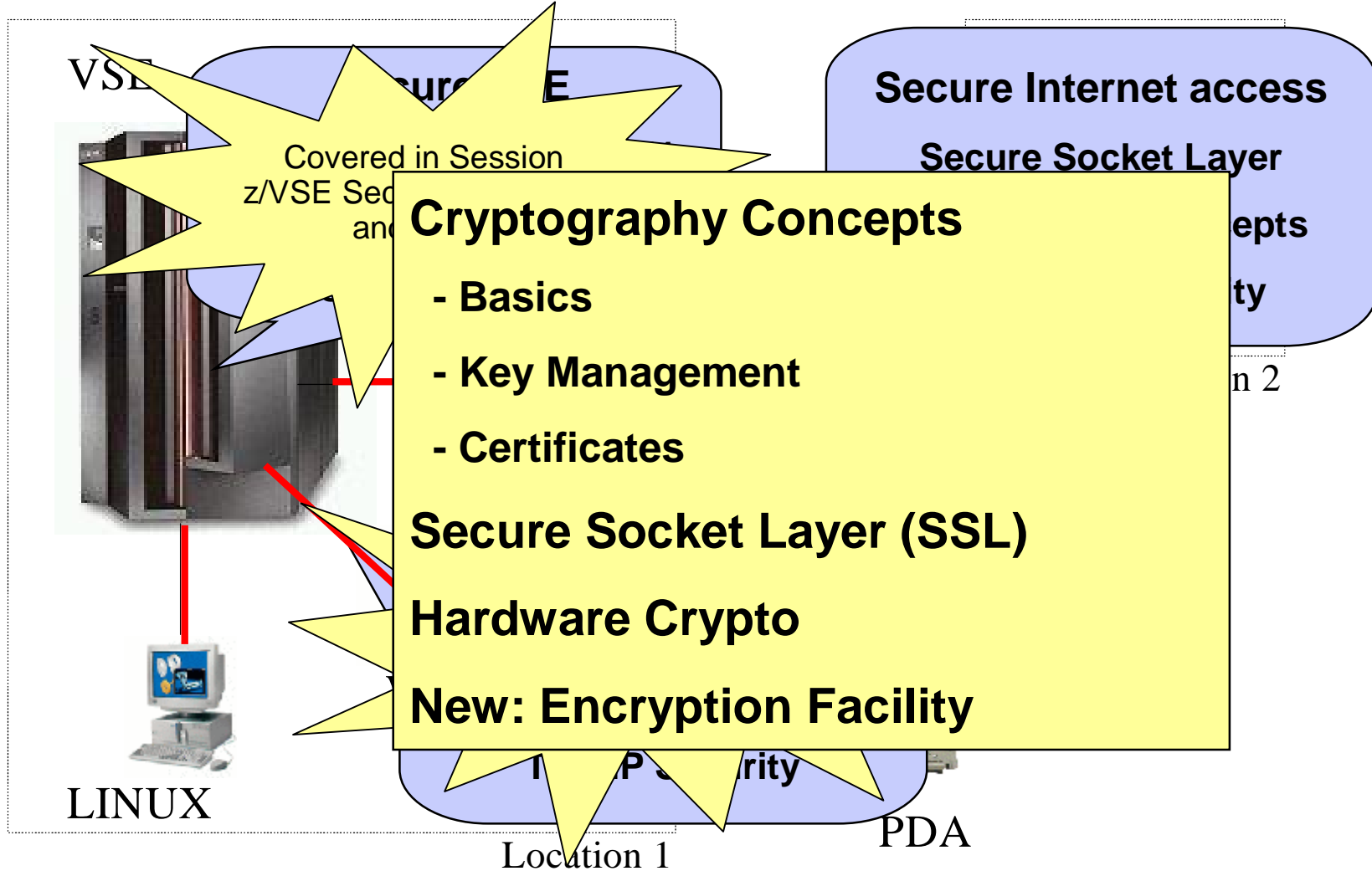
- ▶ HMRC
- ▶ Treasury committee

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TOP UK POLITICS STORIES

Done

Security in a heterogeneous environment



What can cryptography do for you?

§ 2 main areas

- Encryption of data transmitted over TCP/IP connections
 - SSL, HTTPS
 - SecureFTP

- Encryption of data stored on disk or tape
 - Encryption of backups or archives
 - Exchange of encrypted and/or signed data with customers or business partners
 - TS1120 Encrypting Tape Drive
 - Encryption Facility for z/VSE

Why Cryptography ?

§ Keeping secrets

- Alice wants to send Bob confidential information,
- Charly should not be able to read it.

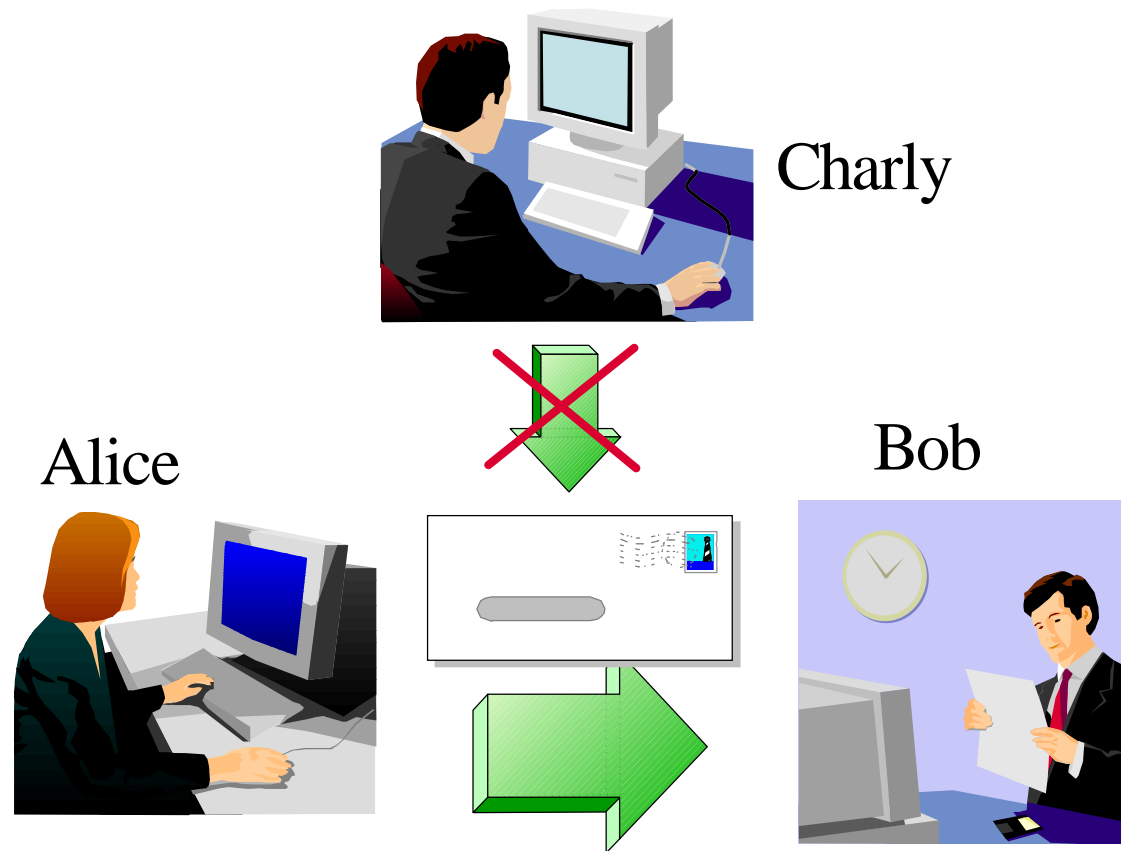
§ Proving identity

- Bob receives a message from Alice. How he can be sure that it is really from Alice?

§ Verifying information

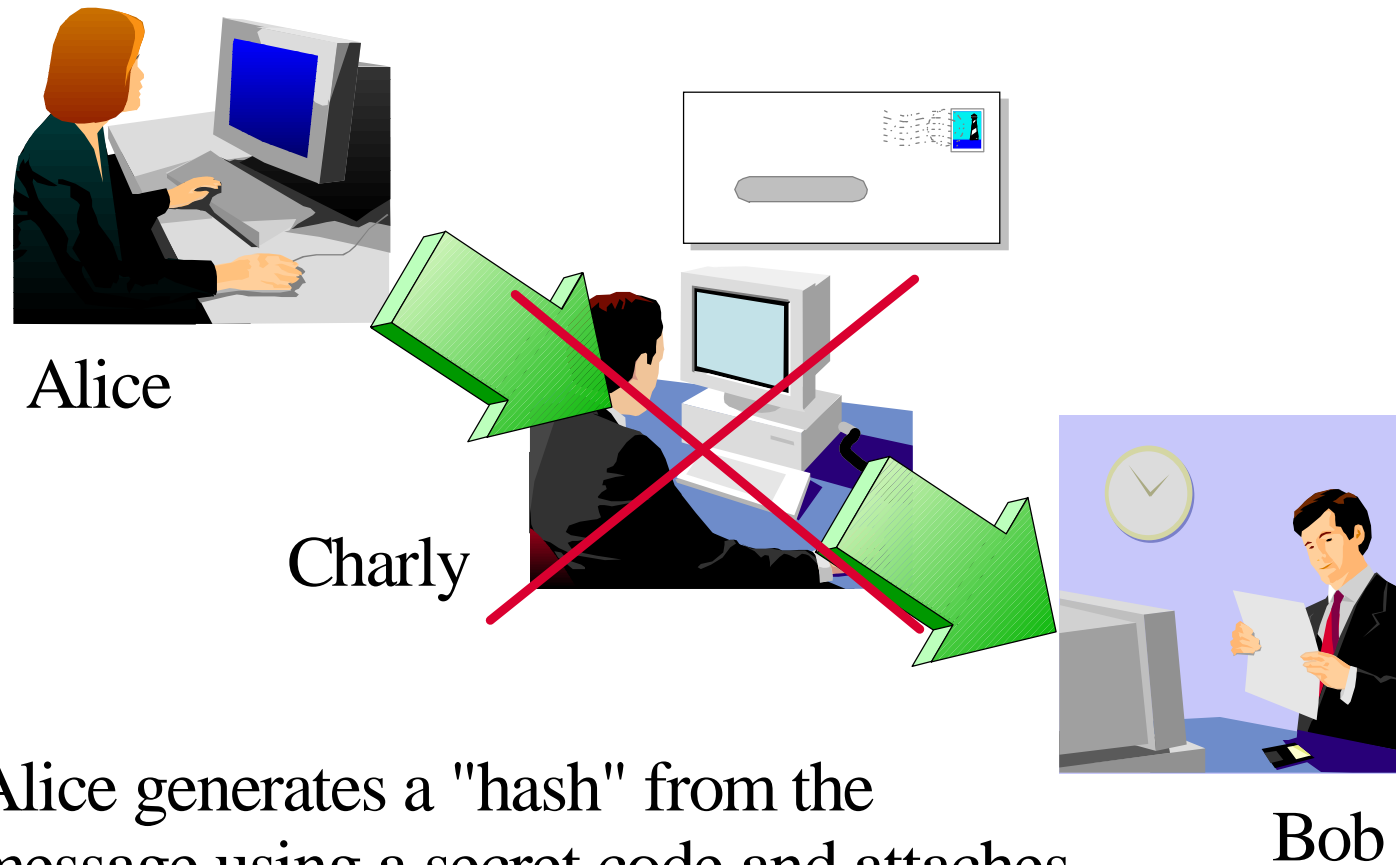
- Bob receives a message from Alice. How he can be sure that the content has not been modified?

Keeping Secrets



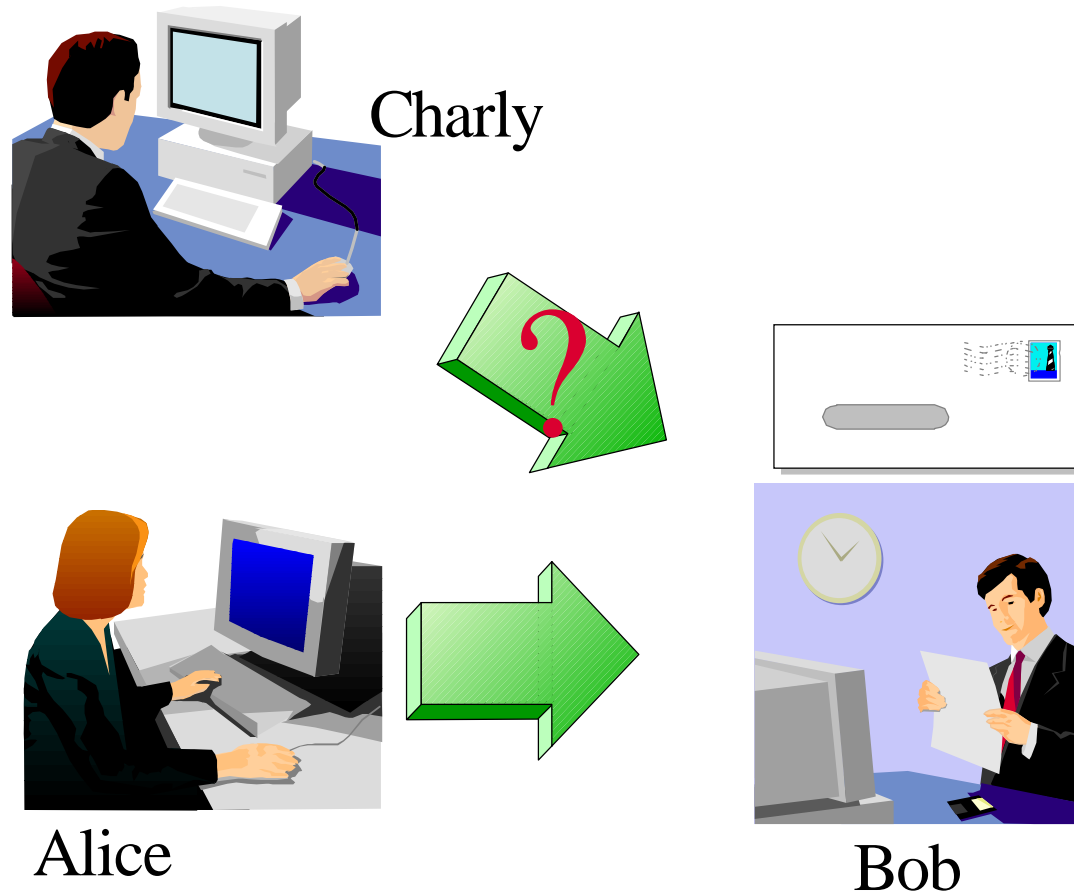
Alice encrypts the message with a secret code that only she and Bob knows

Verifying Information



Alice generates a "hash" from the message using a secret code and attaches it to the message. Bob also generates the hash from the received message and compares it.

