z/OS
Integrated Cryptographic Service Facility

Overview

SA22-7519-01

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Note!
Before using this information and the product it supports, be sure to read the general information under “Appendix C. Notices” on page 71.

Second Edition (October 2001)

This is a major revision of SA22-7519-00.

This edition applies to Version 1 Release 2 of the z/OS (5694-A01) and all subsequent releases and modifications until otherwise indicated in new editions.

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About This Book

This publication contains overview and planning information for the z/OS Integrated Cryptographic Service Facility (ICSF). The z/OS Cryptographic Services includes the following components:

- z/OS Integrated Cryptographic Service Facility (ICSF)
- z/OS Open Cryptographic Services Facility (OCSF)

ICSF is a software element of z/OS that works with the hardware cryptographic feature and the SecureWay Security Server (RACF) to provide secure, high-speed cryptographic services in the z/OS environment. ICSF provides the application programming interfaces by which applications request the cryptographic services. The cryptographic feature is secure, high-speed hardware that performs the actual cryptographic functions. The cryptographic feature available to your applications depends on the server or processor hardware.

The Cryptographic Coprocessor Feature can have up to two cryptographic coprocessor chips protected by tamper-detection circuitry and a cryptographic battery unit. The Cryptographic Coprocessor Feature is available on the following servers:

- IBM S/390 Parallel Enterprise Server - Generation 3 (S/390 Enterprise Servers and S/390 Multiprise) with feature code 0800 and one of the following feature codes: 0801, 0802, 0803, 0804, 0805
- IBM S/390 Multiprise 2000 with feature code 0800 and one of the following feature codes: 0801, 0802, 0803, 0804, 0805
- IBM S/390 Parallel Enterprise Server - Generation 4 (S/390 G4 Enterprise Server) with feature code 0800 and one of the following feature codes: 0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835
- IBM S/390 Parallel Enterprise Server - Generation 5 (S/390 G5 Enterprise Server) with feature code 0800 and one of the following feature codes: 0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835
- IBM S/390 Parallel Enterprise Server - Generation 6 (S/390 G6 Enterprise Server) with feature code 0800 and one of the following feature codes: 0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835
- IBM @server zSeries 900 with feature code 800 plus one of the following feature codes (0874 or 0875)

The PCI Cryptographic Coprocessor is the 4758 model 2 standard PCI-bus card package available on the following servers:

- S/390 G5 Enterprise Server or the S/390 G6 Enterprise Server with feature codes 0864 or 0865. Feature code 0860 is needed for each PCI Cryptographic Coprocessor.
- IBM @server zSeries 900 with feature codes 0861 and 0865

| The PCI Cryptographic Accelerator (feature code 0862) is available on the following
| server and can support any combination of PCI Cryptographic Coprocessors or PCI
| Cryptographic Accelerators, but the total must not exceed 16.

- IBM @server zSeries 900

ICSF supports the ANSI Data Encryption Algorithm (DEA) for the encryption and decryption of data. DEA is also known as the U.S. National Institute of Science and

Technology (NIST) Data Encryption Standard (DES) algorithm. In this publication, we use the term DES when referring to this algorithm.

ICSF also provides support for:

- The Commercial Data Masking Facility (CDMF), an exportable version of DES cryptography
- Triple DES encryption for privacy
- The transport of data keys through the use of the Rivest-Shamir-Adelman (RSA) public key algorithm
- The generation and verification of digital signatures through the use of both the RSA and the Digital Signature Standard (DSS) algorithm
- The generation of RSA and DSS keys
- The Secure Electronic Transaction (SET) standard which was created by VISA International and MasterCard
- The PKA Encrypt and PKA Decrypt callable services that can be used to enhance the security and performance of Secure Sockets Layer (SSL) security protocol applications

ICSF enhances security as follows:

- It ensures data privacy by encrypting and decrypting the data.
- It manages personal identification numbers (PINs).
- It ensures the integrity of data through the use of message authentication codes (MACs), modification detection codes (MDCs), hash functions, digital signatures, or VISA Card Verification Value.
- It ensures the privacy of cryptographic keys themselves by encrypting them under a master key or another key-encrypting key.
- It enforces DES key separation, which ensures that cryptographic keys are used only for their intended purposes.
- It enhances system availability by providing continuous operation.
- It enables the use of Rivest-Shamir-Adelman (RSA) and Digital Signature Standard (DSS) public and private keys on a multi-user, multi-application platform.

