z/VSE Live Virtual Class Series

Security and Cryptography on z/VSE

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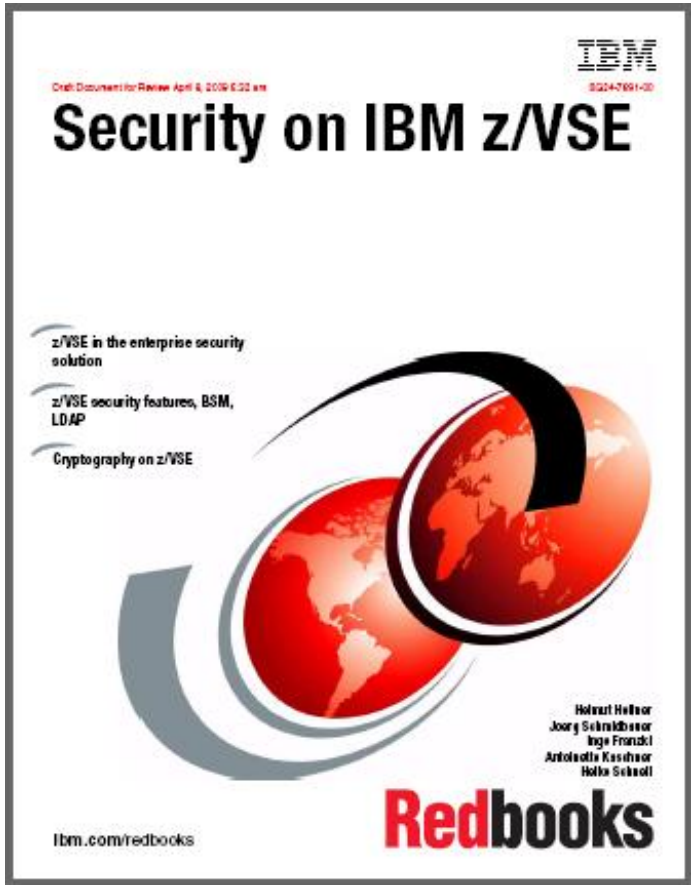
Agenda

- **Overview on security**
  - New VSE redbook
  - VSE Health Checker updates
- **Encryption Facility for z/VSE**
  - Password-based encryption
  - Public key encryption
- **OpenPGP support**
  - Encryption Facility V1.2
  - Keyman/VSE
  - Open Source GnuPG
  - Support on z/OS

New Redbook: "Security on IBM z/VSE"



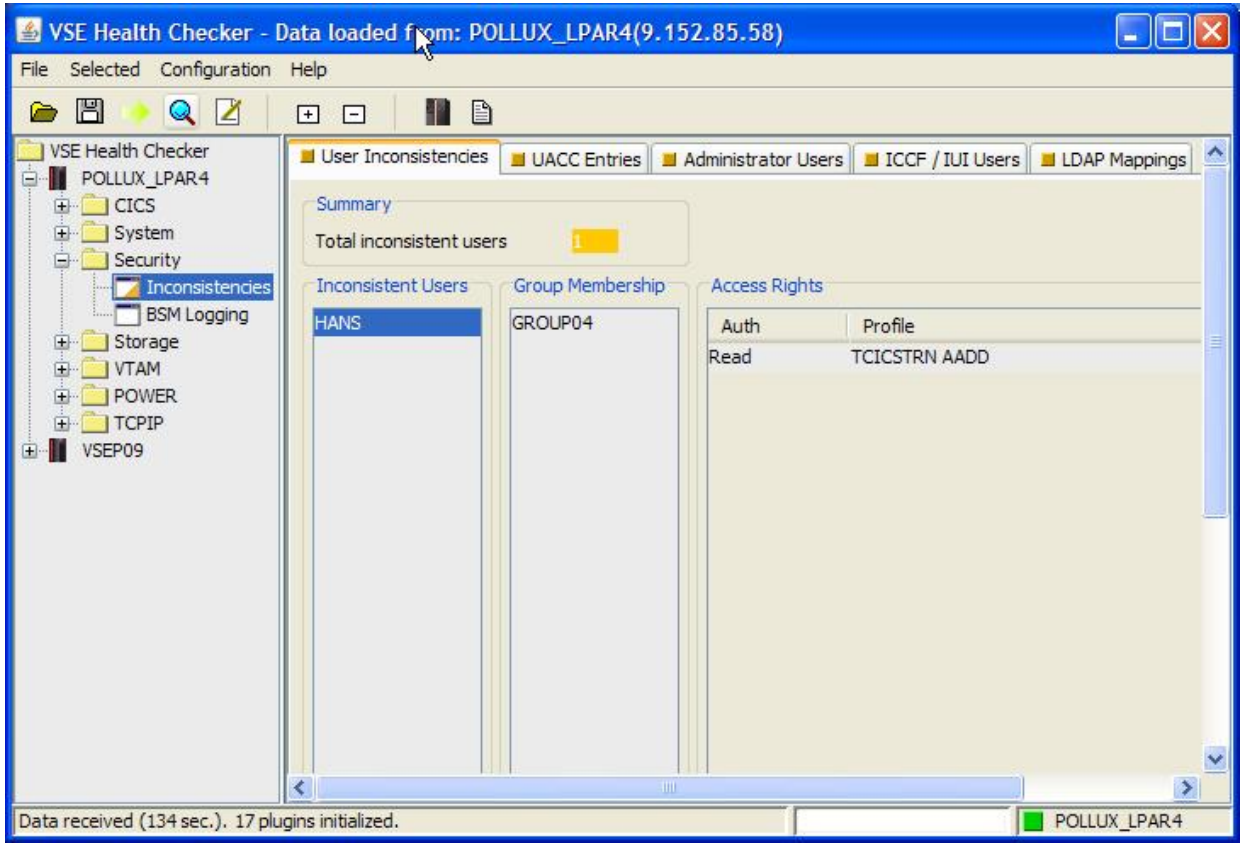
Available on:

http://www.redbooks.ibm.com/redpieces/abstracts/sg247691.html?Open

Table of contents

VSE Health Checker

- **New security support**
  - BSMXREF tool used in HC
  - User and UACC inconsistencies
  - LDAP mappings
  - BSM logging
- **Needs the VSE Connector Client**
- **Download from VSE homepage**
- **Free tool, provided "as is"**