Proving Identity



Alice "signs" the message by attaching a secret phrase that only she and Bob knows

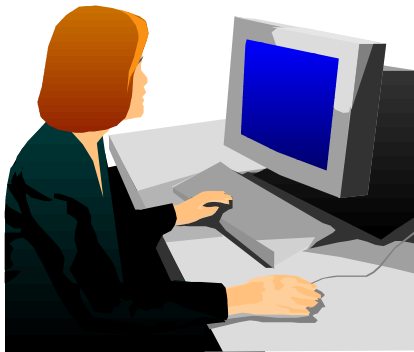
Secret Key Cryptography (symmetric)

- § **Both parties know the same secret code (key)**
- § **The key must be kept secret**
- § **Encryption algorithm = mathematical transformation of the data with the key**
 - DES Data Encryption standard
 - 3DES Triple strength DES
 - AES Advanced Encryption Standard

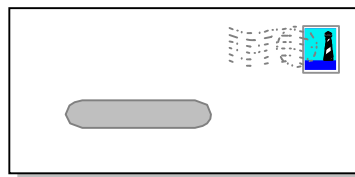
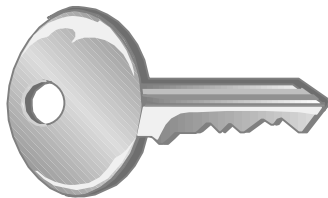
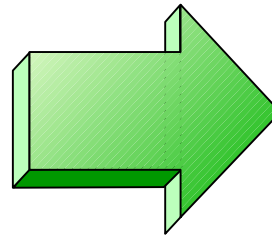


Secret Key Cryptography - continued

Alice



Bob



Alice encrypts the message with the secret key and sends it to Bob. Bob decrypts the message with the secret key.

Public Key Cryptography (asymmetric)

- § One "public key" and one "private key"
- § "Private key" is kept secret (private)
- § "Public key" is published

- § Asymmetric cryptography is based on mathematical problems, that are much easier to create than to solve
 - RSA Rivest Shamir Adleman
 - DSA Digital Signature Algorithm
 - DHE Diffie Hellman Algorithm

- § Typical key length: 512, 1024 or 2048 bit

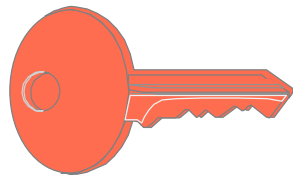
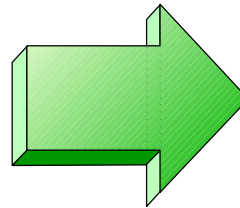


Public Key Cryptography - Encrypting

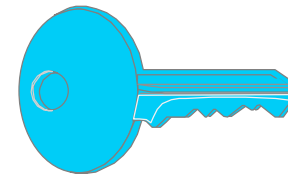
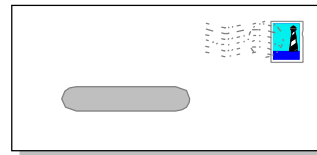
Alice



Bob



Bob's public key



Bob's private key

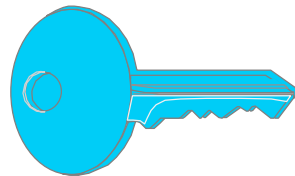
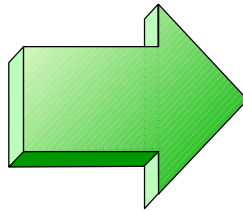
Alice encrypts the message using Bobs public key and sends it to Bob. Bob decrypts it using his private key. Since only Bob knows his private key, only he can read the message.

Public Key Cryptography - Signing

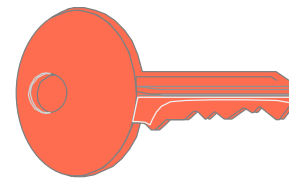
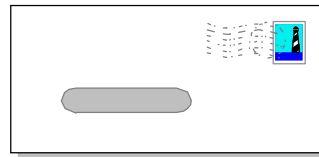
Alice



Bob



Alice's private key



Alice's public key

Alice encrypts the message using her private key and sends it to Bob. Bob decrypts it using Alice's public key. The message is "signed" by Alice since it can only be decrypted using **her** public key.

Combined Symmetric and Asymmetric Cryptography

Asymmetric cryptography is very CPU-time consuming

- § **Use asymmetric cryptography only for secret key exchange**
- § **Data encryption uses symmetric cryptography**
- § **Secret key is generated by random**

- § **SSL also uses this mechanism**

Combined Symmetric and Asymmetric Cryptography

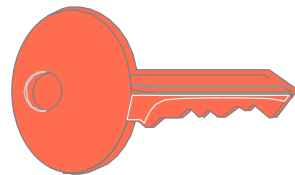
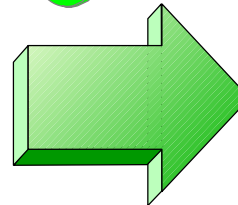
Alice



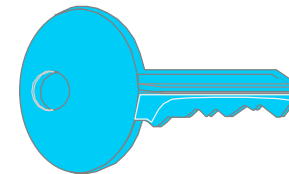
Bob



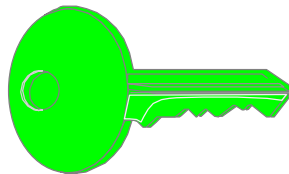
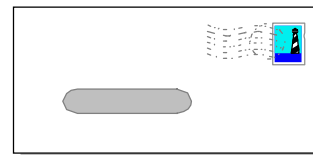
secret key



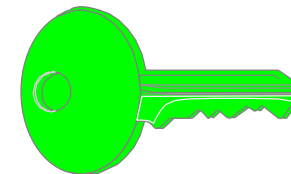
Bob's public key



Bob's private key



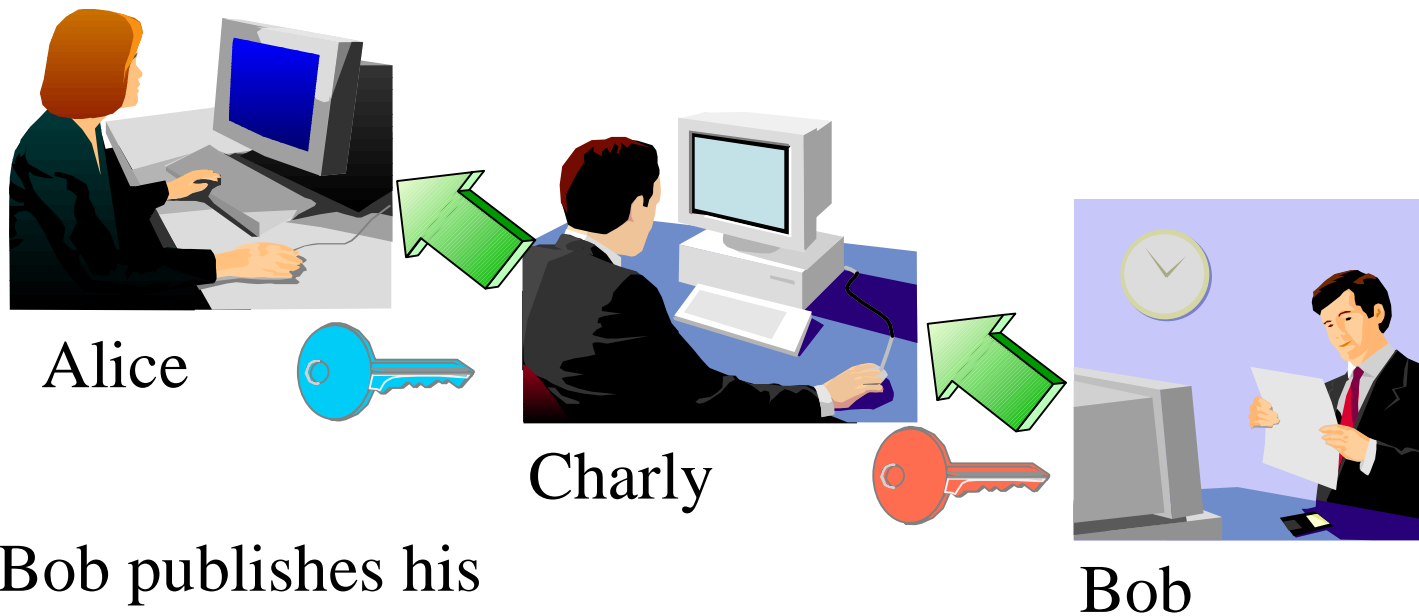
secret key



secret key

Key Management

- Key exchange is not trivial:
 - ▶ Is the public key really from the right person?



Bob publishes his public key, but Charly intercepts this and instead sends his public key to Alice.

Key Management

§ Key Management is not trivial

- Key must often be kept secure for a very long time
- You must be able to associate the encrypted data with the corresponding key(s)
- Encrypted data and the corresponding key(s) must be strictly separated

§ Keyman/VSE

- Creation of RSA keys and digital certificates
- Upload of keys and certificates to VSE
- Creation of PKCS#12 keyring files (use with Java-based connector or import into a Web browser)
- Download from VSE Homepage
<http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#vkeyman>



Certificates

§ A certificate contains the following items

- The subject (name of the person)
- The subject's public key
- Period of validity
- The issuer
- Issuers signature

§ The issuer "signs" the certificate by encrypting a hash of the certificate content with his private key

§ Everyone can check the sign by decrypting it with the issuers public key



Certificate Authorities

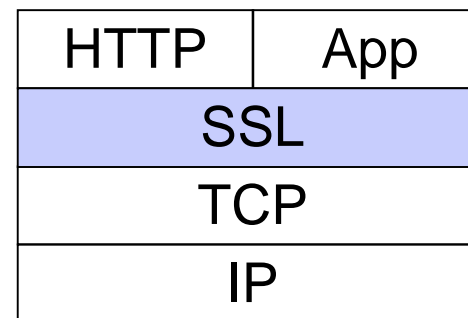
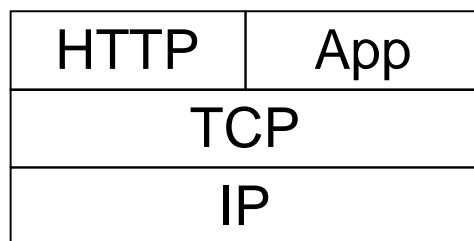
- § **A certificate is issued by a certificate authority (CA)**
- § **If a user trusts the certificate authority, he can trust the certificates issued by this CA**

- § **CAs identify itself with a "self signed certificate":**
 - The public key in the certificate is also the public key used to decrypt the signature
 - Subject and issuer are the same

- § **It is possible to build certificate hierarchies**
- § **Certificate revocation lists are used to mark certificates that have been issued by error**

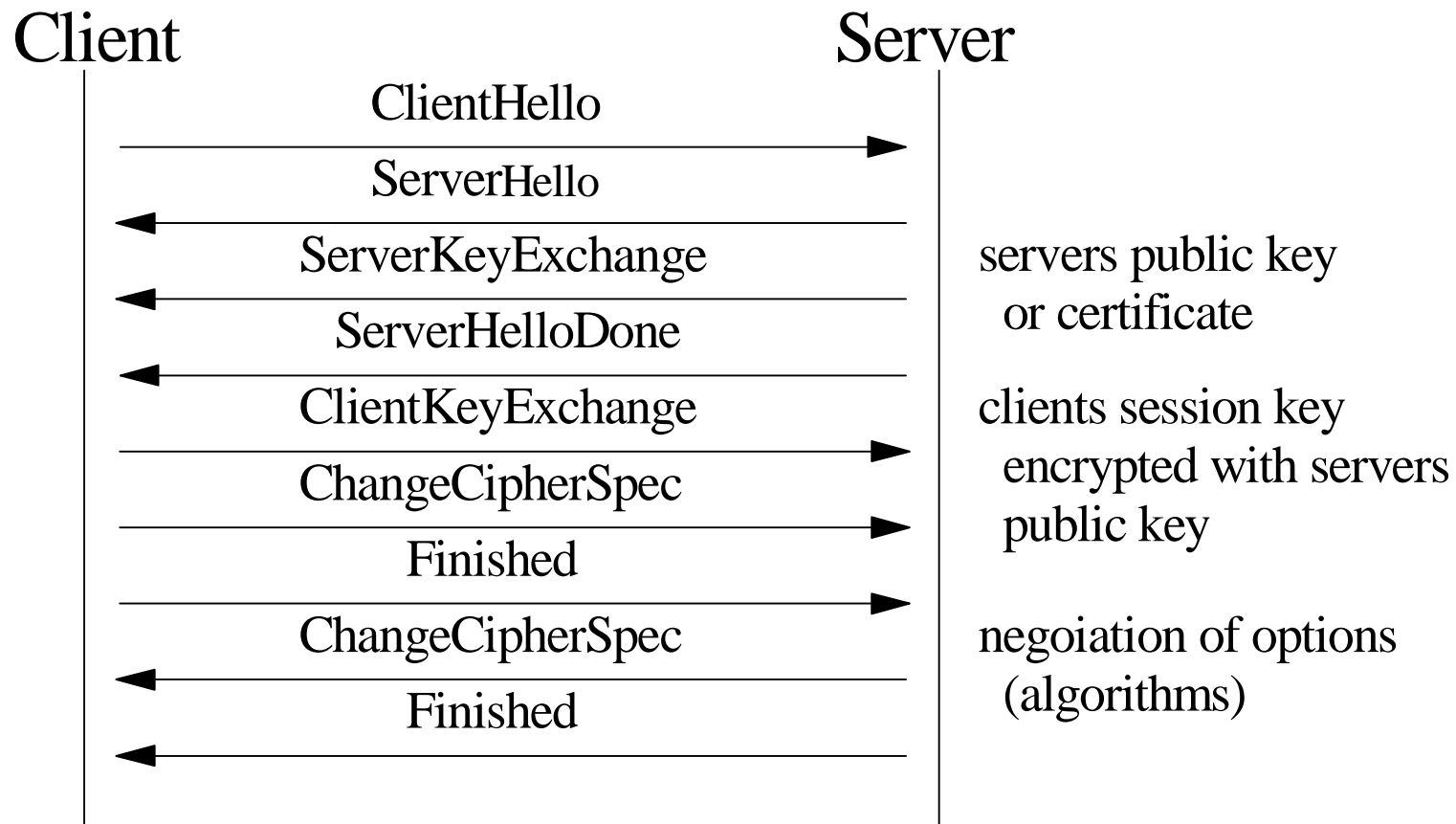
SSL (Secure Socket Layer)

- § **SSL provides a communication channel with message integrity, authentication, and confidentiality**
- § **SSL is a widely used protocol**
 - Secure HTTP (HTTPS) is used very often in the Internet
- § **SSL uses a TCP connection to transfer encrypted messages**
 - Uses asymmetric cryptography for session initiating
 - Uses symmetric cryptography for data encryption
- § **As the name implies, SSL is a layer on top of TCP**



SSL Protocol

§ The SSL protocol defines a set of messages



Cipher Suites

§ Cipher suites defines the algorithms used:

