

Crypto Support for Linux on System z - Introduction

Share Conference, Boston Thursday, August 5, 2010: 8:00 AM-9:00 AM Room 305 (Hynes Convention Center)





Agenda

- Why Cryptography
- System z cryptographic hardware
 - CP Assist for Cryptographic Function (CPACF)
 - System z Crypto cards
- Accelerated Linux kernel functions
- Pseudo Random Number Generator
- File system encryption: eCryptfs
- Iszcrypt & chzcrypt
- Cryptographic Libraries
- Apache SSL Setup
- Java
- Summary





The Importance of Security



SOCIETE

Jan 24, 2008





Why cryptography?

Regulation & Compliance

- PCI Payment Card Industry
- Standards for all organizations
- Debit Cards and Credit Cards
- Sarbanes-Oxley (SOX), etc.

Secure messaging and Non-repudiation

- Needs certificate management system.
- Public Key Infrastructure (PKI).

Money management

- ATMs, PINs, Chip & PIN cards.
- Banking and eCommerce on the internet
- Secure signon.

Off-site backups

• Do tapes fall off your lorries?

....just to name a few reasons...





What types of cryptography are there?

Symmetric Algorithms

- Same key for encrypt and decrypt
- Relatively fast algorithms
- Used to encrypt the data
- Problem is key exchange
- Examples: DES, 3-DES, AES, IDEA, Twofish





What types of cryptography are there? (cont.)

Asymmetric Algorithms

- Key-pair, one key for encrypt and one for decrypt (public & private key)
- Relatively slow algorithms
- Used for key exchange and digital signatures
- Examples: RSA, ElGamal, Elliptic curve cryptosystem, Diffie-Hellman



6 Note: Usually Asymmetric cryptography is much slower that symmetric cryptography © 2010 IBM Corporation



What types of cryptography are there? (cont.)

Message Digest / Hashing Algorithms

- Used for message integrity (message authentication)
- Examples: MD5, SHA-1, SHA-512







System z cryptographic hardware

System z has two flavours for accelerating cryptographic operations:

- CP assists for symmetric algorithms (CPACF)
- Crypto cards for asymmetric algorithms

Purpose:

- move cryptographic workload away from central processor
- accelerate encryption / decryption
- achieve higher security level





CP Assist for Cryptographic Function (CPACF)

- CPACF is a no-charge enablement feature on System z hardware.
- CPU support for symmetric algorithms is included in every standard CP & IPL



If you plan to enable CPACF, consider that it can only be enabled or disabled on a per central processor complex (CPC) basis and will affect all logical partitions (LPAR). The CPACF feature code is 3863. For information about how to enable a feature code see System z10 Support Element Operations Guide , SC28-6979.



System z Crypto cards

- Coprocessor vs. accelerator
 - Coprocessor: secure key transactions
 - Accelerator: SSL acceleration
- PCI Cryptographic Coprocessor (PCICC)
- PCI Cryptographic Accelerator (PCICA)
- PCI-X Cryptographic Coprocessor (PCIXCC)
- Crypto Express2 Coprocessor (CEX2C)
- Crypto Express2 Accelerator (CEX2A)
- z9-109: PCIXCC & PCICA -> Crypto Express 2 (CEX2)
 - 2x PCI-X adapter, configurable as coprocessor or accelerator
- If you are running Linux under z/VM, version 5.1 or later is required
- For the newer cards (CEX2A and CEX2C) you require a System z9 or later







System z Crypto cards (cont.)







Linux on System z Cryptography Support Overview



0-0



Distribution Support

- SLES and RHEL ship with libica, openCryptoki and openssl-ibmca support
- Red Hat Enterprise Linux (RHEL)
 - RHEL 4: z90crypt, CPACF with z990 / z890 support, CEX2A support with U4
 - RHEL 5: z9 CPACF included (SHA1 not usable), PRNG in U1, new zcrypt driver with U1, z10 CPACF with U2
- Novell SUSE Enterprise Linux Server (SLES)
 - SLES9 : z90crypt driver, CPACF with z990 / z890 support
 - SLES10 : new zcrypt driver with SP1, z9 CPACF included, PRNG in SP1 z10 CPACF with SP2
 - SLES11 : new zcrypt driver & z9/z10 CPACF





Enabling CPACF

To check whether CPACF is enabled for your CPC, open the CPC's details in the Support Element interface and check the value of "CP Assist for Crypto functions" in the lower right corner of the dialog.