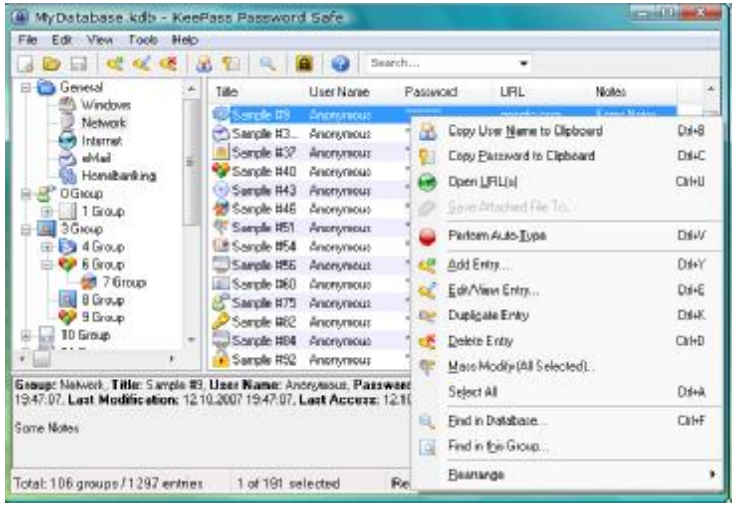


Encryption Facility for z/VSE

- **Host-based optional priced feature, first shipped in 2007**
- **New release 1.2 available with z/VSE 4.2.1 in July 2009 with OpenPGP support in addition to currently used encrypted data format**
- **Provides encryption for single SAM files, VSAM files, or VSE Library members, but also for complete backups made with any backup tool either from IBM or vendors (tapes, vtapes)**
- **Similar to the "Encryption Facility for z/OS"**
  - http://www.ibm.com/servers/eserver/zseries/zos/encryption_facility/
- **IBM crypto hardware exploitation**
  - Crypto cards (PCICA, PCIXCC, CEX2) and CPACF
- **Eligible for MWLC pricing**
- **Two main functions**
  - Password-based encryption
  - Public-key encryption

Password-based encryption (PBE)

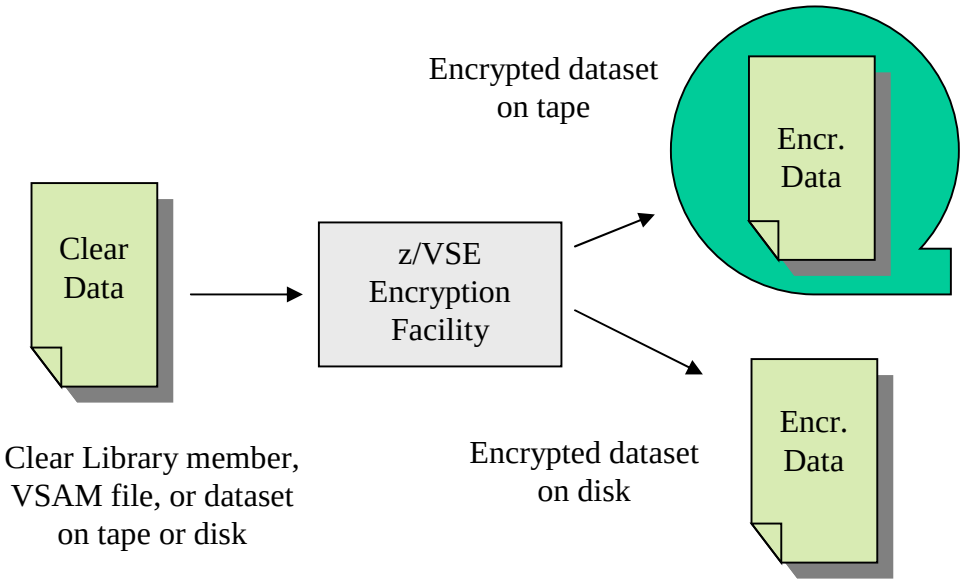
- **Encryption key (data key) is generated from**
  - the given secret password (8 … 32 characters)
  - and some additional parameters including some random number (the “salt” value)
- **These additional values are stored in the encrypted dataset**
  - When encrypting the same data twice with the same password, 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/



Public-key encryption (PKE)