- For key exchange
- For encryption
- For hash algorithm

SSL_RSA_WITH_DES_CBC_SHA

↑
Key exchange

↑
Encryption

↑
Hash algorithm

Session Caching

- § **"SSL Session" means**
 - Secret key used for data encryption
 - Negotiated algorithms
- § **Establishing a SSL Session is a complex and time consuming mechanism**
- § **Session caching allows to reuse previously negotiated SSL parameters**
- § **No need of repeating the negotiations or authentications**
 - The same symmetric key is used
- § **The connection becomes more unsecured**
- § **A SSL Session time-out defines how long a session is kept alive**

SSL for VSE

- § **SSL for VSE is part of the TCP/IP for VSE base**
 - Enabled with the Application Pak
 - Integrated into TCP/IP for VSE

- § **Supports SSL 3.0 and TLS 1.0**
 - Key exchange: RSA
 - Data Encryption: DES and Triple DES, AES
 - Hash algorithm: MD5, SHA
 - Supports X.509v3 PKI Certificates

- § **SSL daemon implementation for HTTPS, Telnet**
- § **SSL API compatible with the OS/390 SSL API**
- § **Uses Hardware Crypto acceleration if available**

SSL Daemon (SSLD)

§ Define a SSL daemon for each TCP port that you want to secure:

```
DEFINE TLSD, ID=MYSSLD,  
        PORT=443,  
        HTTPS port  
        PASSPORT=443,  
        CIPHER=0A096208,  
        CERTLIB=CRYPTO,  
        CERTSUB=KEYRING,  
        CERTMEM=MYKEY,  
        TYPE=1,  
        MINVERS=0300,  
        DRIVER=SSLD
```

Cipher suites
library name
sub library name
member name
server application
SSL 3.0
Driver phase name

Secure Socket Layer API

§ **Compatible to OS/390 SSL API**

§ **Functions available for**

- Session initiating
- Sending/receiving data
- Ending a session

§ **SSL API is based on Socket API**

§ **SSL API can be called from**

- LE-C programs
- Assembler programs

Secure Socket Layer - Concepts

§ When using **SSL**, you need to have a set of certificates and keys

- A Public/Private key pair
- Root Certificate
 - Certificate of a Certificate Authority (CA) that has issued the other certificates
- Your own certificate
 - A certificate that was issued to you by a certificate authority
- Partner Certificate(s)
 - Certificate(s) of your communication partners

§ When you do **HTTPS** with your browser usually already contains these keys and certificates

Secure Socket Layer - Concepts

- § **For production purposes, certificates are usually issued by a well known and trusted Certificate Authorities (CA)**
 - For example Thawte, VeriSign
 - Usually this cost money

- § **For in-house use (Intranet), you can have your own Company-wide Certificate Authority**
 - Certificates are trusted inside your company, but not outside

- § **For test purposes you can use self-signed Certificates (you are your own Certificate Authority)**
 - Nobody trusts these Certificates (except you)

Secure Socket Layer - Setup

§ **To setup all required keys and certificates, it is recommended to use the Tool Keyman/VSE**

– Download from VSE Homepage

<http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#vkeyman>

§ **Supports creation of keys and CA-signed or self-signed Certificates for use with SSL**



§ **Online documentation contains 'How to' sections with step by step descriptions for creating keys and certificates**

Setup a self signed certificate

§ Steps for creating a self-signed certificate:

1. Create an RSA key pair
2. Create a self-signed root certificate
3. Create a VSE server certificate
4. Sign the request with your root certificate
5. Make your VSE host ready for uploading
6. Upload the key to VSE
7. Upload the root certificate to VSE
8. Upload the server certificate to VSE
9. Save your local keyring file

§ Use Wizard Dialog “Create self-signed keyring”

Setup a self signed certificate - Wizard

The screenshot illustrates the 'Create self-signed keyring' wizard in Keyman software, divided into three numbered steps:

- Step 1:** The main Keyman window shows the 'Create self-signed keyring' button in the toolbar.
- Step 2:** The 'VSE Host Properties' dialog box is shown with the following fields:
 - VSE Name: VSE01
 - IP Address: 9.152.92.57
 - Port: 2893
 - VSE User: JSCH
 - VSE Password: [masked]
 - VSE Job Class: A
 - VSE Crypto Library: CRYPTO . KEYRING
 - Cert. Member Name: JSCH02
 - VSE TCP/IP Library: PRD1 . BASE
- Step 3:** The 'Local Keyring File Properties' dialog box is shown with the following fields:
 - Name: D:\keyman\VSE01_selfsigned.pfx
 - Keyring File Password: [masked]
 - Retype password: [masked]
 - Encryption of public items: 3DES (168 bits)
 - Encryption of private items: 3DES (168 bits)
 - Password protection: 2000 1 ... 2000

Setup a self signed certificate - Wizard

4

Generate RSA Key Pair

Generate new RSA key pair with strength:

1024 bits

Available cipher suites with this key length:

- 09 : RSA1024_DESCBC_SHA (56-bit DES)
- 0A : RSA1024_3DESCBC_SHA (168-bit Triple-DES)
- 62 : RSA1024_EXPORT_DESCBC_SHA (56-bit DES)

This key will be your VSE private key and stored in your VSE crypto library as .PRVK member. Further keys with the same strength will be created for your client and server certificates.

Make sure the VSE Connector Server is started non-SSL!

Cancel << Back Next >> Help

5

Personal Information for VSE ROOT Certificate

Common name: VSE/ESA ROOT Certificate

Organizational unit: Development

Organization: IBM Germany

City/Location: Boeblingen

State/Province: N/A

Country: DE Germany (DE)

e-mail: vseesa@de.ibm.com

Expires: 2004-3-11 1 year

This certificate will be cataloged on VSE as .ROOT member in the VSE keyring library.

New 1024-bit Key generated, elapsed time: 2 second(s).

Cancel << Back Next >> Help

Setup a self signed certificate - Wizard

6

Personal Information for VSE Server Certificate

Common name: VSE Server Certificate

Organizational unit: Development

Organization: Your organization

City/Location: Your city/location

State/Province: Your state/province

Country: DE Germany (DE)

e-mail: info@your_company.com

Expires: 2004-3-11 1 year

This certificate will be cataloged on VSE as .CERT member in the VSE keyring library.

New 1024-bit ROOT certificate generated.

Cancel << Back Next >> Help

7

Personal Information for VSE Client Certificate

Common name: VSE/ESA Client Certificate

Organizational unit: Your company

Organization: Your organization

City/Location: Your location

State/Province: Your state/province

Country: DE Germany (DE)

e-mail: vsecient@your_company.com

Expires: 2004-3-11 1 year

Map to VSE User: SYSA (Optional)

New 1024-bit server certificate generated.

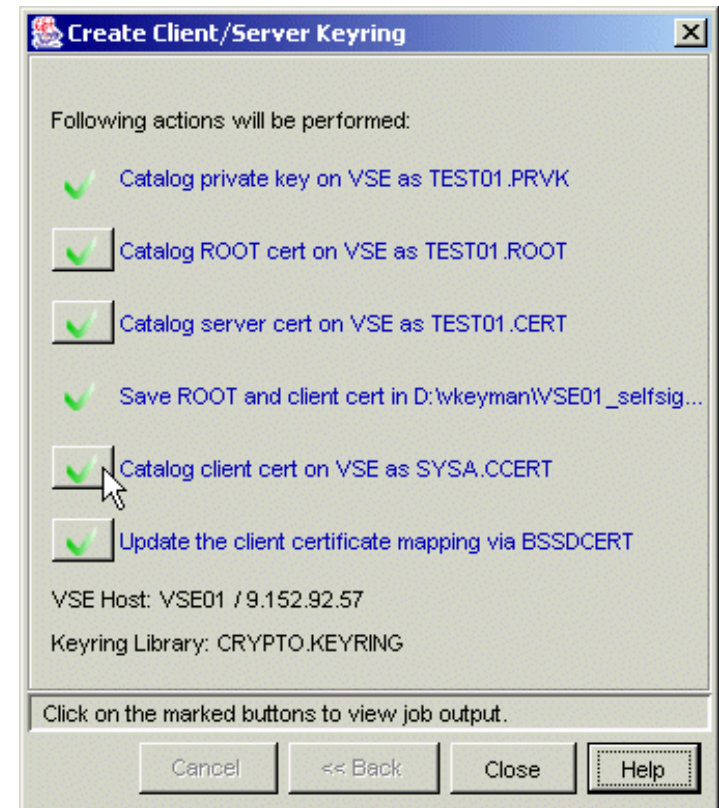
Cancel << Back Next >> Help

Setup a self signed certificate - Wizard

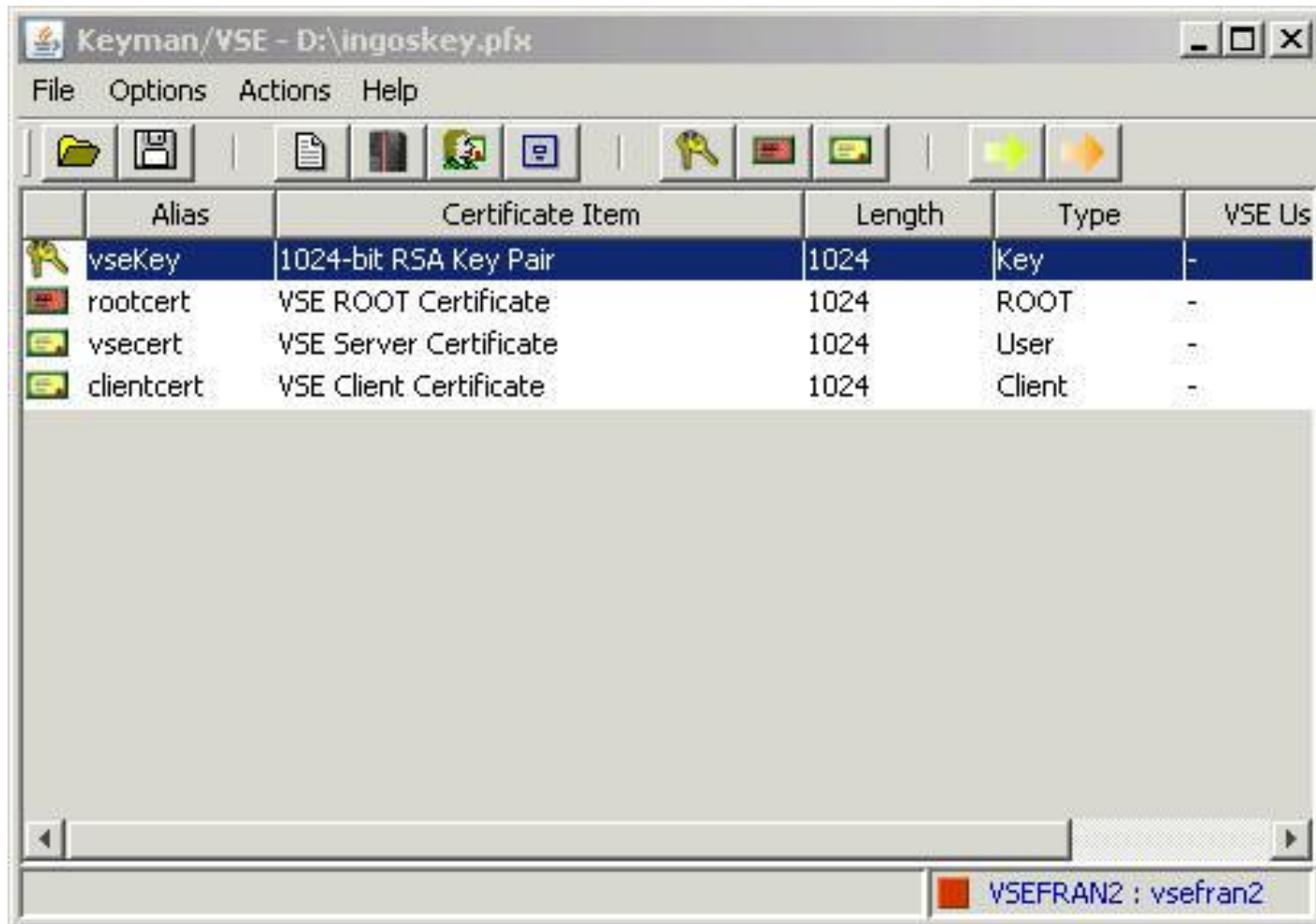
8



9



Setup a self signed certificate - Wizard



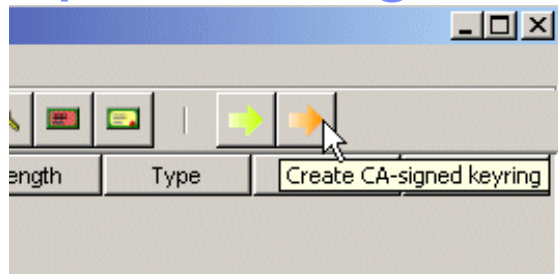
Setup a CA signed certificate

§ Steps for creating a CA signed certificate:

1. Create an RSA key pair
2. Create a certificate request
3. Copy request to clipboard
4. Go to the CA's web site (e.g. Thawte, VeriSign)
5. Request the server certificate on the CA's web site
6. Import signed server cert into Keyman/VSE
7. Get the CA's public root certificate
8. Make your VSE host ready for uploading
9. Upload the key to VSE
10. Upload the root certificate to VSE
11. Upload the server certificate to VSE
12. Save your local keyring file

§ Use Wizard Dialog “Create CA signed keyring”

Setup a CA signed certificate - Wizard



1

2

VSE Host Properties

VSE Name	VSE01	
IP Address	9.152.92.57	
Port	2893	
VSE User	JSCH	
VSE Password	*****	*****
VSE Job Class	A	
VSE Crypto Library	CRYPTO	KEYRING
Cert. Member Name	JSCH02	
VSE TCP/IP Library	PRD1	BASE

Maybe it's a good idea to open a VSE console now...

Cancel << Back Next >> Help

3

Local Keyring File Properties

Name	D:\keyman\VSE01_selfsigned.ptx	
	Browse...	
Keyring File Password	*****	
Retype password	*****	
Encryption of public items	3DES (168 bits)	
Encryption of private items	3DES (168 bits)	
Password protection	2000	1 ... 2000

This keyring file can be directly used on the client side by the VSE Connector Client. To use it with CWS you must import it into your Web Browser.

Cancel << Back Next >> Help

Setup a CA signed certificate - Wizard

4

Generate RSA Key Pair

Generate new RSA key pair with strength:

1024 bits

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- 0A : RSA1024_3DESCBC_SHA (168-bit Triple-DES)
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Make sure the VSE Connector Server is started non-SSL!

Cancel << Back Next >> Help

5

Personal Information for VSE Server Cert

Common name: VSE Server Certificate

Organizational unit: Development

Organization: Your organization

City/Location: Your city/location

State/Province: Your state/province

Country: DE Germany (DE)

e-mail: info@your.company.com

Expires: 2004-3-5 1 year

This certificate will be cataloged on VSE as .CERT member in the VSE keyring library.