- If the value indicates "Installed" as in screenshot, CPACF is enabled.
- After CPACF has been enabled, you can use the icainfo tool from the libica package on Linux to verify that your Linux guest has access to the hardware-supported cryptography functions.

```
root@larsson:~> icainfo
                                                  SCZP201 Details - SCZP201
The following CP Assist for
                                              Instance Information Product Information
                                                                                 Acceptable CP/PCHID Status
                                                                                                         STP Information
Cryptographic Function
                                               Instance Information -
(CPACF) operations are
                                               CP status:
                                                                    Operating
                                                                                 Activation profile:
                                                                                                          SCZP201
                                               PCHID status:
                                                                    Exceptions
                                                                                 Last profile used:
                                                                                                          SCZP201
supported by libica on this
                                                                                 Service state:
                                                                                                          false
system:
                                               Group:
                                                                    CPC
                                                                                 Number of CPs:
                                                                                                          14
                                               IOCDS identifier:
                                                                                Number of ICEs:
SHA-1: yes
                                                                    A2
                                                                                                          6
                                               IOCDS name:
                                                                                Number of zAAPs:
                                                                    IODF26
                                                                                                          2
SHA-256: yes
                                               System Mode:
                                                                                Number of IFLs:
                                                                    Logically
                                                                                                          2
SHA-512: yes
                                                                    Partitioned
                                               Alternate SE Status:
                                                                                Number of zIIPs:
                                                                    Operating
                                                                                                          2
DES: yes
                                                                    Yes No Dual AC power maintenance:
                                                                                                          Fully
                                               Lockout disruptive tasks:
[...]
                                                                                                          Redundant
                                                                                 CP Assist for Crypto functions: Installed
                                                    Change Options...
                                                                    Cancel Help
                                              Apply
```



Crypto Express support for z/VM user

• To check, from CP, whether your LPAR definition includes both a CEX2C and a CEX2A configuration, issue a QUERY CRYPTO AP statement.

```
#CP QUERY CRYPTO AP
AP 00 CEX2A Queue 11 is installed
AP 07 CEX2C Queue 11 is dedicated to LNXRH2
```

- Access from Linux to the Crypto Express adapter is provided by the z90crypt Linux kernel module.
- Use lsmod command to determine whether the z90crypt module is loaded. If not, use modprobe to load it and check the /dev file system to verify that the z90crypt device was created successfully

```
root@larsson:~> lsmod | grep z90crypt || echo "not loaded"
not loaded
root@larsson:~> modprobe z90crypt
root@larsson:~> lsmod | grep z90crypt || echo "not loaded"
z90crypt 106668 0
root@larsson:~> ls -l /dev/z90crypt
crw-rw-rw- 1 root root 10, 61 Feb 14 23:44 /dev/z90crypt
```





Troubleshooting

 If modprobe fails, you probably have not defined in the user directory and Linux has no access to any Crypto Express adapter

root@larsson:~> modprobe z90crypt
FATAL: Error inserting z90crypt
(/lib/modules/[...]/s390/crypto/z90crypt.ko): No such device
root@larsson:~> dmesg | tail -1
The hardware system does not support AP instructions

• To verify that a virtual cryptographic device has been defined for your z/VM user, issue the QUERY VIRTUAL CRYPTO through the vmcp command

```
root@larsson:~> vmcp QUERY VIRTUAL CRYPTO
AP 47 CEX2A Queue 06 shared
```

 Successfully loading the z90crypt driver creates a new file in the procfs directory under /proc/driver/z90crypt which provides statistical information about the driver and the underlying (virtual) hardware.

```
[root@larsson ~]# cat /proc/driver/z90crypt
[...]
PCICA count: 1
PCICC count: 0
[...]
```



Accelerated Linux kernel functions

- The standard Linux kernel includes modules that exploit the CPACF capabilities of the System z hardware.
- This enhances the generic Linux crypto support
 - generic, platform independent implementation of several symmetric encryption algorithms (see next slide)
 - support for optimized implementations
 - used by kernel functions, e.g. IPsec, dm-crypt
- The hardware-dependent modules for the CPACF are typically located in the /lib/modules directory unless they have been compiled into the kernel itself

```
[root@larsson ~]# ls -l /lib/modules/`uname -r`/kernel/arch/s390/crypto/
total 292
drwxr-xr-x 2 root root 4096 Feb 11 12:10 ./
drwxr-xr-x 6 root root 4096 Feb 11 12:10 ../
-rwxr--r-- 1 root root 36664 Feb 18 16:11 aes_s390.ko*
-rwxr--r-- 1 root root 27392 Feb 18 16:11 des_check_key.ko*
[...]
```





