IBM Americas, ATS, Washington Systems Center

# 10192 ICSF Update – Cryptographic Support On z114 and z196

Greg Boyd (boydg@us.ibm.com)
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Atlanta, GA


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# Agenda

- **HCR7790**
  - Dynamic PKA Master Key Change
  - Coordinated KDS Administration
  - KDS Related Changes
  - Other Enhancements
  - Suite B
- **TKE 7.1**
- **HCR7770**
  - MSA-3 (Protected Key)
  - CEX3
- **HCR7780**
  - FIPS SPE
- **Toleration and Migration**
- **VM and Linux**

# Dynamic RSA-MK Change

| Prior to HCR7790 or without CEX3 on z196/z114 | HCR7790 with CEX3 on z196/z114 |
|---|---|
| **Generate key parts and calculate checksums** | **Generate key parts and calculate checksums** |
| **Disable PKA Services** | |
| **Load the RSA-MK parts** | **Load the RSA-MK parts** |
| **Reencipher the PKDS under the new master key** | **Reencipher the PKDS under the new master key** |
| **Activate the PKDS** | **Change the RSA-MK and activate the PKDS** |
| **Enable PKA Services** | |
| **Enable PKA read, write, create and delete access** | |
| **Change the ICSF Options data set to point to the new PKDS** | **Change the ICSF Options data set to point to the new PKDS** |

# Coordinated KDS Administration:
## Coordinated CKDS Master Key Change
## Coordinated CKDS Refresh

- **Problem:**
  - ICSF CKDS Administration involves many manual steps that require repeating when LPARs share a CKDS in a sysplex environment.
- **Solution:**
  - Provide a function that coordinates CKDS administration across members of a sysplex cluster (ICSF instances sharing the same active CKDS).
- **Benefits:**
  - Simplified process for performing ICSF CKDS administration in both a single system environment and more importantly in a sysplex environment.
  - In a sysplex environment coordinated CKDS refreshes and coordinated CKDS change-mk operations are driven from a single ICSF instance across the sysplex.
  - CKDS sysplex communication protocol level 2 provides better sysplex communication performance, uses less overhead, and is more serviceable then the prior release sysplex communication protocol.

# ICSF Master Key Management

```
CSFMKM10  ---------------------- ICSF – Master Key management ----------------------------
OPTION ===>
Enter the number of the desired option.
  1  INIT / REFRESH / UPDATE CKDS – Initialize a Cryptographic Key Data Set or
                                    activate an updated Cryptographic Key Data Set
  2  SET MK                       -- Set a master key (AES, DES, ECC)
  3  REENCIPHER CKDS              -- Reencipher the CKDS prior to changing a symmetric
                                     master key
  4  CHANGE SYM MK                -- Change a symmetric master key and activate the
                                     reenciphered CKDS
  5  INIT/REFRESH/UPDATE PKDS --  Initialize a Public Key Data Set or
                                     activate an updated Public Key Data Set or
                                     update the Public Key Data set header
  6  REENCIPHER PKDS              -- Reencipher the PKDS
  7  CHANGE ASYM MK               -- Change an asymmetric master key and activate the
                                     reenciphered PKDS
  8  COORDINATED KDS REFERESH – Perform a coordinated KDS refresh
  9  COORDINATED KDS CHANGE MK – Perform a coordinated KDS change master key

Press ENTER to go to the selected option.
Press END     to exit the previous menu.
```

# Select the KDS to Refresh

CSFCRC4P ---------- ICSF - Coordinated Refresh KDS Selection ----------

Select one Key Data Set type and press ENTER to continue.