New 1024-bit Key generated, elapsed time: 2 seconds.

Cancel << Back Next >> Help

Setup a CA signed certificate - Wizard

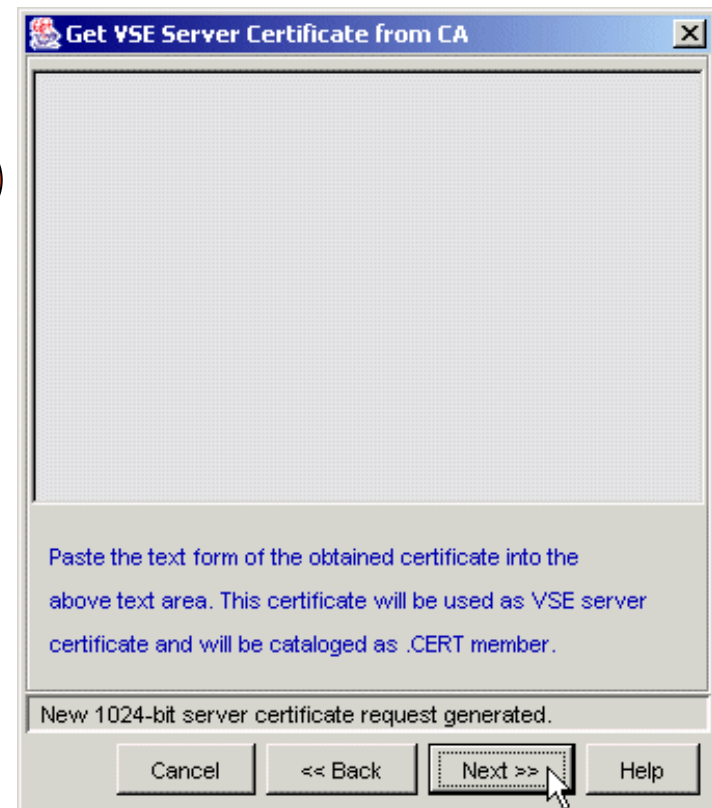
6



7

Copy and Paste the request into a CA's web site and let them sign the request.

You can paste the generated certificate into the text area on the following dialog box.



Setup a CA signed certificate - Wizard

The image displays a multi-step process for setting up a CA signed certificate. It includes:

- A browser window showing the Thawte landing page with a security warning and a 'Test-drive it NOW!' button.
- A 'Step 3 - Certificate Signing Request' dialog box with a form for entering user information (First Name, Last Name, E-Mail Address, Company, Phone, State/US or Prov, Country).
- A 'Get VSE Server Certificate from CA' dialog box containing a large text area with a generated certificate request (PEM format).
- A note below the text area: "Note: The certificate displayed above needs to include the email address you want to be fully automatically generated. Hence, please make sure the private key from which it was originally created..."
- Buttons for 'Cancel', '<< Back', 'Next >>', and 'Help' at the bottom of the wizard window.

Setup a CA signed certificate - Wizard

8

Personal Information for VSE Client Cert

Common name: VSE/ESA Client Certificate

Organizational unit: Your company

Organization: Your organization

City/Location: Your location

State/Province: Your state/province

Country: DE Germany (DE)

e-mail: vseclient@your.company.com

Expires: 2004-3-5 1 year

Map to VSE User: JSCH (Optional)

Server certificate created from Base64 text form.

Buttons: Cancel, << Back, Next >>, Help

9

Request Client Certificate from CA

```

-----BEGIN NEW CERTIFICATE REQUEST-----
MIICBzCCAXACAQAwgcYxKTAnBgkqhkiG9w0BCQEWGnZ:
bXBhbhbnkuY29tMQswCQYDVQQGEwJERTEcMBoGA1UECBM:
aW5jZTEWMBQGA1UEBxMNVW91ciBsb2NhdG1vbjEaMBGQ:
bm16YXRpb24xFTATBgNVBAsTDFlvdXlY29tcGFueTE:
QSBDbG1lbnQgQ2VydG1maWNhdGUwgZ8wDQYJKoZIhvcI:
AL4wRq1shW+17JEMZEyZBMAMmhZueMcWYs26ZLavTbn:
b50rVkggTl15StRDiCsDbNuyCr+/lnKivPq+QpFoxQm:
kP9nbqOwclmtKIaGx+qqAooj6PHkNJVLxNPN1ARDHZ+:
9w0BAQUFAA0BgQC0tTqj7gkaV9k9AbbPX75+YXoPgWQ:
3ZeXfG0amctrUu708x9tD3jG981cBBGwyNoT7MNLn+Q:

```

Go to an online CA and request a client certificate using this certificate request. The client certificate will be stored in your local keyring file.

New 1024-bit client certificate request generated.

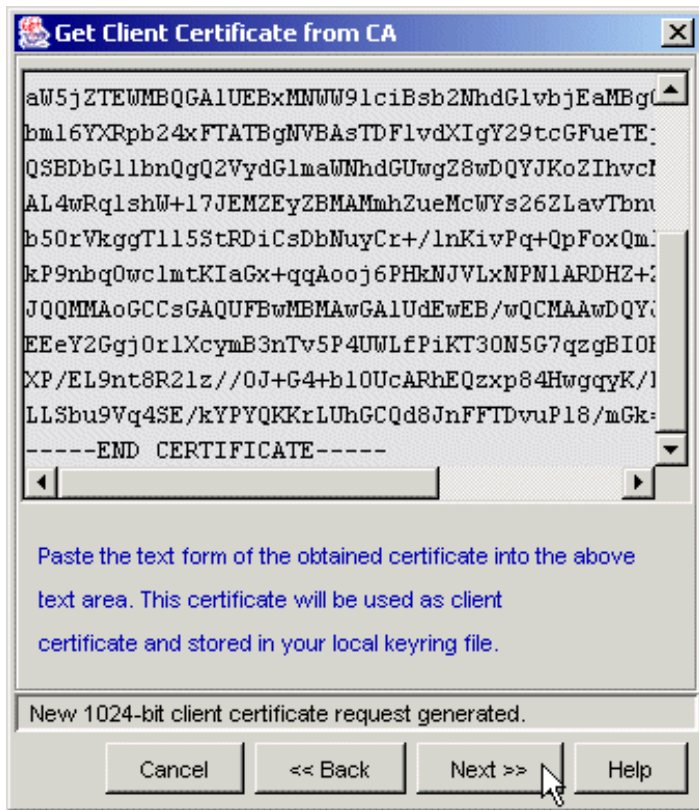
Buttons: Cancel, << Back, Next >>, Help

Copy and Paste the request into a CA's web site and let them sign the request.

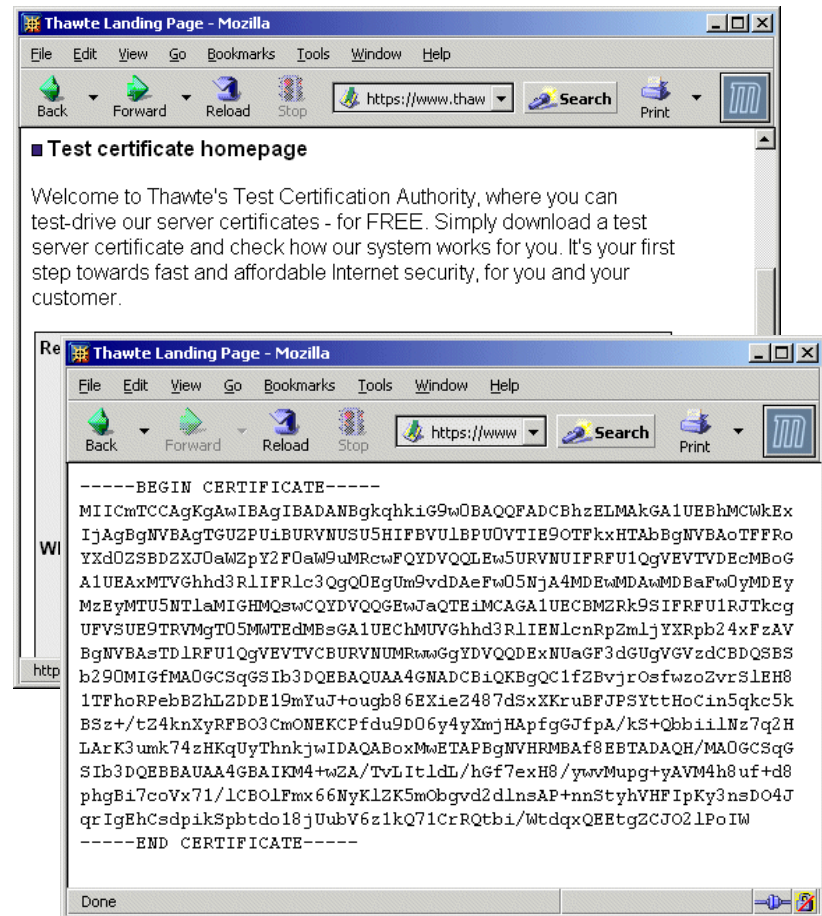
You can paste the generated certificate into the text area on the following dialog box.

Setup a CA signed certificate - Wizard

10

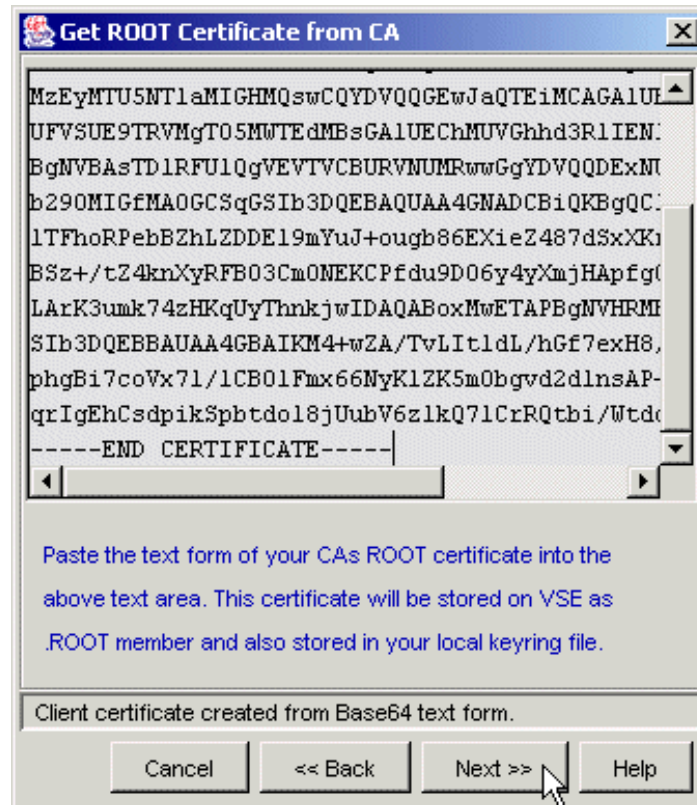


11

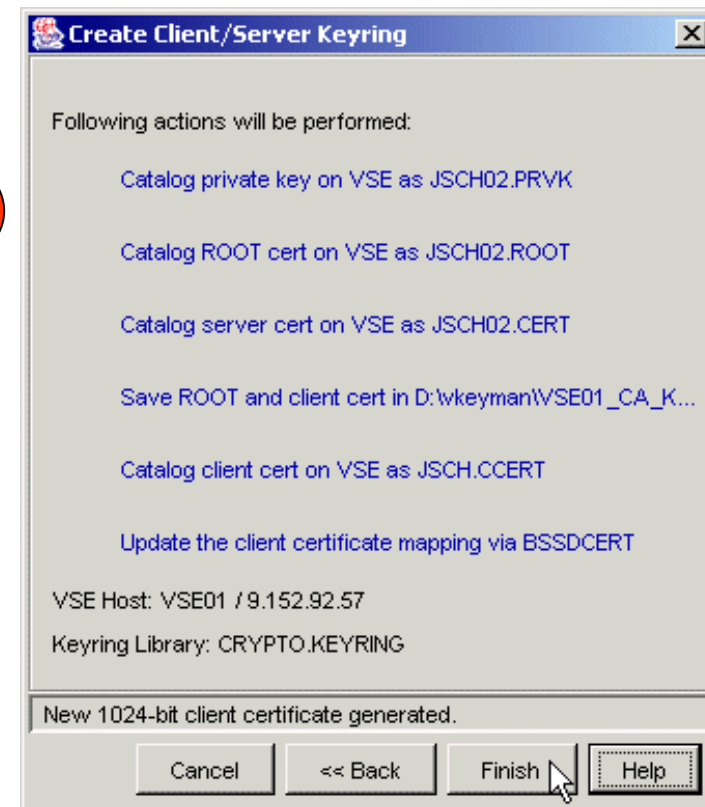


Setup a CA signed certificate - Wizard

12

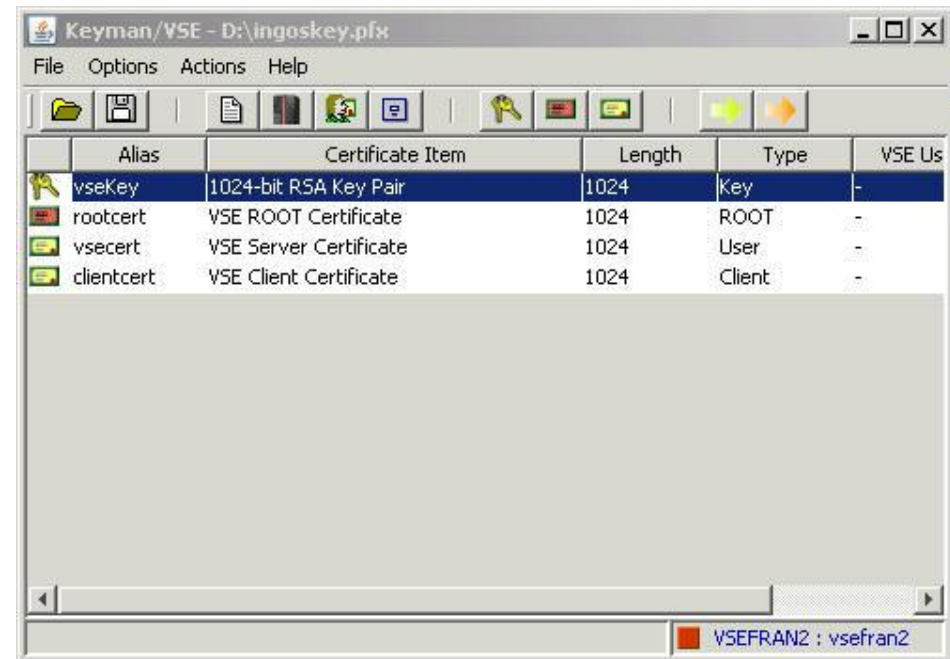
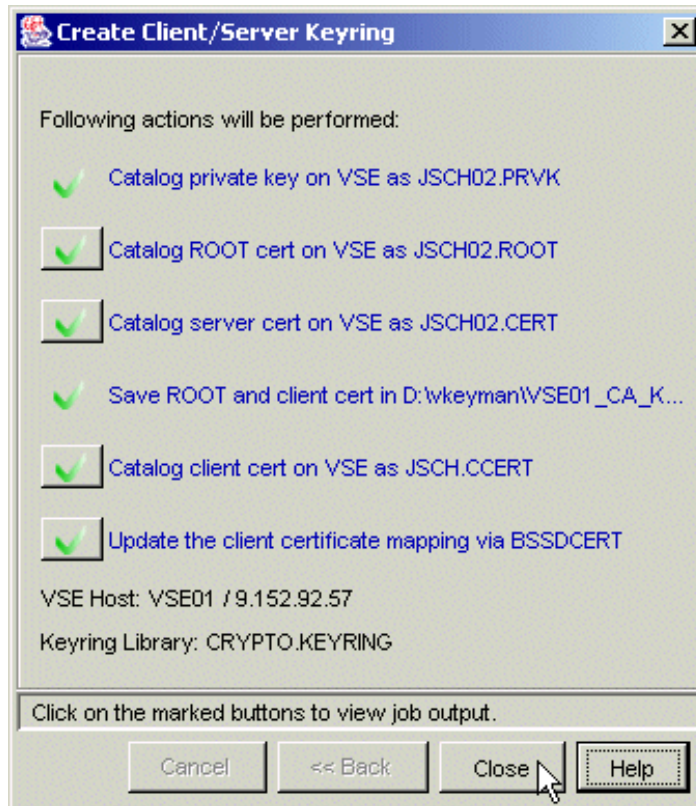