Accelerated Linux kernel functions (cont)

[root@larsson	~]# modprobe
aes_generic	
[root@larsson	~]# modprobe aes_s390
[root@larsson	~]# cat /proc/crypto
name :	cbc(aes)
driver :	cbc-aes-s390
module :	aes_s390
priority :	400
refcnt :	1
type :	blkcipher
blocksize :	16
min keysize :	16
max keysize :	16
ivsize :	16
name :	ecb(aes)
driver :	ecb-aes-s390
module :	aes_s390
priority :	400
refcnt :	1
[]	

Symmetric algorithms and hash Functions

CPACF currently includes:

- SHA-1, DES and 3-DES with z990 / z890
- SHA-256 and AES with 128 with z9
- SHA-512 and AES with 192/256 bit keys
- with z10

Algorithms exploiting CP assist functions can be used instead of generic software implementation

AES fall-back support for unsupported key lengths on z9

Pseudo random number generator

Algorithm description at /proc/crypto





Pseudo Random Number Generator

Another important aspect of cryptography is the availability of enough entropy to ensure secrecy because many cryptographic functions rely on randomly chosen values that are used, for example, to generate session keys or initialize the internal pseudo random number generator (PRNG).

- The PRNG driver is a character device that provides user-space applications with pseudo-random numbers generated by the pseudo-random number generator of the CPACF (based on the 3-DES CPACF algorithm)
- PRNG provides pseudo-random numbers similar to the Linux pseudo-random number device /dev/urandom but provides a better performance

The module has two parameter:

- prng_chunk_size: The number of bytes that the Linux kernel reads from the hardware in a single read operation (independent from the number of bytes a user-space program reads
- entropy_limit: The number of bytes read from the hardware after which extra randomness is added to the state of the pseudo random number generator

[root@larsson ~]# modprobe prng
[root@larsson ~]# modprobe prng_chunk_size=256
[root@larsson ~]# modprobe prng_entropy_limit=4096



Pseudo random number generator (cont.)

- You can test the speed of the new pseudorandom number generator by using the dd tool.
- The following shows that the CPACF-assisted random number generator is roughly twice as fast as the default generator that is being used for the /dev/urandom device.

```
[root@larsson ~]# dd if=/dev/random of=/dev/null bs=4k
0+3 records in
0+3 records out
24 bytes (24 B) copied, 11.0261 seconds, 0.0 kB/s
[root@larsson ~]# dd if=/dev/urandom of=/dev/null bs=4k
14975+0 records in
14974+0 records out
61333504 bytes (61 MB) copied, 11.0188 seconds, 5.6 MB/s
[root@larsson ~]# dd if=/dev/prandom of=/dev/null bs=4k
34746+0 records in
34745+0 records out
142315520 bytes (142 MB) copied, 11.0129 seconds, 12.9 MB/s
```



File system encryption: eCryptfs

- The additional cryptographic capabilities of System z can also be used to speed up the process of protecting your file system data using encryption.
- Native to the kernel, eCryptfs is a stacked cryptographic file system for Linux.
 - A stacked file system is layered on top of an existing mounted file system, which is referred to as a lower file system.
 - As the files are written to or read from the lower file system, eCryptfs encrypts and decrypts the files.
 - eCryptfs automatically asks you a few questions about the encryption properties when you set up the file system.
 - The CPACF supports the aes, des, and des3_ede128 modes.
 - All other encryption is performed in software only!





File system encryption: eCryptfs (cont.)

```
[root@larsson ~]# mkdir /mnt/{un,}encrypted
[root@larsson ~]# mount -t ecryptfs /mnt/encrypted /mnt/unencrypted
Select key type to use for newly created files:
1) openssl
2) tspi
3) passphrase
Selection: 3
Passphrase: ****
Select cipher:
1) aes: blocksize = 16; min keysize = 16; max keysize = 32 (loaded)
[...]
Selection [aes]: aes
Select key bytes:
1) 16
2) 32
3) 24
Selection [16]: 24
[...]
```





