MAINFRAME CRYPTO

Pervasive Encryption – Are You Ready?

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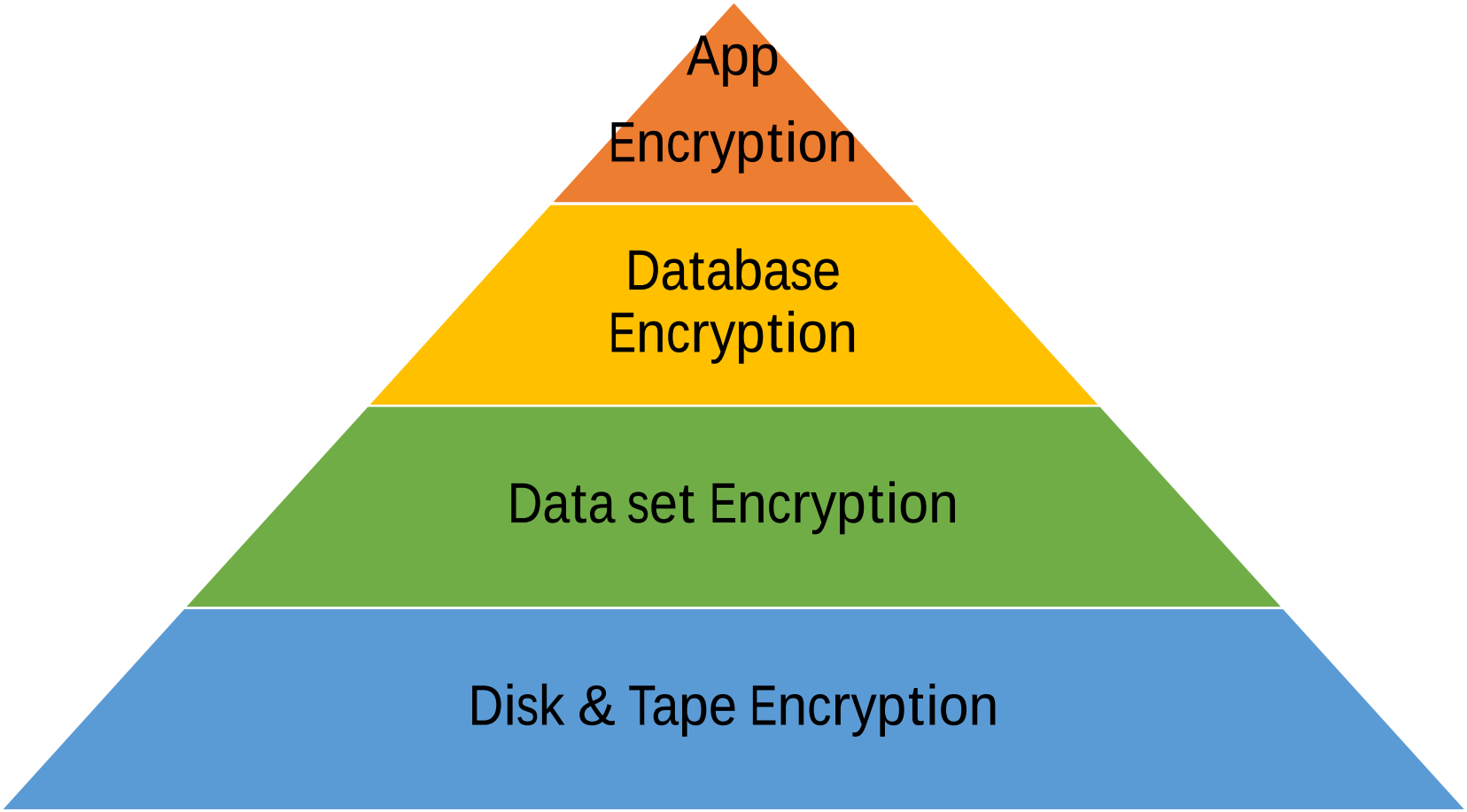
Agenda – Pervasive Encryption

- Introduction
- How it works
- Operational Stuff (Key Management and Performance)
- Coupling Facility
- Summary

An Apology – Just what is Pervasive Encryption?