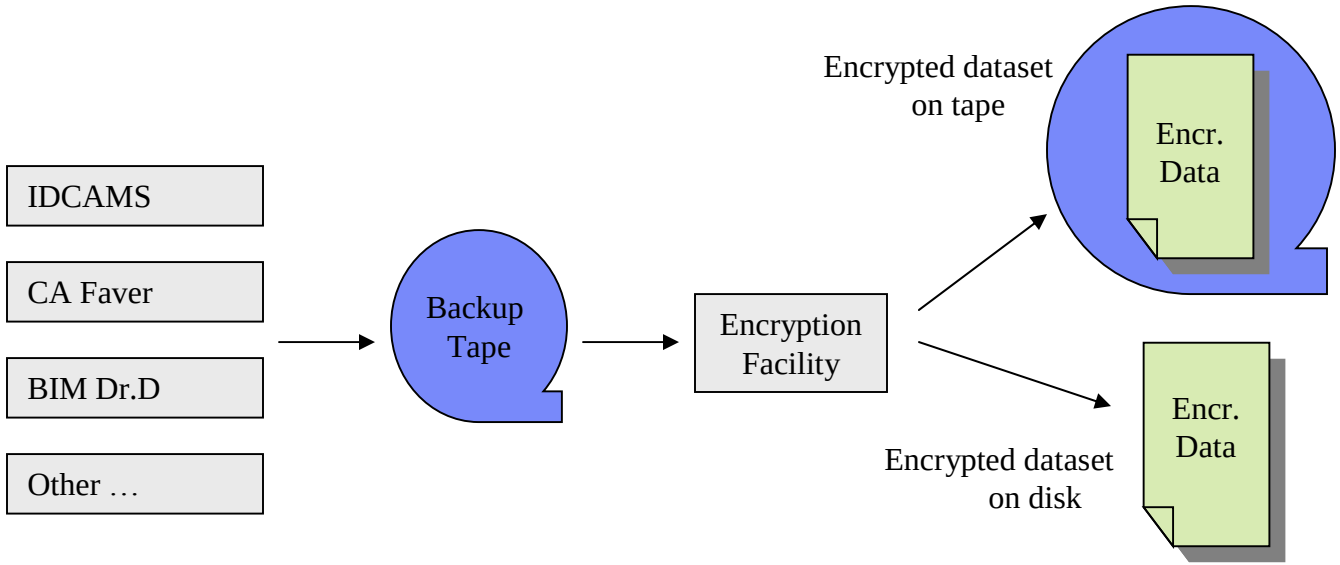
- **Encryption key (data key) is randomly generated**
- **Data key is then encrypted with one or more public keys of the recipients of the encrypted data**
  - Needs a Crypto Express2 or PCIXCC card for 2048 bit keys
  - Crypto cards are transparently used also for 1024 bit keys when available
- **Encrypted data key is put into the encrypted dataset together with the encrypted data**
- **Up to 16 recipients are able to decrypt the data key and thus, the encrypted data, using their corresponding private key**
- **No passwords, but need to manage / exchange RSA keys**
  - Can be done with the Keyman/VSE tool

Encryption of a single file



§ Same behavior for both releases of Encryption Facility.

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.

Customer value

- No special tape hardware requirements (e.g. TS1120, TS1130)
  - 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
  - By just encrypting any given tape
- Encrypted datasets and tapes can easily be exchanged between business partners even on non z platforms
  - Password-based
  - Public-key based
  - System z data format
  - *New:* OpenPGP data format

What is PGP?

- **PGP: “Pretty good privacy”**
  - originally created by Philip Zimmermann in 1991
  - often used for signing and encrypting e-mails
  - OpenPGP standard (RFC 2440 / 4880) in 1998.
- **Trust model**
  - Web-of-trust model in contrast to hierarchical trust model
  - Public keys are wrapped into PGP certificates, which are different to the usual x.509 certificates
- **Implementations**
  - Free implementations, like GnuPG, GPG4Win
  - Commercial implementations from PGP Corp., McAfee Inc., IBM (Encryption Facility for z/OS, now also for z/VSE).

Refer to Wikipedia for more information about OpenPGP:
http://en.wikipedia.org/wiki/Openpgp

Relationship Encryption Facility V1.1 and V1.2

- **V1.1 ships one utility:**

IJBEFVSE

- TDES, AES-128
- System z data format
- System z based compression

- **V1.2 ships two utilities:**

IJBEFVSE (unchanged)

- TDES, AES-128
- System z data format
- System z based compression

IJBEFPGP

- DES, TDES, AES-128, 192, 256
- OpenPGP data format
- ZIP/ZLIB based compression

V1.1 no more orderable when V1.2 available.

What's the same for both utilities?

- **Password-based encryption**
  - Encryption key created from given password
  - But: the way how the encryption key is calculated from the password is different in IJBEFVSE and IJBEFPGP
- **Public-key encryption**
  - Encryption key generated by random
  - Encryption key encrypted by an RSA public key
  - Max. 16 recipients possible

What's different?

