How to Virtualize IBM Z Hardware Cryptography with z/VM

With a discussion on workloads, keys, and
Dynamic Crypto Support for z/VM

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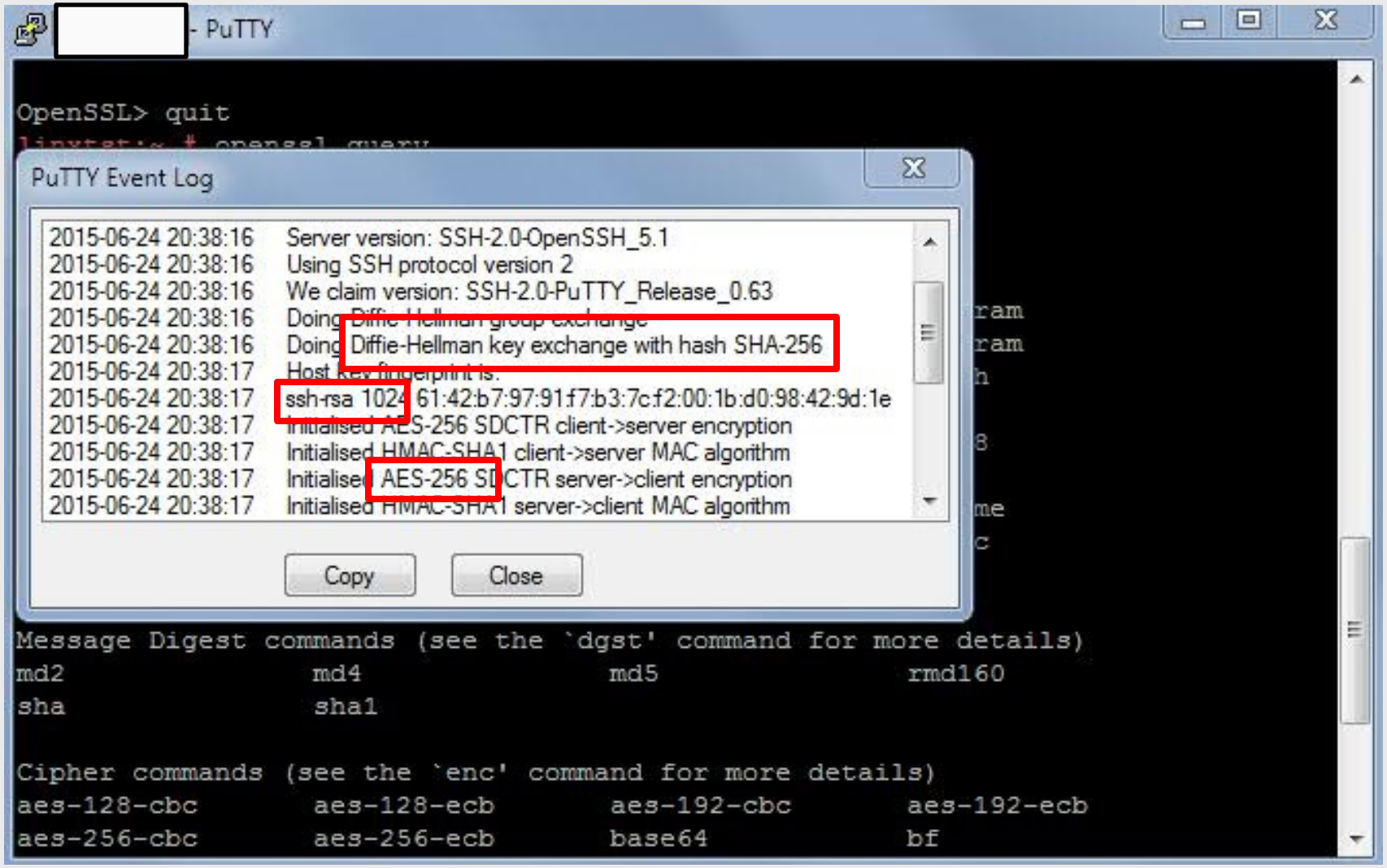
V7.2.2022

you IBM

Cryptography acronyms and terms. There will be a quiz later.

AES	Advanced Encryption Standard
ARL	Authority Revocation List
CA	Certification Authority
CBC	Cipher Block Chaining
CCA	IBM Common Cryptographic Architecture
CCF	Cryptographic Coprocessor Facility
CDSA	Common Data Security Architecture
CEX7S/6A	Crypto Express7S Accelerator Mode
CEX7S/6C	Crypto Express7S CCA Coprocessor Mode
CFB	Cipher Feedback
CKDS	Cryptographic Key Data Set
CRL	Certificate Revocation List
CRT	Chinese Remainder Theorem
CVC	Card Verification Code
CVV	Card Verification Value
DES	Data Encryption Standard
DSA	Digital Signature Algorithm
DSS	Digital Signature Sometthing
ECB	Electronic Code Book
FIPS	Federal Information Processing Standard
GCM	AES Galois/Counter Mode
ICSF	Integrated Cryptographic Service Facility
IETF	Internet Engineering Task Force
IPKI	Is Anyone Reading This Line
KGUP	If You Can Read This Raise Your Hand
LDAP	Lightweight Directory Access Protocol
MAC	Message Authentication Code
MDC	Message Detection Code
MD5	Message Digest 5
OAEP	Optimal Asymmetric Encryption Padding
OCSF	OS/390 Open Cryptographic Services Facility
OCSP	Online Certificate Status Protocol
PCICA	PCI Cryptographic Accelerator
PCICC	PCI Cryptographic Coprocessor
PCIXCC	PCIX Cryptographic Coprocessor
PKA	Public Key Architecture
PKCS	Cryptographic Standards
PKDS	Public Key Data Set
PKI	Public Key Infrastructure
RA	Registration Authority
RACF	Resource Access Control Facility
RSA	Rivest-Shamir-Adleman
SET	Secure Electronic Transaction
SHA	Secure Hash Algorithm
SLE	Secure Cookie Monster Encryption
SSL	Secure Sockets Layer. See TLS
TKE	Trusted Key Entry
TLS	Transport Layer Security. See SSL.
VPN	Virtual Private Network

Crypto looks complicated, and it happens quickly.



What just happened?

SSH connections and TLS connections use:

- **Asymmetric** key exchange to establish a connection
- **Symmetric** keys to encrypt bulk traffic
- **Hashing** to validate content integrity between source and target

That's a lot of math … and it's processing power that adds up

- Happens for every secure operation (connection, application math, etc.)
- The bigger (more secure) the keys, the longer it takes
- Costs time, money

Why Use IBM Z Hardware Cryptography?
(or: why you‘re here)

- Maximize Trust & reliability – proven hardware implementations

- Minimize Cost
  - Save money: offload expensive CPU workload
  - Save time: Faster crypto algorithms

- Industry-leading security
  - special built-in functions for banking and financial applications (secure key)

- Regulatory compliance starts at hardware (FIPS 140-2)

Pervasive encryption: A paradigm shift in data protection

Protecting only enough data to achieve compliance should be the bare minimum, not a best practice.

Focus on eliminating barriers:

- Decouple encryption from classification
- Extensive application changes
- Encryption of database indexes and/or key fields
- High cost associated with processor overhead

Today’s Topics

IBM Z Hardware Cryptography
(and why it matters)

z/VM Virtualization of IBM Z Cryptography
(and how to use it)

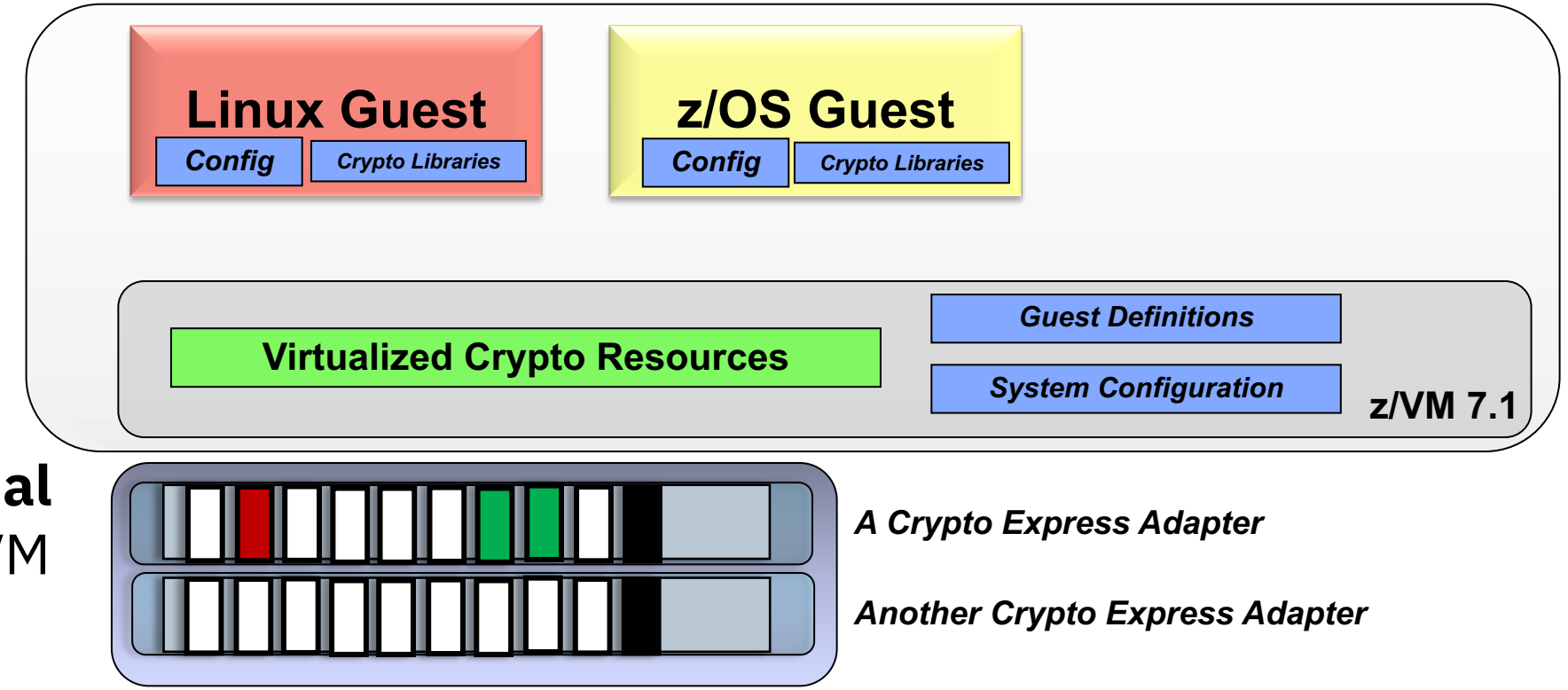
Guest Support: Operating Systems Running on z/VM

Extra: Frequently Asked Questions (if you don't ask them first)

IBM Z Hardware Crypto Support

How To: Configure your Crypto on IBM Z and LinuxONE

1. Install the **features**
2. Configure **adapters** on HMC/SE
3. Configure your **hypervisor**
4. Configure your **virtual machines** at the z/VM level
5. Configure your **guest operating system(s)**

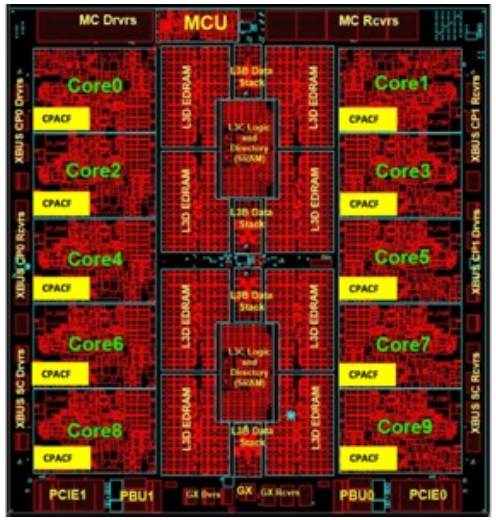


IBM Z and LinuxONE Integrated Cryptographic Hardware

CP Assist for Cryptographic Functions (CPACF)

- Hardware accelerated encryption on every microprocessor core
- Performance improvements of up to 6x* for selected encryption modes

Suited for high speed bulk symmetric encryption



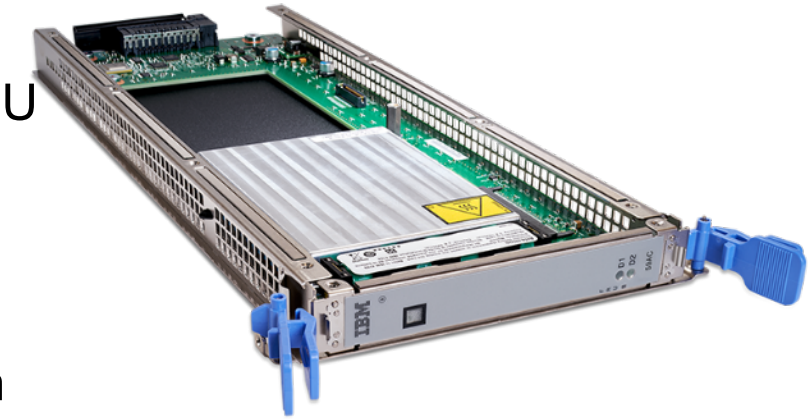
Crypto Express6S

- Next generation PCIe Hardware Security Module (HSM)
- Performance improvements up to 2x*
- Industry leading FIPS 140-2 Level 4 Certification Design

Suited for high value transactions, key protection and asymmetric acceleration

Why is it valuable:

- More performance = lower latency + less CPU overhead for encryption operations
- Highest level of protection available for encryption keys
- Industry exclusive “protected key” encryption