Additional Solutions

Dm-crypt

- One of the other cryptography features of the Linux kernel is dm-crypt, which is a device mapper and a transparent disk encryption subsystem that allows you to encrypt whole block devices.
- For more information about dm-crypt, see: http://www.saout.de/tikiwiki/tiki-index.php

IPSec

- The IPSec protocol is used to encrypt on-wire IP traffic to counter eavesdropping and tampering by third parties.
- IPSec uses standard kernel cryptography and benefits from the System z hardware acceleration with CPACF.
- For more information about running IPSec with Linux, see: http://www.ipsec-howto.org





Iszcrypt

Use the **Iszcrypt** command to display information about cryptographic adapters managed by zcrypt and zcrypt's AP bus attributes



 To display card type and online status of all available cryptographic adapters:

root@larsson:~> lszcrypt -V

 To display card type, online status, hardware card type, hardware queue depth, and request count for cryptographic adapters 0, 1, 10, and 12

root@larsson:~> lszcrypt -VV 0 1 10 12

• To display AP bus information:

```
root@larsson:~> lszcrypt -b
```





chzcrypt

Use the **chzcrypt** command to configure cryptographic adapters managed by zcrypt and modify zcrypt's AP bus attributes.



- To set the cryptographic adapters 0, 1, 4, 5, and 12 online:
 root@larsson:~> chzcrypt -e 0 1 4 5 12
- To set all available cryptographic adapters offline:

```
root@larsson:~> chzcrypt -d -a
```

To set the configuration timer for re-scanning the AP bus to 60
 root@larsson:~> chzcrypt -c 60 -n





Cryptographic Libraries



in



Key Management

One important aspect of cryptography is managing the keys that give access to the unencrypted data.

The Crypto Express2 and Crypto Express3 adapters in accelerator mode can be used as an Hardware Security Module (HSM) that protects your private keys from being read even by legitimate key users.

- The only difference to a full featured HSM, like the Crypto Express card in coprocessor mode, is that the encrypted keys are still stored in the file system of the user operating system.
- This situation implies that you take the necessary precautions to prevent the key from being deleted or overwritten, and implement a backup process according to your companies policies.
- If you need a full HSM, you can use the Crypto Express adapters in coprocessor mode.
- The most widespread standard for access tokens to security modules is PKCS#11 from the RSA Laboratories, and is nicknamed Cryptoki.



Cryptographic Libraries: openCryptoki

openCryptoki is an open source package which provides a implementation of the PKCS #11 API that allows interfacing to devices (such as a smart card, smart disk, or PCMCIA card) that hold cryptographic information and perform cryptographic Functions.

- openCryptoki provides application portability by isolating the application from the details of the cryptographic device.
- Both Red Hat Enterprise Linux 5.4 and SUSE Linux Enterprise Server 11 include the necessary tools to initialize and access the security tokens.
- OpenCryptoki provides exploitation of cryptographic hardware via libICA

Before you start working with the PKCS#11 API, be sure that the z90crypt module is loaded and the /dev/z90crypt device is present.

• The next step is to set a new PIN on the slot that you want to use, initialize the token, and set a user PIN on the token - using the pkcsconf application

More Information:

- http://sourceforge.net/projects/opencryptoki/
- 28• http://www.ihm.com/developerworks/linux/library/s-nkcs/

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Network Security Services (NSS) library

- Starting with version 5.4, Red Hat Enterprise Linux supports Network Security Services (NSS), a library for managing cryptographic objects and performing cryptographic functions in a platform independent way.
- Applications built with NSS can support SSL v2 and v3, TLS, PKCS #5, PKCS #7, PKCS #11, PKCS #12, S/MIME, X.509 v3 certificates, and other security standards.
- NSS started out as a Netscape project and is now being developed by the Mozilla Foundation.
- It is also used for key management by other vendors, for example in the Sun Solaris operating system.
- More Information: http://www.mozilla.org/projects/security/pki/nss/





Cryptographic Libraries: GSkit

To access and manage your PKCS#11 tokens, you can also use the Global Security Toolkit (GSKit) from IBM, an API that provides platform-independent functions for secure communication using SSL.

- GSKit supports access to cryptographic tokens and functions since version 7. and is bundled with other IBM software
 - IBM HTTP-Server
 - Tivoli Access Manager
 - Tivoli Directory Server
 - Websphere MQ

One of the utilities that is provided by GSKit is iKeyman.