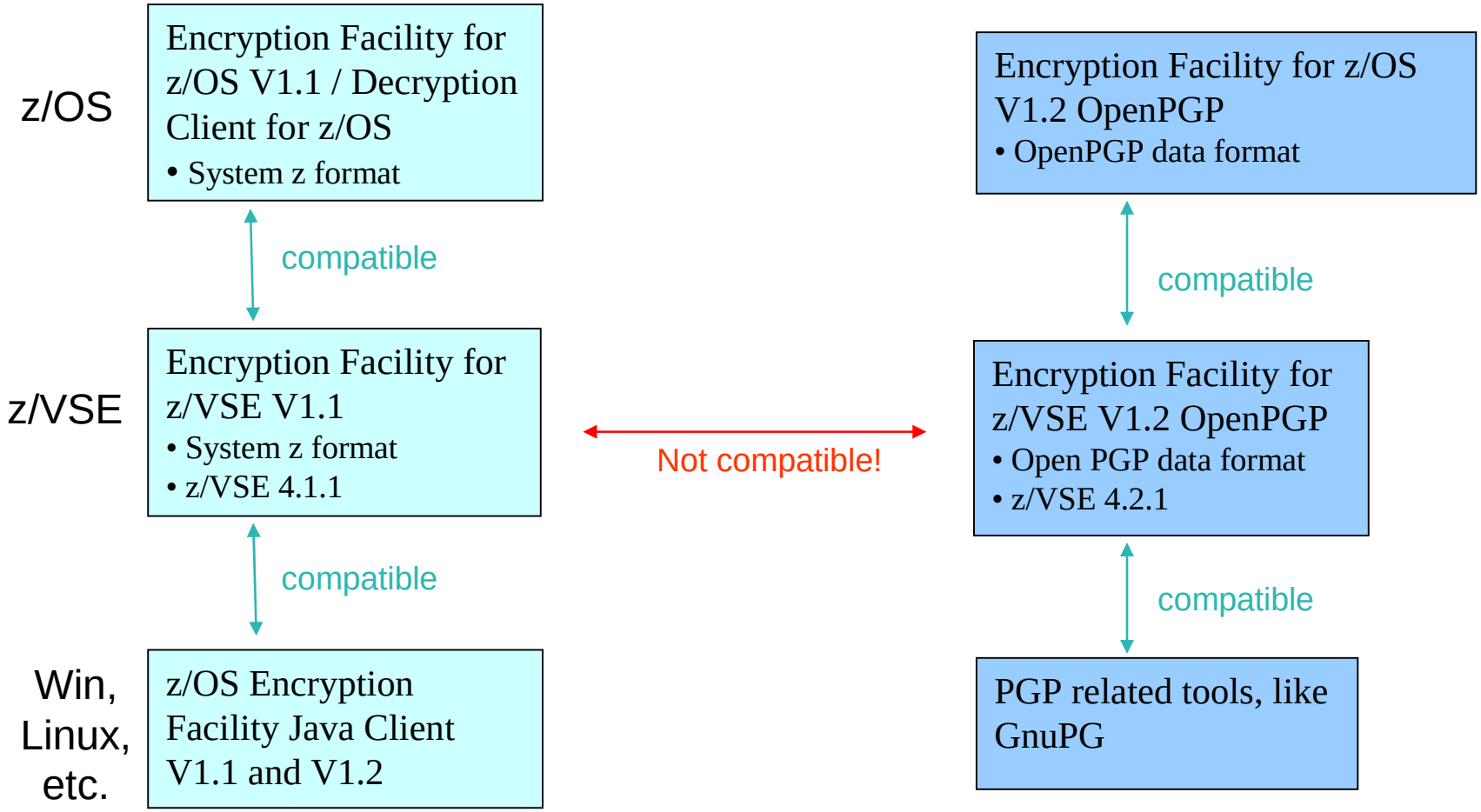
- **Encrypted data format**
  - IJBEFVSE provides System z data format
  - IJBEFPGP provides OpenPGP data format
- **Compatibility**
  - IJBEFVSE provides compatibility to IBM provided Java client, Decryption client for z/OS
  - IJBEFPGP provides compatibility to PGP implementations
- **Algorithms**
  - IJBEFPGP supports more algorithms
  - IJBEFPGP provides better System z hardware exploitation (e.g. AES-256, SHA-512)
- **Compression**
  - ZIP/ZLIB versus System z based compression
  - ZIP/ZLIB compression is done in software !

Summary of Differences

	IJBEFVSE	IJBEFPGP
Encrypted data format	System z format	OpenPGP format
Compatibility with	EF for z/OS V.1.1, EF for z/OS Java client	Any OpenPGP implementations, like GnuPG, EF for z/OS V1.2
Symmetric Algorithms	TDES and AES-128	DES, TDES, AES-128, 192, 256
Hash algos for PBE	SHA-1	MD5, SHA-1, 224, 256, 384, 512
Compression	System z provided compression	ZIP, ZLIB based compression
RSA key lengths	512, 1024, 2048	512, 1024, 2048
Public key format	x.509 certificates	PGP certificates
Signatures	None	RSA signatures (*)

(*) provided in next refresh

Support on z/OS and data format compatibility



Supported algorithms

Algorithm	z890/z990	System z9 BC or EC	System z10 BC or EC
MD5	yes (*)	yes (*)	yes (*)
SHA-1	yes	yes	yes
SHA-224	no	yes	yes
SHA-256	no	yes	yes
SHA-384	no	no	yes
SHA-512	no	no	yes
DES	yes	yes	yes
TDES	yes	yes	yes
AES-128	no	yes	yes
AES-192	no	no	yes
AES-256	no	no	yes
RSA	yes (**)	yes (**)	yes (**)

(*) algorithm available as software implementation in TCP/IP for VSE/ESA 1.5E or higher
(**) requires TCP/IP for VSE/ESA 1.5E or higher. 2048 bit keys require a PCIXCC or Crypto Express2

Algorithms not supported on VSE

- **These algorithms are listed in the OpenPGP standard, but not available on z/VSE:**
  - Symmetric
    - CAST5, Blowfish, Twofish, IDEA
  - Asymmetric
    - DSA
  - Hash
    - RIPEMD-160
  - Compression
    - BZip2

When a dataset has been encrypted or compressed on z/OS or on a workstation using one of these unsupported algorithms, decryption is not possible on VSE!

HW and SW prerequisites

- **z890 / z990 or higher**
- **“CPU Assist for cryptographic function” (CPACF) enabled (*)**
- **TCP/IP for VSE/ESA for public key encryption**
  - 1.5E with ZP15E214 or
  - 1.5F
- **Crypto Express2 or PCIXCC for 2048-bit public keys**
- **z/VSE 4.1 or later**
  - Encryption Facility V1.1 still available for z/VSE 4.1 (unchanged)
  - OpenPGP support requires z/VSE 4.2.1, because of dependencies to the z/VSE base

(*) CPACF is a no-charge feature, available only on z890, z990, z9 and z10 servers

Availability of EF V1.2

- **July 17, 2009, together with z/VSE 4.2.1**
- **Optional priced feature**
- **Program number: 5686-CF8**
- **Documentation in z/VSE 4.1.2 Administration book, Chapter 45**
  - Available in July on CD-ROM, or
  - Download as PDF from:

    http://www.ibm.com/servers/eserver/zseries/zvse/documentation/#vse

Corrective service

EF V1.1	EF V1.2
DY46717 (PTF UD53196) DY47051 (PTF UD53499)	DY46973 (z/VSE 4.2.1 refresh)

How to handle record-based data

- **Integrate the PGP standard into a VSE mainframe environment**
  - PGP has been invented to support workstation files, email exchange
  - On a mainframe we typically have record-based data (e.g. VSAM), but also some kind of stream data (tapes, vtapes)
- **Exchange of public keys with a PGP environment**
  - PGP certificates are different to x.509 certificates

Flexible support of record and stream data

- **Option USE_RECORDINFO**
  - Should only be used when encrypting *AND* decrypting on VSE
  - Puts a data structure with LRECL, RECFM, and BLKSIZE of clear input dataset into encrypted dataset
  - The use of such “private/experimental” data structures is described in the OpenPGP standard
  - This data structure is ignored by other PGP implementations
  - In addition to that, each clear data record is prefixed with a 6-byte header containing its length
  - This length information is processed when decrypting the encrypted data
  - Therefore: decrypted data has exactly the same record structure as original input data.