- Full Disk Encryption
- Integrated Crypto Hardware
- Network Encryption
- **Data set and File Encryption**
- **Coupling Facility Encryption**
- Secure Service Container
- Key Management (EKMF – Enterprise Key Management Foundation)

IBM's Encryption Pyramid



Access Method Encryption

Standard Read/Write (BSAM/QSAM/VSAM)

vs

Non-Standard Read/Write (Track/Cylinder level)

Access Authority for Dataset Encryption

- Dataset
  - Access list
- API Access (to CSNBKRR2)
  - Access list or
  - PERMIT ID(*) ACCESS(READ)?
- Key Label
  - Access list, PERMIT WHEN …

  (SYMCPACFWRAP / SYMCPACFRET)

User

Storage Admin

Configuration requirements

- Machine type
  - z196/z114 w/CEX3C (FC #0864)
  - zEC12/zBC12 w/CEX3C (FC #0864) or CEX4C (FC #0865)
  - z13/z13s w/CEX5C (FC #0890)
- Operating System
  - z/OS 2.3
  - z/OS 2.2 w/APAR OA50569
  - z/OS 2.1 w/APAR OA50569 (supports reading/writing an encrypted data set, but not creating an encrypted data set)
- ICSF
  - HCR77C1
  - HCR77C0
  - HCR77A0-HCR77B1 w/APAR OA50450

Supported filetypes

- Extended Format
  - Sequential BSAM/QSAM
  - VSAM (KSDS, ESDS, RRDS, VRRDS, LDS)

    DB2, IMS, logs
- zFS (not Extended Format)

Restricted data sets

- Restrictions
  - DFSMSdss REBLOCK ignored on COPY and RESTORE
  - DFSMSdss VALIDATE ignored when backing up encrypted indexed VSAM
- Data sets used during IPL
- Catalogs, SHCDS, HSM data sets, ICSF Keystores
- Temporary, SORTWKxx, BLKSIZE<16 (can’t be Extended Format)

Encryption enabled at allocation (by assigning a key label)

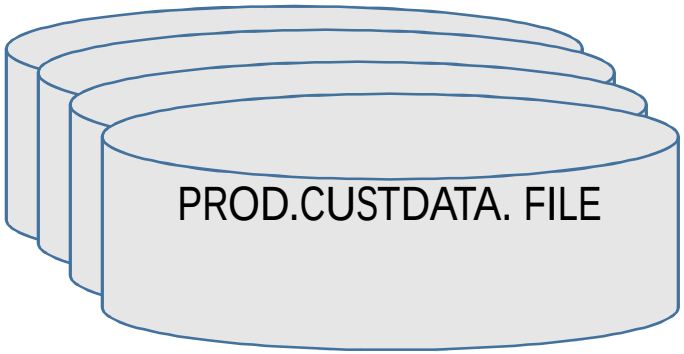
- DFP Segment of the SAF data set profile
  - ALTDSD 'PROJECTA.DATA.*' UACC(NONE)
    DFP(RESOWNER(iduser1)) DATAKEY(Key-Label for ProjectA))
- JCL, TSO Allocate (Dynamic Allocation)
  - DSKEYLBL=key-label
- IDCAMS
  - DEFINE CLUSTER -

    (NAME(DSN1.EXAMPLE.ESDS1) -

    ... -

    KEYLABEL (LABEL.FOR.DSN1))
- SMS Data Class

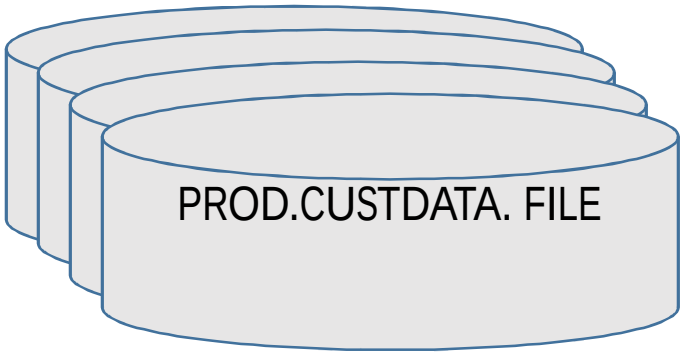
Creating a ciphertext copy of a file (1 of 5)