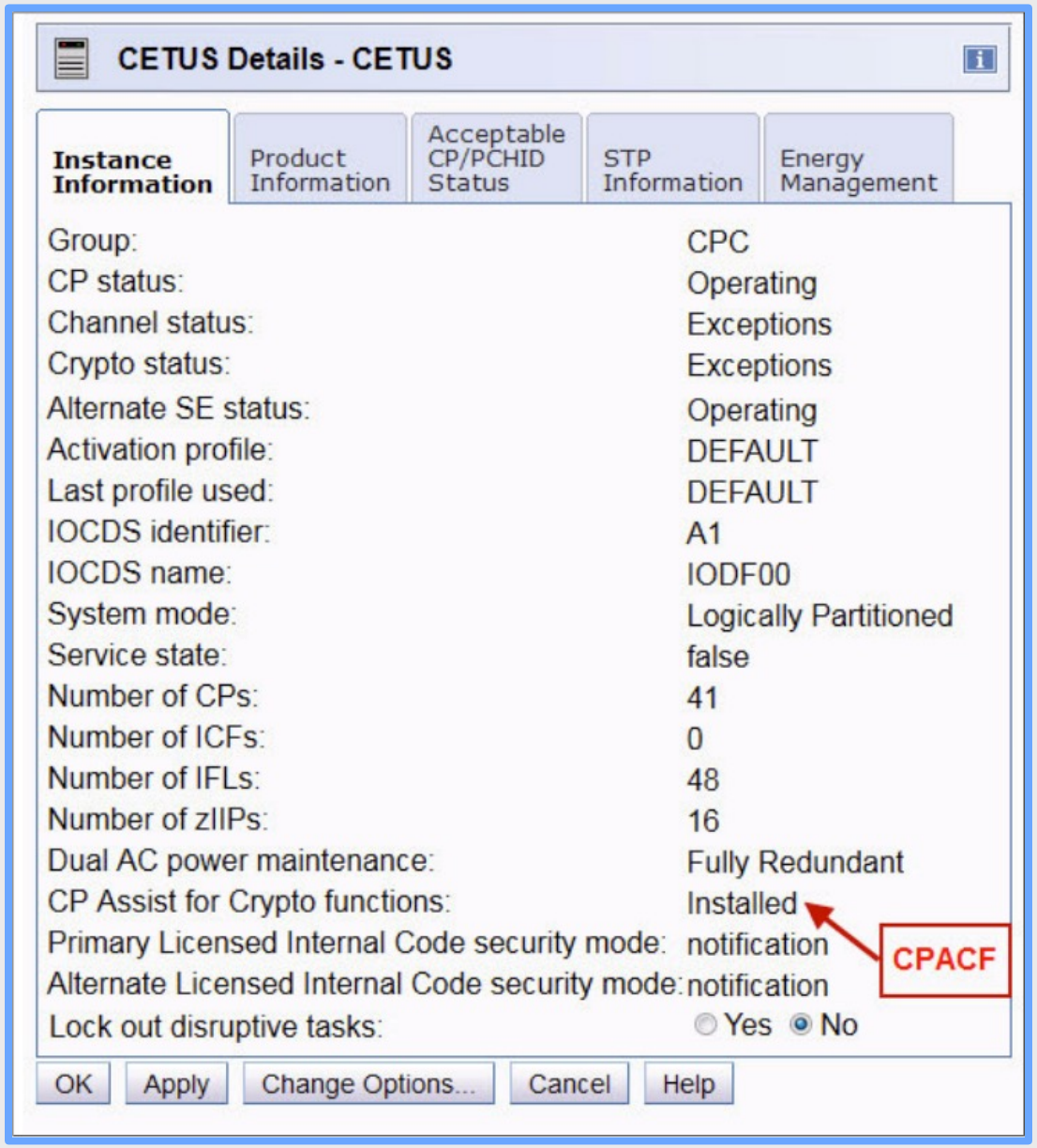
**compared to previous generation of Z or LinuxONE hardware*

CP-Assisted Cryptographic Facility (CPACF)

No-charge feature on IBM Z hardware (Feature 3863)

On-chip cryptographic acceleration and operations

Enablement required to use the Crypto Express hardware



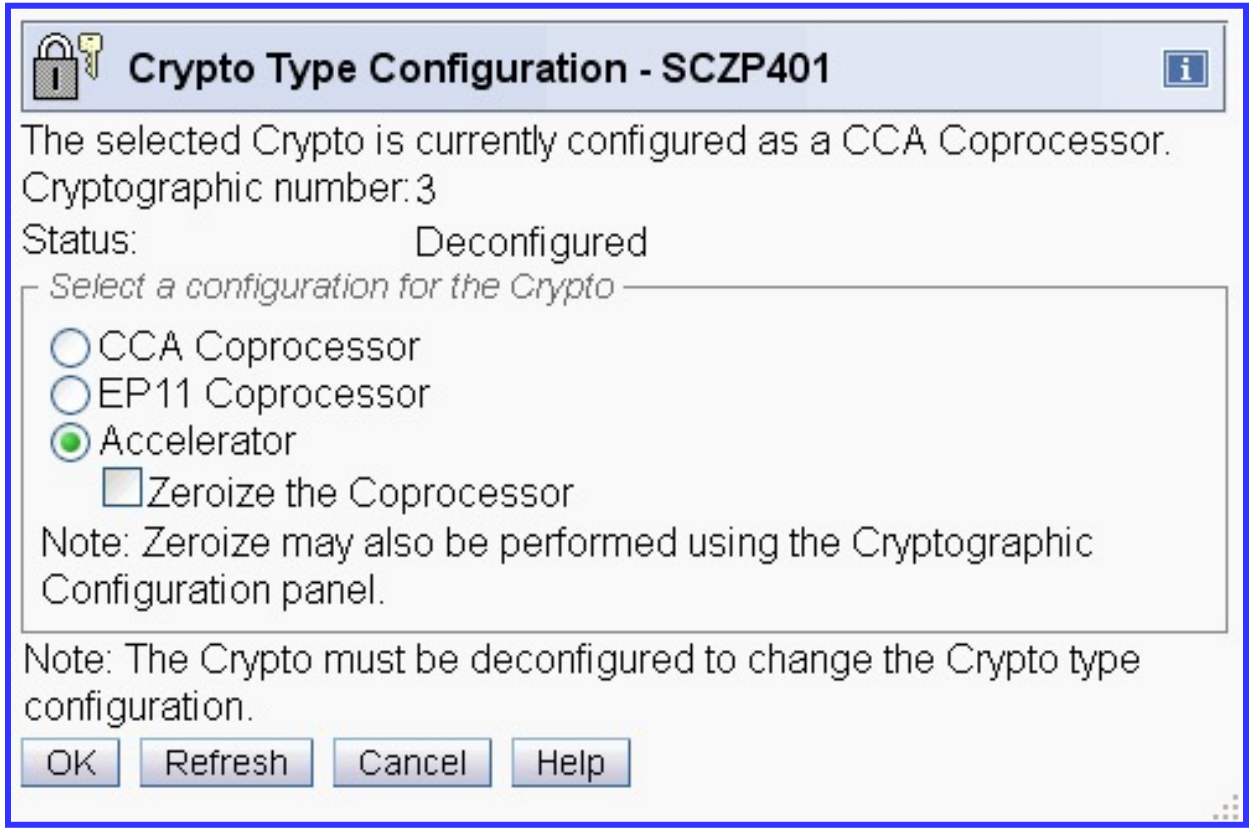
Setting Operational Mode for a Crypto Express Adapter (1/2)

Configuration for a Crypto Express feature is done on the **Hardware Management Console (HMC)**

– **Step 1**: Make sure CPACF is enabled.

– **Step 2**: Select adapter, then choose the operational mode

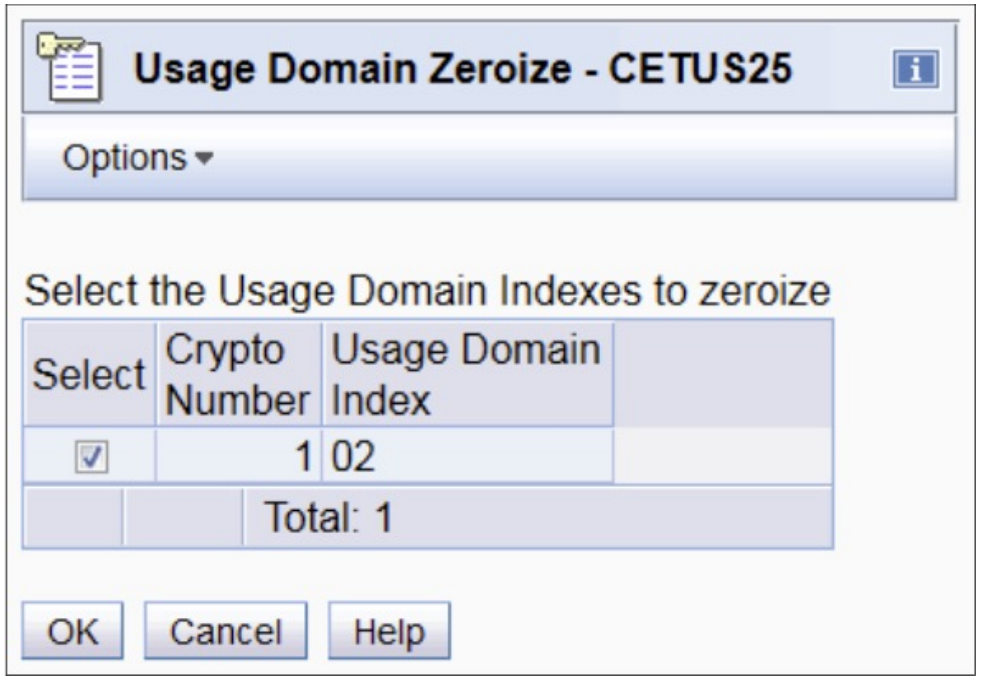
- Accelerator (clear key only)
- CCA Coprocessor (more security, HSM features)
- EP11 (open-source crypto framework, also has HSM features)

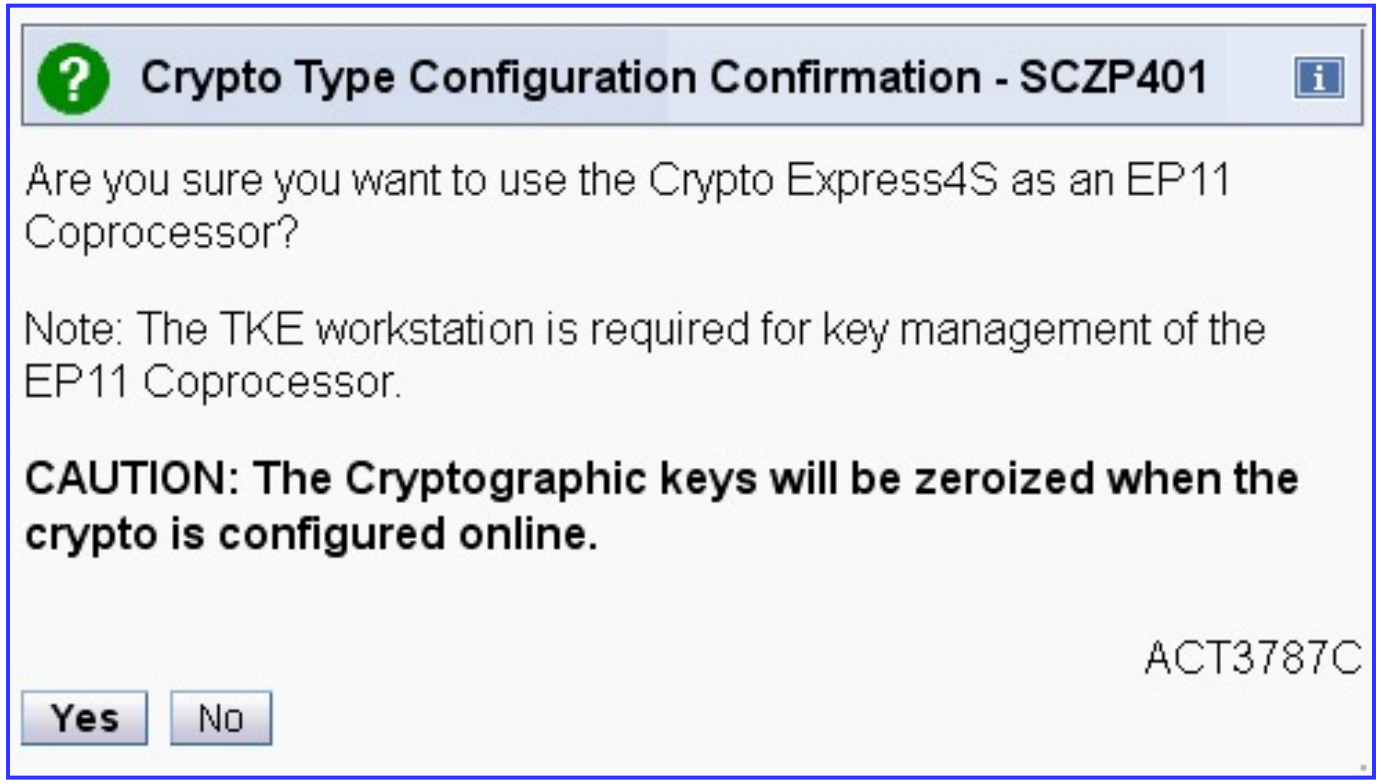


Setting Operational Mode for a Crypto Express Adapter (2/2)

Step 3: Validate option selection

- May zeroize existing keys in the process (destroy any residual secrets)

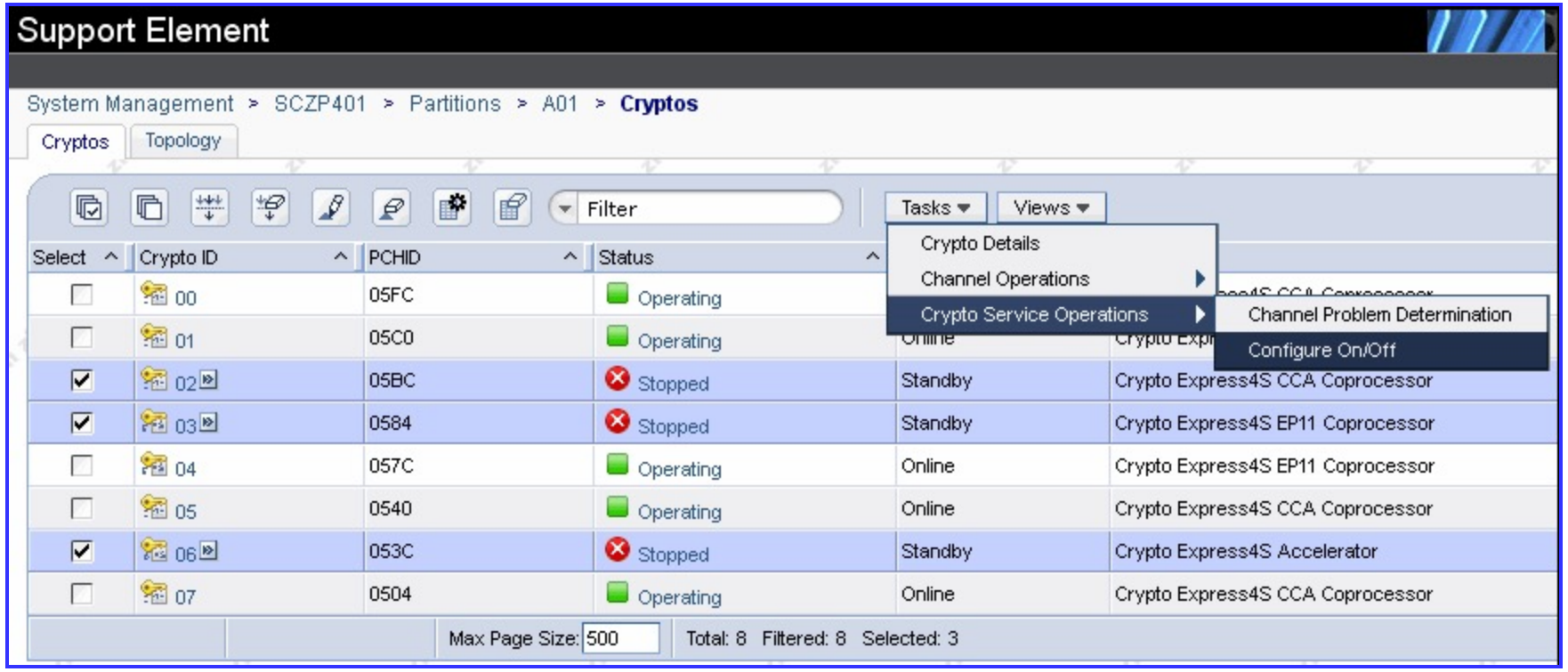




Activating a Crypto Express Adapter

Hardware activation is done from the Support Element

Select pertinent feature, "Configure On/Off"