==> / CKDS - Cryptographic Key Data Set

# Coordinated KDS Refresh

```
CSFCRC10 ------------------- ICSF – Coordinated KDS Refresh -------------------

COMMAND ===>

To perform a coordinated KDS refresh to a new KDS, enter the KDS names below
and optionally select the rename option. To perform a coordinated KDS refresh
of the active KDS, simply press enter without entering anything on this panel.

    KDS Type ===>          CKDS
  Active KDS ===>          'PLEX.TEST.CKDS'
    New KDS ===>

          Rename Active to Archived and New to Active (Y/N) ===> N

          Archived KDS ===>

Press ENTER to perform a coordinated KDS refresh.

Press END to exit to the previous menu.
```

# ICSF Master Key Management

```
CSFMKM10  ---------------------- ICSF – Master Key management ----------------------------
OPTION ===>

Enter the number of the desired option.

 1  INIT / REFRESH / UPDATE CKDS – Initialize a Cryptographic Key Data Set or
                                   activate an updated Cryptographic Key Data Set
 2  SET MK                      -- Set a master key (AES, DES, ECC)
 3  REENCIPHER CKDS             -- Reencipher the CKDS prior to changing a symmetric
                                   master key
 4  CHANGE SYM MK               -- Change a symmetric master key and activate the
                                   reenciphered CKDS
 5  INIT/REFRESH/UPDATE PKDS --  Initialize a Public Key Data Set or
                                   activate an updated Public Key Data Set or
                                   update the Public Key Data set header
 6  REENCIPHER PKDS             -- Reencipher the PKDS
 7  CHANGE ASYM MK              -- Change an asymmetric master key and activate the
                                   reenciphered PKDS
 8  COORDINATED KDS REFERESH – Perform a coordinated KDS refresh
 9  COORDINATED KDS CHANGE MK – Perform a coordinated KDS change master key

Press ENTER to go to the selected option.
Press END   to exit the previous menu.
```

# Select the KDS for the MK Change

CSFCRC4P ---------- ICSF - Coordinated Refresh KDS Selection ----------

Select one Key Data Set type and press ENTER to continue.

==> / CKDS - Cryptographic Key Data Set

# Coordinated KDS Change MK

```
CSFCRC20 ------------- ICSF – Coordinated KDS change master key ------------------
COMMAND ===>

To perform a coordinated KDS change master key, enter the KDS names below
and optionally select the rename option.

     KDS Type ===> CKDS
   Active KDS ===> 'PLEX.TEST.CKDS'
     New KDS ===>
           Rename Active to Archived and New to Active (Y/N) ===> N
           Archived KDS ===>
           Create a backup of the reenciphered KDS (Y/N) ===> N
           Backup KDS ===>

Press ENTER to perform a coordinated KDS refresh.
Press END to exit to the previous menu.
```

# Related Changes

- **New messages**

**CSFCM624I ICSF Communication Level Changed**

**CSFC0316 Reencipher Fail … for entry ckdslabel**

- **New healthcheck**

**ICSF_COPROCESSOR_STATE_NEGCHANGE**

**See TechDoc Flash10749 ‘Activation of Cryptographic Coprocessors and Cryptographic Algorithms with ICSF, HCR7780’**

# Coprocessor Management Panel

```
Select the coprocessors to be processed and press ENTER.

Action characters are: A, D, E, K, R and S. See the help panel for
  details.

                  Serial
  CoProcessor     Number          Status    AES   DES   ECC   RSA
  -----------   ---------         ------    ---   ---   ----  ---
  __ G01          00000001        ONLINE    U     U     C     U
  __ G02          00000002        ACTIVE    A     U     A     E
  __ G03          00000003        ACTIVE    A     U     A     C
  __ E04          00000004        ACTIVE    A     U     -     C
  __ H05                          ACTIVE
```

# Other Enhancements

- **Additional ECC functionality**
  - ECC-DH
  - AES KEK for wrapping ECC private keys
- **Expanded AES key support**
  - AES KEK
  - Variable length AES keys (HMAC support)
- **Enhanced ANSI TR-31 interoperable secure key exchange**