PROD.CUSTDATA.**
ACCESS LIST

Cleartext file(s)

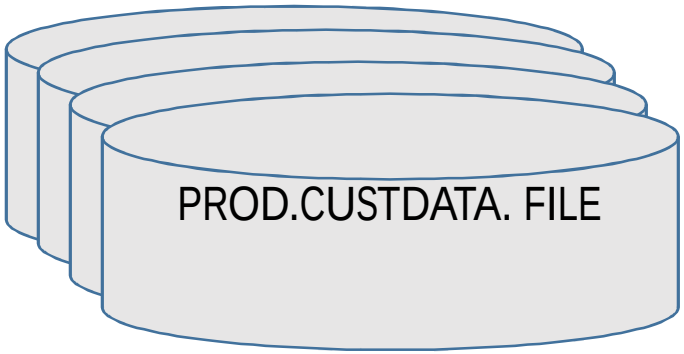
Creating a ciphertext copy of a file (2 of 5)



PROD.CUSTDATA.**
ACCESS LIST
DFP Segment
KEYLABEL(PRODCUST.KEY1)

Specify the key label in the DFP Segment of the data set profile

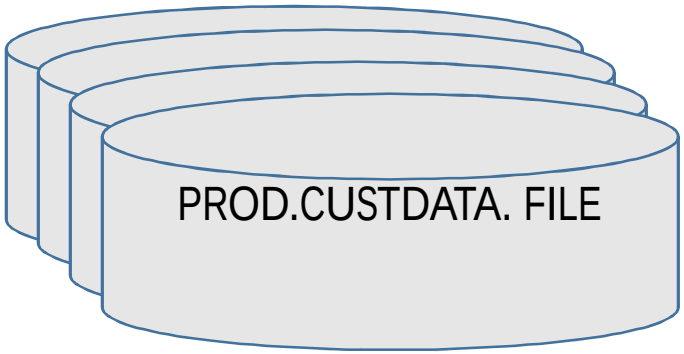
Creating a ciphertext copy of a file (3 of 5)



PROD.CUSTDATA.**
ACCESS LIST
DFP Segment
KEYLABEL(PRODCUST.KEY1)

Allocate the new file

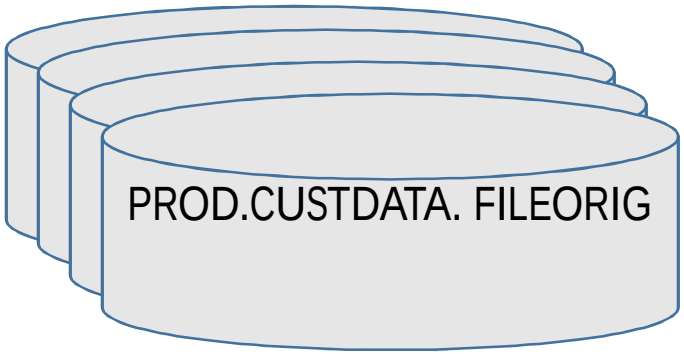
Creating a ciphertext copy of a file (4 of 5)



PROD.CUSTDATA.**
ACCESS LIST
DFP Segment
KEYLABEL(PRODCUST.KEY1)

Copy the file

Creating a ciphertext copy of a file (5 of 5)



Rename the two files

Reencipher a file (1 of 5)

PROD.CUSTDATA.**
ACCESS LIST

Ciphertext file, protected by PRODCUST.KEY1

Reencipher a file (2 of 5)

PROD.CUSTDATA.**
ACCESS LIST

PE. **
ACCESS LIST
DFP Segment
KEYLABEL(PRODCUST.KEY2)