- It allows you to effectively manage key stores through the GSKit interfaces and supports various key store formats by using a plug-in mechanism.
- One of the plug-ins enables GSKit to access PKCS#11 key stores, and you can use it to access and manipulate the contents of the security tokens managed by openCryptoki.

See the respective manuals of those software packages for a description of how to install GSKit.





Cryptographic Libraries: OpenSSL

OpenSSL is most likely the most prominent open source (licensed under BSDstyle license) cryptographic library

The core library implements the basic cryptographic functions and provides various utility functions:

- The OpenSSL library has a plug-in mechanism that allows various engines to be used for cryptographic operations.
- One of these engines is the ibmca engine
- It is usually located in: /usr/lib/openssl/engines/libibmca.so and uses CPACF and Crypto Express functionality if they are present in the system
- More Information: http://www.openssl.org/

```
root@larsson:~> openssl engine -c
(dynamic) Dynamic engine loading support
(ibmca) Ibmca hardware engine support
[RSA, DSA, DH, RAND, DES-ECB, DES-CBC, DES-EDE3, DES-EDE3-
CBC, AES-128-ECB, AES-128-CBC, AES-192-ECB, AES-192-CBC,
AES-256-ECB, AES-256-CBC, SHA1]
```





Apache-SSL Setup

- The Apache HTTP Server, commonly referred to simply as Apache is a popular open source web server AND supports a variety of features, including SSL support
- We can utilize hardware cryptographic devices to improve performance during SSL handshake negotiation

IBM HTTP Server		Apache		
mod_ibm_ssl		mod_ssl		
OpenCryptoki		OpenSSL		
libica				
z90crypt				
PCICC PCICA PCIXCC CEX2C CEX2A Hardware adapter				





RHEL: To enable SSL with Apache 2.0:

- Load the z90crypt device driver & ensure that OpenSSL is installed and enabled
- Add a certificate to the key database.
- The /etc/httpd/conf/httpd.conf file contains two directives to configure the key database:
 - The SSLCertificateFile directive specifies the SSL certificate.
 - The SSLCertificatekeyFile directive specifies the key file for the SSL Certificate.
- By default, these point to a fake self-signed certificate and key
- suitable tor testing.
- OpenSSL provides an interface to create a new certificate and key.
- Create a new certificate and key files in the /etc/httpd/conf directory





RHEL: Apache-SSL Setup (cont.)

```
root@larsson:~> cd /etc/httpd/conf
root@larsson:~> mkdir ssl.csr
root@larsson:~> mkdir ssl.key; mkdir ssl.crt
root@larsson:~> openssl req -new > ./ssl.csr/ap2.cert.csr
root@larsson:~> cd /etc/httpd/conf; mkdir ssl.csr
root@larsson:~> mkdir ssl.key; mkdir ssl.crt
root@larsson:~> openssl req -new > ./ssl.csr/ap2.cert.csr
root@larsson:~> openssl rsa -in privkey.pem -out \
./ssl.key/ap2.cert.key
root@larsson:~> openssl x509 -in ./ssl.csr/ap2.cert.csr \
-out ./ssl.crt/ap2.cert.cert -reg \
-signkey ./ssl.key/ap2.cert.key -days 365
```





RHEL: Apache-SSL Setup (cont.)

Remove the passphrase from the key (saving the key in a key file): root@larsson:~> openssl rsa -in privkey.pem -out ./ssl.key/ap2.cert.key

Convert the request to a signed certificate:

```
root@larsson:~> openssl x509 -in ./ssl.csr/ap2.cert.csr
```

```
-out \ ./ssl.crt/ap2.cert.cert -req \
```

```
-signkey ./ssl.key/ap2.cert.key -days 365
```

Point to the new certificate and key in the /etc/httpd/conf/httpd.conf:

SSLCertificateFile /etc/httpd/conf/ssl.crt/ap2.cert.cert
SSLCertificatekeyFile /etc/httpd/conf/ssl.key/ap2.cert.key

SSL configuration directives are contained in the /etc/httpd/conf.d/ssl.conf file. The "SSLCryptoDevice" directive defines which engine interface is enabled:

SSLCryptoDevice ibmca

Activate the webserver

root@larsson:~> apachectl start



•



SLES: To enable SSL with Apache 2.0:

- Load the z90crypt device driver
- Edit the /etc/sysconfig/apache2 file
 - The APACHE_MODULES="module_list" directive must include "ssl" in module_list.
 - The APACHE_SERVER_FLAGS="SSL" directive must include "SSL".
- Run SuSEConfig
- Generate a server certificate or import an existing server certificate (e.g. /usr/share/packages/apache2/certificates.sh)
- Create a virtual host configuration file
- Copy a template virtual host configuration file to the virtual host configuration directory:
 - # cp /etc/apache2/vhost.d/vhost-ssl.template /etc/apache2/vhost.d/vhost ssl.conf
 - Edit the vhost-ssl.conf file and add the location of the server certificate and the serverprivate key.