# Other Enhancements

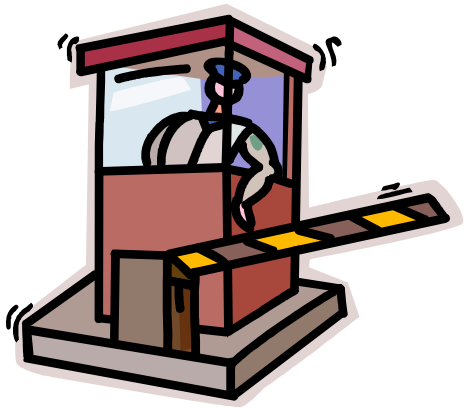
- **PIN Block Decimalization support**

  `0123456789ABCDEF`

  `0123456789012345`


- **PKA RSA OAEP with SHA-256 Algorithm**
- **Accelerator support for 2048 thru 4096-bit keys**

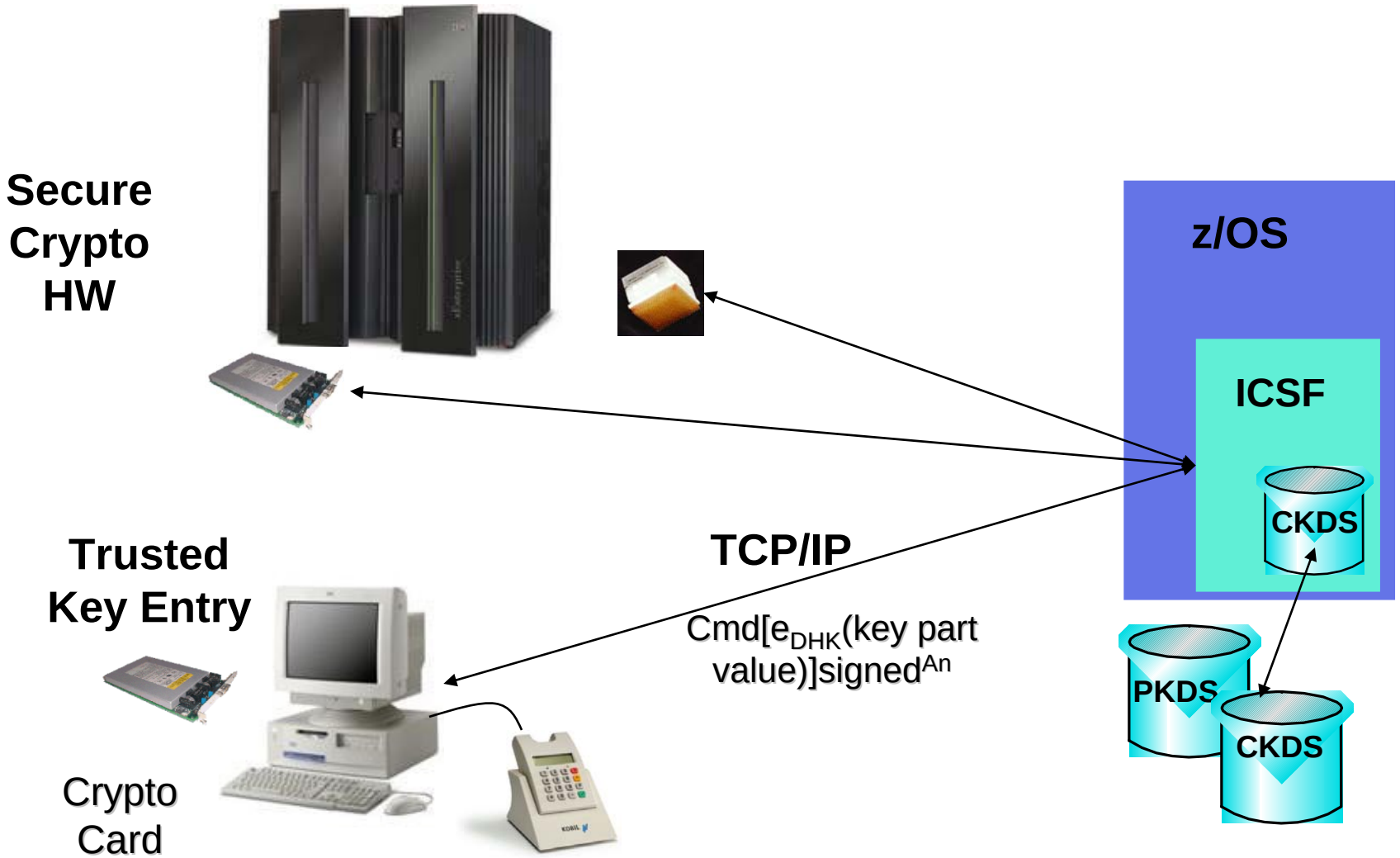
# Suite B



- **Symmetric Encryption**
  - AES w/key sizes of 128 and 256
- **Digital Signatures**
  - ECDSA – Elliptic Curve, Digital Signature Algorithm
- **Key Agreement**
  - ECDH – Elliptic Curve, Diffie Hellman
- **Message Digest**
  - SHA-2 (SHA-256 and SHA-384)

http://www.nsa.gov/ia/programs/suiteb_cryptography/

# TKE – Trusted Key Entry Workstation



# TKE 7.0 – New hardware platform

- **TKE 7.0 will run on a new hardware platform**
  - 4765 (CEX3) Crypto Card
  - Add USB ports; Drop serial ports
    - Old Kobil Smart Card readers used a serial port
    - New Omnikey Smart Card readers use the USB