Create a new data set profile, referencing the new key label, PRODCUST.KEY2

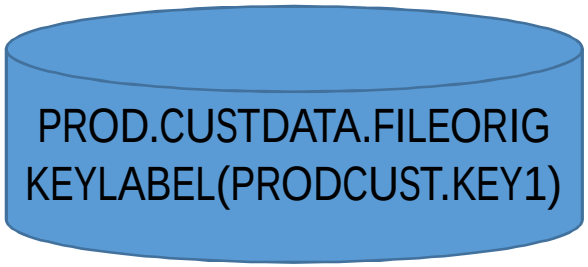
Reencipher a file (3 of 5)

Allocate

Reencipher a file (4 of 5)

Copy the file

Reencipher a file (5 of 5)



PROD.CUSTDATA.**
ACCESS LIST

PE. **
ACCESS LIST
DFP Segment
KEYLABEL(PRODCUST.KEY2)

Rename the two files

Data set lifecycle

- Backups, Replication
  - Still encrypted
- Migrated (in the storage hierarchy)
  - It's still encrypted!

Key Management Tools

- HCR77C1 – CKDS Browser
  - Proof of Concept
- Key Generation Utility Program
  - Comes with ICSF
  - Low volume of keys
- Trusted Key Entry (TKE) Workstation
  - Priced product
  - Must be managed
  - Additional benefits
  - Mid volume of keys
- Enterprise Key Management Foundation
  - Priced product
  - Must be managed
  - High volume of keys

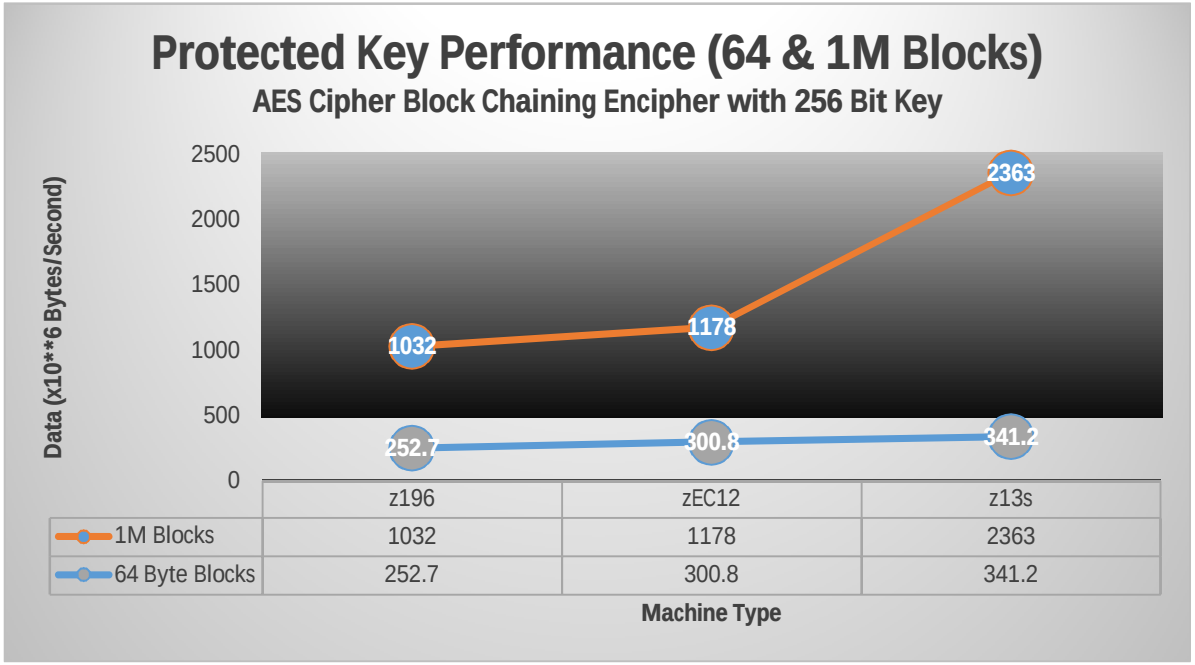
Compression

- Encryption still impacts compression
  - May impact space savings
  - Compress, then encrypt
- Compression
  - Generic – uses system supplied dictionary building blocks
  - Tailored – system generated compression dictionary
  - zEDC – uses zEnterprise Data Compression functionality (Required or Preferred)
- IBM recommends compressing all data sets before encrypting