Encrypt / decrypt	z/VSE	z/OS or workstation
z/VSE	USE_RECORD INFO	-
z/OS or workstation	-	-

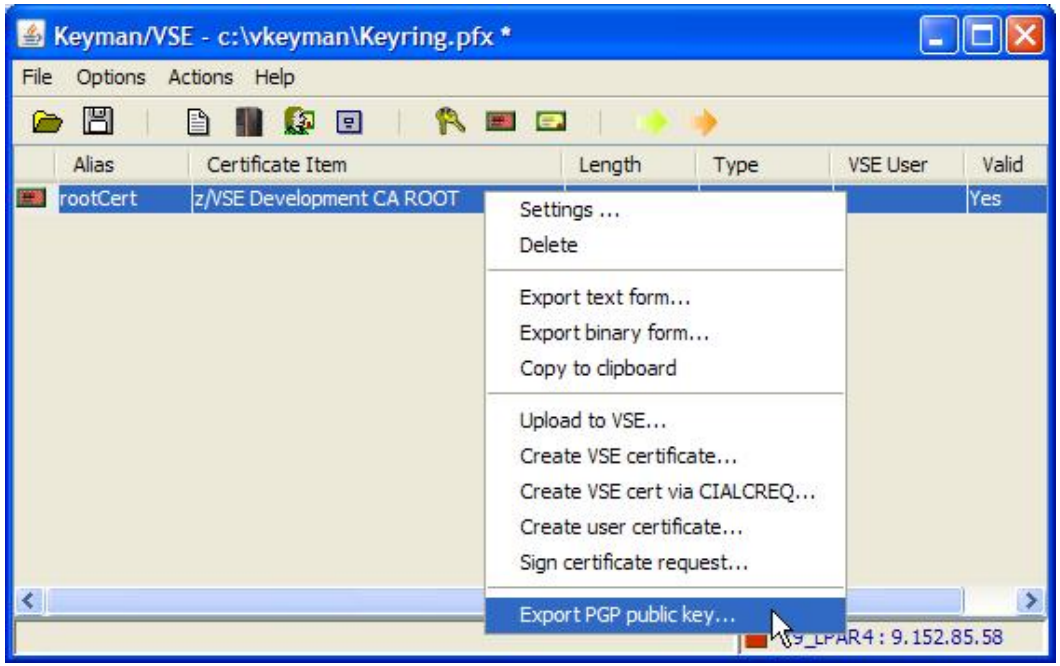
JCL example

```
* $$ JOB JNM=PBE,CLASS=S,DISP=D
// JOB PBE ENCRYPT USING A PASSWORD
// LIBDEF *,SEARCH=(PRD2.SCEEBASE,PRD2.PROD,PRD2.DBASE)
// EXEC IJBEFPGP
PB_ENCRYPT     <- password-based encryption
S2K_PASSPHRASE=MYPASSWD    <- 8 to 32 char password
S2K_CIPHER_NAME=AES_256    <- encryption algorithm
COMPRESSION=1   <- use best speed for compression
COMPRESS_NAME=ZIP   <- ZIP compression
USE_RECORDINFO    <- maintain record structure of clear input file (only on z/VSE!)
DIGEST_NAME=SHA224   <- this digest algo is used when creating the data key from the password
CLRFILE=DD:CLRDATA   <- clear input VSAM file (ESDS, KSDS, RRDS)
ENCFILE=DD:ENCDATA   <- encrypted VSAM file (ESDS)
/*
/&
* $$ EOJ
```

Keywords are mainly the same as in EF for z/OS V1.2 and GnuPG.

Exchange of public keys

- **Done with Keyman/VSE tool:**
  - http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#vkeyman
- **New version provides some additional functions for OpenPGP:**
  - Import / export of PGP public keys
  - Conversion between PGP format and x.509 format
  - Send converted x.509 certificates to VSE and vice versa
  - Will be available for download in July 2009