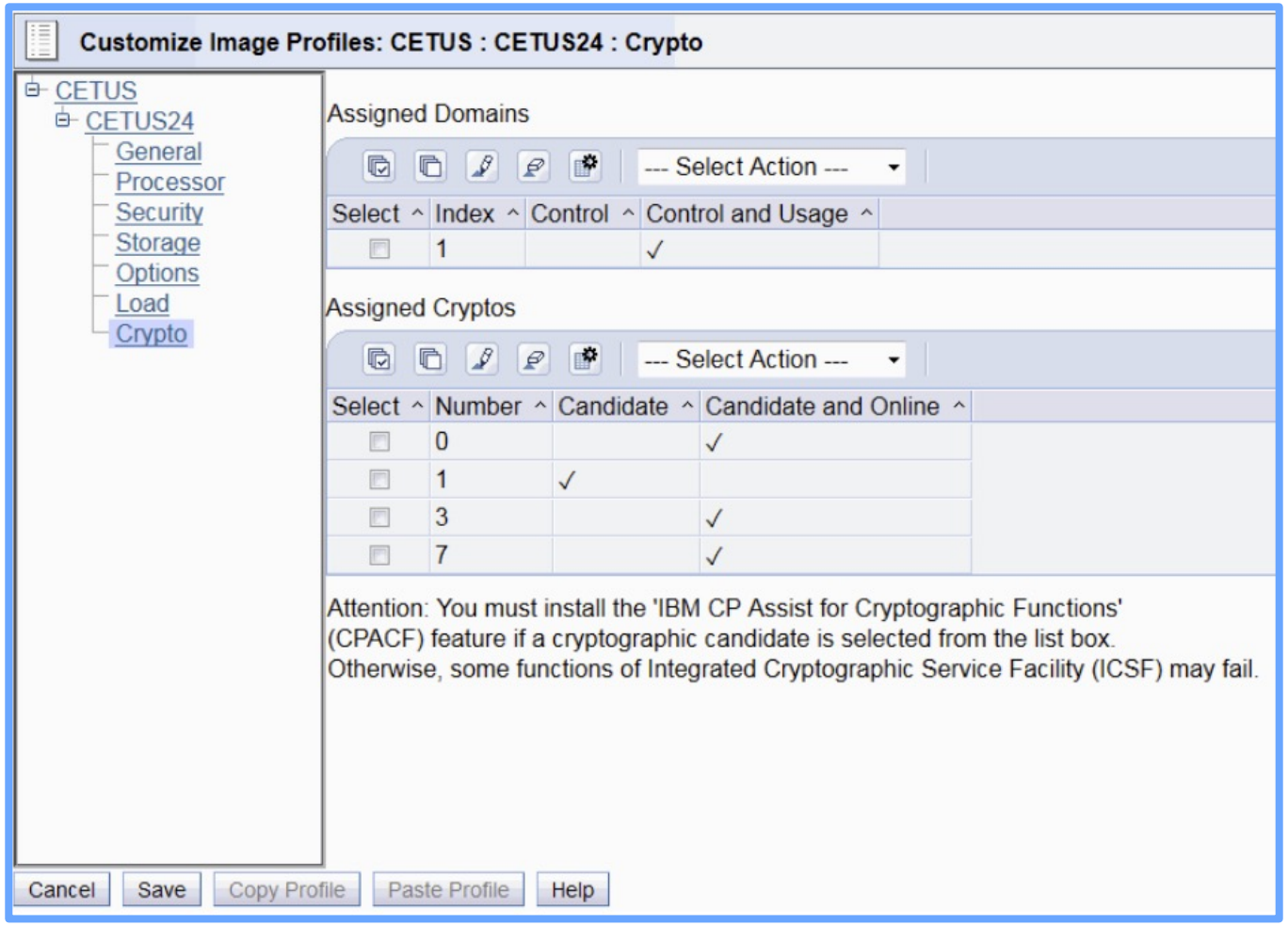


Attaching a Crypto Express logical domain to an LPAR

LPAR assignation is done from the HMC (building an activation profile)

- **Candidate list**: domains on this adapter which are eligible to be accessed by this partition
- **Online List**: crypto resources automatically brought online at LPAR startup.
- **Usage Domain**: bundles domains together inside a common cryptographic boundary
- **Control Domain**: identifies domain index pertinent to TKE control of the LPAR. *If the Usage Domain is checked, the Control Domain must also be checked.*

z/VM will only detect those adapters and domains assigned to the LPAR



Getting Keys into Your Crypto Express features

Trusted Key Entry (TKE) Workstation – an optional priced feature which communicates directly with the Crypto Express features over a secure TCP/IP connection.

- Functions as a separate physical device to the side of your IBM Z or LinuxONE
- Card reader for crypto secret storage
- Generates new secrets, stores data in Crypto Express domains
- Required if running Crypto Express features in EP11 mode!

z/OS Integrated Cryptographic Services Facility (ICSF) – a base component which allows interaction with Crypto Express features. (Requires z/OS.)

Panel and Catcher Utilities for Linux – **Panel** is a Linux package installed as part of the IBM .rpms which allows for key management function. **Catcher** is the Linux daemon for communicating with TKE.

- `/opt/IBM/CEX5C/bin/panel.exe`

IBM Enterprise Key Management Foundation (EKMF) – an IBM Lab Services offering for flexible and secure key management services.

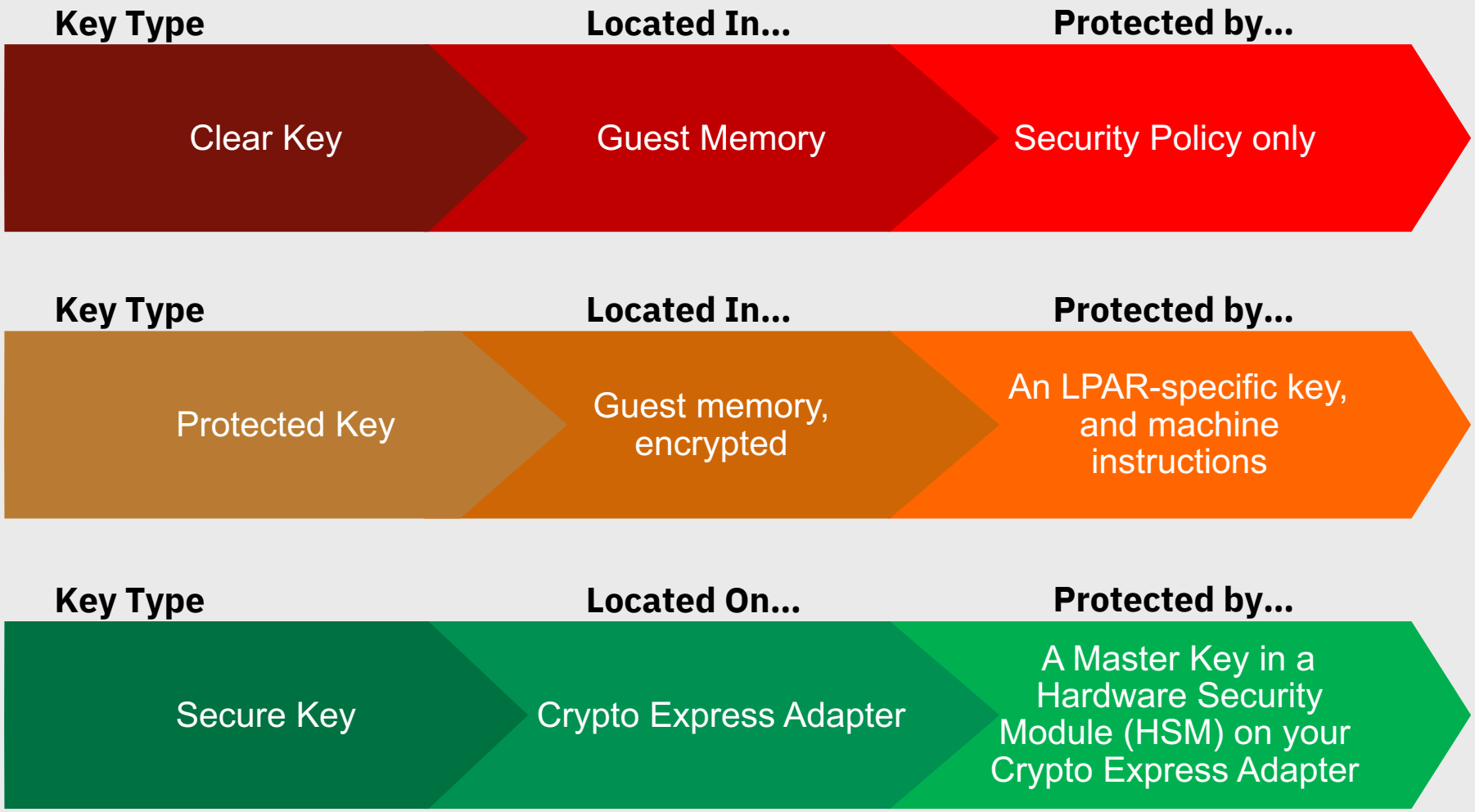
- See also *Advanced Crypto Service Provider*
- http://www-05.ibm.com/dk/security/cccc/products/acsp.html

IBM HyperProtect Crypto Services – a cloud offering for key storage and retrieval.

- https://www.ibm.com/cloud/hyper-protect-crypto

IBM Z Operational Keys: Explaining Clear, Protected, Secure

- Clear Keys are not encrypted. **Crypto operations may be performed in CPACF or on a Crypto Express adapter**
- Protected keys are encrypted under a CPACF wrapping key. **Crypto operations are performed only using CPACF**
- Secure keys have key values that are encrypted by a Master Key on a tamper-responding **Crypto Express adapter**.