A couple of other things

- Data set encryption breaks deduplication
- Shared (or replicated) DASD – be careful
  - Encryption enabled on LPAR1
  - Encryption not enabled on LPAR2
  - Not good
- Restricting
  - STGADMIN.SMS.ALLOWED.DATASET.ENCRYPT UACC(NONE)
  - If FIELD Class is active, DATASET.DFP.DATAKEY

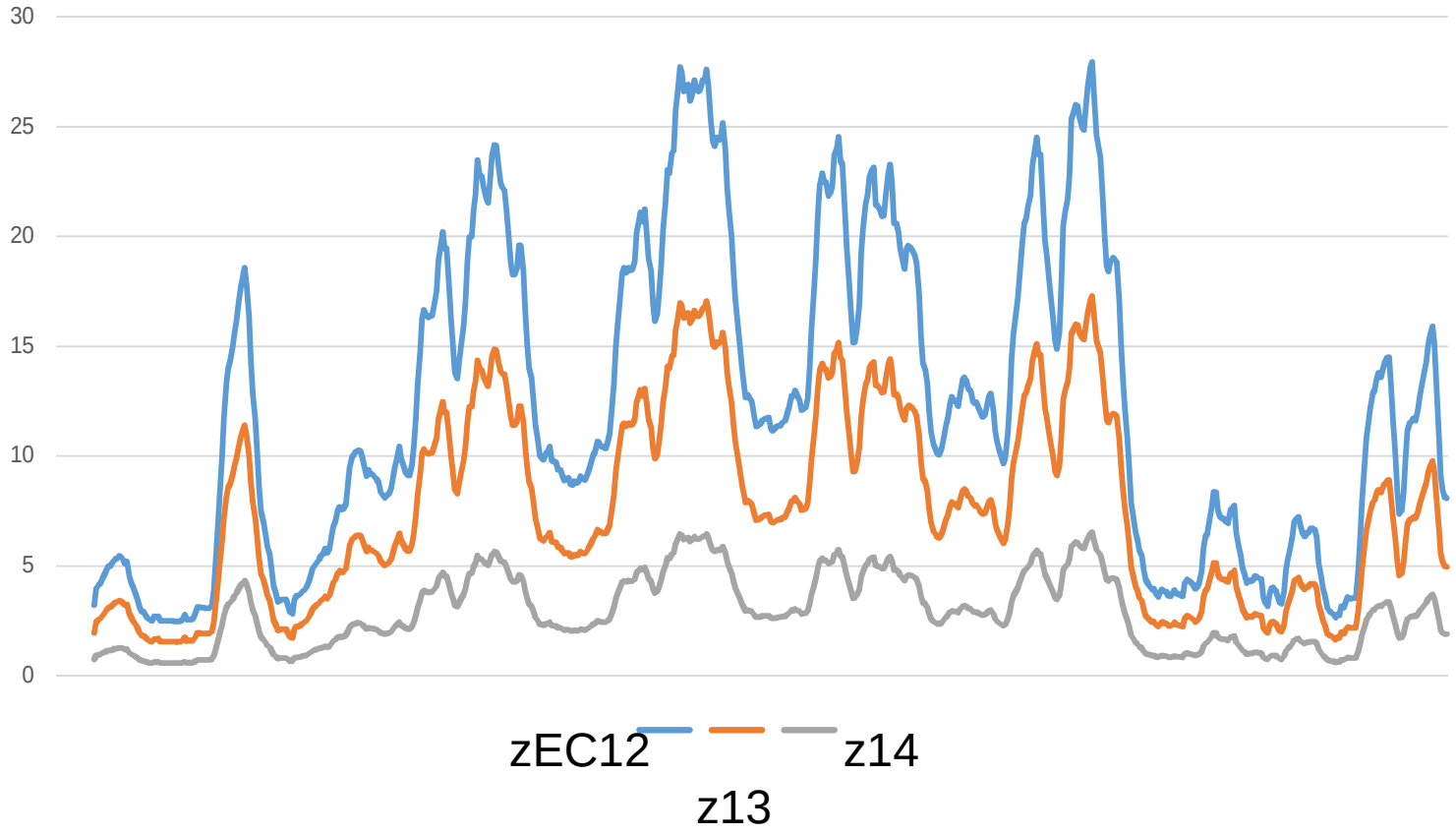
Performance



- IBM z13 Performance of Cryptographic Operations (Cryptographic Hardware: CPACF, CEX5S)