    - Support USB Flash Memory Drive (as an alternative to the DVDRAM media)
  - New Smart Cards
    - JCOP41 NXP Smart Cards replacing the older Data Key Smart Cards
    - Six digit PINs

# TKE 7.0 - New Key Support

- **Support ECC Master Keys**
  - 32-byte AES Key to protect ECC Keys
  - Generation and loading of ECC keys not supported on TKE 7.0
- **CBC Key Wrapping**
  - KW-ENH Key Wrapping Enhanced
  - KW-ORIG Key Wrapping Original

# TKE 7.0 - Migration Wizard

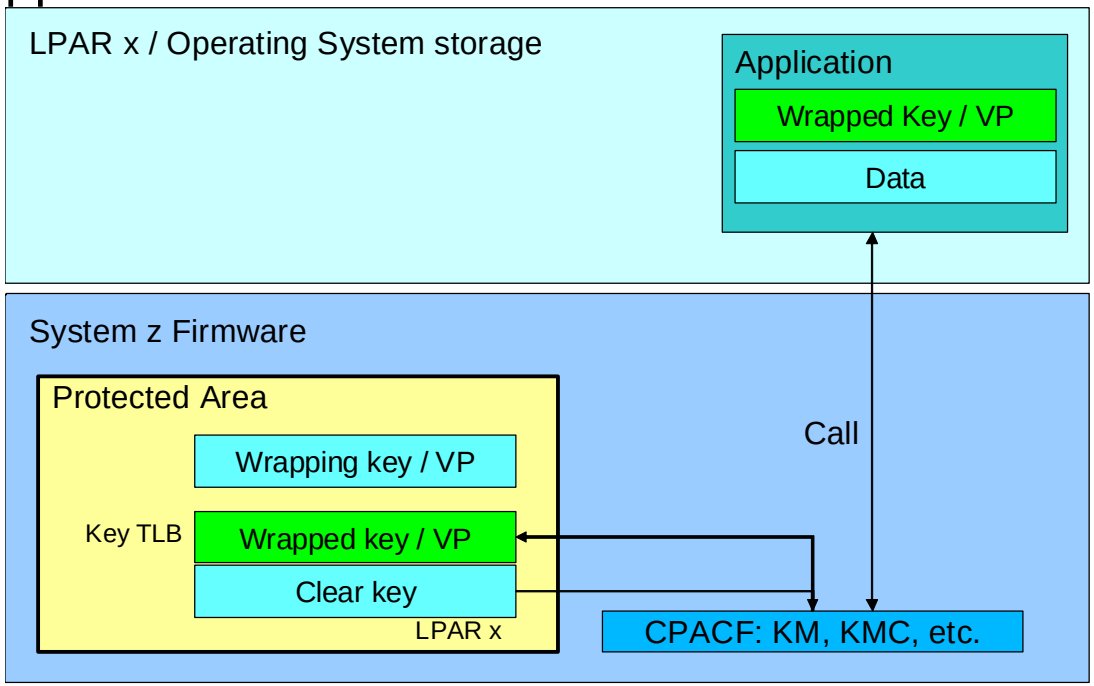
- **TKE 6.0 introduced a configuration migration utility to automate the process of replacing a host crypto adapter**
  - Captured public configuration data
    - Roles
    - Authorities
    - Domain Control Settings
    - Only ‘public’ (non-secret data), no key material
- **TKE 7.0 adds support for migration of key material**
  - Master Keys only
  - New Smart Card Types
    - Migration CA (MCA)
    - Injection Authority (IA)
    - Key Part Holder (KPH)