13



Setup a CA signed certificate - Wizard

14



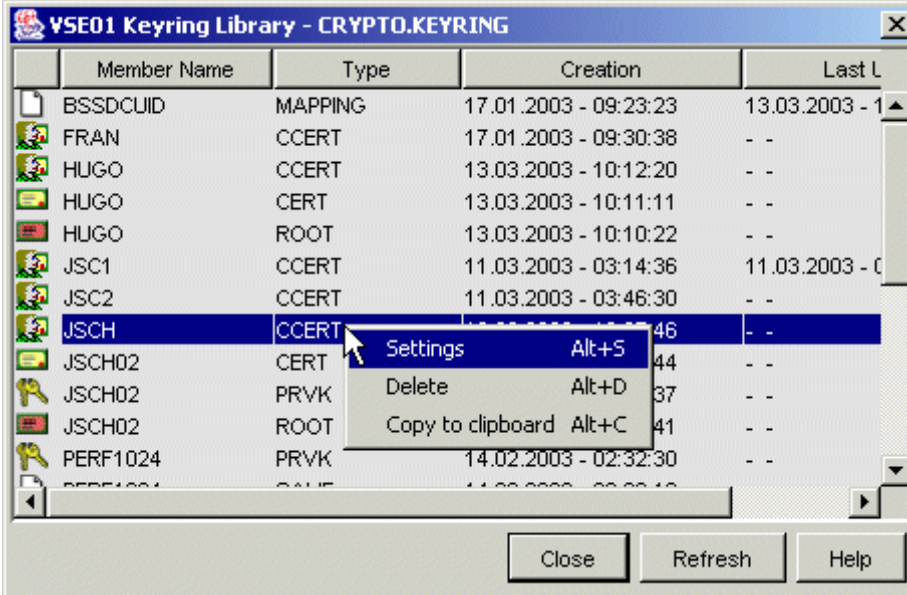
Where are keys and certificates stored on VSE ?

§ Keys and certificates are stored on a VSE Library

- Usually in CRYPTO.KEYRING
- This library should be secured using the VSE security mechanisms (access protection)

§ Member types:

- .PRVK – Public/Private Key
- .ROOT – Root Certificate
- .CERT – Server Certificate
- .CCERT – Client Certificate
- BSSDCUID.MAPPING – Contains the User to Certificate mapping information



Member Name	Type	Creation	Last L
BSSDCUID	MAPPING	17.01.2003 - 09:23:23	13.03.2003 - 1
FRAN	CCERT	17.01.2003 - 09:30:38	- -
HUGO	CCERT	13.03.2003 - 10:12:20	- -
HUGO	CERT	13.03.2003 - 10:11:11	- -
HUGO	ROOT	13.03.2003 - 10:10:22	- -
JSC1	CCERT	11.03.2003 - 03:14:36	11.03.2003 - 0
JSC2	CCERT	11.03.2003 - 03:46:30	- -
JSCH	CCERT	11.03.2003 - 03:46:30	- -
JSCH02	CERT	11.03.2003 - 03:46:30	- -
JSCH02	PRVK	11.03.2003 - 03:46:30	- -
JSCH02	ROOT	11.03.2003 - 03:46:30	- -
PERF1024	PRVK	14.02.2003 - 02:32:30	- -
PERF1024	PRVK	14.02.2003 - 02:32:30	- -

SSL with client authentication

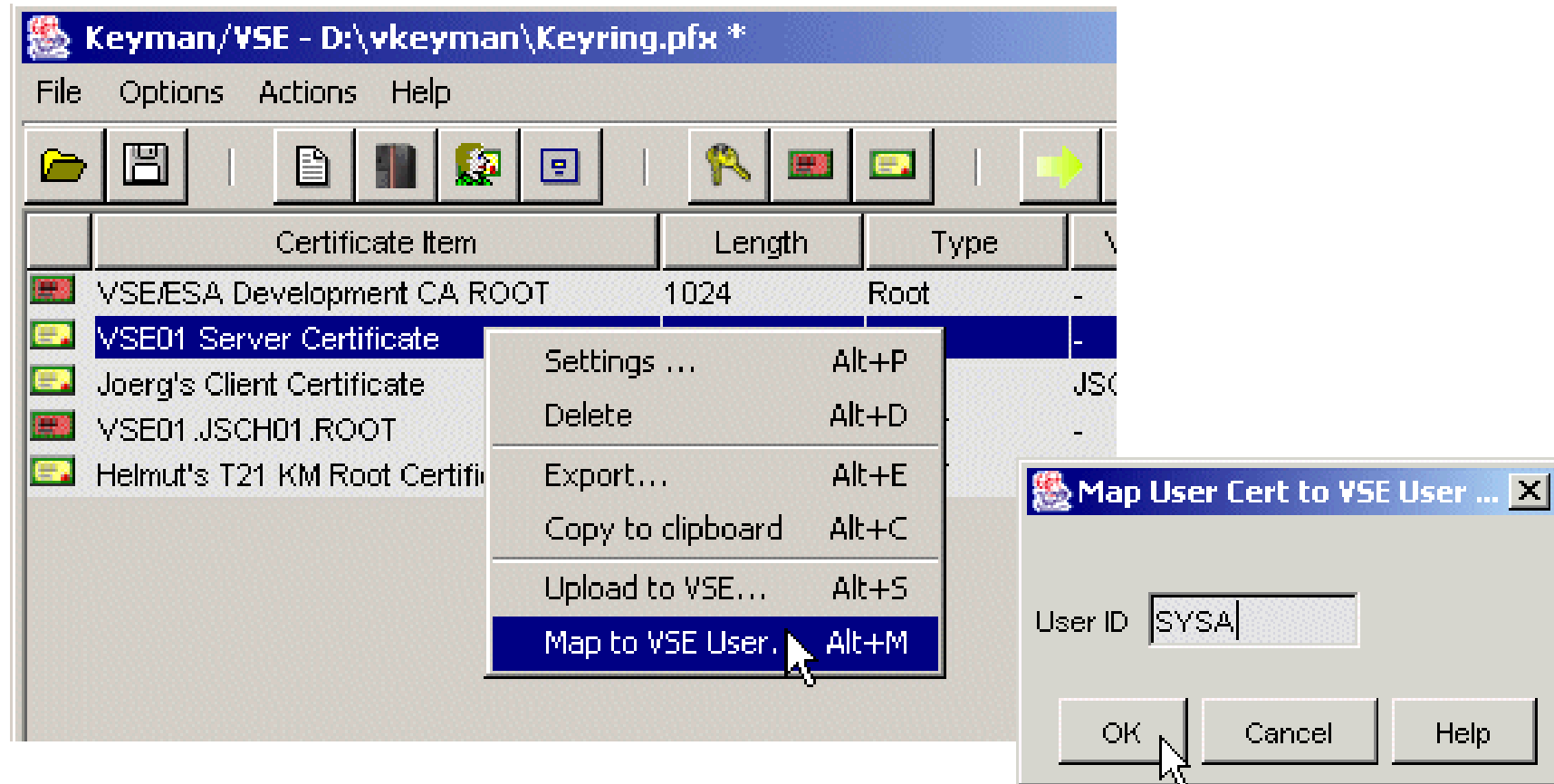
§ Server authentication means

- The clients verifies the certificate received from the server
- To make sure they are talking to the right server

§ Client authentication means

- The server verifies the certificates(s) received from the client(s)
- To make sure only known clients can talk to the server
- To do implicit logon by using the certificate (optional)
 - Map a user id to a certificate

Map a VSE user id to a client certificate



SecureFTP

§ **The FTP protocol provides a easy and straight forward protocol for transferring files between systems on different platforms**

- Many installations rely on it to efficiently transmit critical files that can contain vital information such as customer names, credit card account numbers, social security numbers, corporate secrets and other sensitive information
- FTP protocol transmits data without any authentication, privacy or integrity

§ **SecureFTP provides user authentication, privacy and integrity by using RSA digitally signed certificates, DES encryption and SHA-1 secure hash functions**

- SecureFTP is integrated into TCP/IP for VSE with z/VSE V4.1 (at no additional charge) or offered as separately priced product by CSI

§ **How to setup Secure FTP with VSE:**

[ftp://ftp.software.ibm.com/eserver/zseries/zos/vse/pdf3/How to setup SecureFTP with VSE.pdf](ftp://ftp.software.ibm.com/eserver/zseries/zos/vse/pdf3/How_to_setup_SecureFTP_with_VSE.pdf)

Hardware Crypto Support on System z and VSE

by release

	z/VSE 4.1	z/VSE 3.1	VSE/ESA 2.7	VSE/ESA 2.6
PCICA	Yes	Yes	Yes	-
CEX2C	Yes	Yes	-	-
CPACF	Yes	Yes	-	-
CEX2A	Yes	Yes	-	-
PCIXCC	Yes	-	-	-

	prior z800	z800	z900	z890	z990	Z9	z10
PCICA	-	Yes	Yes	Yes	Yes	-	-
PCIXCC	-	-	-	Yes	Yes	-	-
CEX2C	-	-	-	Yes	Yes	Yes	Yes
CPACF	-	-	-	Yes	Yes	Yes	Yes
CEX2A	-	-	-	-	-	Yes	Yes

by server



CEX2C = Crypto Express2 in coprocessor mode

CEX2A = Crypto Express2 in accelerator mode

See: <http://www.ibm.com/systems/z/security/cryptography.html>

VSE Hardware Configuration

§ VSE hardware configuration not necessary for crypto hardware

- No IOCDS definition in VSE
- No device type
- No ADD statement
- You may have to define the devices in the HMC (LPAR) or z/VM directory

§ Use of crypto hardware is transparent to end users and even TCP/IP applications

- But use of crypto hardware can be disabled via TCP/IP SOCKOPT phase

§ **How to setup cryptographic hardware for VSE:**

[ftp://ftp.software.ibm.com/eserver/zseries/zos/vse/pdf3/How to setup crypto hardware for VSE.pdf](ftp://ftp.software.ibm.com/eserver/zseries/zos/vse/pdf3/How_to_setup_crypto_hardware_for_VSE.pdf)

HW-Crypto related console messages

§ System with crypto hardware

```
FB 0095 1J023I FOUND A CRYPTO EXPRESS2 CARD AT DEVICE INDEX 0
FB 0095 1J023I FOUND A CRYPTO EXPRESS2 CARD AT DEVICE INDEX 1
FB 0095 1J014I FOUND A PCICA CARD AT DEVICE INDEX 6
FB 0095 1J014I FOUND A PCICA CARD AT DEVICE INDEX 7
FB 0095 1J005I HARDWARE CRYPTO ENVIRONMENT INITIALIZED SUCCESSFULLY.
FB 0095 1J006I USING CRYPTO DOMAIN 0
FB 0095 1J022I CPU CRYPTOGRAPHIC ASSIST FEATURE AVAILABLE.
```

§ System without crypto hardware

```
FB 0093 1J020W THERE WAS NO PCICA OR CRYPTO EXPRESS2 CARD
FB 0093          FOUND. HARDWARE CRYPTO NOT AVAILABLE.
```

HW-Crypto status display

```
msg fb,data=status=cr
AR 0015 1I40I  READY
FB 0011 BST223I CURRENT STATUS OF THE SECURITY TRANSACTION SERVER:
FB 0011 ADJUNCT PROCESSOR CRYPTO SUBTASK STATUS:
FB 0011  AP CRYPTO SUBTASK STARTED ..... : YES
FB 0011  MAX REQUEST QUEUE SIZE ..... : 1
FB 0011  MAX PENDING QUEUE SIZE ..... : 1
FB 0011  TOTAL NO. OF AP REQUESTS ..... : 1234
FB 0011  NO. OF POSTED CALLERS ..... : 1234
FB 0011  AP CRYPTO POLLING TIME (1/300 SEC).. : 1
FB 0011  AP CRYPTO TRACE LEVEL ..... : 3
FB 0011  ASSIGNED APS : PCICC / PCICA ..... : 0 / 0
FB 0011                      CEX2C / CEX2A ..... : 1 / 2
FB 0011                      PCIXCC ..... : 0
FB 0011  AP  0 : CEX2C  - ONLINE
FB 0011  AP  4 : CEX2A  - ONLINE
FB 0011  AP  9 : CEX2A  - ONLINE
FB 0011  ASSIGNED AP QUEUE (CRYPTO DOMAIN)... : 6
FB 0011 CPU CRYPTOGRAPHIC ASSIST FEATURE:
FB 0011  CPACF AVAILABLE ..... : YES
FB 0011  INSTALLED CPACF FUNCTIONS:
FB 0011  DES, TDES-128, TDES-192, SHA-1
FB 0011  AES-128
FB 0011  PRNG, SHA-256
FB 0011 END OF CPACF STATUS
```

Crypto HW exploitation in VSE

§ **Crypto cards are only used for RSA acceleration**

- RSA decrypt/encrypt for SSL session initiation
- RSA encrypt for signing of certificates (CIALCREQ)

§ **CPACF**

- Acceleration of symmetric algorithms:
DES, TDES, AES-128 (z9 only), SHA-1
- Used at
 - SSL data transfer
 - CIAL functions in TCP/IP

§ **Usage is transparent for TCP/IP applications**

- If Crypto HW is available, it will be used. If not available, the SW implementation (as part of TCP/IP) will be used
- You can disable the use of Crypto HW via a setting in \$SOCKOPT Phase

Crypto HW exploitation in VSE

§ HW Crypto Functions that are not exploited in VSE

- Special functions available in Coprocessor-Modus
 - **RSA Key-Generation**
 - RSA keys could be generated directly on VSE, no workstation tool would be required
 - **Secure Key functions**
 - PIN functions
 - Symmetric Key Import / Export (Key Transport)
 - **Special functions for banking-software**
 - ANSI X9.17 Standard: Key generate, export, import

§ Requirements are welcome !