  - https://www.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSW03283USEN
- IBM zEnterprise EC12 Performance of Cryptographic Operations (Cryptographic Hardware: CPACF, CEX4S)
- IBM zEnterprise 196 Performance of Cryptographic Operations (Cryptographic Hardware: CPACF, CEX3C, CEX3A)

4-Hour Rolling Average

Customer Encryption Overhead



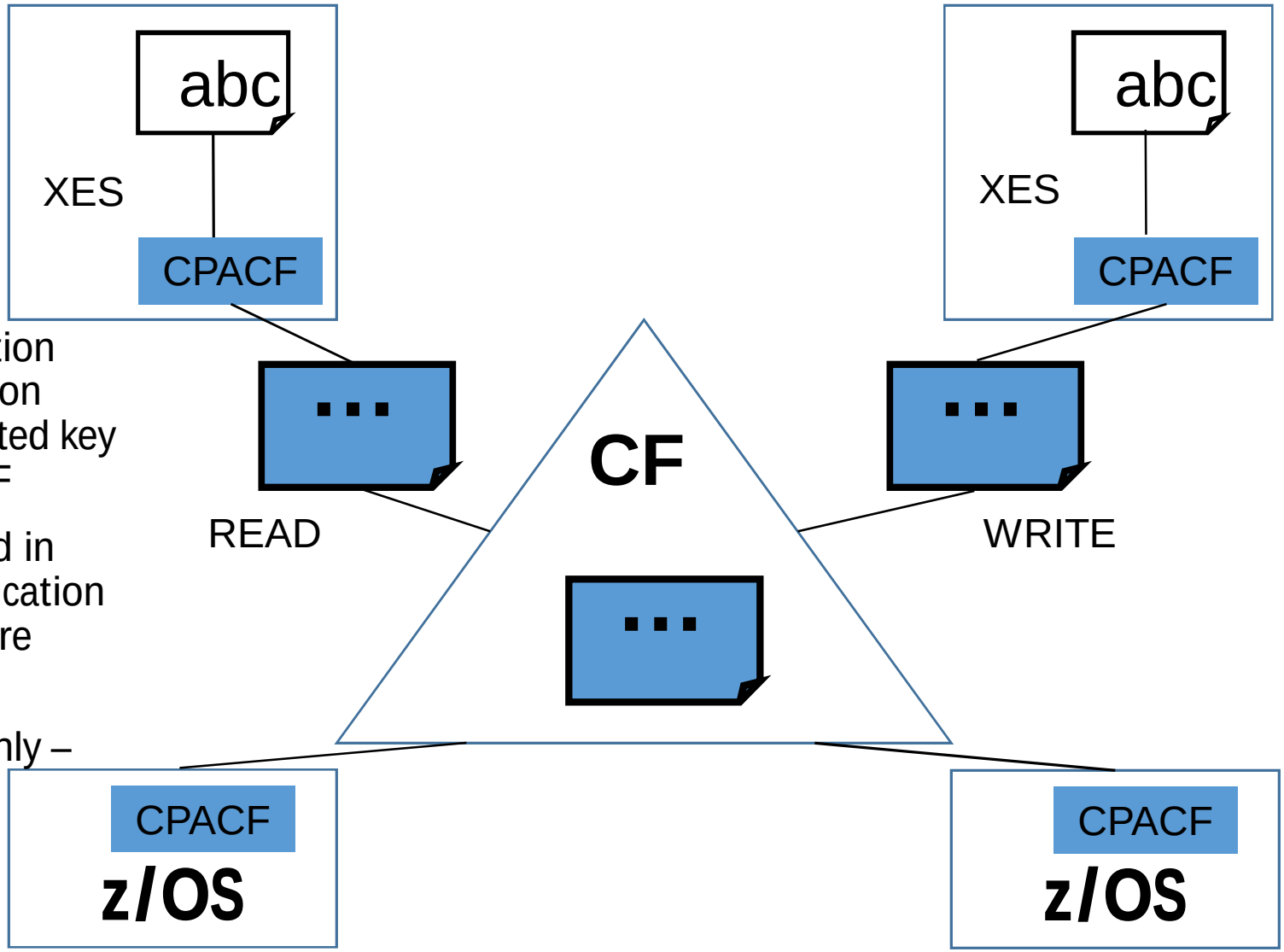
IBM z Systems Batch Network Analyzer (zBNA) Tool

