MAINFRAME CRYPTO

Policy-Based Data Set Encryption

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Agenda – Pervasive Encryption

- Introduction
- How it works
- Key Management
- Configuration
- Performance

Announcement Letter 216-391

- IBM plans to deliver application transparent, policy-controlled dataset encryption in IBM z/OS. IBM DB2 for z/OS and IBM Information Management System (IMS) intend to exploit z/OS dataset encryption.

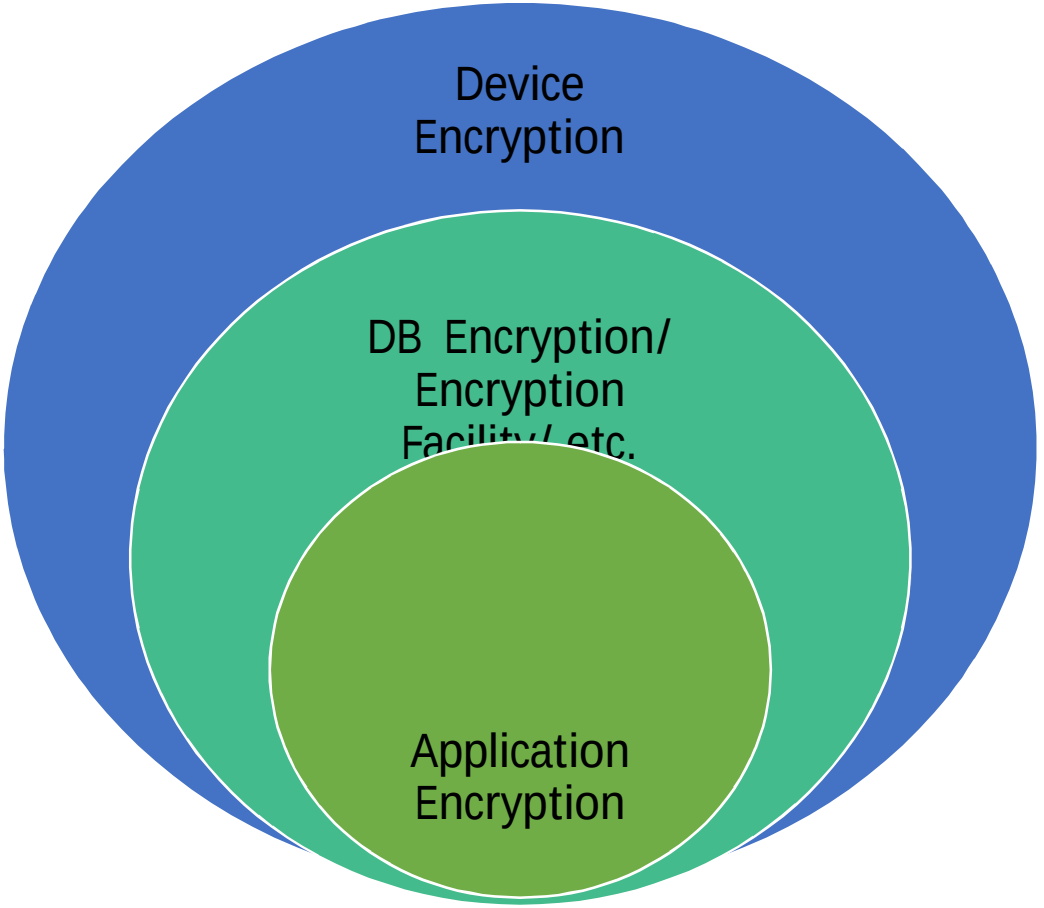
Announcement Letter 217-085

- z/OS V2.3 plans to replace application development efforts with transparent, policy-based data set encryption:
  - Planning enhanced data protection for z/OS data sets, zFS file systems, and Coupling Facility structures to give users the ability to encrypt data without needing to make costly application program changes.
  - Designing new z/OS policy controls to make it possible to use pervasive encryption to protect user data and simplify the task of compliance.
  - z/OS Communications Server will be designed to include encryption readiness technology to enable z/OS administrators to determine which TCP and Enterprise Extender traffic patterns to and from their z/OS systems meet approved encryption criteria and which do not.