# TKE 7.1

- **AES operational key support**
- **Single process for loading an entire key**
- **Single process for generating multiple key parts**
- **Use of ECDH to exchange encrypted key material with a CEX3**
- **New access control points**
- **Migrate roles utility**
- **Support for more key parts on a smart card**
- **Host cryptographic module support**
- **Display of active IDs on the TKE console**

# HCR7770 – Protected Key

- **MSA-3 (Message Security Assist 3)**
  - Became available on the GA3 of the z10 EC/GA2 of the z10 BC
    - Protected Key Support



# Protected Key – How it works

- **Create a key, with the value 'ABCD' and store it as a secure key in the CKDS (i.e. encrypted under the Master Key, MK)**
  - $E_{MK}$(x'ABCD') => x'4A!2' written to the CKDS and stored with a label of MYKEY
- **Execute CSNBSYE (the clear key API to encrypt data), but pass it the key label of our secure key, MYKEY; and text to be encrypted of 'MY MSG  '**
  - CALL CSNBSYE(….,

    MYKEY,

    'MY MSG  ' ….)

# Protected Key – How it works (cont …)

- **ICSF will read MYKEY from the CKDS and pass the key value x'4A!2' to the CEX3**
- **Inside the CEX3, recover the original key value and then wrap it using the wrapping key**
  - $D_{MK}$(x' 4A!2') => x' ABCD'
  - $E_{WK}$(x'ABCD') => x'*94E'
- **ICSF will pass the wrapped key value of x'*94E' to the CPACF, along with the message to be encrypted**
- **In the CPACF, we'll retrieve the wrapping key, WK**
  - $D_{wk}$(x'*94E') => x'ABCD'
  - $E_{x'ABCD'}$('MY MSG  ') => ciphertext of x'81FF18019717D183'

# HCR7770 – ECC Support

- **Effective Key Size Security**

| Symmetric Key Size | RSA Key Size | ECC Key Size |
|---|---|---|
| 80 | 1024 | 163 |
| 112 | 2048 | 224 |
| 128 | 3072 | 256 |
| 192 | 7680 | 384 |
| 256 | 15360 | 512 |

**From NIST SP 800-57 Part 1 (Table 2) at www.nist.gov**

- **Elliptic Curve Support**
  - ECDSA
  - New ECC Master Key

- Point multiplication $Q=kP$
- Repeated point addition and doubling: $9P = 2(2(2P)) + P$
- Public key operation: $Q(x,y) = kP(x,y)$
  - $Q$ = public key
  - $P$ = base point (curve parameter)
  - $k$ = private key
  - $n$ = order of P
- Elliptic curve discrete logarithm
  Given public key kP, find private key k
- Best known attack: Pollard's rho method with running time: $\frac{(\pi n)^{1/2}}{2}$