Who Should Use This Book

This book is for chief information officers, information system executives, and information security professionals and auditors. Installation managers and security administrators who are responsible for planning the data security strategy for their installation will also find this book to be helpful. This publication applies to installations that have z/OS with ICSF and a hardware cryptographic feature installed.

How to Use This Book

The major topics by chapter are:

- Chapter 1. Introducing Cryptography and ICSF introduces the general subject of cryptography, and describes why ICSF may be right for your installation.
- Chapter 2. Solving Your Business Needs with ICSF describes how ICSF can help your business.
- Chapter 3. ICSF Callable Services and Key Management describes the cryptographic callable services available with ICSF and the basic concepts of managing cryptographic keys.

- Chapter 4. Using ICSF with Other Cryptographic Products describes how ICSF relates to other cryptographic products.
- Chapter 5. Planning for the Integrated Cryptographic Service Facility identifies the system facilities and system resources that ICSF requires and presents guidelines and suggestions to help you when you plan for installing, operating, and migrating ICSF.
- "Appendix A. Standards" on page 63 provides a list of International and USA standards for the Cryptographic Coprocessor Feature, PCI Cryptographic Coprocessor, and ICSF.
- "Appendix B. Summary of Callable Service Support by Hardware Configuration" on page 65 summarizes ICSF callable services by configuration.
- "Appendix C. Notices" on page 71 contains notices and trademarks.

Where to Find More Information

This section describes books that contain ICSF information.

The ICSF Library

Figure 1 on page xiv shows the ICSF library, which includes the following publications:

- *z/OS ICSF Overview*, SA22-7519

  This publication provides an introduction to ICSF, an overview of cryptography, and planning information.

- *z/OS ICSF Administrator's Guide*, SA22-7521

  See this book for information on managing cryptographic keys. It describes the tasks of entering DES and PKA master keys, changing a DES master key, using the key generator utility program, and viewing the status of the cryptographic feature.

- *z/OS ICSF System Programmer's Guide*, SA22-7520

  See this book for information on initialization, customization, migration, and problem diagnosis.

- *z/OS ICSF Application Programmer's Guide*, SA22-7522

  See this book for information on writing application programs that use the callable services that are provided by ICSF to access cryptographic functions. These callable services can be used in high-level languages such as C, COBOL, FORTRAN, and PL/I, as well as in Assembler.

- *z/OS ICSF Messages*, SA22-7523

  See this book for explanations of messages that are produced by ICSF, and for the routing and descriptor codes for those messages.

- *z/OS ICSF TKE Workstation User's Guide 2000*, SA22-7524

  This book is available with the optional Trusted Key Entry (TKE) workstation and explains how to install and run the TKE workstation for key distribution (Version 3).