SLES: Apache-SSL Setup (cont.)

Configure Apache 2.0 to use the ibmca OpenSSL engine interface.

Edit the /etc/apache2/ssl-global.conf file and set the SSLCryptoDevice directive to

<IfDefine SSL>
<IfDefine !NOSSL>
<IfModule mod_ssl.c>
SSLCryptoDevice ibmca
AddType application/x-x509-ca-cert .crt
AddType application/x-pkcs7-crl .crl

• The server can be started and stopped as a service using the rcapache command (rcapache start)





Apache & PRNG

The hardware-supported PRNG can be used in any application that uses /dev/ random or /dev/urandom to read random values. One example is the Apache httpd server program where you can use it for seeding the SSL or NSS pseudorandom number generator.

SLES 11

- By default, the Apache server in SUSE uses mod_ssl module for serving content over an encrypted communication channel.
- Adjust mod_ssl to access the PRNG device that utilizes CPACF and modify the file /etc apache2/ssl-global.conf configuration file as follows SSLRandomSeed startup file:/dev/prandom 1024 SSLRandomSeed connect file:/dev/prandom 512

RHEL 5.4

- Red Hat Enterprise Linux includes both mod_ssl and mod_nss for encrypted communication.
- Modify the /etc/httpd/conf.d/nss.conf configuration as following:

NSSRandomSeed startup file:/dev/prandom 512



Java

The hardware cryptography extensions provided by both CPACF and the Crypt Express adapters are also available to you in the Java programming environment, enabling you to build and run applications with increased performance.

 Access to the hardware is mediated by the IBM Java PKCS#11 implementation (IBMPKCS11Impl) library that is, for example, provided with the IBM Java Runtime Environment (JRE).

More Information:

http://www.ibm.com/developerworks/java/jdk/security/50/secguides/pk cs11implDocs/IBMJavaPKCS11ImplementationProvider.html





Summary

Security is more than a "Perimeter" defense" - a firewall alone is not sufficient

Security begins with the security capabilities / functions available within the Enterprise infrastructure

Linux running on System z leverages:

- Unique Hardware Features
- Support for trusted cryptography algorithms
- Secure open source implementation
- A software layer to make use of the hw functionality from the application layer













Questions?



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Appendix





LPAR hardware setup: CryptoExpress2 adapter

https://	/sczhmc8.i	itso.ibm.com:995	0 - SCZP201: Cryptograph	ic Configuration - M	ozilla Firefox		
CI	Cryptographic Configuration - SCZP201						
- Cryptog	Cryptographic Information						
Select	Number	Status	Crypto Serial Number	Туре	UDX Status	TKE Command	s
0	0	Configured	97007984	X2 Coprocessor	IBM Default	Denied	
0	1	Configured	97007985	X2 Coprocessor	IBM Default	Denied	
0	2	Configured	97006647	X2 Coprocessor	IBM Default	Denied	
0	3	Configured	97006644	X2 Coprocessor	IBM Default	Denied	
0	4	Configured	97007866	X2 Coprocessor	IBM Default	Denied	and the state of the
0	5	Configured	97007853	X2 Coprocessor	IBM Default	Denied	
۲	6	Deconfigured	Not available	X2 Coprocessor	Not available	Not available	
0	7	Configured	97006564	X2 Coprocessor	IBM Default	Denied	
Select a Cryptographic number and then click the task push button.							
View Details Test RN Generator Zeroize Usage Domain Zeroize TKE Commands Crypto Type Configuration							
Zerolze All Test RN Generator on All UDX Configuration Refresh Cancel Help							
one						S	czhmc8.itso.ibm.com:9950 🕋