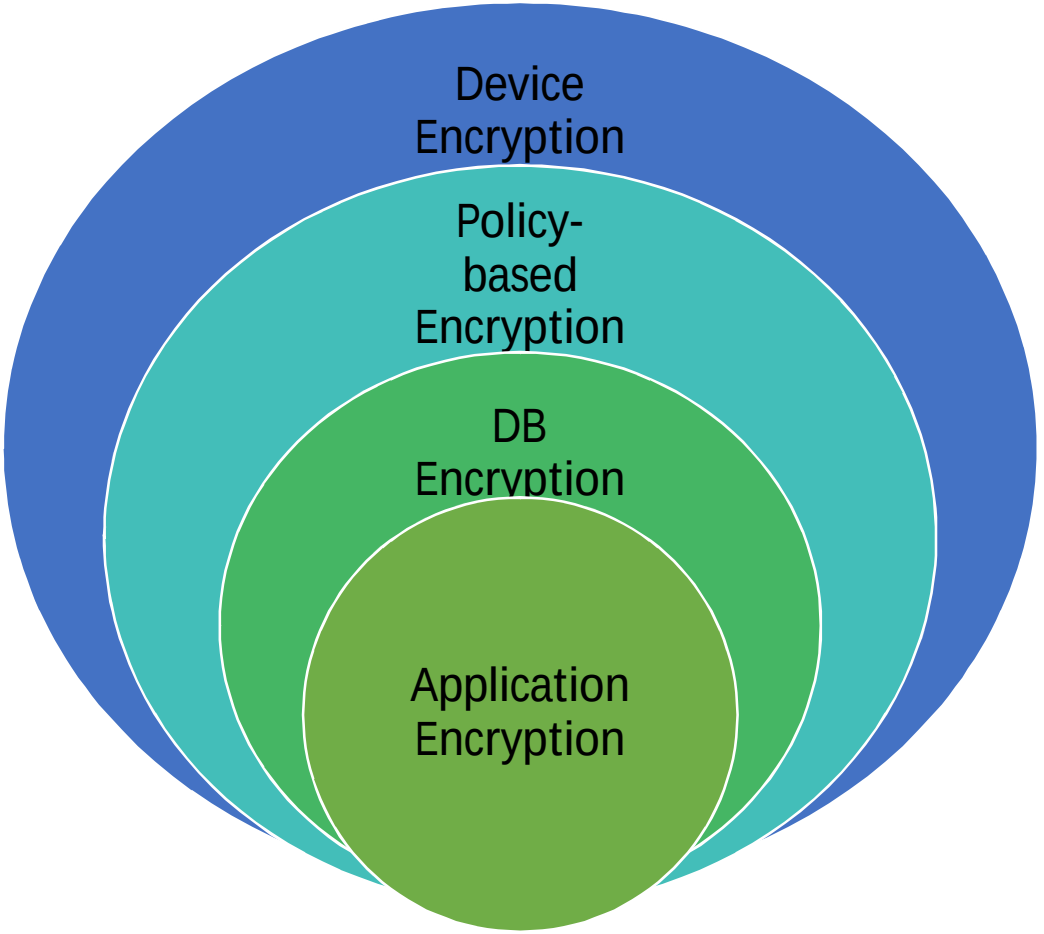
Coupling Facility

- Highlighted in z/OS V2.3 **preview announcement**
  - Plans to encrypt Coupling Facility list and cache structures
- Goal is to encrypt and decrypt CF data as it is sent to and returned from the CF protecting data in flight
- No application changes
- CFCC level 22 is recommended