Secure Key vs. Clear Key

§ Different way of managing, storing and usage of keys

- Keys reside unencrypted (clear) in the file system (“Clear Key”)

- Keys reside encrypted (TDES with fixed key) in the file system
 - è That’s how VSE works today

- Keys reside encrypted (using a “Secure Master Key”) in the file system
 - The Master Key is stored in the hardware
 - Secure master key entry via TKE or Dialogs
 - Crypto operations are done in main storage, i.e. data keys are visible (unencrypted) in main storage for a very short time
 - Crypto operations are done on a coprocessor card, i.e. data keys will never reside unencrypted in the main storage
 - è Required for banking applications, e.g. PIN Verification
 - è Supported by z/OS ICSF

CryptoVSE API

§ Native cryptographic API

- Can also be used directly from within COBOL programs

§ Provides cryptographic services:

- Data encryption
 - DES
 - Triple DES
 - AES
 - RSA PKCS #1
- Message Digest
 - MD5
 - SHA-1
- Digital Signatures
 - RSA PKCS #1 with SHA1 or MD5
- Message Authentication
 - HMAC

§ Uses Hardware Crypto functions transparently when available

Customer Data Protection Requirements

- § Regulatory requirements driving need for greater data security, integrity, retention/auditability, and privacy
- § Severe business impacts caused by loss or theft of data including financial liability, reputation damage, legal/compliance risk
- § Increasing need to share data securely with business partners and maintain backups at remote locations
- § Need to reduce complexity and improve processes around enterprise encryption management
- § Need ability to cost effectively encrypt large quantities of tape data



Secondary Site



Business Partners

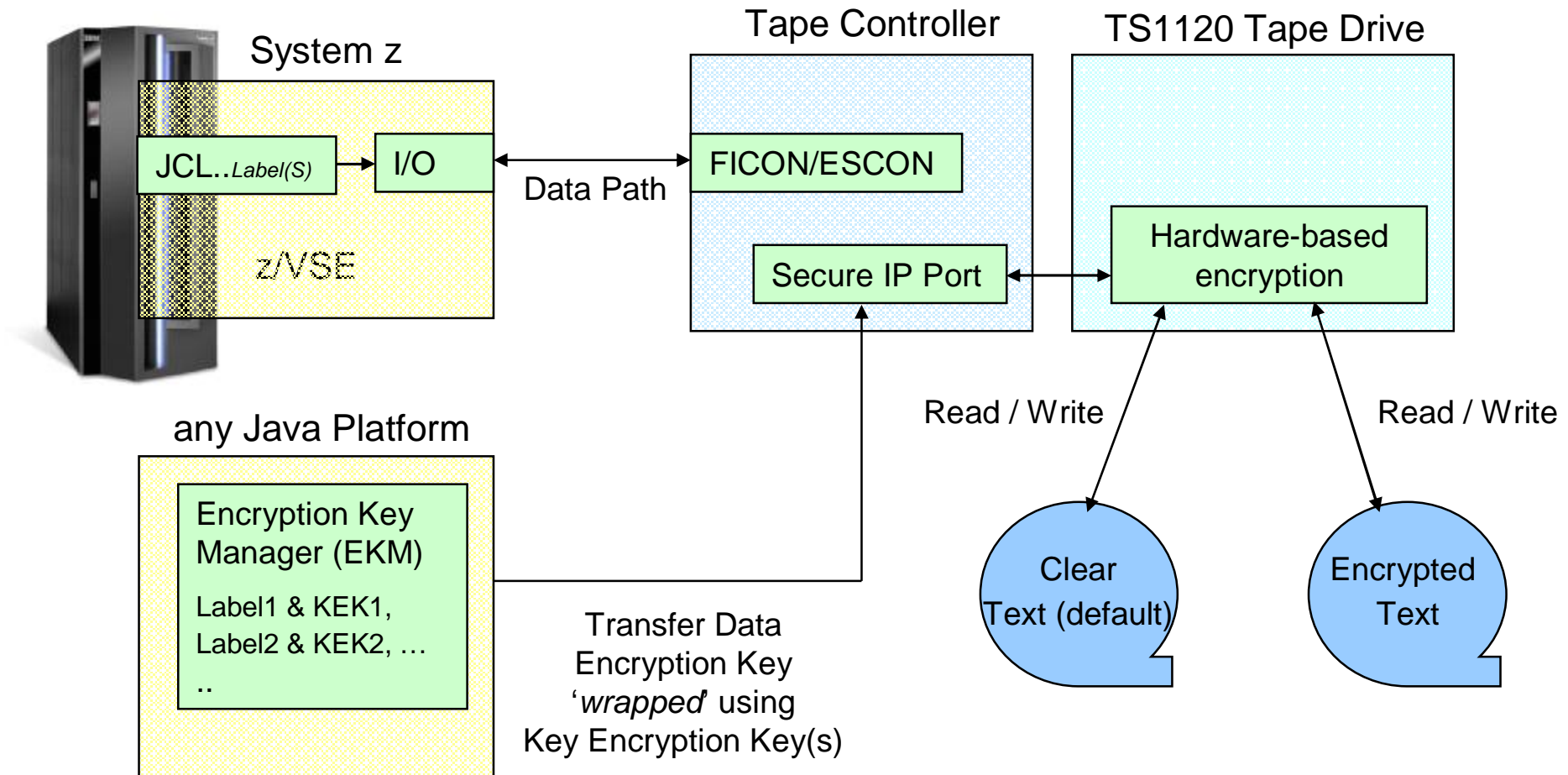


IBM Tape Encryption – TS1120

- § The IBM System Storage TS1120 Tape Drive has been enhanced to provide drive based data encryption
- § A new, separate IBM Encryption Key Manager component for the Java Platform (Encryption Key Manager) program is also being introduced:
 - supports the generation and communication of encryption keys for the tape drives across the enterprise.
- § **New: Support is now available for z/VSE V4 and V3:**
 - z/VSE V4.1: [DY46682](#) (UD53141 and UD53142)
 - z/VSE V3.1: [DY46685](#) (UD53143, UD53144, UD53146) and [PK43473](#) (UK24398)
 - z/VM: [VM64062](#) (UM32012)
 - DITTO: [PK44172](#) - With this Apar, DITTO/ESA for VSE supports tape encryption interactively and via standard VSE JCL in BATCH mode



IBM Tape Encryption – TS1120



IBM Tape Encryption – TS1120

```

// JOB ENCRYPT
// ASSGN SYS005,480,03
// KEKL UNIT=480,KEKL1='MYKEKL1',KEM1=L,KEKL2='MYKEKL2',KEM2=L
// EXEC LIBR
  BACKUP LIB=PRD2 TAPE=SYS005
/*
/ &

```

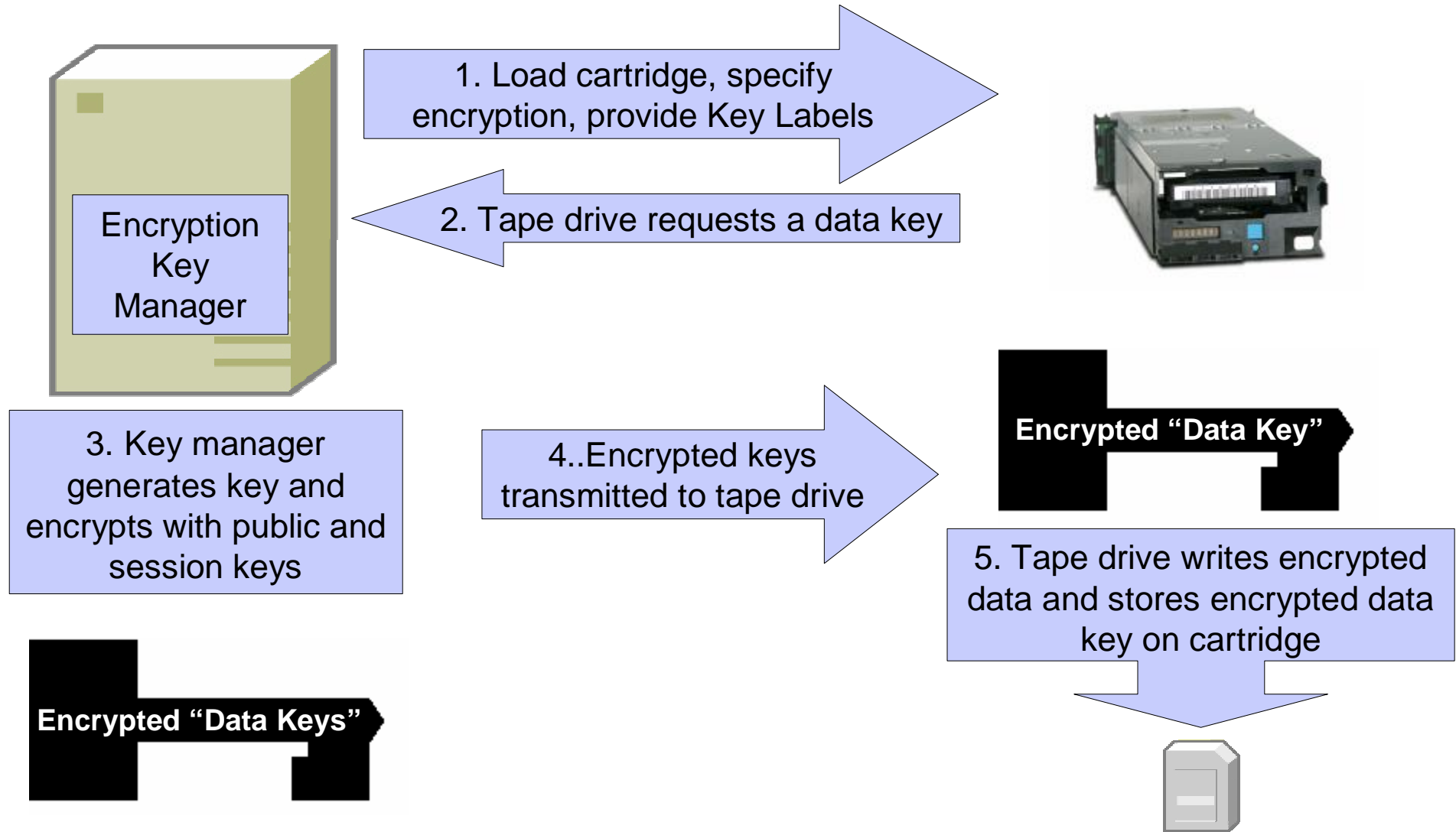
encryption mode
 (03=write)

key label1
 (name of the 1. KEK-key in EKM)

encoding mechanism
 (L=Label, H=Hash)

- § The Data-Key can be encrypted using 2 different public keys (KEK = Key Encrypting Keys), to be able to send the tape to 2 different receivers
- § More info can be found in the *z/VSE 4.1 Administration* manual (VSE Homepage)

IBM Tape Encryption – TS1120



IBM Tape Encryption – TS1120

§ Considerations and Restrictions:

- A tape can either contain encrypted data or unencrypted data
- If you encrypt the first file on the tape, all subsequent files will also be encrypted using the same key
 - Important for multi file tapes
- If you send an encrypted tape to a business partner, the other side will also require a TS1120 to be able to read the tape

IBM Tape Encryption – TS1120 - Summary

§ Hardware-based encryption

- No host cycles used

§ Designed for high volume backup

§ Encryption Key Manager (EKM) on a Java platform

- for centralized key management
- with SSL connection between tape controller and EKM

§ Encryption option specified in VSE via JCL commands

- // ASSGN ...
- // KEKL ...

New: Encryption Facility for z/VSE

§ IBM Encryption Facility for z/VSE V1.1 can help you:

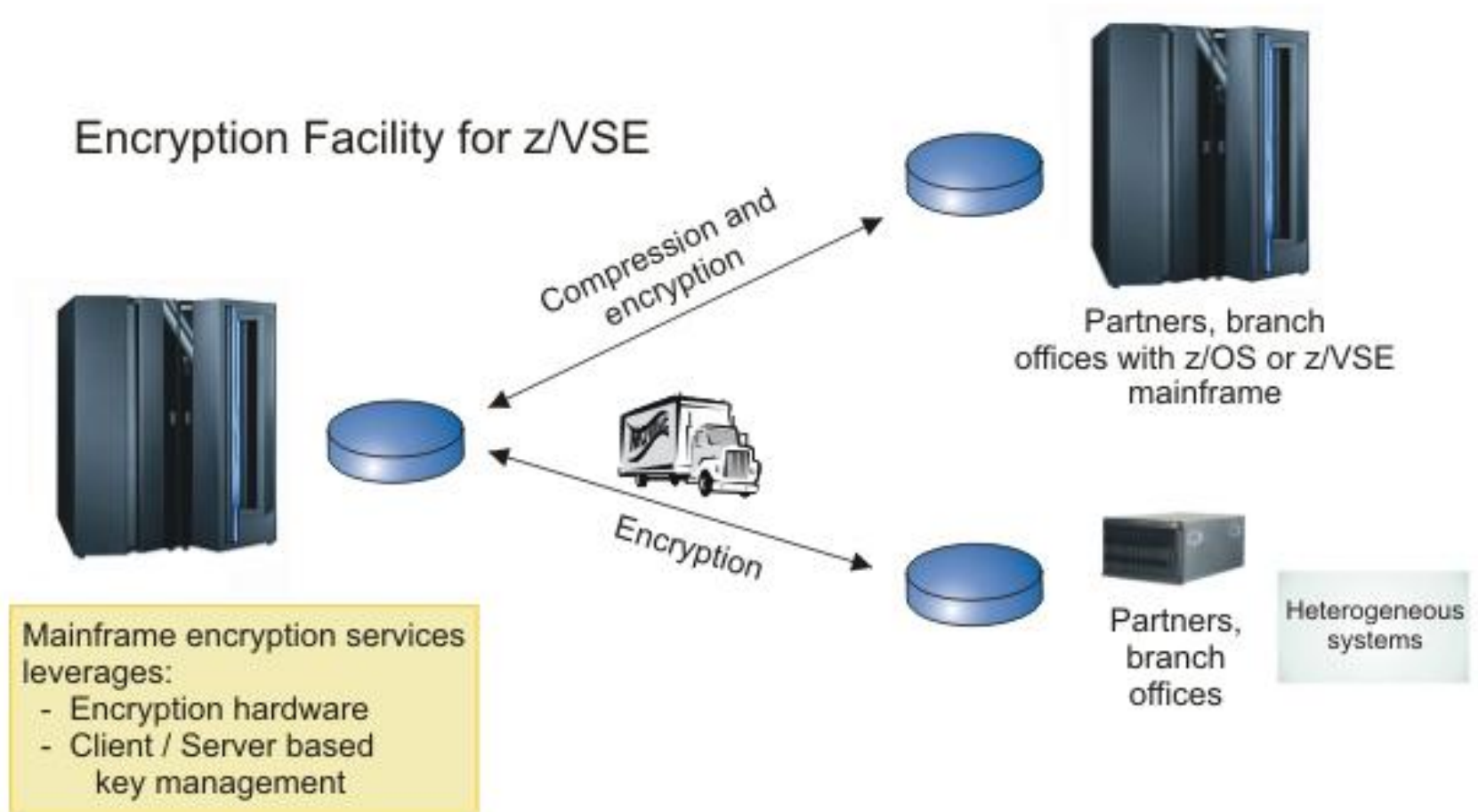
- Secure business and customer data
- Address regulatory requirements
- Protect data from loss and inadvertent or deliberate compromise
- Enable sharing of sensitive information across platforms with partners, vendors, and customers
- Enable decrypting and encrypting of data to be exchanged between z/VSE and non-z/VSE platforms



§ The Encryption Facility for z/VSE V1.1 is packaged as an optional, priced feature of VSE Central Functions V8.1 (5686-CF8-40).