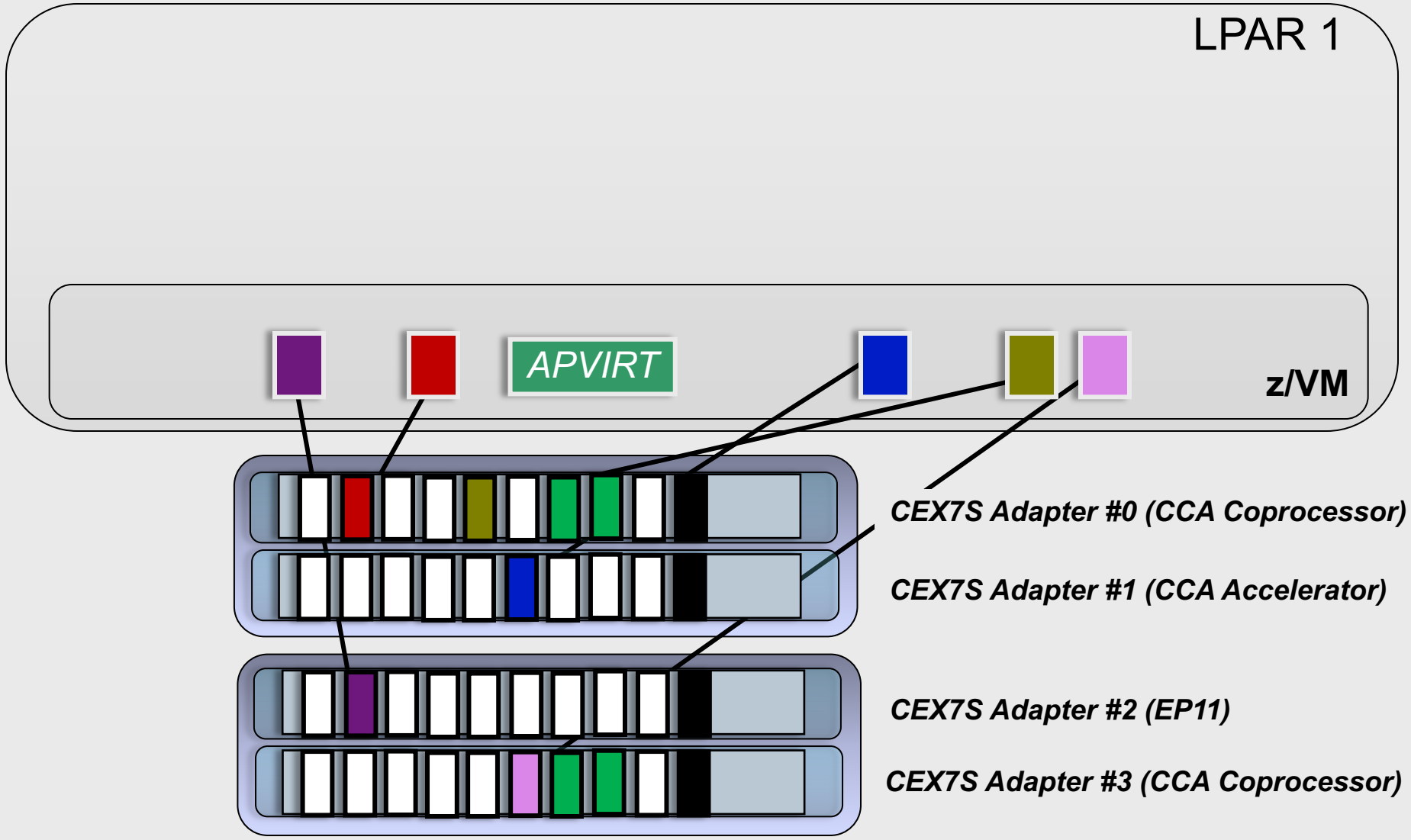


z/VM Support for Hardware Crypto

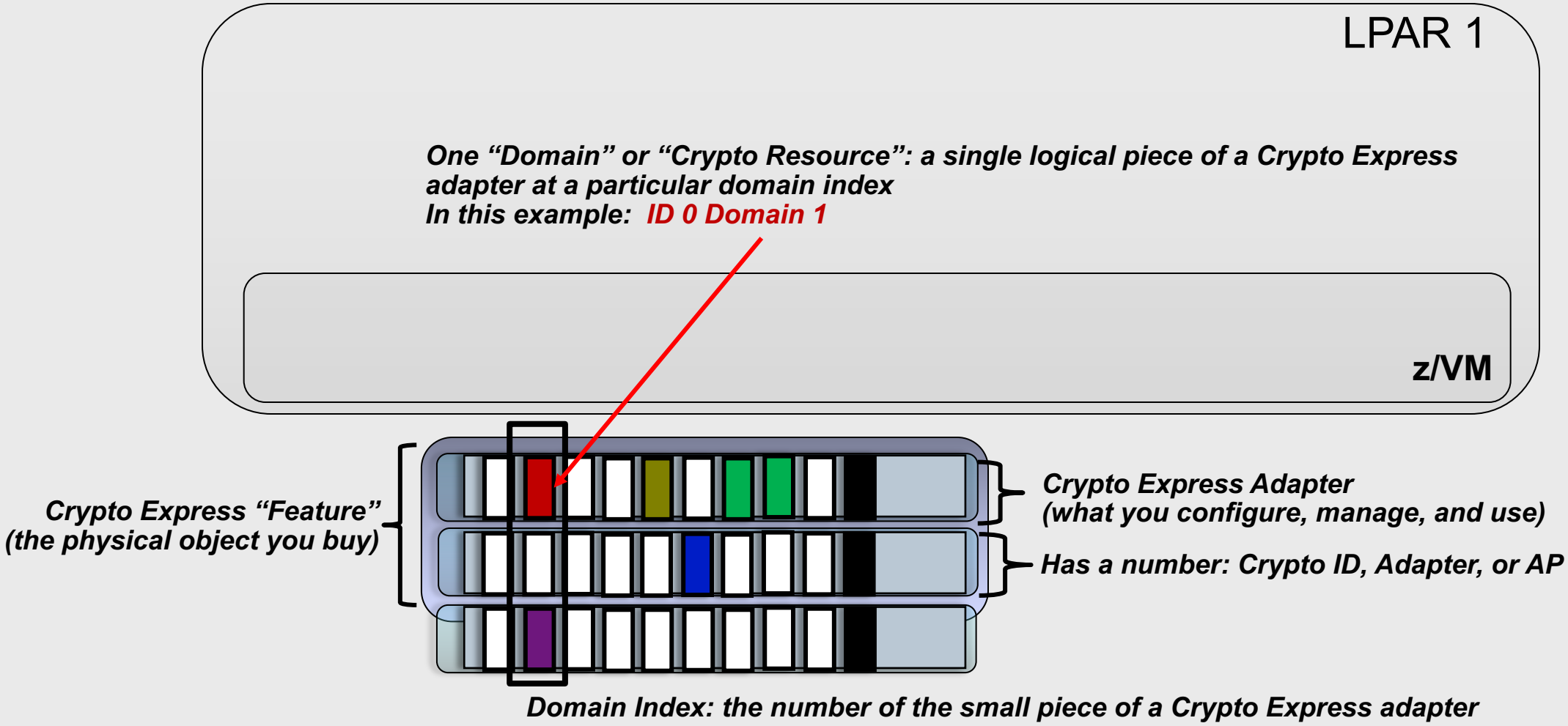
z/VM Virtualization of Hardware Cryptography (z/VM's view)

Once domains are assigned to a z/VM LPAR for use, they appear to the hypervisor and can be used by virtual machines.

z/VM sees crypto resources as virtual devices represented by a **Crypto ID** and a **domain index**.

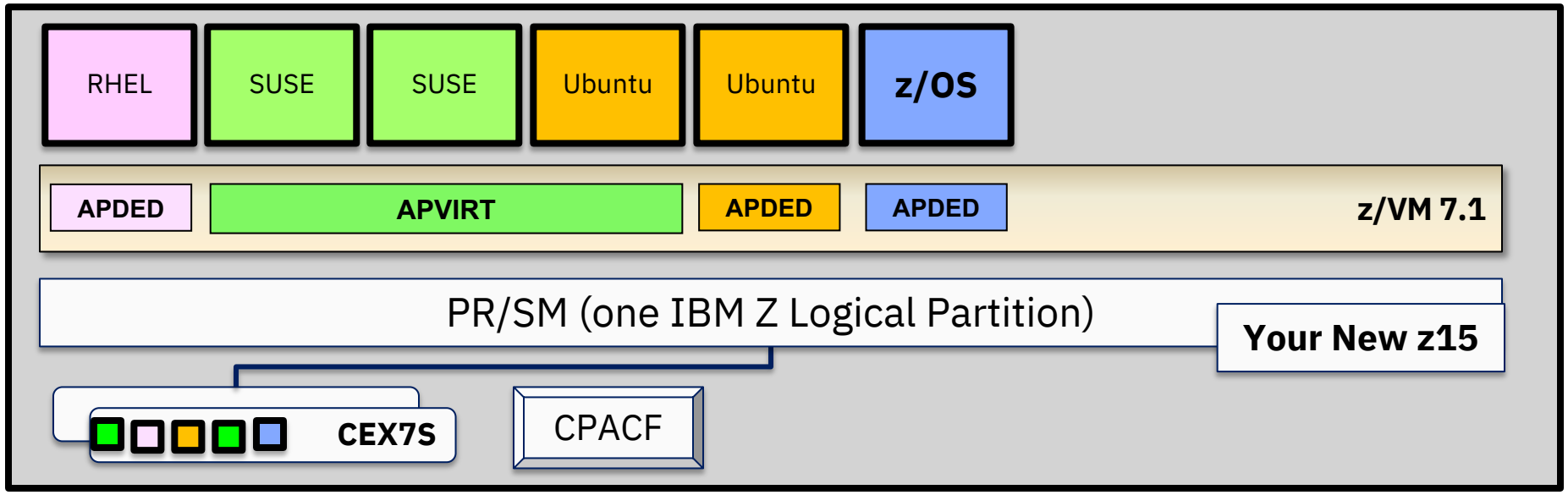


Your Crypto Lexicon (what the terms mean)



Intro to z/VM and Cryptographic Virtualization

Crypto Express adapters attached to your z/VM partition are **virtualized for the benefit of your guests**:



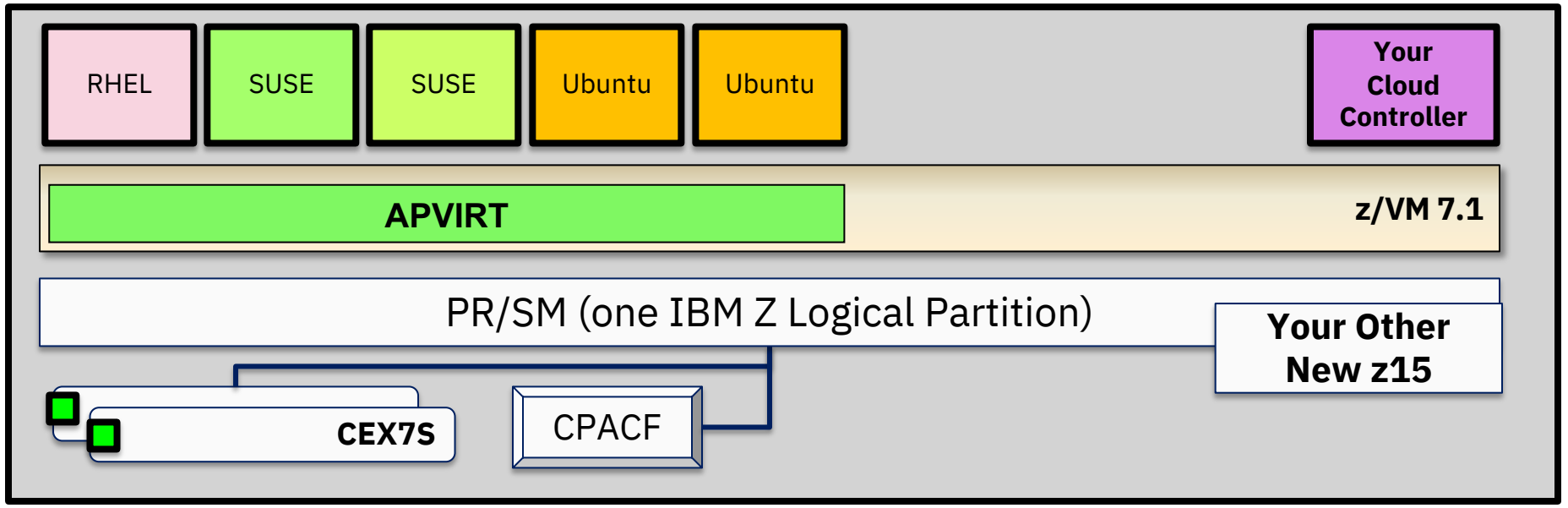
`Dedicated` (“APDED”)

Connects a particular Crypto Express domain (or multiple crypto resources) directly to a virtual machine – no hypervisor interference
All card functions are available to the guest

`Shared` (“APVIRT”)

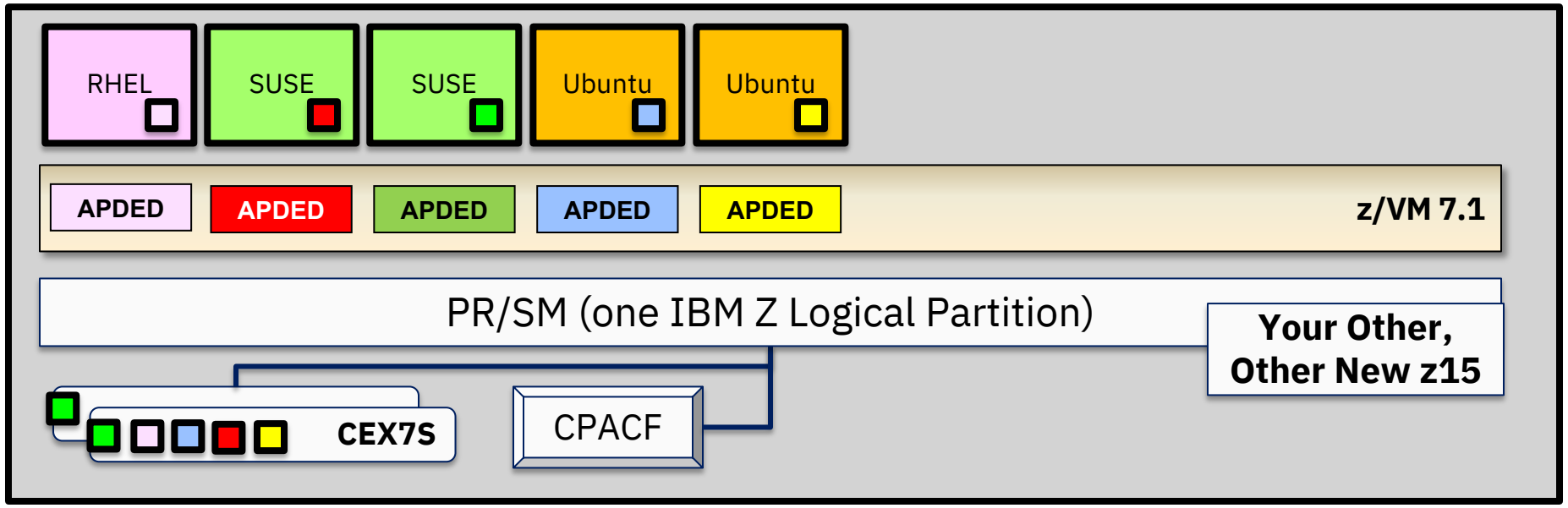
Virtual machine can access a collection of domains controlled by the hypervisor layer
Meant for **clear-key operations only** – sharing crypto material might otherwise break security policy.

Sample of Virtualization: LinuxONE Developer Cloud



Crypto operations: SSH (RSA, SHA-2, AES), and *whatever data handled inside the guests*
Environmental Requirements: Guests must be relocatable (it's a cloud)
Recommended Hardware: CPACF and a Crypto Express CCA Accelerator in shared configuration ("APVIRT")
– Assign 1 domain from 2-3 different adapters (for hardware failover and better performance)

Sample of Virtualization: Linux on IBM Z Blockchain (*not* HSBN)

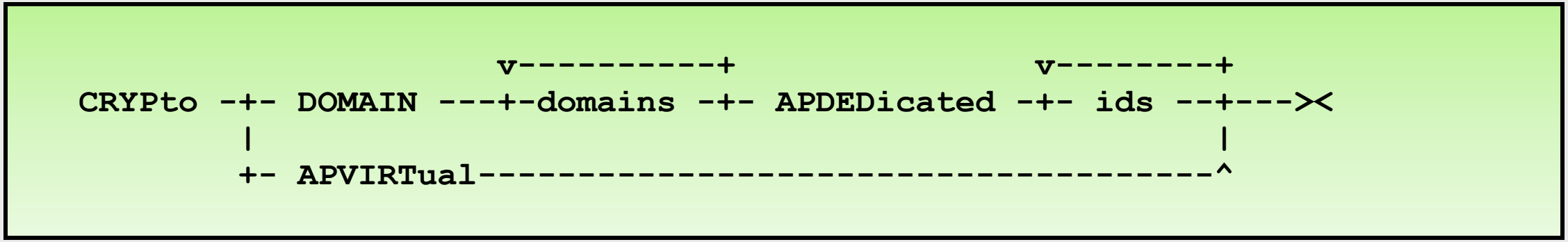


Crypto operations: A lot. It's a Blockchain
Environmental Requirements: Protection of key material. (It's a Blockchain.)
Recommended Hardware: CPACF and Crypto Express adapters in EP11 (PKCS #11) mode

- One domain per guest participating in the Hyperledger fabric

z/VM Virtualization of Hardware Cryptography

The **CRYPTO User Directory statement** grants a z/VM userid access to crypto resources associated with the Crypto Express adapters:



Notes:

- Guests should not try to dedicate the same domains *(first to IPL wins, all others complain)*
- Guests with a dedicated crypto resource may not be relocated
- Guests may not have both dedicated and shared crypto resources
- Shared crypto resources are treated as clear-key (Accelerator) mode only*

Assigning Domains to APVIRT

The CRYPTO APVIRT statement in your System Configuration file allows you to request particular crypto resources (by Crypto ID and domain index) to be assigned to hypervisor's list of **shared crypto resources**:

```
CRYPTO APVIRT AP 1 DOMAIN 0 1
CRYPTO APVIRT AP 0 DOMAIN 22
```

Usage Notes:

- z/VM will designate the first available domain in this list as the preferred type
- Any other available domains in SYSTEM CONFIG also of that type are designated for shared usage
- Domains that do not meet criteria are ignored.
- If no domains meet criteria, no APVIRT usage will be allowed
- EP11 domains (and adapters) may not be used for shared use or assigned to APVIRT

If this statement is not present in the System Configuration file, z/VM will select two available domains, with a preference for Accelerator mode domains on the latest hardware.