Layers of Encryption



Layers of Encryption



Segregate roles and duties

- Data Owner
  - Required authority
    - Data Set
    - Key Label

- Storage Administrator
  - Required authority
    - Data Set

Supported filetypes

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

    DB2, IMS, zFS, logs

- Restrictions
  - DFSMSdss REBLOCK ignored on COPY and RESTORE
  - DFSMSdss VALIDATE ignored when backing up encrypted indexed VSAM

Restricted data sets

- Data sets used during IPL
- Catalogs, SHCDS, HSM data sets, ICSF Keystores
- Temporary, SORTWKxx, BLKSIZE<16 (can’t be Extended Format)

Data set lifecycle

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

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
    - Only works for DASD devices
- IDCAMS
  - DEFINE CLUSTER -
    (NAME(DSN1.EXAMPLE.ESDS1) -
    ... -
    KEYLABEL (LABEL.FOR.DSN1))
- SMS Data Class

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)
- Extended Format
  - Sequential support generic, tailored, or zEDC compression
  - VSAM support generic compression

Key labels – business as usual

- Key must be in the CKDS
- Further segregate across line of business, or application or …
  - Unique key per data set
  - Unique key by HLQ
  - Unique key per any qualifier
  - Or any combination thereof

Key Management – the hard part of crypto

- Key Volume
  - Naming Conventions
  - Key administrators – need access to KGUP
  - Tools – EKMF, TKE or …
- Key Criticality
  - Master Keys
  - Process & Procedure
- Key Security
- Operational Key Change
  - Define a new key with new key label
  - Create/copy the data to a new data set

Utilities and Control Blocks

- LISTCAT
  - Encryption Data Section
    - Data Set Encryption (Yes or No)
    - Data Set Key Label
- LISTVTOC
  - Encryption Attribute in SMS.IND field
- ISMF
  - DASD Data Set Level Encryption Management
    - Data Set Key Label
  - Data Set List
    - Encryption Indicator

The Players

- Sysprog – Implement and support ICSF
- ICSF Administrator – Manage the ICSF environment
- Master Key Officers – Own responsibility for the care of master keys
- Key Administrators – define and manage operational (symmetric) keys
- Security Administrator – setup the rules or profiles for securing crypto resources and associating keys with data set profiles
- Storage Administrator – update data classes via ISMF, update ACS routines to associate key labels with data sets
- User – needs the access to the resources, and probably cares the most about the data
- Security Auditor – monitors all of the above

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
  - HCR77C0
  - HCR77A0-HCR77B1 w/APAR OA50450

ICSF Support

- ICSF Segment of the CSFKEYS profile
  - SYMCPACFWRAP(YES) – key is eligible to be used as protected key
  - SYMCPACFRET(YES) – key is eligible to be returned to the caller in wrapped format (RACF APAR OA50367)
- ICSF APIs
  - CKDS Key Record Read2 (CSNBKRR2) – now can return the wrapped key to a caller
- Keylabel – AES-256 bit key