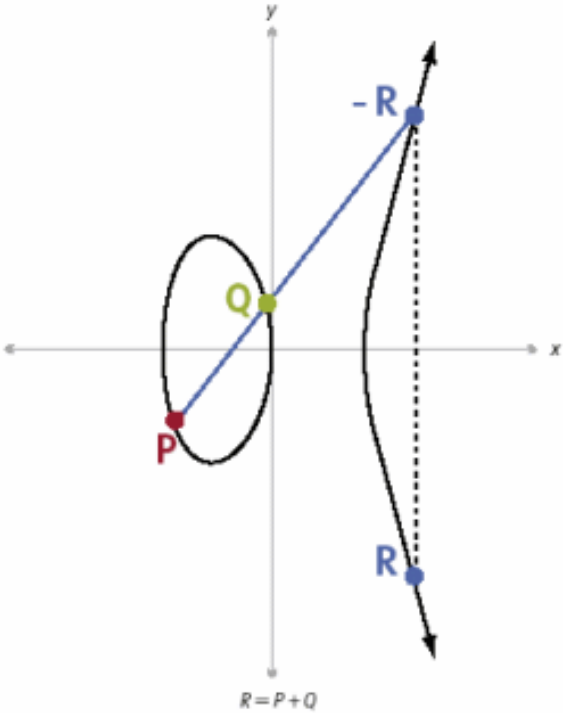


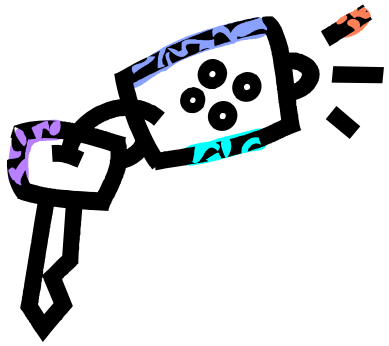

Image from DeviceForge and other sites

# ICSF – HCR7780

- **FIPS Mode SPE (OA32012/UA55967) for PKCS #11 – Public Key Cryptographic Token Interface**
  - PKCS #11 provides APIs for talking to devices which hold crypto info or perform crypto operations (think Smart Cards)
  - FIPSMODE was an option in HCR7770
  - SPE provides additional support required for FIPS certification
- **CKDS Constraint Relief**
  - CKT, in-storage copy of CKDS, above the bar
  - Optimized for speeding up searches (binary tree)
  - Limit performance impact of bulk updates
    - Buffering Read-Aheads
    - Tighten allocate / open / IO / close / deallocate process

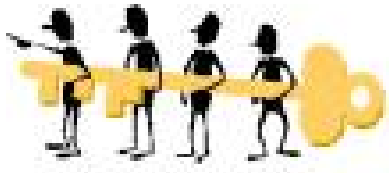
# FIPS-198 Keyed HMAC Support (OA33260)

- **New algorithm**
- **New Key/Token**
  - Variable-length key token
- **Variable Length CKDS (LRECL 1024)**
  - Fixed- and variable-length records
  - Conversion Utility – CSFCNV2
- **New callable services**
  - Key Management
  - HMAC Generate and Verify



# ICSF Versions supported on z196/z114

- **ICSF FMIDs**
  - HCR7790 (www.ibm.com/systems/z/os/zos/downloads)
  - HCR7780 (z/OS V1.13)
  - HCR7770 (z/OS V1.12)
  - HCR7751 (z/OS V1.11)
  - HCR7750 (z/OS V1.10)
  - HCR7740 (z/OS V1.9 with IBM Lifecycle Extension with PTFs)
  - HCR7731 (z/OS V1.8 with IBM Lifecycle Extension with PTFs)
  - HCR7731 (z/OS V1.7 with IBM Lifecycle Extension with PTFs)*



**(*note that z/OS V1.7 included HCR7720, but HCR7720 will not support the z196, you must have upgraded to HCR7731 or later on your z/OS 1.7 system)**