Assigning Domains to APVIRT

Given the following System Configuration:

```
CRYPTO APVIRT 1 2 DOMAIN 7 8
CRYPTO APVIRT 4 DOMAIN 9
```

… z/VM will check domains in the following order:

```
AP 1 DOMAIN 7          /* CEX6A */
AP 1 DOMAIN 8          /* CEX6A */
AP 2 DOMAIN 7          /* CEX5A */
AP 2 DOMAIN 8          /* CEX5A */
AP 4 DOMAIN 9          /* CEX6C */
```

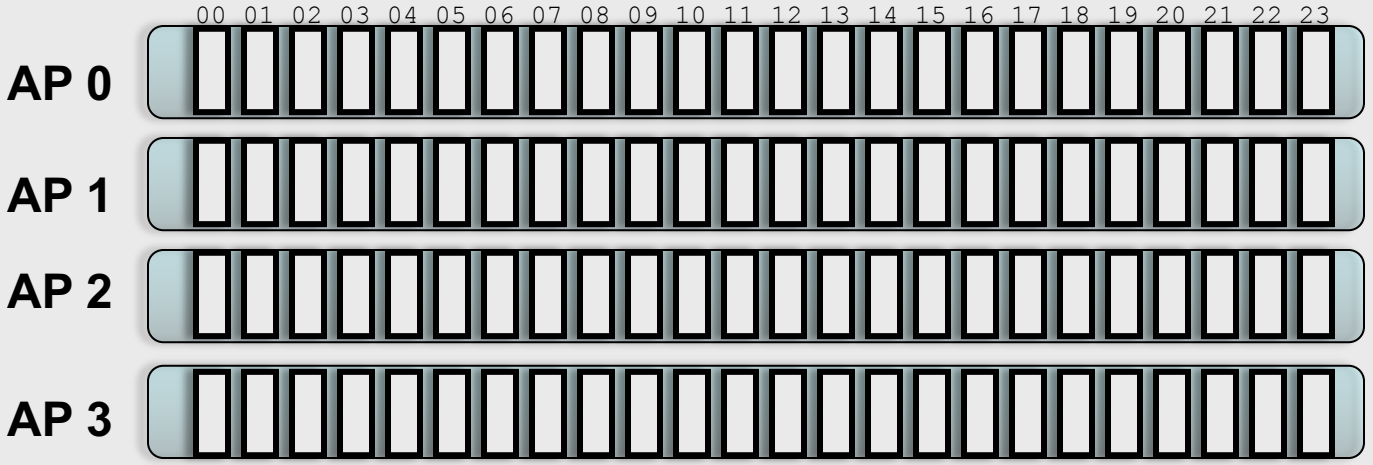
If **AP 1 DOMAIN 7** is available at system initialization, it will be APVIRT.

- APVIRT must then use type CEX6A
- Only AP 1 DOMAIN 8, with a matching type, is set as APVIRT
- If a guest lists AP 1 DOMAIN 7 as **APDED**, the guest will be denied access

Example: Static Assignment of Domains for z/VM Guests

```
System Configuration:  CRYPTO APVIRT  AP 1-2 DOMAIN 15-16
Guest A:  CRYPTO DOMAIN 13-18 APDED 0-3
/* Conflicts on AP 1-2; no domains granted on AP 1 or 2. */
Guest B:  CRYPTO DOMAIN 11-14 APDED 0
/* Conflict at Domain 14. No Domains granted on this AP. */
Guest C:  CRYPTO DOMAIN 2 APDED 0-3
/* No conflicts. */
```

Reverse the logon order of Guest A and Guest B ...

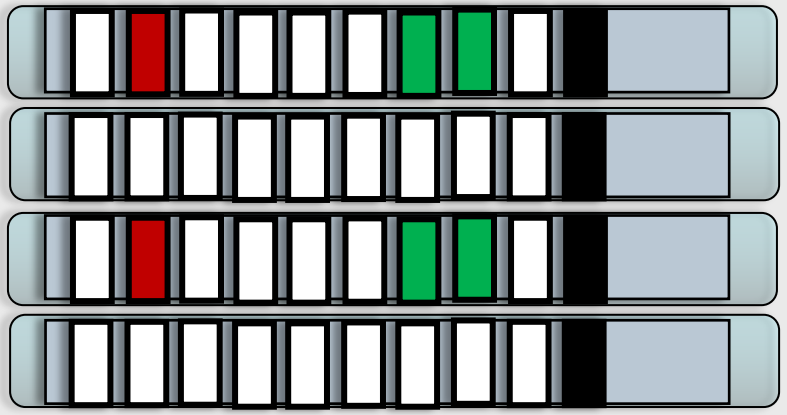


z/VM Virtualization of Hardware Cryptography

QUERY CRYPTO

(Class A, B, C, or E) will display which crypto resources are available to your z/VM system. Note that this list will be limited to adapters and domains associated with a z/VM instance.

```
>>-Query--CRYPto--+---------------------+--------------------><
                  '-DOMains--+--------+-'
                             '-Users-'
```



CEX7S Adapter #0 (CCA Coprocessor)

CEX7S Adapter #1 (CCA Accelerator)

CEX7S Adapter #2 (EP11)

CEX7S Adapter #3 (CCA Coprocessor)

z/VM Virtualization of Hardware Cryptography

(Old Version of the Output… we'll get to the changes in a moment)

```
QUERY CRYPTO DOMAINS USERS
```

Crypto ID	device	Domain Index	device status	system usage	planned usage
01: AP 02	CEX6C	Domain 08	available	free	unspecified
01: AP 03	CEX6A	Domain 06	available	dedicated to BWHUGEN	dedication
01: AP 03	CEX6A	Domain 07	available	free	unspecified
01: AP 03	CEX6A	Domain 08	available	shared	shared
01: AP 04	CEX5C	Domain 06	available	free	dedication
01: AP 04	CEX5C	Domain 07	available	free	dedication
01: AP 04	CEX5C	Domain 08	available	free	unspecified

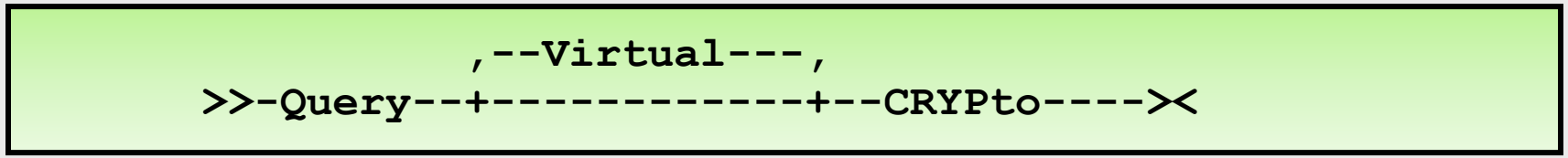
```
Ready;
```

z/VM Virtualization of Hardware Cryptography

QUERY VIRTUAL CRYPTO

(Class G) will display virtual crypto resources for your guest.

Keyword “virtual” required for Guests with A, B, C, or E privileges.




```
QUERY VIRTUAL CRYPTO
```

```
AP 03 CEX6A Domain 06 dedicated
Ready;
```

Assigning AP Domains to z/VM Guests

The Big Question: Which type of adapter do I need, and what domains do I want to assign to my guest?

It depends:

- Do you need secure key operations? (APDED)
- Does your security policy require physical isolation? (APDED)
- Do your guests need to exploit EP11 mode? (APDED **only**)
- Do you need to relocate your guest? (APVIRT*)
- Can you share your domains without impact to security or performance? (APVIRT)
- Are you running out of domains attached to the LPAR?
- Are your guests similar, cloned, or tied to HA solutions?
- Does your guest operating system have particular restrictions?

Different guests will have different needs, based upon their drivers and configuration requirements.

And, until recently, this meant a lot of planning, because changing your config at the LPAR level, or changing shared crypto resource assignments, meant a re-IPL of your z/VM system...

*Note: some restrictions apply. Consult the *CP Planning and Administration Guide* or *Getting Started With Linux* manuals.

Dynamic Crypto Support for z/VM

http://www.vm.ibm.com/newfunction/#dynamic_crypto

z/VM 7.1
PTF for APAR VM66266

Dynamic Crypto support enables changes to the z/VM crypto environment without requiring an IPL of z/VM or its guests (e.g. Linux on Z).

This allows:

- Less disruptive addition or removal of Crypto Express hardware to/from a z/VM system and its guests
- Less disruptive maintenance and repair of Crypto Express hardware attached and in-use by a z/VM system
- Reassignment and allocation of crypto resources without requiring a system IPL or user logoff/logon
- Greater flexibility to change crypto resources between shared and dedicated use.

Additionally, there are RAS benefits for shared-use crypto resources:

- Better detection of Crypto Express adapter errors with "silent" retrying of shared pool requests to alternative resources
- Ability to recover failed Crypto Express adapters
- Improved internal diagnostics for IBM service
- Improved logoff and live guest relocation latency for users of shared crypto.

z/VM Dynamic Crypto – Query Output Updated

z/VM 7.1
PTF for APAR VM66266

```
QUERY CRYPTO DOMAINS USERS
```

Crypto ID	device	Domain Index	device status	config state	planned crypto resource usage
AP 001	CEX5A	Domain 010	operational	online	free, dedication planned
AP 001	CEX5A	Domain 011	operational	online	free, dedication planned
AP 001	CEX5A	Domain 084	operational	online	free
AP 002	CEX5C	Domain 010	resetting	online	free, dedication planned
AP 002	CEX5C	Domain 011	resetting	online	free, dedication planned
AP 002	CEX5C	Domain 084	resetting	online	shared
AP 003	CEX5C	Domain 010	operational	online	attached to BWHUGEN
AP 003	CEX5C	Domain 011	operational	online	attached to BWHUGEN
AP 003	CEX5C	Domain 084	operational	online	shared

Notes:

- **Device Status** can be operational, resetting, checkstop, deconfigured, busy, revoked, unsupported
- **Configuration State** can be online or offline. **These are logical states (how the card looks to z/VM)**
- **Device assignment** can be reserved_for_dedication, dediated_to_*userid*, free, shared

z/VM Dynamic Crypto – Commands

z/VM 7.1
PTF for APAR VM66266

VARY ONLINE CRYPTO (B)
- Bring a Crypto Express adapter online

VARY OFFLINE CRYPTO (B)
- Take a Crypto Express adapter offline (device associations remain in place)

ATTACH CRYPTO (B)
- Add crypto resource(s) to your z/VM guest (or APVIRT)

DETACH CRYPTO (B or G)
- Remove dedicated crypto resources from a guest
- Remove crypto resources from the shared crypto pool
- Remove guest access to the shared crypto pool

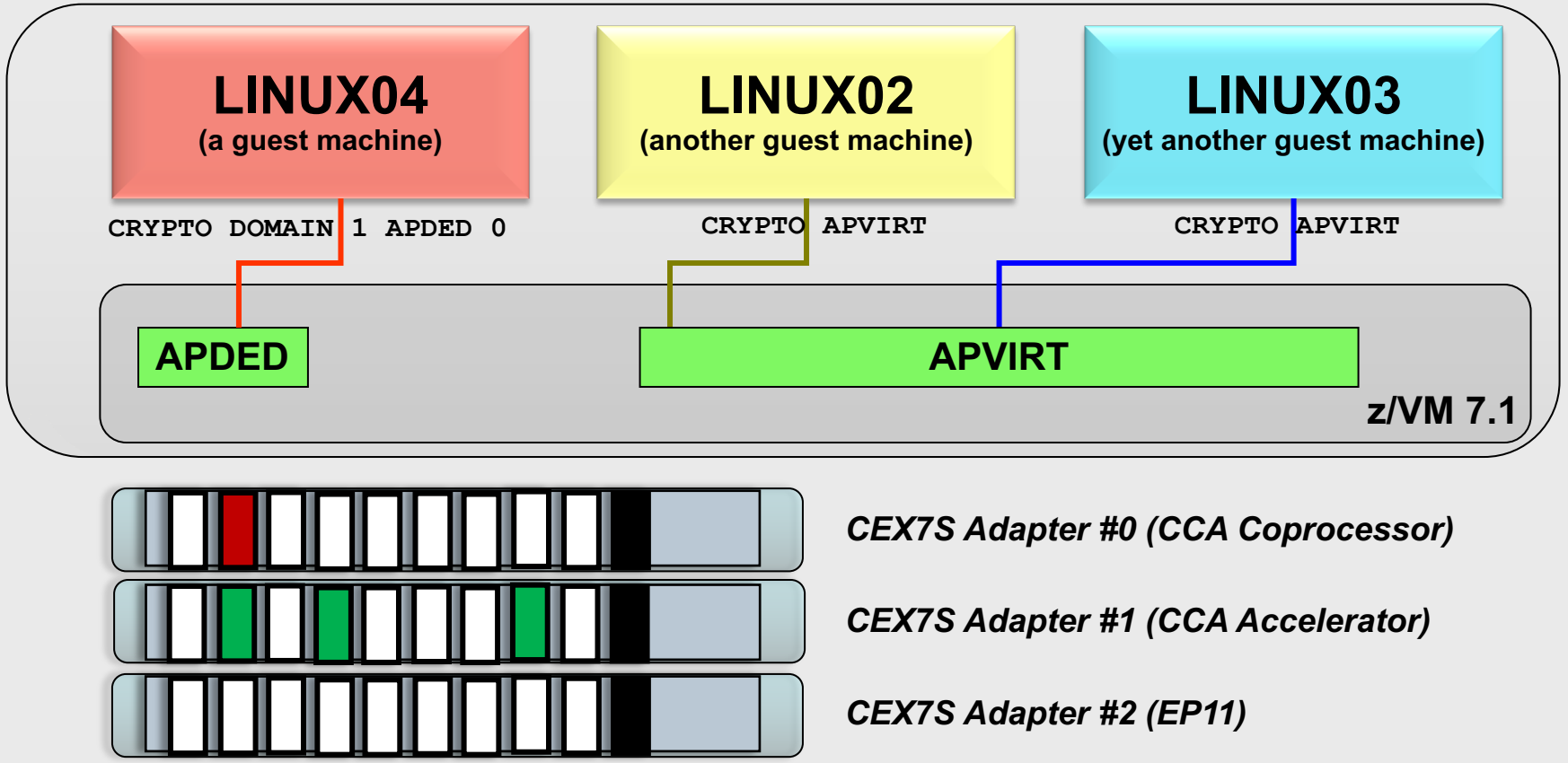
– **DEFINE CRYPTO** APVirtual (G)
- assign or reassign shared crypto resource access to a z/VM guest

– **QUERY CRYPTO DOMAINS** (per previous slide)

