Crypto Coding Lab: Welcome to the CIA!

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Session Goals

Learn how to code ICSF crypto applications

- Identifying API Naming Conventions
- Using the Application Programmer's Guide
- Performing basic crypto operations
  - Key Generation
  - Key Distribution
  - Data Encrypt & Decrypt
  - Data Hashing
  - Digital Signature Generation & Verification

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Information Security Basics

- **Confidentiality:** Ensuring information is accessible only to those authorized to have access
- **Integrity:** Safeguarding the accuracy and completeness of information and processing methods
- **Availability:** Ensuring that authorized users have access to information and associated assets when required

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Integrated Cryptographic Services Facility (ICSF)

ICSF works with the hardware cryptographic features and the Security Server (RACF element) to provide secure, high-speed cryptographic services in the z/OS environment.

- ICSF provides the application programming interfaces by which applications request cryptographic services.
- ICSF is the default means by which the secure cryptographic features are loaded with master key values, allowing the hardware features to be used by applications.
- ICSF callable services and programs can be used to generate, maintain, and manage keys that are used in the cryptographic functions.

ICSF uses keys in cryptographic functions to

- Protect data
- Protect other keys
- Verify that messages were not altered
- Generate, protect and verify PINs
- Distribute keys
- Generate and verify signatures

ICSF Key Data Sets

CKDS

Cryptographic Key Data Set
- CCA Symmetric Keys
- AES and DES

PKDS

PKA Key Data Set
- CCA Asymmetric Keys
- RSA and ECC

TKDS

Token Key Data Set
- PKCS#11 Keys, Certificates
- All algorithms

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IBM Common Cryptographic Architecture (CCA) for z/OS ICSF

IBM Common Cryptographic Architecture (CCA)

- IBM proprietary cryptographic application programmers interface (API) providing a broad range of cryptographic services including
  - standard cryptographic algorithms
  - financial services standards

z/OS ICSF Naming Conventions for CCA

CSNB* = CCA 31-bit Symmetric Key API
CSNE* = CCA 64-bit Symmetric Key API
CSND* = CCA 31-bit Asymmetric Key API
CSNF* = CCA 64-bit Asymmetric Key API

CCA Functions & Algorithms

Encrypt / Decrypt (AES, DES, DES3, RSA)
Sign / Verify (RSA, ECC)
MAC Generate / Verify (AES, DES, DES3)
HMAC Generate / Verify (HMAC)
Key Generate (AES, DES, DES3, HMAC)
Key Pair Generate (RSA, ECC)
Key Agreement (ECC, DH)
One Way Hash
Random Number Generate
Key Import / Export
TR-31 Block Import / Export
Financial Crypto
PIN Generate / Verify / Translate
PIN Encrypt
Diversified Key Generate
Derive Unique Key Per Transaction (DUKPT)
CVV Generate / Verify
Secure Messaging for Keys / Pins
… And Many More!

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PKCS#11 Cryptographic Token Interface Standard for z/OS ICSF

PKCS #11 Cryptographic Architecture

- Originally published by RSA Laboratories, now maintained by OASIS
  - Defines a standard API for devices that hold cryptographic information and perform cryptographic functions
  - Enterprise PKCS#11 – EP11

z/OS ICSF Naming Convention for PKCS#11

CSFP* = PKCS#11 APIs

PKCS#11 Functions & Algorithms

Encrypt / Decrypt (AES, DES, TDES, RSA)
Sign / Verify (RSA, DSA, ECDSA)
HMAC Generate / Verify
Key Generate (DES, TDES, AES, Blowfish, RC4)
Key Pair Generate (RSA, DSA, EC)
Key Derivation
Domain Parameter Generation (DH)
One Way Hash
Random Number Generate
Wrap / Unwrap Key

Designed for portability and FIPS/Common Criteria certification

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Your Mission… Should you choose to accept it…

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Let's Begin!