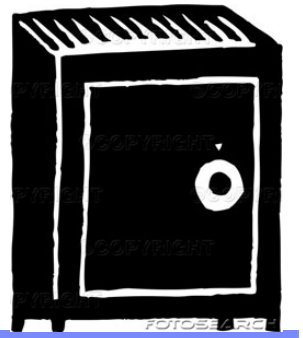
# Crypto Express3 Support

- **Crypto Express3 Toleration APARs**
  - ICSF OA29839
  - RMF OA28670
  - SAF OA29194
  - RACF OA29193

# ICSF Toleration

- **HCR7780 - Toleration APAR OA33320**
  - CBC Key Wrapping – 'Enhanced' key wrapping
  - ECDSA Keys in the PKDS
- **HCR7780 - HMAC Toleration Support OA34402**
  - Old versions of ICSF (HCR7750, HCR7751, HCR77770) will ignore XCF messages with a longer format coming from HCR7780 systems
- **HCR7790 - Variable Length AES OA36718**
  - HCR7780 can tolerate the new AES keys

See SMPE Support for ICSF FIXCAT ICSF790C/K



# z/VM 5.4 and z/VM 6.1

- **Provides guest support, VM does not directly use the crypto hardware**
  - Crypto Express3 - VM64656
  - Protected Key Support - VM64793

# Linux on System z

- **CPACF**
  - MSA-4 support in a future distribution
- **CEX3**
  - Drivers in SUSE SLES11 SP1/SLES12 andd RedHat RHEL 6.0 provide exploitation support for the CEX3
  - Drivers in SUSE SLES10 SP3 and SLES11 and Red Hat RHEL 5.4 provide toleration support (CEX3 acts like a CEX2)
  - CCA (secure key support) software download at the CryptoCards website (http://www.ibm.com/security/cryptocards/?S_TACT=107AG01W&S_CMP=campaign)

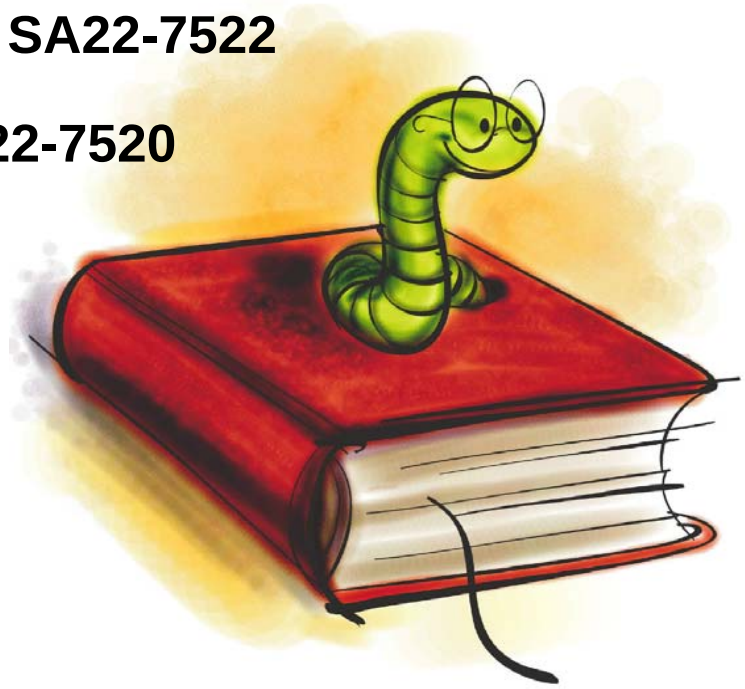
# Summary

- **z196 and z114 continues the implementation and support of new crypto technology, techniques and standards to support the evolving world of data security**

# References

## IBM Pubs

- **ICSF Overview, SA22-7519**
- **ICSF Administrator's Guide, SA22-7521**
- **ICSF Application Programmer's Guide, SA22-7522**
- **ICSF System Programmer's Guide, SA22-7520**



## TechDocs

- **www.ibm.com/support/techdocs**

  and search on 'crypto'

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