How To: Make a new adapter available to z/VM

z/VM 7.1
PTF for APAR VM66266

`VARY ON CRYPTO 2`



How To: Assign a crypto resource to a user

z/VM 7.1
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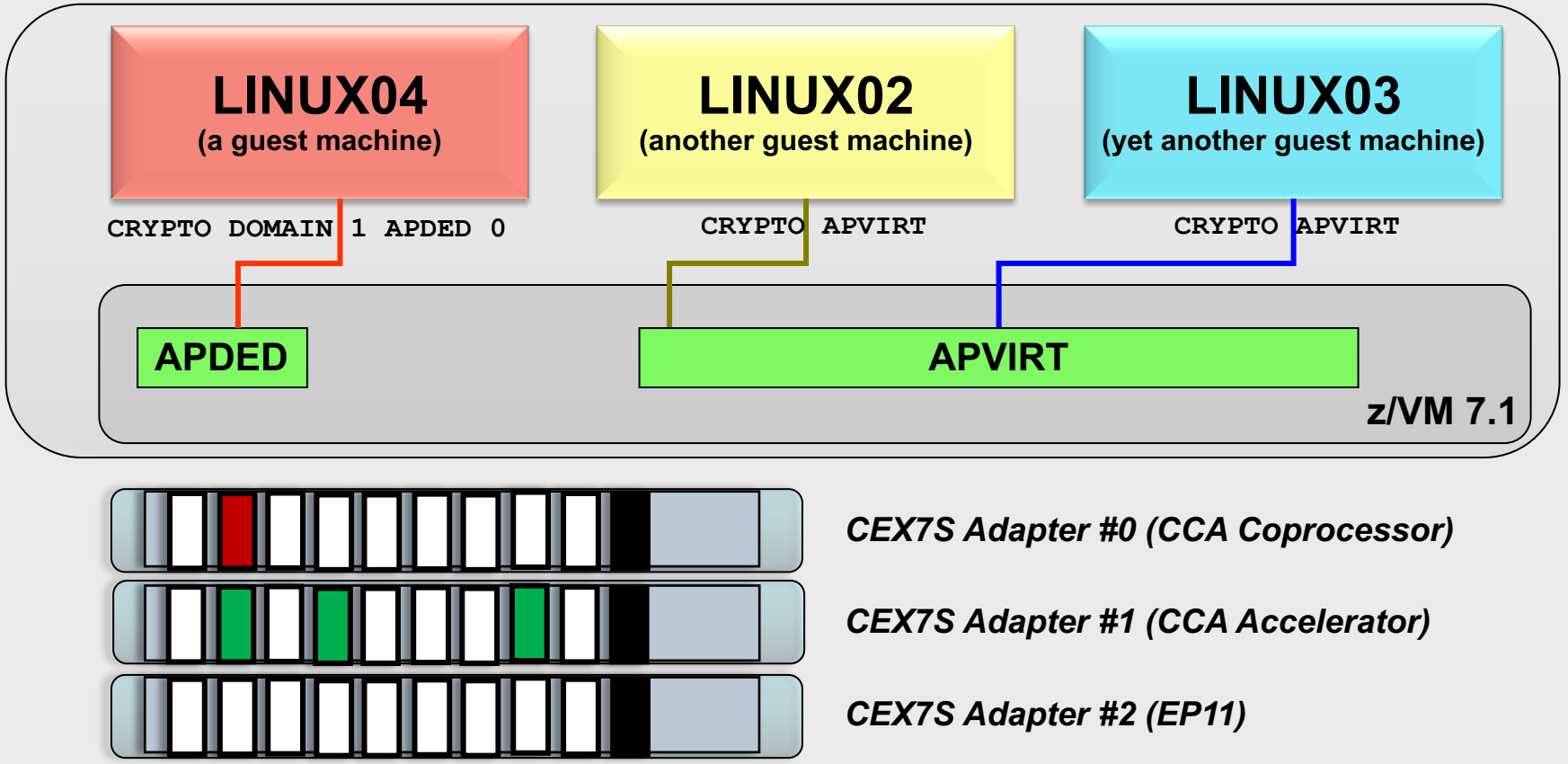
`ATTACH CRYPTO AP 2 DOMAIN 1 to LINUX04`

Warning: does not change your z/VM User Directory… so static configuration does not update automatically.

Don't forget to update your defaults!



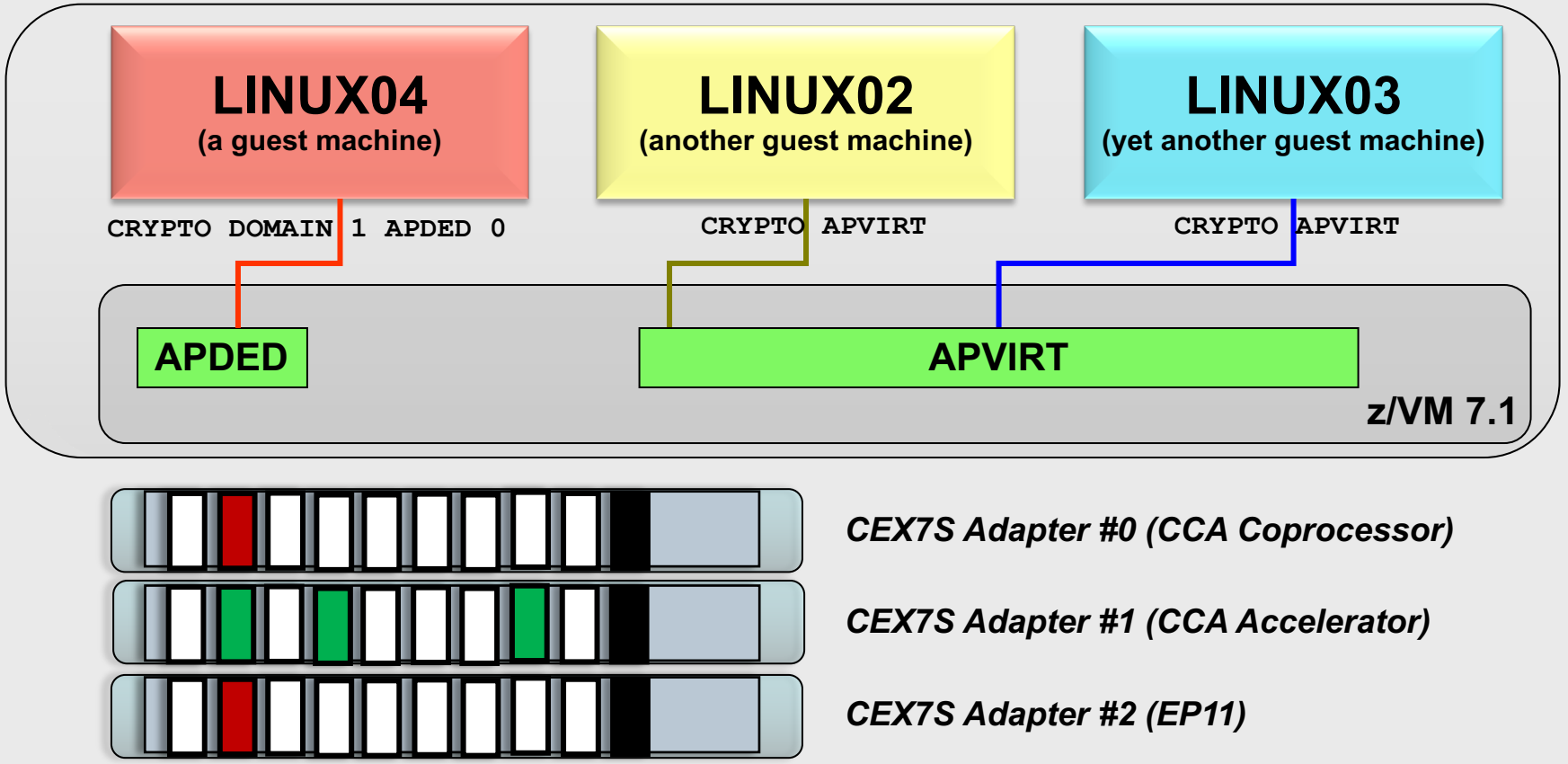
How To: remove crypto resources from shared pool

z/VM 7.1
PTF for APAR VM66266

`DETACH CRYPTO AP 1 DOMAINS 1 3 7 from SYSTEM (FORCE`

Change does not remove APVIRT access from the guests.

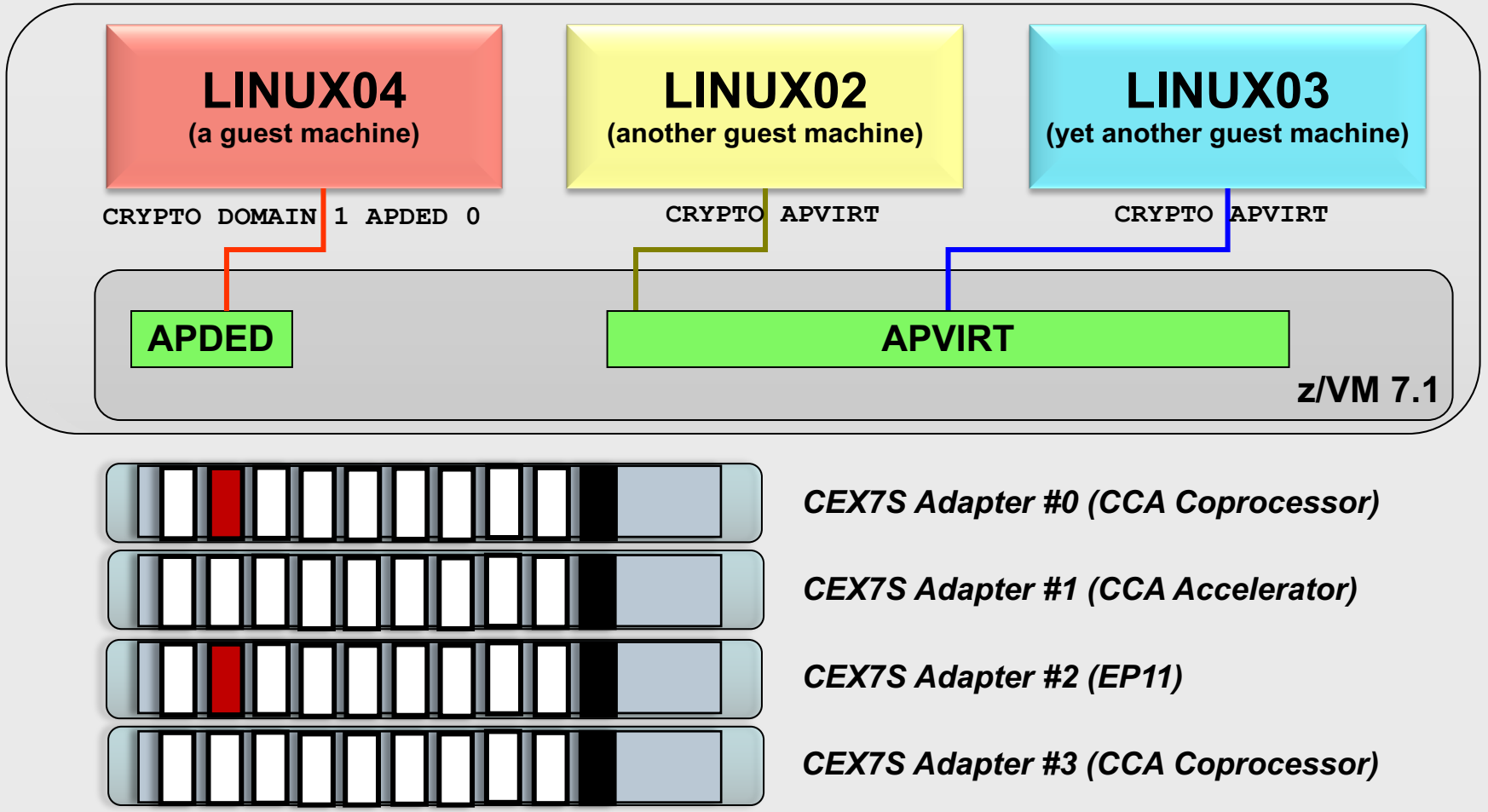
Note: this is an extreme example, you may not want to remove these all at once.



How To: Assign new crypto resources for sharing

z/VM 7.1
PTF for APAR VM66266

```
VARY ON CRYPTO 3
ATTACH CRYPTO AP 0 3 DOMAIN 6 7 to SYSTEM
```



How To: Take an adapter offline

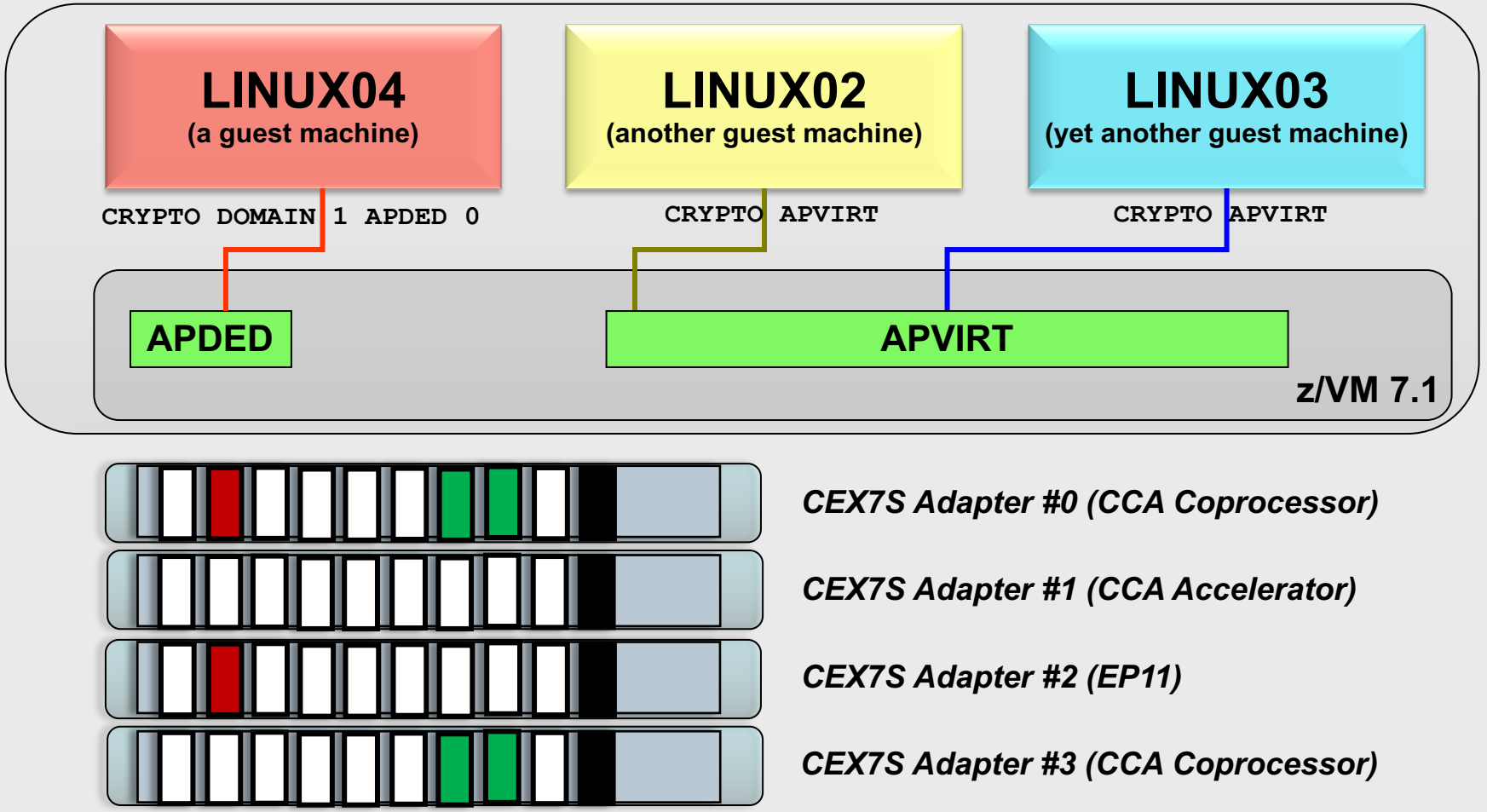
z/VM 7.1
PTF for APAR VM66266

`VARY OFF CRYPTO 1`

Adapter will be listed as offline, and will not available for use.