- Enhanced to estimate the impact of enabling data set encryption
  - PC Based
  - Analyzes SMF data

- http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS5132

Coupling Facility Encryption

- Host encryption and decryption using protected key on the CPACF
- Implemented in XES, no application or middleware
- List & Cache Structures only – No locks



Coupling Facility Structure Encryption

- CFRM Policy Keyword
  - ENCRYPT(NO) – the default
  - ENCRYPT(YES)
- Encryption performed when the structure is written
  - New structure with ENCRYPT(YES) as it's built
  - Existing structure with rebuild
- Neither the Coupling Facility nor the CF Links do encryption/decryption – it's done on the CPACF
- Encryption is transparent

Coupling Facility Structures

- All entry and adjunct data moving between z/OS and the Coupling Facility is encrypted
  - Control info & metadata is not encrypted

- Cache Structure
- Serialized List Structure
- CF Lock Structure – not encrypted

Requirements for running policy utility with ENCRYPT(YES)

- ICSF must be active on the system where the job runs
- Job must have READ access to CSFSERV CSFKGN and CSFKYT resource profiles
- AES master key must be the same where the job is run and where the encrypted structures are used

Summary (of Data Set Encryption)

- Traditional access methods
  - Allocation will flag a data set for pervasive encryption and assign a key to that data set
  - If that flag is on,
    - Access to the Data set is not sufficient
    - Also need access to CSNBKRR2 and the key associated with the data set
- Non-Traditional access methods (Utilities that manage the data set, not the data work differently)
  - Work on the ciphertext

Summary (operational impact)

- From a crypto perspective, business as usual, but …
  - Criticality of keys
  - Volume of keys
  - Performance
- From an operational perspective
  - Potential data set conversion (i.e. making sure PII data sets are extended format)
  - Assigning key labels
  - Key assigned at allocation
  - Performance impact

References

- Share Presentations
  - **Securing Your Environment With Encryption**, *Session Number 20564 Speaker: Julie Bergh & Greg Boyd*
  - **Protect Your Data at Rest with z/OS Data Set Encryption**, *Session 20612 Speaker: Cecilia Carranza Lewis*
- Other presentations (Google 'IBM Encryption' and the speaker)
  - Eysha Powers
  - Mark Brooks
- Redbook – coming …

References

- OA50569 Data Set Encryption PDF
  http://publibz.boulder.ibm.com/zoslib/pdf/OA50569.pdf

- TechDocs – IBM z Systems Batch Network Analyzer (zBNA) Tool A PC-based tool for estimating elapsed time
  - http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS5132
- IBM DeveloperWorks
  - https://www.ibm.com/developerworks/community/groups/community/crypto

Questions?