Policy-Based Data Set Encryption

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Agenda – Pervasive Encryption

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

- Device Encryption
- DB Encryption/Encryption Facility/etc.
- Application Encryption
Layers of Encryption

- Device Encryption
- Policy-based Encryption
- DB Encryption
- Application 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 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)

- 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

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
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
Questions?