VARY ON the adapter to bring it back to active configuration…

…no IPL required.



z/VM Dynamic Crypto – Usage Notes

Attachments persist even when a device is taken offline

Resource assignment (dedicated/shared) does not change when an adapter is varied on/off

FORCE option:

- Not required when DETACHing crypto resources
- Required when VARYing OFF an adapter with crypto resources in use
- Either way, exercise caution when using

The Importance of Cryptographic Hygiene

Dynamic Crypto gives you a lot of power to modify the environment

- This is a good thing and a bad thing
- **“With great power comes great responsibility.”**

z/VM does not zeroize domains before reassigning to a guest (or to APVIRT)

- We don’t want to make that assumption (traditionally, this is HMC territory)
- **This might lead to “residual crypto” (Ewww)**

Basic guidelines:

- Zeroize (at HMC) when changing adapter modes or changing security zones
- Changes between unused and APVIRT: safe (no key material involved)
- Changes involving clear-key APDED: consider zeroizing
- Changes involving secure-key APDED: definitely zeroize

New chapter from z/VM Development forthcoming for web / publications

z/VM Dynamic Crypto – Summary

z/VM 7.1
PTF for APAR VM66266

Now available via PTF for APAR VM66266 for z/VM 7.1 only

- ***Prereq VM66206 for z/VM 6.4 and z/VM 7.1 (installed on all SSI members before dynamic crypto is applied.)***

Dynamic Crypto support enables changes to the z/VM crypto environment without requiring an IPL of z/VM or its guests (e.g. Linux on Z).

Sponsor users were engaged heavily in the process

- Design playbacks and to-be scenarios
- Usability iterations
- Demos and hands-on-code early testing

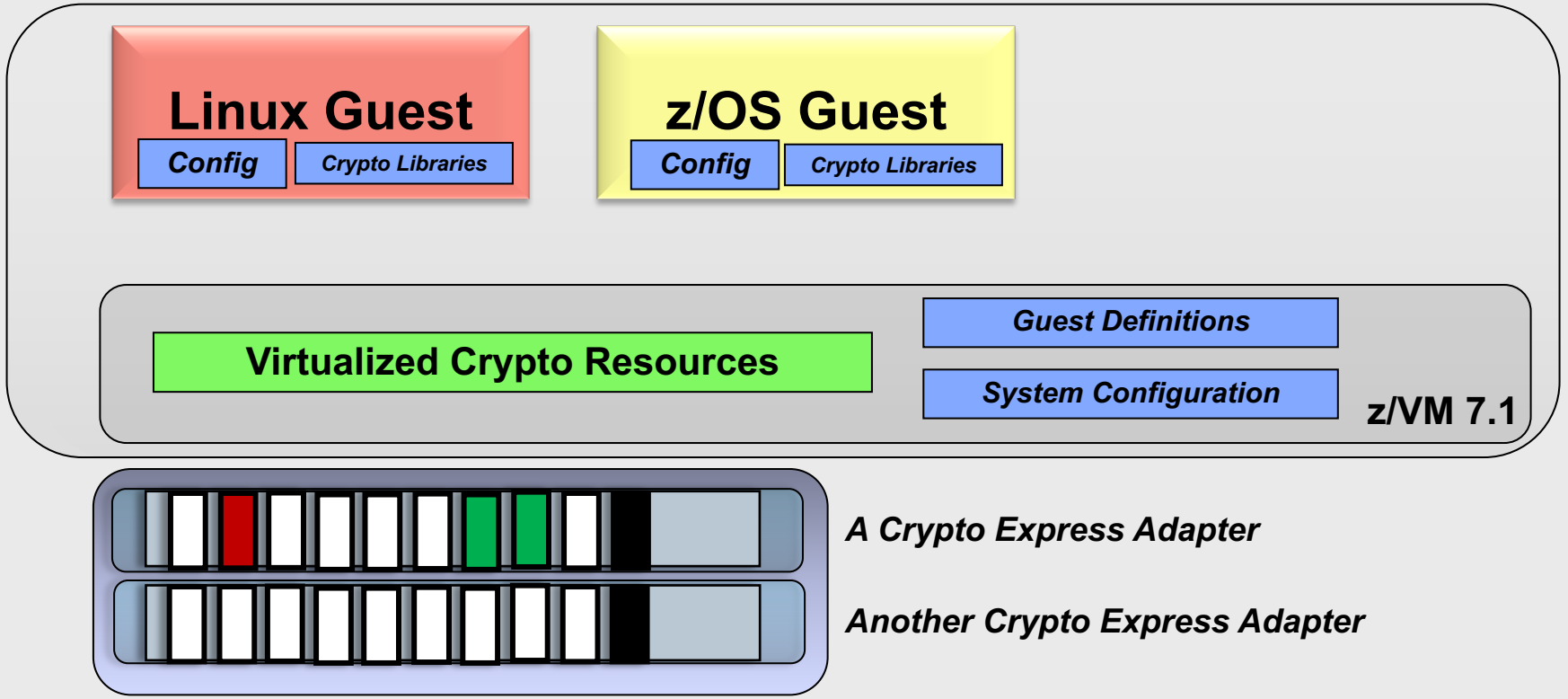
Guest Use of Hardware Crypto

How To: Configure your Crypto on IBM Z and LinuxONE

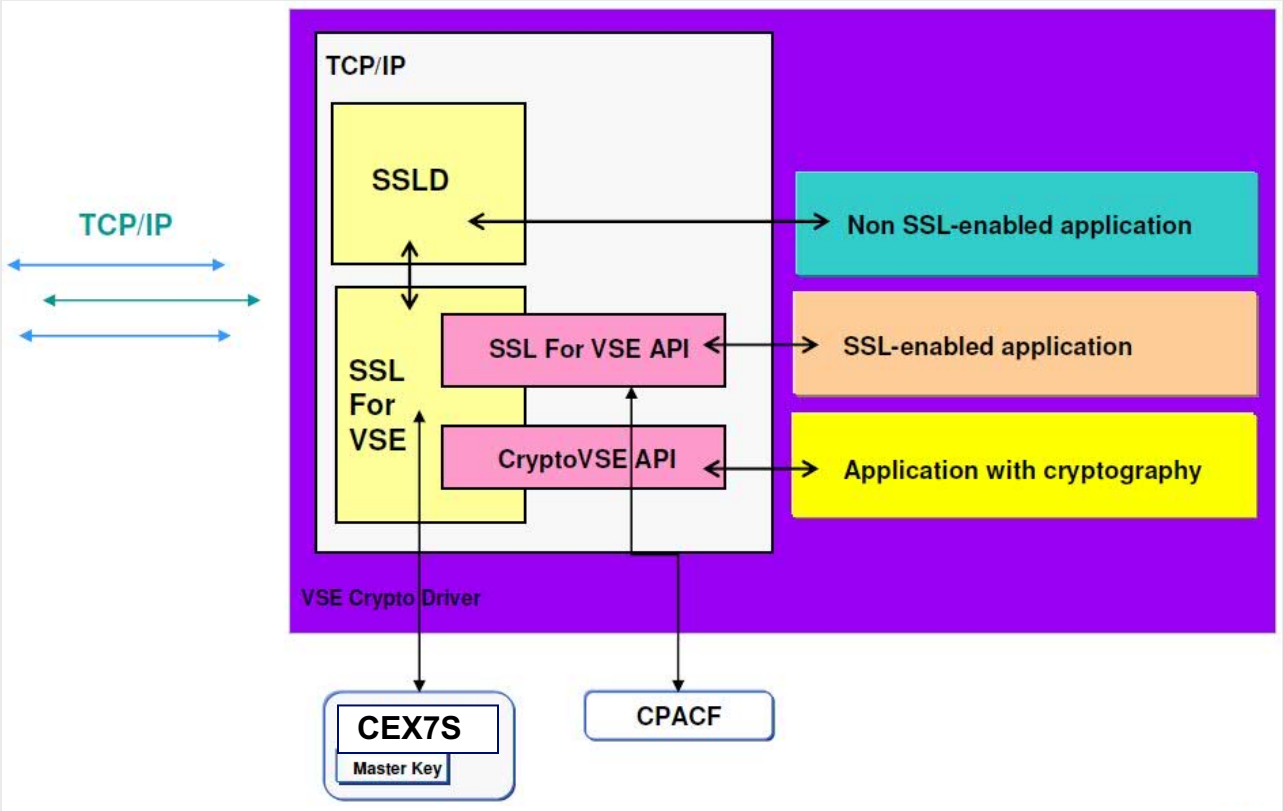
Crypto libraries will vary from OS to OS

Some may require specific configuration to make use of certain features

Consult pertinent local documentation



z/VSE Cryptographic Infrastructure



z/VSE automatically detects any Crypto Express features dedicated to (or shared with) the virtual machine in which it's running

CMS Guests Running on z/VM

CMS guests can utilize CPACF if enabled

- Need to issue appropriate machine instructions
- Some features (Pipelines, TLS/SSL Server) use these automatically

The CMS environment does **not** have Crypto Express libraries

- Different instructions / communication paths than CPACF
- Nothing available yet for general system programmer use
- **Exception**: TLS/SSL Server for data-in-flight encryption to/from/within the hypervisor

Crypto APVIRT for the z/VM TLS/SSL Server

PTFs for APAR PI72106, or by default in z/VM 7.1

```
PROFILE TCPSSLU
  CRYPTO APVIRTUAL
  IPL CMS PARM FILEPOOL VMSYS
  IUCV ALLOW
  LOGONBY BWHUGEN
  NAMESAVE TCPIP
  OPTION ACCT MAXCONN 1024 QUICKDSP
  POSIXINFO UID 7 GNAME security
  SHARE RELATIVE 3000
  CONSOLE 0009 3215 T
  [...]
```

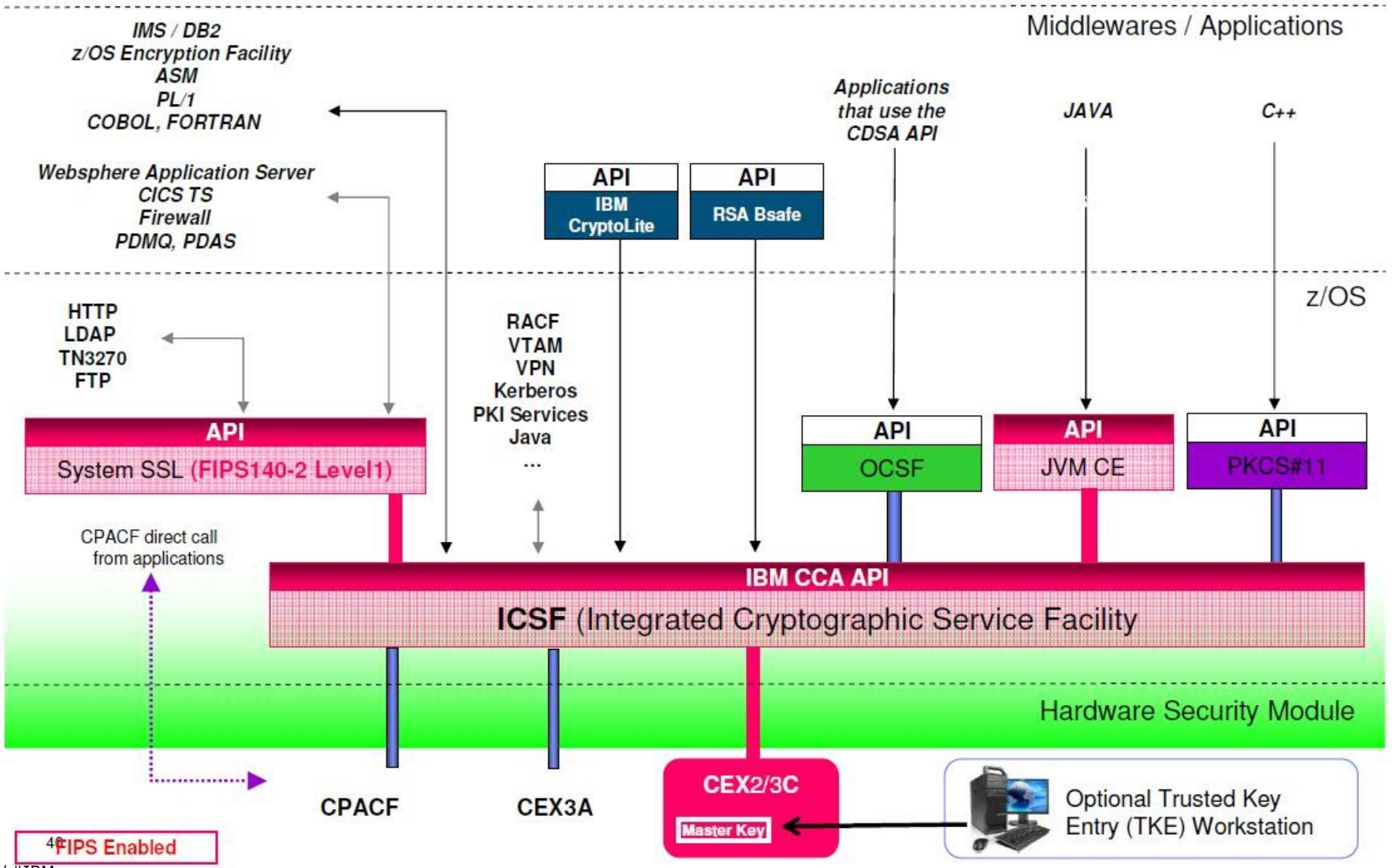
Add **`CRYPTO APVIRT`** to your SSL server's PROFILE entry