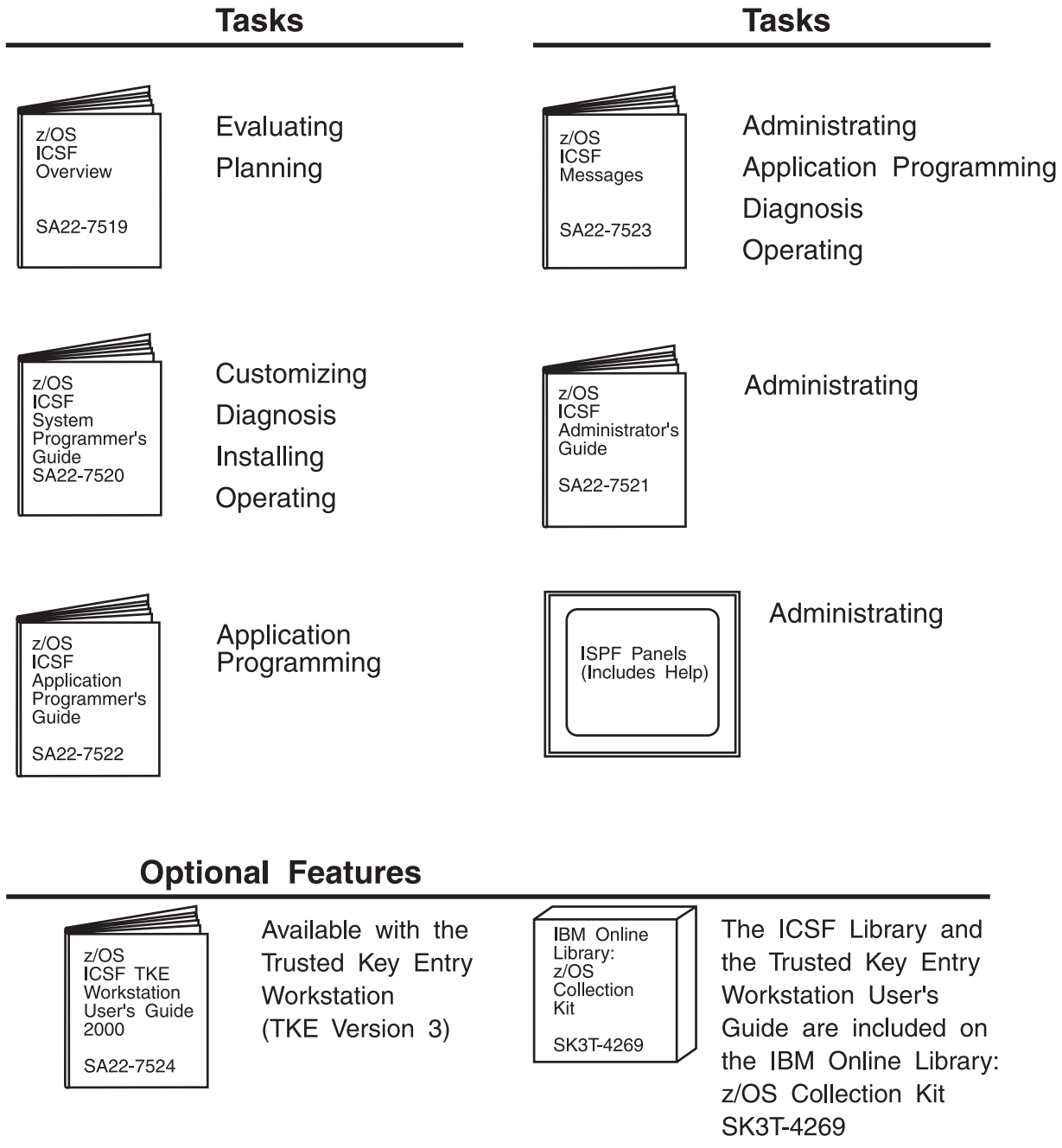

Figure 1. The z/OS ICSF Library

The following publications contain additional ICSF information:

- *z/OS MVS System Codes*, SA22-7626
  This book describes reason codes for ICSF X'18F' abend code.
- *z/OS MVS System Management Facilities (SMF)*, SA22-7630
  This book describes SMF record type 82, where ICSF records events.
- *z/OS MVS Initialization and Tuning Guide*, SA22-7591
- *z/OS MVS Initialization and Tuning Reference*, SA22-7592
- *z/OS MVS Programming: Callable Services for HLL*, SA22-7613
- *z/OS MVS Programming: Authorized Assembler Services Guide*, SA22-7608

- *z/OS MVS Programming: Extended Addressability Guide*, SA22-7614
- *z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN*, SA22-7609
- *z/OS MVS Programming: Authorized Assembler Services Reference ENF-IXG*, SA22-7610
- *z/OS MVS Programming: Authorized Assembler Services Reference LLA-SDU*, SA22-7611
- *z/OS MVS Programming: Authorized Assembler Services Reference SET-WTO*, SA22-7612

Related Publications

- *IBM Common Cryptographic Architecture: Cryptographic Application Programming Interface Reference*, SC40-1675
- *IBM ES/9000 and ES/3090 Processor Complex PR/SM Planning Guide*, GA22-7123
- *IBM Security Architecture: Securing the Open Client/Server Distributed Enterprise*, SC28-8135
- *VTAM Programming for LU 6.2*, SC31-6551
- *RSA's Frequently Asked Questions About Today's Cryptography*, available on the World Wide Web. See RSA's home page at http://www.rsa.com.
- *BSAFE User's Manual*
- *BSAFE Library Reference Manual*
- *Applied Cryptography, Second Edition*, Second Edition, by Bruce Schneier

Information on Other IBM Cryptographic Products

- *IBM Transaction Security System: General Information Manual and Planning Guide*, GA34-2137
- *IBM Transaction Security System: Concepts and Programming Guide: Volume I, Access Controls and DES Cryptography*, GC31-3937
- *IBM Transaction Security System: Basic CCA Cryptographic Services*, SA34-2362
- *IBM Transaction Security System: Concepts and Programming Guide: Volume II, Public-Key Cryptography*, GC31-2889
- *IBM Distributed Key Management System, Installation and Customization Guide*, GG24-4406

Using LookAt to look up message explanations

LookAt is an online facility that allows you to look up explanations for z/OS messages and system abends.

Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

LookAt can be accessed from the Internet at:

`http://www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/lookat.html`

or from a TSO command line.