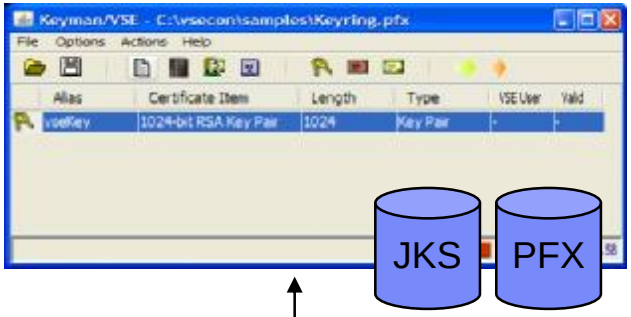


Exchange of public keys

EF for z/OS
- PGP public keys
- x.509 certificates
- Java keystores

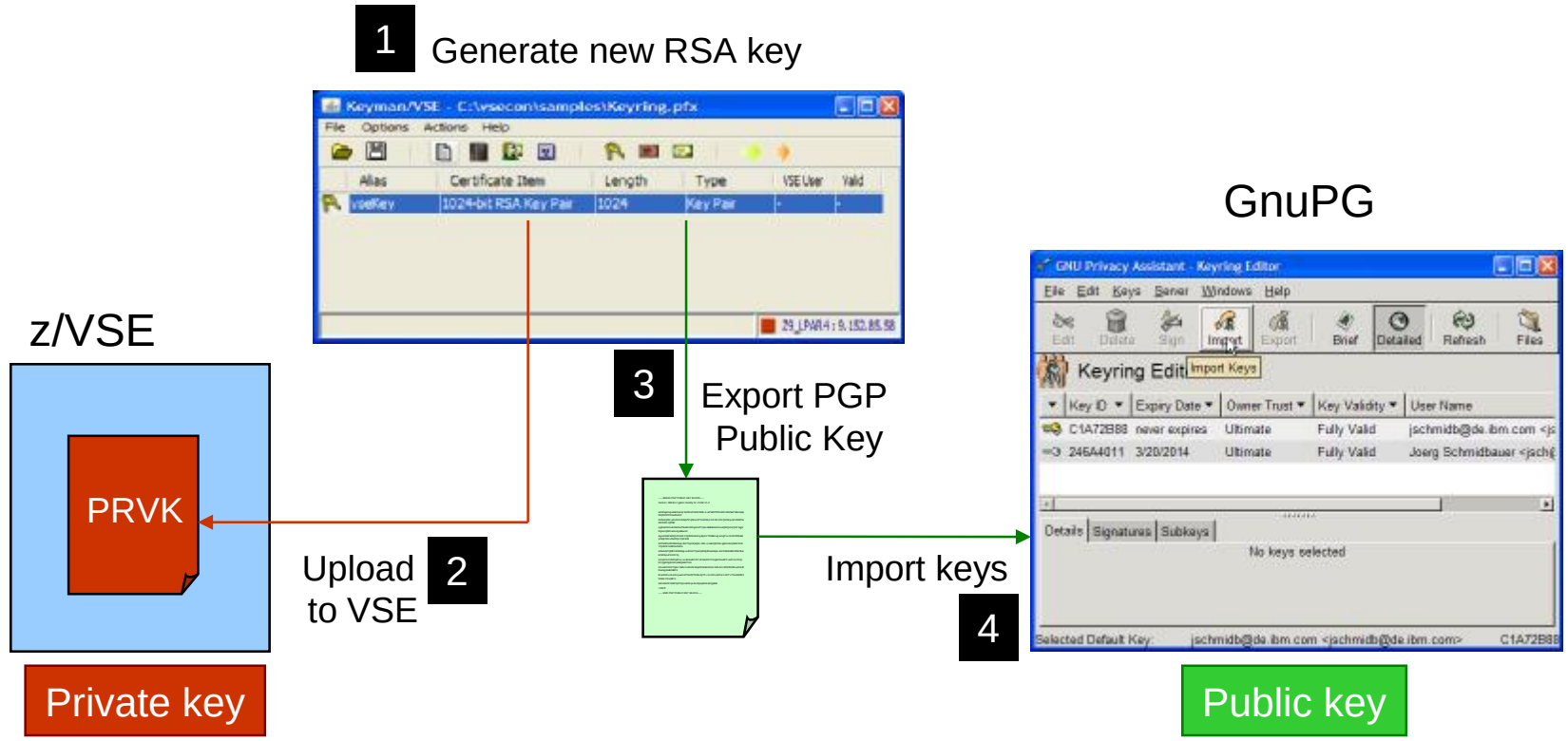
GnuPG
- PGP public keys

Keyman/VSE

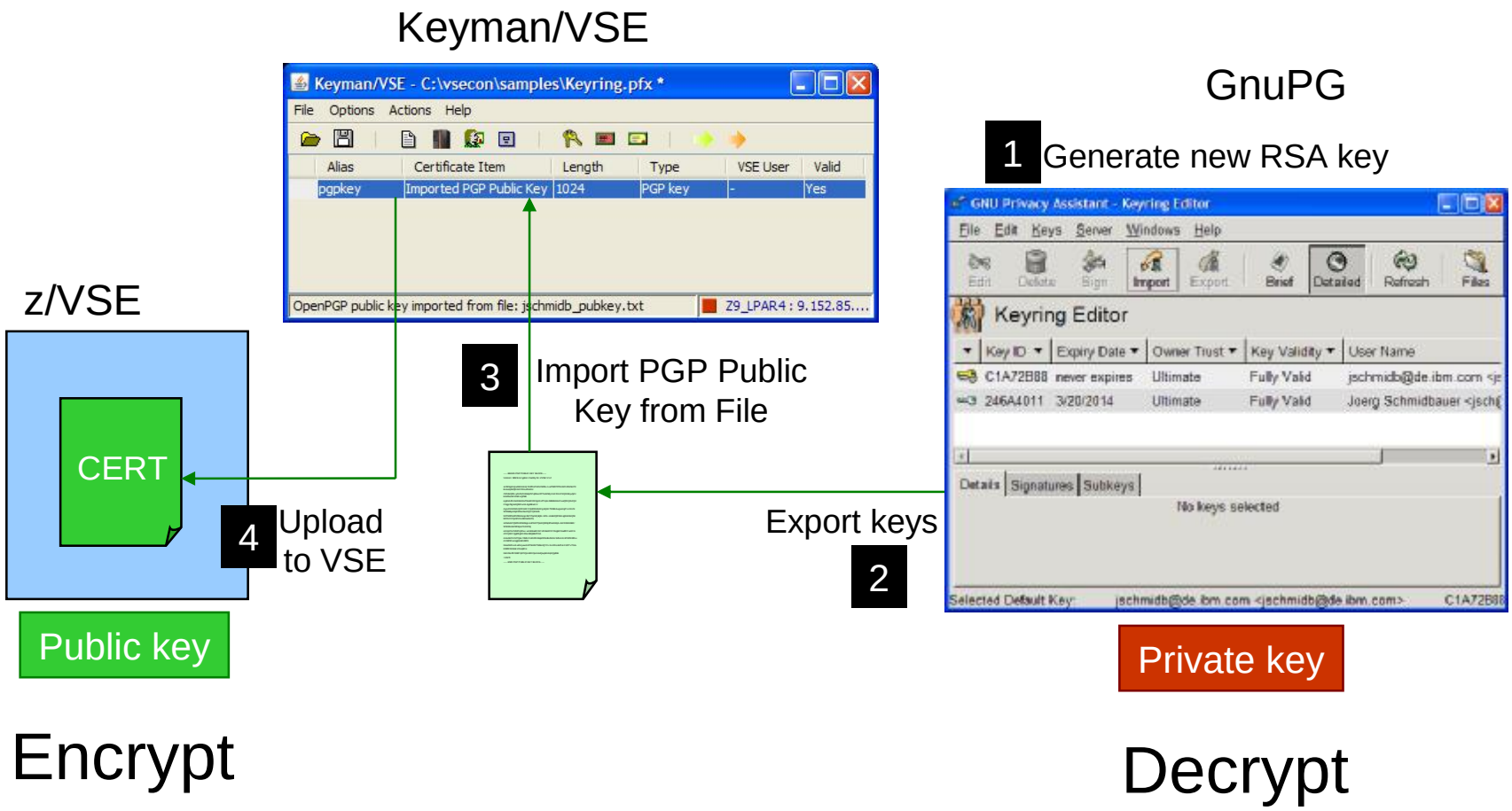


EF for z/VSE
- x.509 certificates
- PRVK members

Scenario 1: decrypt on VSE



Scenario 2: encrypt on VSE

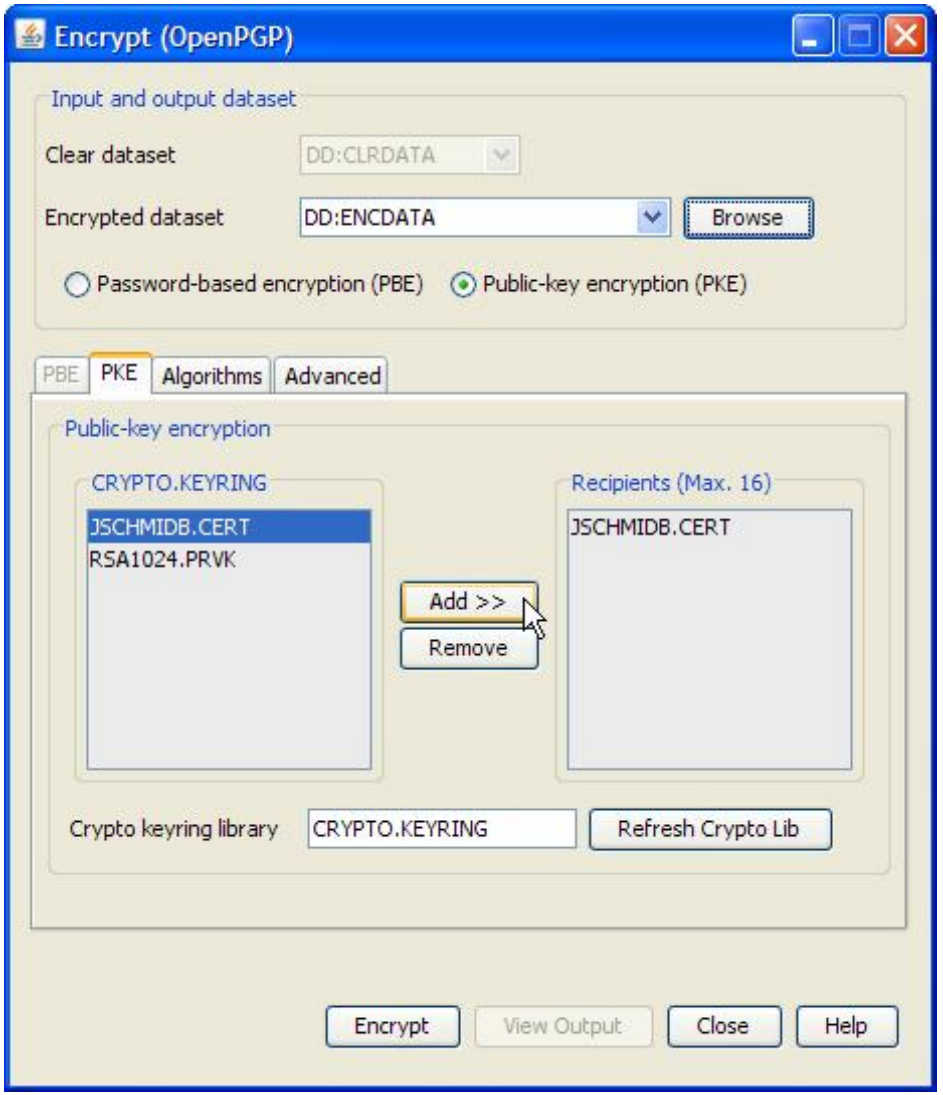


Some thoughts on compression

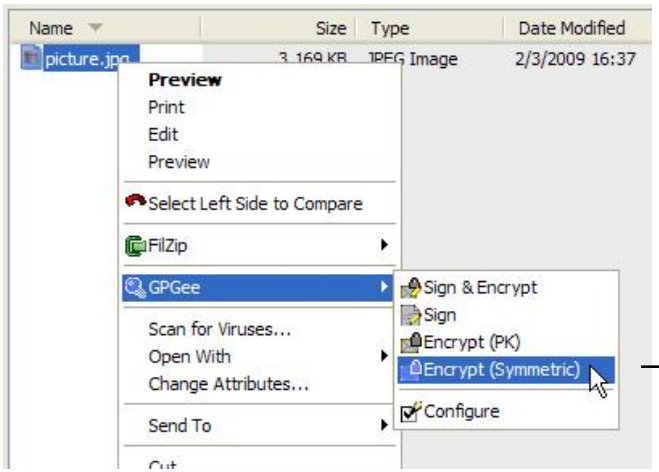
- Compression is always applied before encryption.
- Amount of data
  - When using compression, less data has to be encrypted.
    - Except when clear data is binary, like .jpg, where the compression ratio is very small, sometimes zero.
    - In very rare situations compressed data can get bigger than uncompressed data using ZIP
- Security
  - Compression adds additional security by removing any recognizable patterns from original clear data before encryption.
- Speed
  - Compression is usually slower than decompression, because a compression dictionary has to be built during compression. Decompression is just a simple table lookup.
- File size
  - When encrypting/compressing small files, the process may get slower compared to not using compression, because of the compression overhead.
- Hardware support
  - ZIP/ZLIB compression is pure software, while System z compression is done in microcode.