- **TCPSSLU** - the default PROFILE entry for the TLS/SSL Server
- APDED not allowed for a POOL of userids

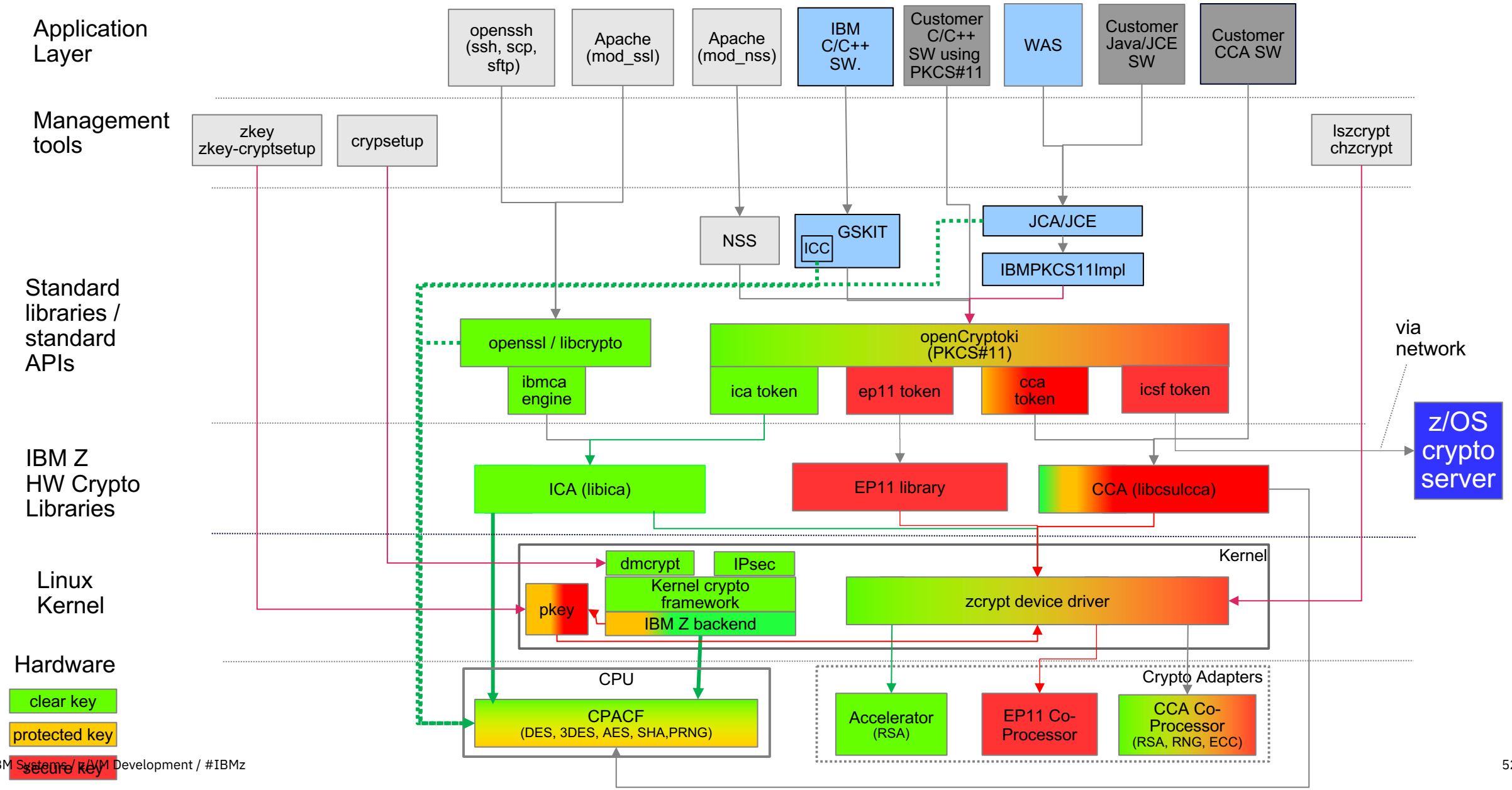
Insert directly into VM definition for:

- **LDAPSRV** - uses its own System SSL calls
- **GSKADMIN** - for certificate creation / management

z/OS Cryptographic Infrastructure



Linux on Z Cryptographic Infrastructure



Linux Kernel and Cryptography

The Linux kernel provides a set of cryptographic functions

- Generic, platform-independent implementations of cryptographic algorithms
- Support for platform-optimized algorithms that are automatically used if available

The Linux on z Systems kernel includes support for

- Exploiting CPACF to optimize and accelerate symmetric cryptographic functions
- Managing Crypto Express cards with the ***zcrypt*** device driver

Which applications can benefit from accelerated in-kernel cryptographic functions?

- IPsec and ssh (from the beginning of the presentation, remember?)
- Linux device-mappers – for example, **dm-crypt** or **eCryptFS**

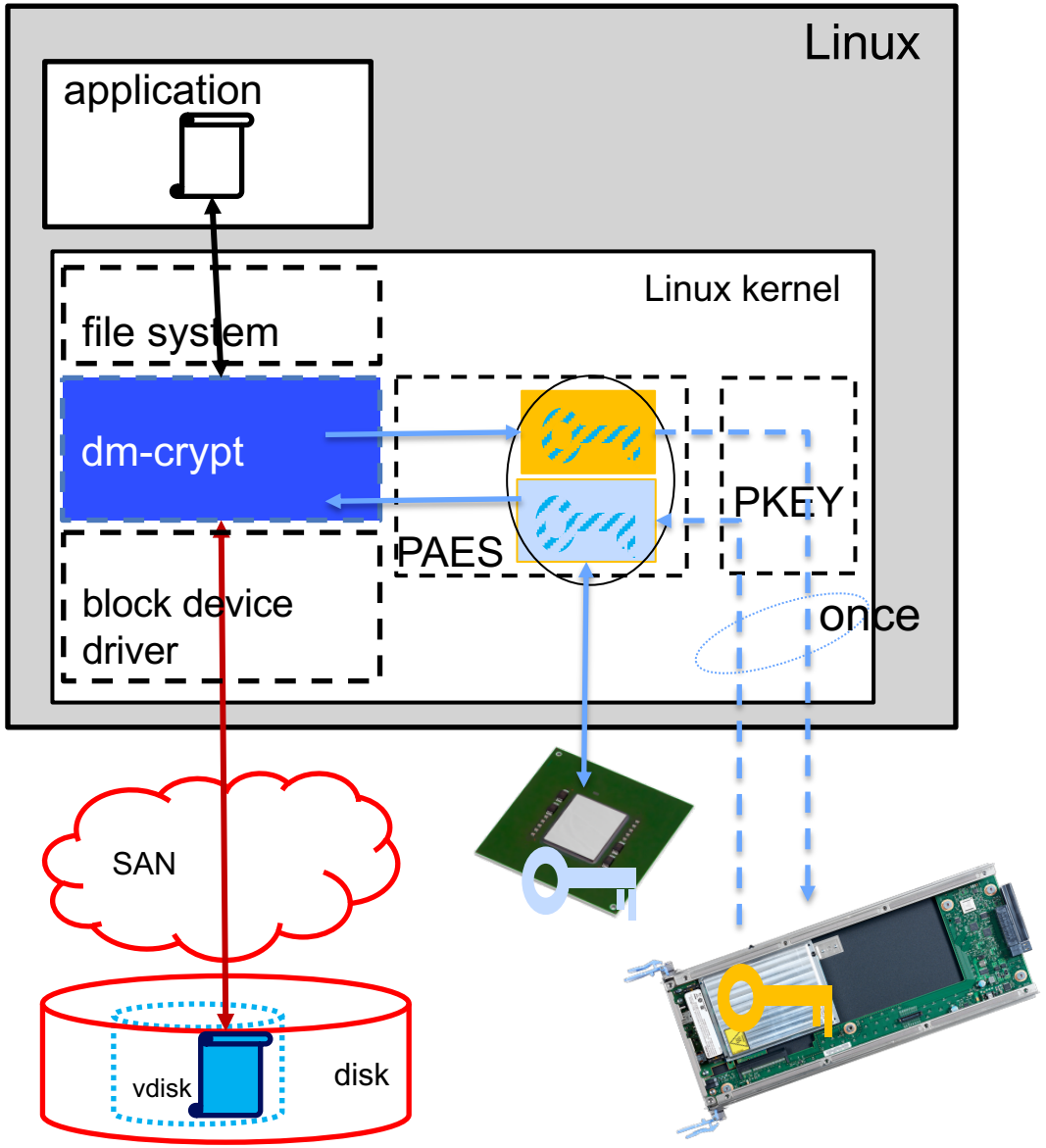
File System Encryption with dm-crypt for Linux on Z

- dm-crypt
  - a mechanism for end-to-end data encryption
  - data only appears in the clear in application

- Linux kernel component that transparently
  - for all applications
  - for a whole block device (partition or LV)
  - encrypts all data written to disk
  - decrypts all data read from disk

- E2E data encryption
  - The complete I/O path outside the kernel is encrypted:
    - HV, adapters, links, switches, disks

- How it works:
  - uses in kernel-crypto
    - can use IBM Z CPACF Protected Key Crypto:
      - XTS-PAES as from the paes_s390 module
  - encrypted volumes must be opened before usage
    - opening provides encryption key to kernel
    - establishes virtual volume in `/dev/mapper`



Validating Linux and z/VM Configuration

```
certlxb:~ # cat /proc/driver/z90crypt
zcrypt version: 2.1.1
Cryptographic domain: 6
Total device count: 1
PCICA count: 0
PCICC count: 0
PCIXCC MCL2 count: 0
PCIXCC MCL3 count: 0
CEX4C count: 0
CEX4A count: 1
requestq count: 0
pendingq count: 0
Total open handles: 0
```

Validating Linux and z/VM Configuration

```
Last login: Thu Mar 28 10:18:05 2013 from nn.nn.nn.nnn
certlxb:~ # cat /proc/crypto
name         : stdrng
driver       : krng
module       : kernel
priority     : 200
refcnt       : 1
selftest     : passed
type         : rng
seedsize     : 0

name         : sha1
driver       : sha1-generic
module       : kernel
priority     : 0
refcnt       : 1
selftest     : passed
type         : shash
blocksize    : 64
digestsize   : 20
```

Validating Linux and z/VM Configuration

```
certlxb:~ # icainfo


The following CP Assist for Cryptographic Function
(CPACF) operations are supported by libica on this
system:

SHA-1:    yes
SHA-256:  yes
SHA-512:  yes
DES:      yes
TDES-128: yes
TDES-192: yes
AES-128:  yes
AES-192:  yes
AES-256:  yes
PRNG:     yes
```

Validating Linux and z/VM Configuration

`icastats` – data from the libica crypto library

– SLES 12 and RHEL 7.1 onward

`cpacfstats` – data about CPACF on-chip usage

– On s390tools

– Works for Linux running in an LPAR directly

– CPUMF data (authorization required)

`lszcrypt` – statistics on Crypto Express requests

Validating Linux and z/VM Configuration

```
certlxb:~ # sudo vmcp QUERY VIRTUAL CRYPTO
AP 01 CEX6A Queue 01 shared
```

Remember that **QUERY VIRTUAL CRYPTO** is a Class G command

This indicates the virtual AP number and virtual Domain number provided to the guest and the type of crypto feature being shared.

Cryptography and The Cloud

Create an HSM as a Service

IBM Cloud

View all

Hyper Protect Crypto Services

Lite Experimental

Attention: This service is experimental. It might not yet be stable and might change in ways that make it incompatible with earlier versions. This service is not recommended for production environments.

IBM Cloud Hyper Protect Crypto Services is a complete set of encryption and key management services backed by IBM Z technology. These services bring the security and integrity of IBM Z to the cloud. The same state of the art cryptographic technology relied upon by banks and financial services is now offered to cloud users via IBM Cloud. The network addressable Hardware Security Module provides safe and secure PKCS#11 cryptography via industry standard open source application programming interfaces. It supports secure key operations and random number generation via IBM Z cryptographic hardware, FIPS-140-2 level 4 certified technology. This is the industry's first and only FIPS 140-2 Level 4 certified technology in the public cloud market today and is the same technology that is the backbone of the IBM Enterprise Blockchain solution.

View Docs Terms

AUTHOR IBM
PUBLISHED 05/30/2018
TYPE Service

Service name: MyHSM

Choose a region/location to deploy in: US South

Select a resource group: Default

FEEDBACK

Pricing Plans

Monthly prices shown are for country or region: Germany

	PLAN	FEATURES	PRICING
✓	**Hyper Protect Crypto Services - Lite Plan**	**10 Crypto Slots**	Free

This Lite Plan enables you to use Hyper Protect Crypto Services for free as an Experimental offering

Lite plan services are deleted after 30 days of inactivity.

Need Help?
Contact IBM Cloud Sales

Estimate Monthly Cost
Cost Calculator

Create

Summary

Summary

IBM Z **hardware** accelerates the hard math of cryptographic operations

- Saves **time**, saves CPU processing **power**, saves MIPS **cost**
- Secure Key operations are FIPS 140-2 Level 4 certified

z/VM **virtualizes** IBM Z hardware cryptography

- Architectural fidelity in all things Z
- A "shared" flavor as well as dedicated use of crypto resources

Guests understand they can utilize IBM Z cryptography

- May require configuration of the guest to exploit
- Different guests provide different options

Don't let cryptography (or its acronyms) scare you away

- Security is meant to enhance business, not impede it
- Cryptography protects your data, whether at rest or in flight

Resources

Redbook: Getting Started with Linux on Z Encryption for Data At-Rest Redbook ***new***
http://www.redbooks.ibm.com/abstracts/sg248436.html?Open

Redbook: Security and Linux on z Systems
http://www.redbooks.ibm.com/abstracts/redp5464.html?Open

New: IBM Z pervasive encryption landing page
https://izswebpage.mybluemix.net/

IBM Z pervasive encryption solution guide (Knowledge Center)
https://www.ibm.com/support/knowledgecenter/en/SSLTBW_2.3.0/com.ibm.zos.v2r3.izs/izs.htm

IBM Z pervasive encryption FAQ:
https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSQ03116USEN

IBM Crypto Education page: https://ibm.biz/BdiAah

zPET Test Reports:
https://www.ibm.com/developerworks/community/groups/service/html/communitystart?communityUuid=43ea8e78-acbe-49f5-9290-379e4f4569cb

MOP demo white paper:
http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102734

Youtube Videos:

- Data Set Encryption: https://www.youtube.com/watch?v=zdSXRUSmkb4
- CF Encryption: https://www.youtube.com/watch?v=lTmsFWuJwJU
- zERT: https://www.youtube.com/watch?v=1CgEcCTX_o8
- MOP MPL Bank: https://www.youtube.com/watch?v=EP488nLdGts

THANK YOU

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