Sender

1. Generate Keys
2. Encrypt Data
3. Hash the Cipher Text
4. Sign the Hash

Receiver

- Receive a public key
- Receive some cipher text
- Receive a signature

- Share the public key
- Share the cipher text
- Share the signature

1. Hash the Cipher Text
2. Verify the Signature
3. Decrypt the Data

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But Where Do We Start?

- Which ICSF API should we use?
  - What functionality?
  - What architecture?
  - What algorithm?
  - What key type?

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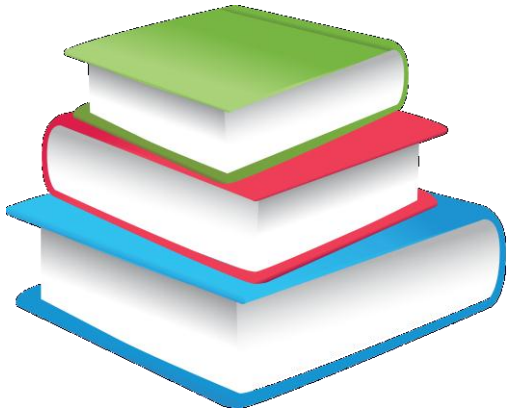
Cryptographic Services ICSF: Application Programmer's Guide

- Describes how to use the callable services provided by the Integrated Cryptographic Service Facility (ICSF).
- Intended for application programmers who:
  - Are responsible for writing application programs that use the security application programming interface (API) to access cryptographic functions.
  - Want to use ICSF callable services in high-level languages such as C, COBOL, FORTRAN, and PL/I, as well as in assembler.

http://www-01.ibm.com/support/knowledgecenter/SSLTBW_2.2.0/com.ibm.zos.v2r2.csf/csf.htm

- Parameters
- Key Token Formats
- Return & Reason Codes



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Step-By-Step: Encryption

- Generate a secret key
  - **SHARB01.ICSFLAB.REXX(KEYGEN1)**
- Generate a public-private key pair
  - **SHARB01.ICSFLAB.REXX(KEYGEN2)**
- Encrypt data with the secret key
  - **SHARB01.ICSFLAB.REXX(ENCRYPT)**
- Hash the encrypted data
  - **SHARB01.ICSFLAB.REXX(HASH)**
- Sign the hash with the private key
  - **SHARB01.ICSFLAB.REXX(SIGN)**

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Step-By-Step: Key Distribution

- Extract the public key from the private key
  - **SHARB01.ICSFLAB.REXX(KEYEXTRC)**

Choose a receiver's userid

- Encrypt the secret key with the receiver's public key
  - **SHARB01.ICSFLAB.REXX(KEYEXPOR)**

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Step-By-Step: Decryption

- Generate a hash of the cipher text
  - **SHARB01.ICSFLAB.REXX(HASH)**
  - **Manual Check:** Does the hash match the sender's hash?
- Verify the hash with the receiver's public key
  - **SHARB01.ICSFLAB.REXX(VERIFY)**
- Import the sender's secret key
  - **SHARB01.ICSFLAB.REXX(KEYIMPOR)**
- Decrypt the data with the sender's secret key
  - **SHARB01.ICSFLAB.REXX(DECRYPT)**

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What You've Learned…

Cryptography enables you to protect your sensitive data:

- Encryption and Decryption to hide data
- Key Distribution to send encrypted data to other parties
- Digital Signatures to prove the originator of the data
- … and more

IBM z Systems provide both hardware and software cryptography to help you protect your IT assets.

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Additional Resources

IBM Crypto Education Community
https://www-304.ibm.com/connections/communities/community/crypto

IBM System z Development Blog
https://ibm.biz/zsystems_development

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Thank You!

Feel free to connect…

- Email: eysha@us.ibm.com
- Twitter: http://www.twitter.com/EyshaShirrine
- LinkedIn: http://www.linkedin.com/in/eysha

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Session Evaluations

YOUR OPINION MATTERS!

1 2 3 4

Submit four or more session evaluations by 5:30pm Wednesday to be eligible for drawings!

*Winners will be notified Thursday morning. Prizes must be picked up at registration desk, during operating hours, by the conclusion of the event.

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