VSE Navigator

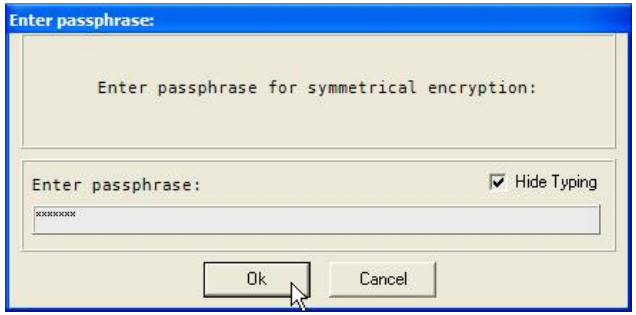
- **GUI for PGP encryption**
  - Right-click VSE library members or VSAM files
  - Menu choices encrypt / decrypt
  - Automatic check if IJBEFPGP phase available on VSE side
  - Check for available algorithms on host side
- **Needs VSE Connector Client**
- **Download from VSE homepage**
- **Provided “as is”**



Example scenario



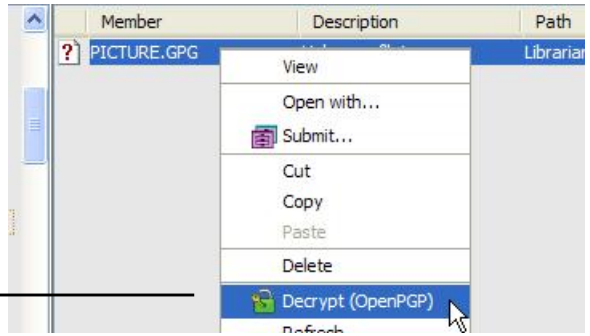
Encrypt via GnuPG / GPGee



Picture.gpg

FTP to VSE

```
* $$ JOB JNM=PBD,CLASS=S,DISP=D
// JOB PBD DECRYPT USING A PASSWORD
// LIBDEF *,SEARCH=(PRD2.SCEEBASE,PRD2.PROD,PRD2.DBASE)
// EXEC IJBEFPGP
DECRYPT
S2K_PASSPHRASE=MYPASSWD
CLRFILE=DD:PRIMARY.JSCH(PICTURE.JPG)
ENCFILE=DD:PRIMARY.JSCH(PICTURE.GPG)
/*
/&
* $$ EOJ
```



Decrypt via VSE Navigator

Positioning of EF to TS1120 / TS1130

	TS1120 / TS1130	Encryption Facility
High volume backup/archiving	**x**	**-**
Data encryption for rest on VSE disks	**-**	**x**
Data encryption for subsequent file transfer (e.g. FTP)	**-**	**x**
Local archiving	**x**	**x**
Data exchange with remote sites having TS11xx	**x**	**-**
Use existing TS11xx environment with EKM	**x**	**-**
Data exchange with Encryption Facility for z/OS	**-**	**x**
Data exchange with workstations	**-**	**x**
Password-based encryption	**-**	**x**
Public key based encryption	**x**	**x**
Offload CPU cycles	**x**	**-**

Summary

- **Encryption Facility for z/VSE now ships two utilities**
  - IJBEFVSE (System z data format)
  - IJBEFPGP (OpenPGP)
- **IBM hardware crypto exploitation**
  - CPACF
  - Crypto cards
- **Many free tools available**
  - IBM z/OS Java client for EF V1.1
  - Open Source tools for PGP support (GnuPG, GPGee, GPG4Win)
  - Keyman/VSE for key management and exchange
  - KeePass for managing passwords
  - VSE Navigator with graphical interface for PGP encryption
- **Password-based encryption for quick data exchange**
- **Public key encryption for higher level of security**
- **OpenPGP support available in July 2009**

More information (1)

Overview on security

New: Redbook: Security on IBM z/VSE, SG24-7691

http://www.redbooks.ibm.com/redpieces/abstracts/sg247691.html?Open

VSE Health Checker

http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#healthchecker

BSM cross reference tool (BSMXREF)

http://www.ibm.com/servers/eserver/zseries/zvse/downloads/tools.html#bsmxref

Encryption Facility

z/VSE 4.2.1 announcement letter on VSE homepage

http://www.ibm.com/servers/eserver/zseries/zvse/

z/VSE Administration

http://www.ibm.com/servers/eserver/zseries/zvse/documentation/#vse

Encryption Facility for z/OS

http://www.ibm.com/systems/z/os/zos/encryption_facility/

More information (2)

OpenPGP support

RFC 4880 OpenPGP Message Format

http://tools.ietf.org/html/rfc4880

OpenPGP on Wikipedia

http://en.wikipedia.org/wiki/Openpgp

The GNU Privacy Guard

http://www.gnupg.org/

Keyman/VSE tool

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

VSE Connector Client

http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#vsecon

VSE Navigator

http://www.ibm.com/servers/eserver/zseries/zvse/downloads/#navi

Redbook: Encryption Facility for z/OS V1.2 OpenPGP Support, SG24-7434

http://www.redbooks.ibm.com/abstracts/sg247434.html?Open

Questions