- Documentation in z/VSE 4.1.1 Administration book, Chapter 43
- Available since November 30, 2007

New: Encryption Facility for z/VSE



New: Encryption Facility for z/VSE

§ **The Encryption Facility for z/VSE V1.1 uses the same data format as the Encryption Services feature in Encryption Facility for z/OS V1.1 and V1.2 (5655-P97)**

– Called 'Encryption Facility System z format'

§ **It allows you to exchange encrypted files between**

– your internal mainframe data centers

– you and your external business partners and vendors

§ **To decrypt an encrypted file, you must have installed any of the following:**

– Encryption Facility for z/VSE feature

– Encryption Facility for z/OS Encryption Services feature (using System z format)

– The no-charge Encryption Facility for z/OS Client Web download

- either Java-based client
- or Decryption Client for z/OS



New: Encryption Facility for z/VSE

Possible choices:

Encrypt data using System z format with:	Decrypt data using System z format with:			
	Encryption Services feature of EF for z/OS	Encryption Facility for z/VSE	Decryption Client for z/OS	Java-based Client
Encryption Services feature of EF for z/OS	Yes	Yes	Yes	Yes
Encryption Facility for z/VSE	Yes	Yes	Yes	Yes
Java-based Client	Yes	Yes	No (*)	No (*)

Note: The terms and conditions for the no-charge Encryption Facility for z/OS Client only allow the use of the Encryption Facility for z/OS Client for decrypting information or data that was encrypted by IBM's Encryption Facility for z/OS or IBM's Encryption Facility for z/VSE, or for encrypting information or data to be decrypted by IBM's Encryption Facility for z/OS or IBM's Encryption Facility for z/VSE.

New: Encryption Facility for z/VSE

§ Encryption Facility for z/VSE supports

- Password-based encryption of session keys
- Data encryption with a randomly generated symmetric session key using AES-128 or Triple-DES algorithms
- Asymmetric encryption of randomly generated symmetric keys using the RSA algorithm with key lengths of 512, 1024 and 2048-bit
- Encryption of single SAM files, VSAM files, or VSE Library members
- Encryption of virtual or real tapes

§ Support of hardware-accelerated compression before encryption

§ Encryption of complete backups made with any backup tool either from IBM or vendors

§ Output of encrypted data on disk, virtual tape, or real tape

- As sequential file (SAM or VSAM)

New: Encryption Facility for z/VSE

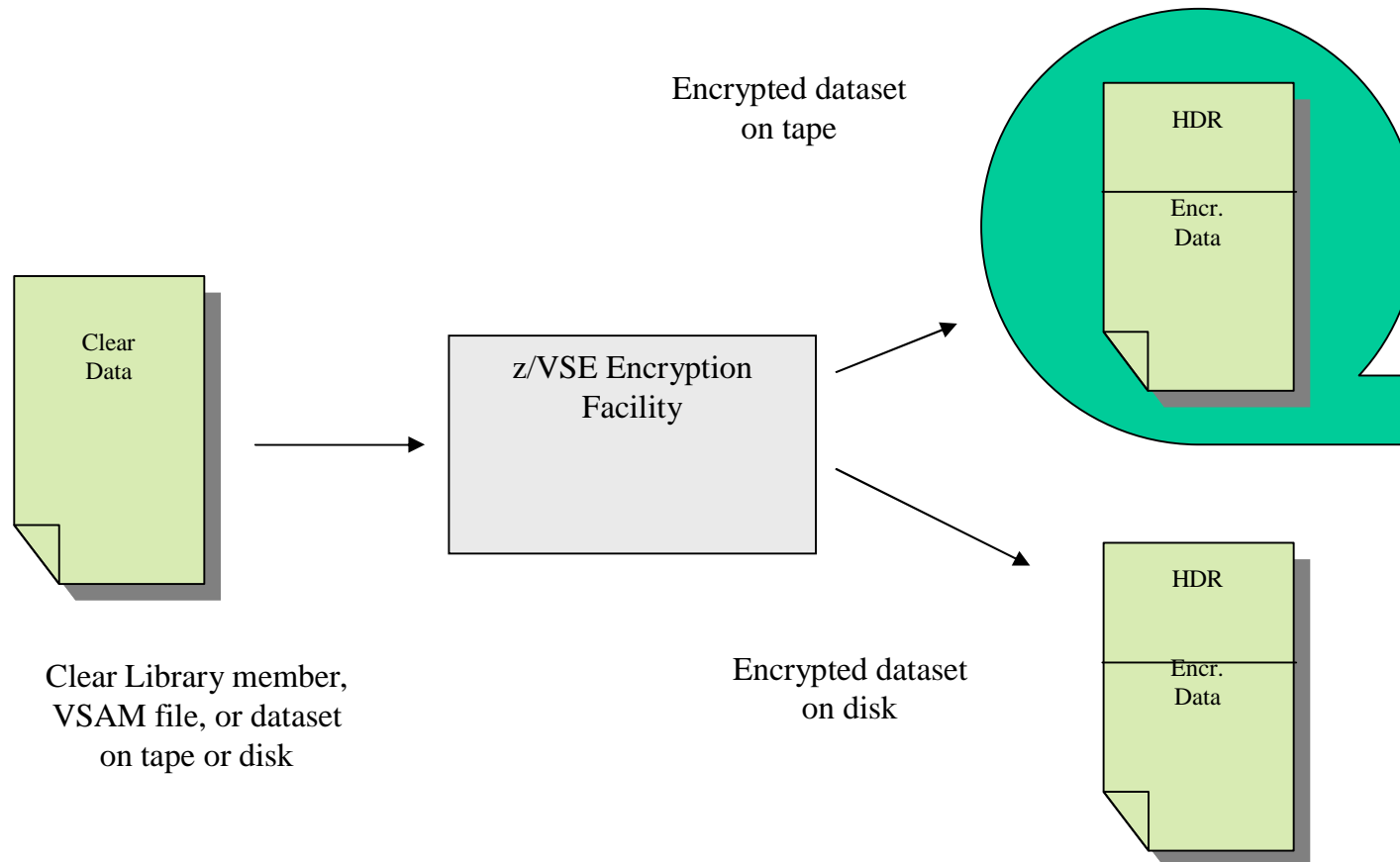
§ Hardware Requirements:

- For the PASSWORD option, use CPACF only.
- For the Clear-TDES and Clear-AES-128 (no ENCTDES), use CPACF only.
- For RSA keys (bit length 2048), use one of the following:
 - Crypto Express2-accelerator mode (CEX2A)
 - Crypto Express2-coprocessor mode (CEX2C)
 - PCIX Cryptographic Coprocessor (PCIXCC)

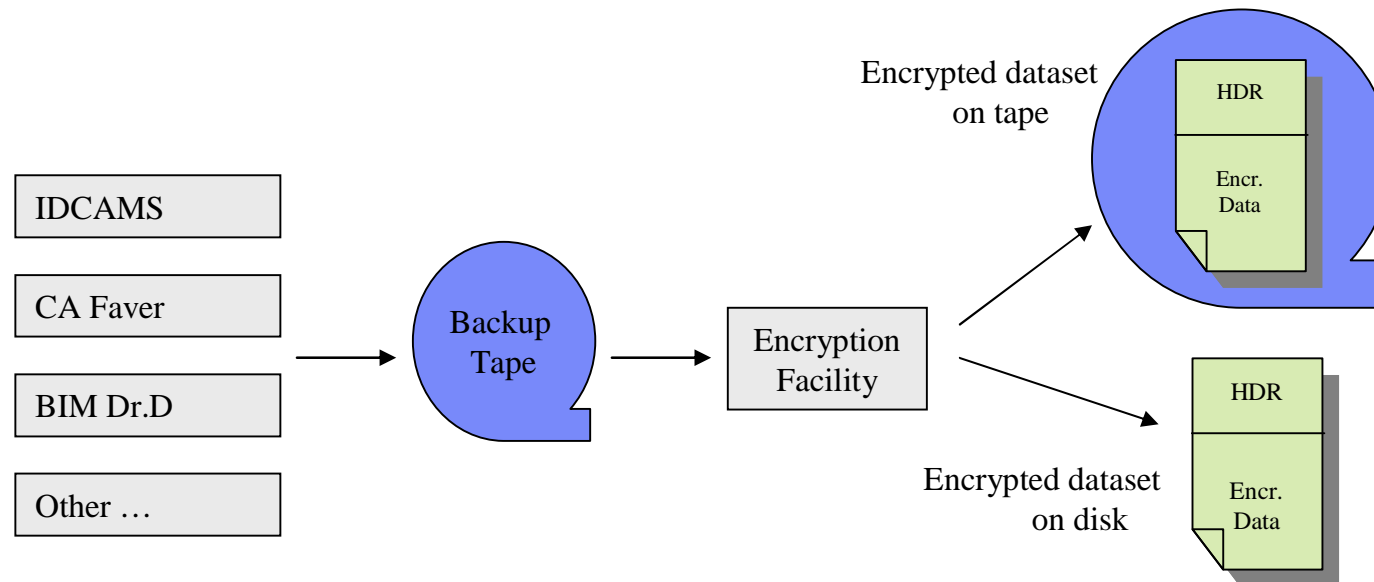
§ Software requirements

- z/VSE 4.1 with APAR DY46717 (PTF UD53196)
- For public encryption, TCP/IP for VSE/ESA V1.5E, or higher, is required.
- For RSA keys (bit length 1024) TCP/IP for VSE/ESA V1.5E, or higher, is required.
- For RSA keys (bit length 2048) refer to the Hardware requirements.

New: Encryption Facility for z/VSE - Encryption of a single file



New: Encryption Facility for z/VSE - Encryption of a complete backup



- § Any proprietary backup tape can be encrypted and written to a second tape or to disk.
- § Note that the complete input tape results in just one encrypted dataset, which resides on tape or disk.

New: Encryption Facility for z/VSE - Password-based encryption (PBE)

§ Encryption key (data key) is generated from

- the given secret password (8 ... 32 characters)
- iteration count, and
- a 8-byte random number (the “salt”), which is different for each encryption process.

§ The iteration count and salt value are stored in the encrypted dataset header.

- icount and salt are not secret
- When encrypting the same data twice with the same password and iteration count, the resulting encrypted data will be completely different, because of the randomly created salt value.

§ No need to deal with keys, but

§ Need to manage/archive passwords

- Many free tools available, e.g.
- KeePass : <http://keepass.sourceforge.net/>

New: Encryption Facility for z/VSE - PBE: Example for generating a key

§ Example of a “Password-based key derivation function”

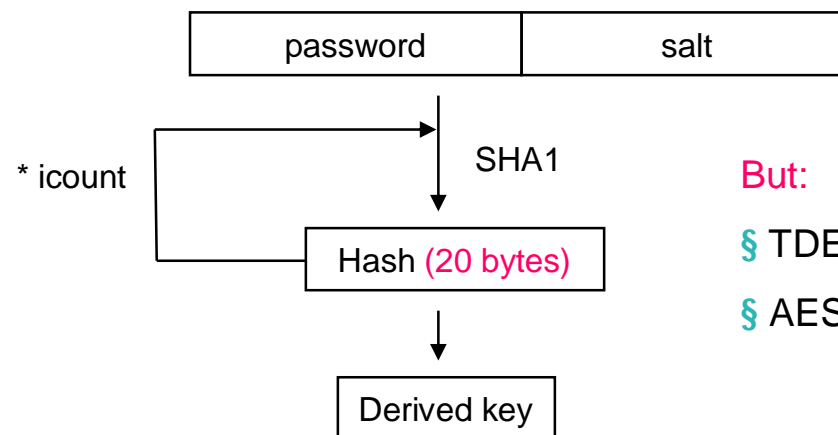
§ PBKDF1(password, salt, iteration_count, dkLen)

§ Disadvantage:

- Derived key length (dkLen) limited to output of underlying hash function (MD5 = 16 bytes, SHA-1 = 20 bytes)
- Used today only for compatibility with older applications

§ Described in RFC 2898

§ Process:



Note: this is not exactly the process used in Encryption Facility for z/VSE. It's only an example.