To use LookAt as a TSO command, LookAt must be installed on your host system. You can obtain the LookAt code for TSO from a disk on your *z/OS Collection*, SK3T-4269, or from the LookAt Web site. To obtain the code from the LookAt Web site, do the following:

1. Go to http://www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/lookat.html.
2. Scroll to and click on the **News and Help** button.
3. Scroll to and click on the **Download LookAt from the Web** link.
4. Click on the ftp directory for the appropriate operating system and release.
5. Find the README file and follow its detailed instructions.

To find a message explanation from a TSO command line, simply enter: **lookat** *message-id* as in the following example:

```
lookat iec192i
```

This results in direct access to the message explanation for message IEC192I.

Note: Some messages have information in more than one book. For example, IEC192I has routing and descriptor codes listed in *z/OS MVS Routing and Descriptor Codes*. For such messages, LookAt prompts you to choose which book to open.

Accessing licensed books on the Web

z/OS licensed documentation in PDF format is available on the Internet at the IBM Resource Link Web site at:

```
http://www.ibm.com/servers/resourcelink
```

Licensed books are available only to customers with a z/OS license. Access to these books requires an IBM Resource Link Web userid and password, and a key code. With your z/OS order you received a memo that includes this key code.

To obtain your IBM Resource Link Web userid and password log on to:

```
http://www.ibm.com/servers/resourcelink
```

To register for access to the z/OS licensed books:

1. Log on to Resource Link using your Resource Link userid and password.
2. Click on **User Profiles** located on the left-hand navigation bar.
3. Click on **Access Profile.**
4. Click on **Request Access to Licensed books.**
5. Supply your key code where requested and click on the **Submit** button.

If you supplied the correct key code you will receive confirmation that your request is being processed. After your request is processed you will receive an e-mail confirmation.

Note: You cannot access the z/OS licensed books unless you have registered for access to them and received an e-mail confirmation informing you that your request has been processed.

To access the licensed books:

1. Log on to Resource Link using your Resource Link userid and password.
2. Click on **Library**.
3. Click on **zSeries**.

4. Click on **Software**.
5. Click on **z/OS**.
6. Access the licensed book by selecting the appropriate element.

Summary of Changes

Summary of Changes
for SA22-7519-01
z/OS Version 1 Release 2

This book contains information previously presented in SA22-7519-00, which supports z/OS Version 1 Release 1.

New Information:

- Callable services
  - PKA Key Token Change (CSNDKTC) callable service - This service changes PKA internal key tokens (RSA and DSS) from encipherment with the old PCI Crytographic Coprocessor asymmetric-keys master key to encipherment with the current PCI Cryptographic Coprocessor asymmetric-keys master key.
  - Secure Messaging for Keys (CSNBSKY) callable service - This service encrypts a text block, including a clear key value decrypted from an internal or external DES token.
  - Secure Messaging for PINs (CSNBSPN) callable service - This service encrypts a text block, including a clear PIN block recovered from an encrypted PIN block.
- Installation Options Data Set
  - PKDSCACHE, an installation option, defines the size of the PKDS Cache in records. The PKDS cache improves performance as it facilitates access to frequently used records. Specify *n* as a decimal value from 0 to 256. If *n* is zero, no cache will be implemented. If PKDSCACHE is not specified, the default value is 64. PKDSCACHE can be implemented on OS/390 V2 R10 and z/OS V1 R1 by installing APAR OW48568.
  - When specifying parameter values within parentheses, leading and trailing blanks are ignored. Embedded blanks may cause unpredictable results.
- PCI Cryptographic Accelerator (PCICA) support has been added. If a PCI Cryptographic Accelerator is available, clear RSA key processing in the CSFDPKD service will be routed to the PCI Cryptographic Accelerator. If you have a PCI Cryptographic Accelerator online, toleration APAR OW49402 is required on lower levels of ICSF (OS/390 V2 R9, OS/390 V2 R10 and z/OS V1 R1).
- Support to REENCIPHER PKDS and ACTIVATE PKDS has been added to the Master Key Management Panels. The new utility, CSFPUTIL, can also be used to reencipher the PKDS from the old asymmetric-keys master key to the current master key and to activate the reenciphered PKDS. Toleration APAR OW49386 is required on the following systems in order to activate the PKDS:
  - HCRP210 (standalone), HCRP220(OS/390 V2 R6, OS/390 V2 R7, OS/390 V2 R8), HCRP230 (OS/390 V2 R9), and HCR7703 (OS/390 V2 R10 and z/OS V1 R1)
- UDX support - Support for writing your own UDX has been added.