LPAR hardware setup: CryptoExpress2 adapter

https://9.152.123.50:9950 - P004A75E: Crypto Type Config	guration - Mozilla 💶 🗖 🔀
Crypto Type Configuration	
The selected Crypto is currently configured as a Coproc Cryptographic number: 2 Status: Deconfigured	essor.
Select a configuration for the Crypto	
 Coprocessor Accelerator Zeroize the Coprocessor Note: Zeroize may also be performed using the Cryptog panel. 	graphic Configuration
Note: The Crypto must be deconfigured to change the C OK Refresh Cancel Help	White the second sec
🔆 🕮 🌿 Done	Are you sure you want to use the Crypto Express2 as an Accelerator?
	The Cryptographic keys in the Coprocessor will not be zeroized by this configuration change. ACT37837
	Done sczhmc8.itso.ibm.com:9950



Setup of Crypto Cards for z/VM guests

For shared crypto cards: Virtualization of crypto cards defined for the LPAR (all available cards which are not dedicated). These cards can be shared among guests

- Statement: CRYPTO APVIRT
- The guest gets one virtual card
- AP number and domain are chosen by VM and not identical with the one for the VM LPAR

For dedicated crypto cards: No virtualization of these crypto cards (not shared) will be done. Only the guest with such a definition can use these cards. The cards are not available to other guests

- Statement: CRYPTO DOMAIN x APDED y
- Domains: x can be one or more domains defined for the VM LPAR
- AP number: y can be one or more CEX2C cards defined for the VM LPAR





z/VM User Directory Example

```
USER LNXRH2 ***** 512M 1G G
INCLUDE IBMDFLT
CRYPTO APVIRT
IPL CMS PARM AUTOCR
MACHINE
       ESA 2
NICDEF C200
           TYPE QDIO LAN SYSTEM
VSWITCH1
NICDEF C300 TYPE QDIO LAN SYSTEM
VSWITCH2
MDISK 0191 3390 0241 0080 LX9U1R MR
MDISK 0201 3390
                0001
                     1000 LXC40B
                                  MR
MDISK 0202 3390 1001 9016 LXC40B
                                  MR
```





How to see cryptographic card definitions in z/VM

• Q CRYPTO AP: Shows the crypto cards and domains for the whole VM as defined in the LPAR activation profile

q crypto ap

AP 00 CEX2C Queue 10 is reserved for dedicated use AP 01 CEX2C Queue 10 is reserved for dedicated use	<= are dedicated for secure key on other guests <=
or AP 01 CEX2C Queue 10 is dedicated to T2912002	<= is dedicated to guest you are logged on
AP 03 CEX2A Queue 10 is installed	1
AP 04 CEX2C Queue 10 is superseded by CEX2A	
AP 06 CEX2C Queue 10 is superseded by CEX2A	> are available for APVIRT (clear key)
AP 07 CEX2C Queue 10 is superseded by CEX2A AP 08 CEX2C Queue 10 is superseded by CEX2A	
AP 09 CEX2A Queue 10 is installed	
AP 10 CEX2C Queue 10 is superseded by CEX2A AP 11 CEX2A Queue 10 is installed	

Note: AP 00 means crypto processor 00, equivalent to AP number in profile Queue 10 means crypto domain 10 as defined in profile





How to see cryptographic card definitions in z/VM

 Q V CRYPTO : Shows an entry with a queue statement and shows that the guest is connected to crypto cards
 q v crypto

No CAM or DAC Crypto Facilities defined AP 13 CEX2A Queue 04 shared <= shown when APVIRT is used (clear key)

No CAM or DAC Crypto Facilities defined AP 01 CEX2C Queue 10 dedicated <= shown when APDED is used (secure key)

Note: shared : AP number and queue numbers are from virtulization

dedicated: AP nmuber and queue numbers are real values from the LPAR profile

Shows that crypto cards (APs) can be used..

q crypto

No CAM or DAC Crypto Facilities are installed Crypto Adjunct Processor Instructions are installed





Dedicated and shared cards under VM



0-0



Performance: CPACF DES









Performance: CPACF 3-DES

3-DES CBC-mode generic vs. s390





Performance: CPACF AES

AES CBC-mode generic vs. s390 (128 bit key)







Performance: CPACF SHA-1

SHA-1 generic vs. s390



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Performance: CPACF SHA-256

SHA-256 generic vs. s390





Performance: PRNG

/dev/urandom vs. /dev/prandom





Performance: openssl

openssl software vs. crypto cards





Certifications on System z

Security Server: RACF, LDAP, Firewall - Encryption - Public Key Infrastructures - Certificate Authority