But:

§ TDES key = 3 * 8 bytes = 24 + 8 bytes ICV = 32

§ AES-128 key = 16 bytes + 16 bytes ICV = 32

New: Encryption Facility for z/VSE - PBE: Job example for encryption

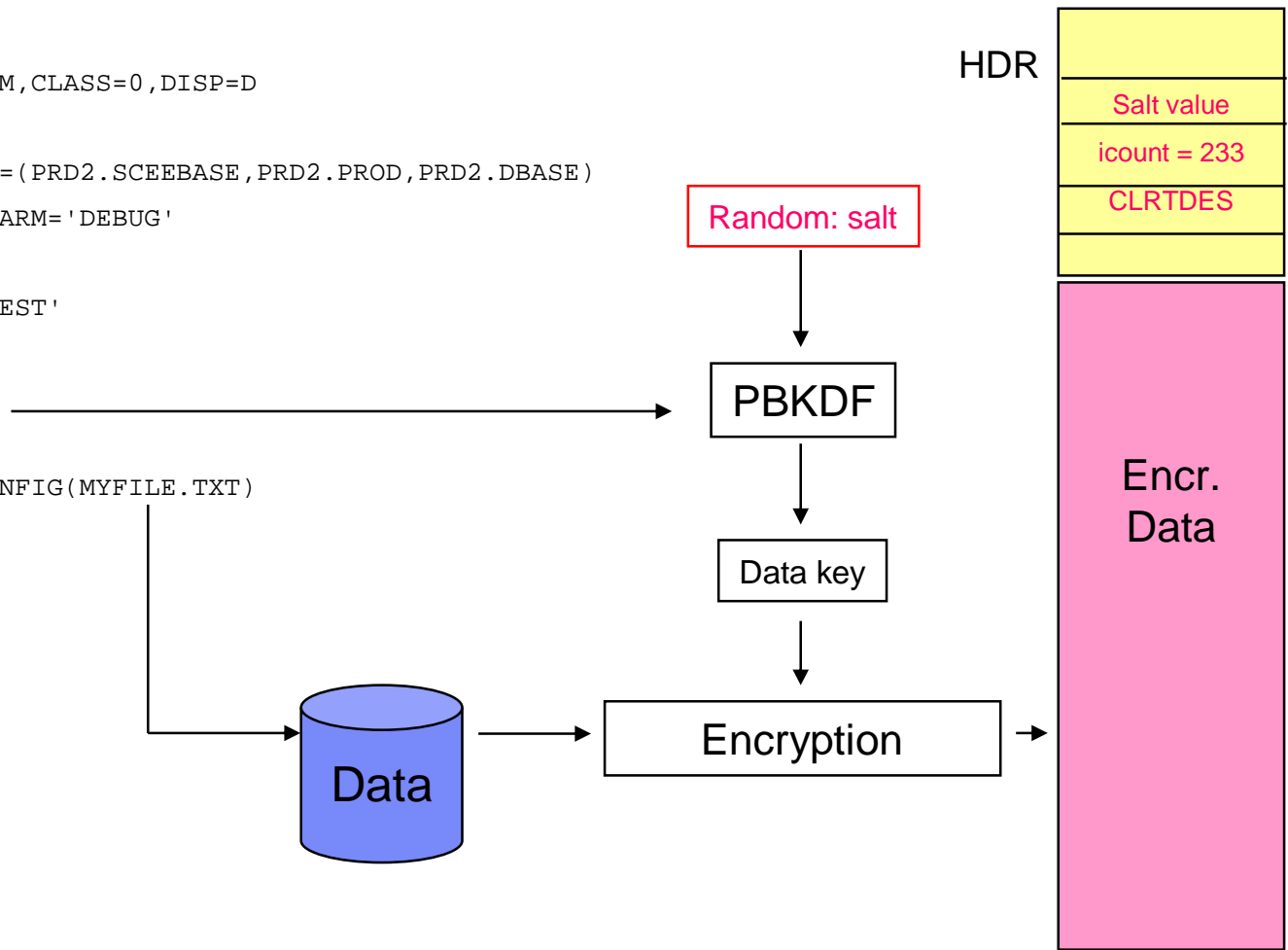
```

* $$ JOB JNM=ENCMEM,CLASS=0,DISP=D
// JOB ENCMEM
// LIBDEF *,SEARCH=(PRD2.SCEEBASE,PRD2.PROD,PRD2.DBASE)
// EXEC IJBFEVSE,PARM='DEBUG'

ENCRYPT
DESC='ENCRYPTION TEST'

CLRTDES
PASSWORD=BLAHBLAH
ICOUNT=233

CLRFILE=DD:PRD2.CONFIG(MYFILE.TXT)
ENCFILE=DD:ENCDATA
/*
/&
* $$ EOJ
    
```



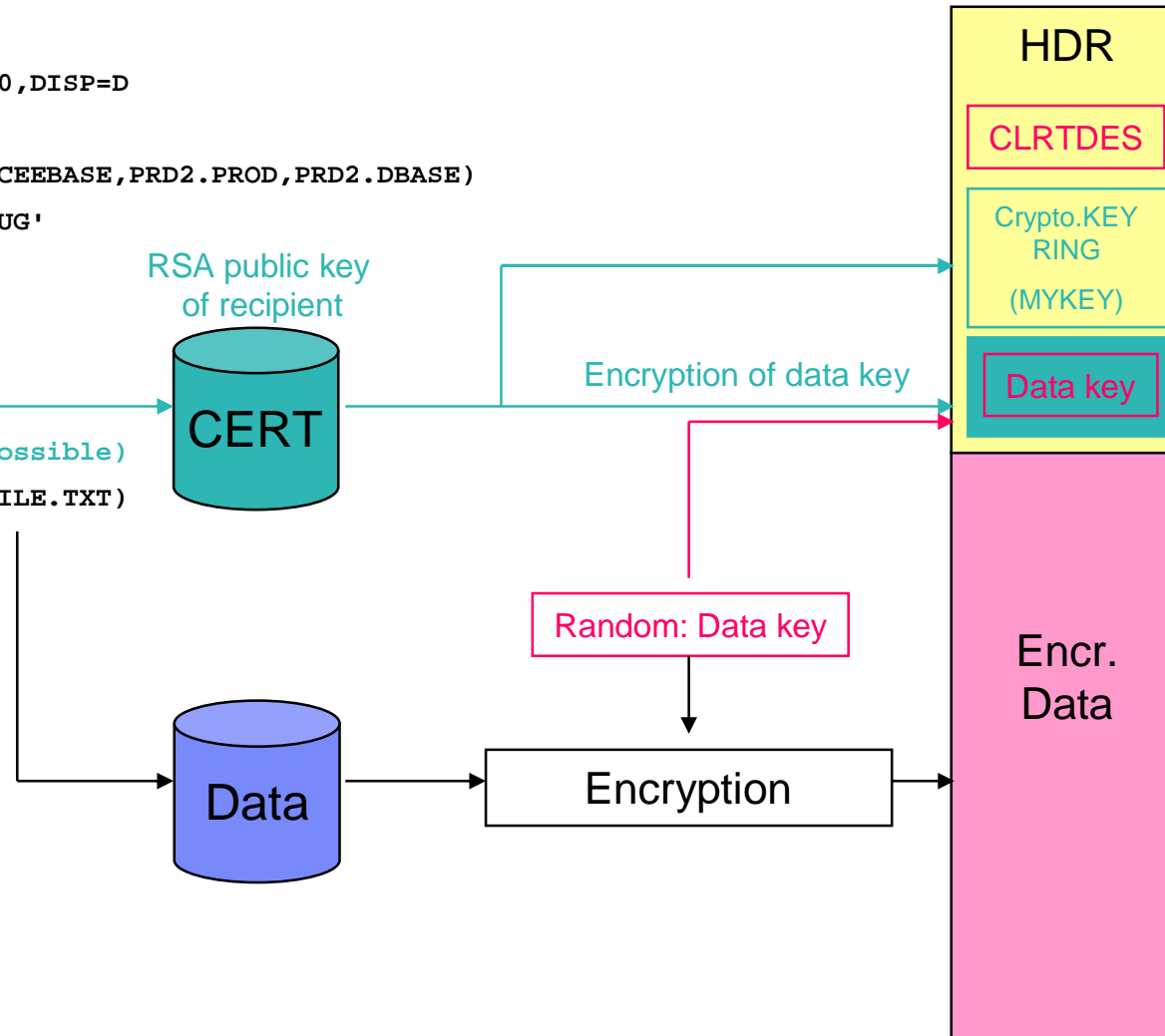
New: Encryption Facility for z/VSE - Public-key encryption (PKE)

- § **Encryption key (data key) is randomly generated**
- § **Data key is then encrypted with the public key of the recipient of the encrypted data**
 - Needs a Crypto Express2 or PCIXCC card for 2048 bit keys
 - Crypto cards are transparently used also for 1024 bit keys when available
- § **Data key is put into the encrypted dataset together with the encrypted data**
- § **Only one recipient is able to decrypt the data key and thus, the encrypted data, using the corresponding private key**
- § **Need to manage / exchange public RSA keys**
 - Can be done with the Keyman/VSE tool

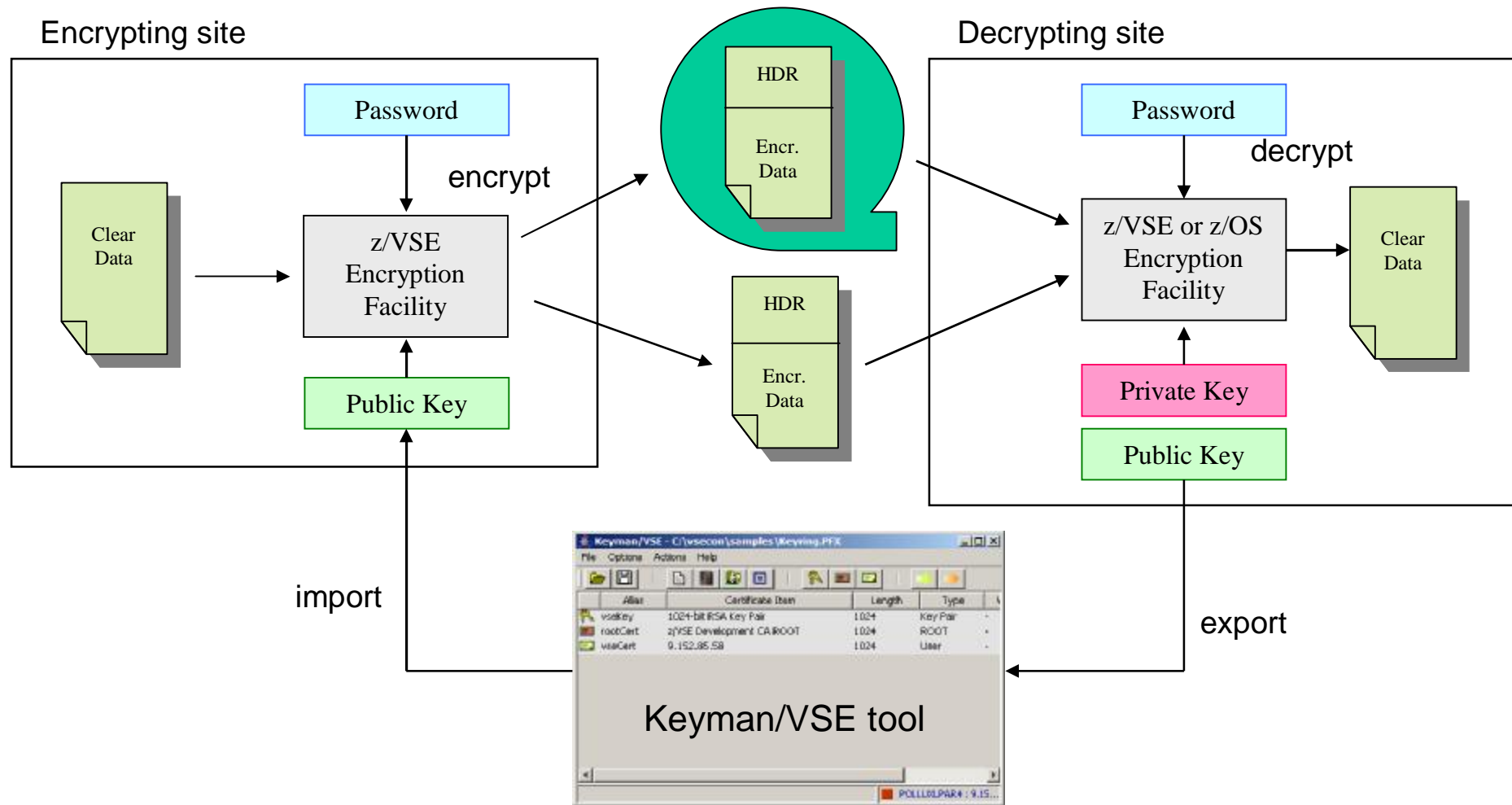
New: Encryption Facility for z/VSE - PKE: Job example for encryption

```

* $$ JOB JNM=ENCMEM,CLASS=0,DISP=D
// JOB ENCMEM
// LIBDEF *,SEARCH=(PRD2.SCEEBASE,PRD2.PROD,PRD2.DBASE)
// EXEC IJBFEVSE,PARM='DEBUG'
ENCRYPT
DESC='ENCRYPTION TEST'
CLRTDES
RSA=CRYPTO.KEYRING(MYKEY)
(up to 16 RSA statements possible)
CLRFILE=DD:PRD2.CONFIG(MYFILE.TXT)
ENCFILE=DD:ENCDATA
/*
/&
* $$ EOJ
    
```



New: Encryption Facility for z/VSE - PBE and PKE scenario



New: Encryption Facility for z/VSE - Customer value

- § No special tape hardware requirements (e.g. TS1120)
 - But exploits IBM crypto hardware (crypto cards and CPACF)
- § Host-based utility, no additional client/server workstations
- § Easy to use
 - No special setup necessary for password-based encryption
- § Supports all VSE data formats: single files and complete tape backups (LIBR, IDCAMS, POWER, etc.)
- § Supports even proprietary vendor backup formats
- § Encrypted datasets and tapes can easily be exchanged between business partners even on non z platforms
 - Password-based
 - Public-key based

Other ways to encrypt your backups or tapes

§ Can be done using VTAPE

- Create a backup on a remote virtual tape
- Store the tape image on an encrypted medium
 - Encrypted file system or directory (e.g. EcryptFS on Linux)
 - Use encryption tools (e.g. TrueCrypt)
 - Use Tivoli Storage Manager to store the backup data





§ Encrypt data in applications

- Use CryptoVSE API to encrypt the data
 - Uses Hardware Crypto Support if available

New technical articles on VSE homepage

<http://www.ibm.com/servers/eserver/zseries/zvse/documentation/security.html#howto>

How to setup hardware crypto with VSE

-  [How to setup SSL with CICS Web Support \(PDF, 1.4MB\)](#)
Joerg Schmidbauer, IBM
-  [How to setup Secure Telnet with VSE \(PDF, 1.7MB\)](#)
Joerg Schmidbauer, IBM
-  [How to setup Secure FTP with VSE \(PDF, 1.2MB\)](#)
Joerg Schmidbauer, IBM
-  [How to setup cryptographic hardware for VSE \(PDF, 1.1MB\)](#)
Joerg Schmidbauer, IBM

Related Documentation

- § **VSE Homepage**
<http://www.ibm.com/servers/eserver/zseries/zvse/>
- § **Keyman/VSE tool and VSE Connector Client**
<http://www.ibm.com/servers/eserver/zseries/zvse/downloads/>
- § **Encryption Facility for z/OS**
http://www.ibm.com/servers/eserver/zseries/zos/encryption_facility/
- § **IBM Encryption Facility for z/OS Java Client**
<http://www.ibm.com/servers/eserver/zseries/zos/downloads/#efclient>
- § **IBM PCI Cryptographic Accelerator (PCICA)**
<http://www.ibm.com/security/cryptocards/pcica.shtml>
- § **IBM Crypto Express2 (CEX2)**
<http://www.ibm.com/systems/z/security/cryptography.html>
- § **CP Assist for Cryptographic Function (CPACF)**
<http://www.ibm.com/systems/z/security/cryptography.html>
- § **IBM Security Products – Overview**
<http://www.ibm.com/security/products/>
- § **Keepass Password Safe – a free Open Source Password Manager for many operating systems**
<http://keepass.sourceforge.net/>

Questions ?