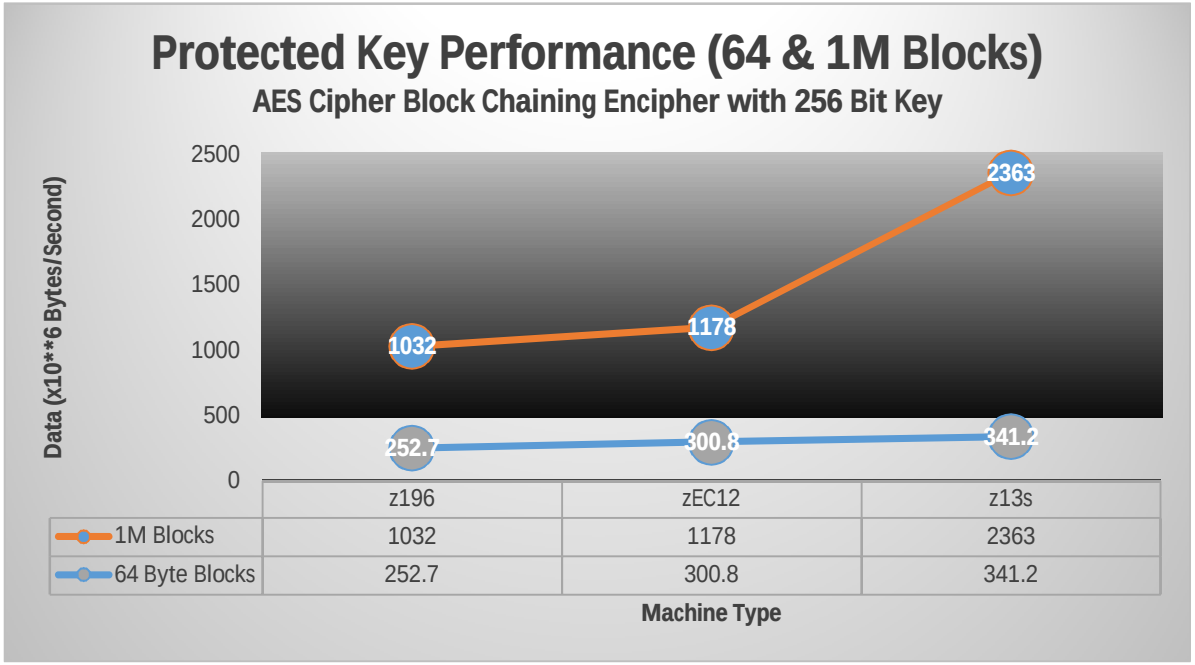
SAF Rules – CSFSERV Class

- CSFSERV
  - CSNBKRR2
    - RDEFINE CSFSERV * UACC(NONE)
    - RDEFINE CSFSERV CSFKRR2 UACC(NONE)
    - PERMIT CSFKRR2 CLASS(CSFSERV) ID(*) ACCESS(READ)

SAF Rules – CSFKEYS Class

- By default, access to key material should be highly restricted!
  - RDEFINE CSFKEYS * UACC(NONE)
  - RDEFINE CSFKEYS keylabel UACC(NONE)
- But, any user that needs the data in the clear must have access to the key label
  - PERMIT keylabel CLASS(CSFKEYS) ID(groupid/userid) ACCESS(READ)
  - PERMIT key-label CLASS(CSFKEYS) ID(*) ACCESS(READ) WHEN(CRITERIA(SMS(DSENCRYPTION)))

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)

IBM z Systems Batch Network Analyzer (zBNA) Tool

- Is being enhanced to help clients estimate the impact of enabling encryption
  - PC Based
  - Analyzes SMF data

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

SMF Records

- Type 14/15 (Sequential data sets)
  - SMF14DEF – Indicator (data set encrypted)
  - SMF14DET – Encryption type
  - SMF14DKL – Key label
- Type 62 (VSAM data sets)
  - SMF62DEF – Indicator (data set encrypted)
  - SMF62DET – Encryption type
  - SMF62DKL – Key label
- DFSMS DCOLLECT

Summary

- From a crypto perspective, there's nothing new here, except:
  - Criticality of keys
  - Volume of keys
- From an operational perspective, there is a lot going on
  - Assigning key labels via RACF, or ISMF or JCL
  - Concept of assigning a key label at data set allocation, not when you create the data
  - Performance impact
  - Potential data set conversion (i.e. making sure PII data sets are extended format)

Pervasive Encryption

- Policy-based – your organization can define a policy that will protect the data using DFSMS constructs
  - Simple (relatively speaking)
  - Automatic (encryption is enabled before the data is created)
  - Bulk encryption
  - Application transparent

References

- Announcement Letters
  - 216-392, Oct. 4, 2016
  - 217-085, Feb. 21, 2017
- 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*

- 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

More references

- *IBM z Systems Webcast, March 7, 2017*

Protection Begins with Data at the Center: Encrypt it all with z Systems Pervasive Encryption - Security Architect Michael Jordan

https://securityintelligence.com/events/protection-begins-with-data-at-the-center-encrypt-it-all-with-z-systems-pervasive-encryption/

Questions?