Changed Information:

- Beginning in z/OS V1 R2, the DOMAIN parameter is an optional parameter in the installation options data set. It is, however, required if more than one domain is specified as the usage domain on the PR/SM panels or if running in native mode. If specified in the options data set, it will be used and it must be one of the usage domains for the LPAR. If DOMAIN is not specified in the options data set,

ICSF determines which domains are available in this LPAR. If only one domain is defined for the LPAR, ICSF will use it. If more than one is available, ICSF will issue error message ″CSFM409E MULTIPLE DOMAINS AVAILABLE. SELECT ONE IN THE OPTIONS DATA SET.″

- Callable services
  - MAXLEN parameter checking has been eliminated for the following services:
    - Encipher (CSNBENC and CSNBENC1)
    - Decipher (CSNBDEC and CSNBDEC1)
    - MAC generate (CSNBMGN and CSNBMGN1)
    - MAC verify (CSNBMVR and CSNBMVR1)
    - Ciphertext translate (CSNBCTT and CSNBCTT1)
    - MDC generate (CSNBMDG and CSNBMDG1)

    The MAXLEN parameter is also no longer enforced in the CUSP compatibility CIPHER service. The MAXLEN parameter may still be specified in the options data set, but only the maximum value limit will be enforced (2147483647). If a value greater than this is specified, an error will result and ICSF will not start.
- Pass Phrase Initialization now allows uninitialized PCI Cryptographic Coprocessors to be initialized without processing all Cryptographic Coprocessors. A new panel option (Initialize new PCICC Only) has been added to the Pass Phrase Initialization panel to allow the initialization of the new PCI Cryptographic Coprocessors.

Deleted Information:

- Message IEC161I has been eliminated during the first time startup of ICSF.
- The following reason codes for ICSF/MVS X'18F' are being eliminated and will be replaced with operator messages.
  - Reason Code X'3C' - replaced by message CSFM105E
  - Reason Code X'48' - replaced by message CSFM120E
  - Reason Code X'1B' - replaced by message CSFM410E
  - Reason Code X'4B' - replaced by message CSFM107E
  - Reason Code X'106' - If the CCC is all zeroes, abend X'18F' reason code 4A will occur. If the CCC does not exist, message CSFM113E will be displayed.

This book includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

You may notice changes in the style and structure of some content in this book - for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our books.

Chapter 1. Introducing Cryptography and ICSF

The Internet is rapidly becoming the basis for electronic commerce. More businesses are automating their data processing operations. Online databases are becoming increasingly large and complex. Many businesses transmit sensitive data on open communication networks and store confidential data offline. Every day the potential for unauthorized persons to access sensitive data increases.

To achieve security in a distributed computing environment, a combination of elements must work together. A security policy should be based on an appraisal of the value of data and the potential threats to that data. This provides the foundation for a secure environment.

IBM has categorized the following security functions according to International Organization for Standardization (ISO) standard 7498-2:

- Identification and authentication — includes the ability to identify users to the system and provide proof that they are who they claim to be.
- Access control — determines which users can access which resources.
- Data confidentiality — protects an organization's sensitive data from being disclosed to unauthorized persons.
- Data integrity — ensures that data is in its original form and that nothing has altered it.
- Security management — administers, controls, and reviews a business security policy.
- Nonrepudiation — assures that the appropriate individual sent the message.

Only cryptographic services can provide the data confidentiality and the identity authentication that is required to protect business commerce on the Internet.

What Is Cryptography?

Cryptography includes a set of techniques for scrambling or disguising data. The scrambled data is available only to someone who can restore the data to its original form. The purpose is to make data unintelligible to unauthorized persons, but readily decipherable to authorized persons. Cryptography deals with several processes:

- **Enciphering** is converting *plaintext*, which is intelligible, into *ciphertext*, which is not intelligible. Enciphering is also called encrypting.
- **Deciphering** is converting ciphertext back into plaintext. Deciphering is also called decrypting.
- **Hashing** involves using a one-way calculation to condense a long message into a compact bit string, or message digest.
- **Generating and verifying digital signatures** involves encrypting a message digest with a private key to create the electronic equivalent of a handwritten signature. Both a handwritten signature and a digital signature verify the identity of the signer and cannot be forged.

  Digital signatures also serve to ensure that nothing has altered the signed document since it was signed.

The growth of distributed systems and the increasing use of the Internet have resulted in the need for increased data security. Cryptography provides a strong, economical basis for keeping data confidential and for verifying data integrity.

Cryptography is already playing a critical and expanding role in electronic commerce and electronic mail services. Emerging markets that require secure data transmission and the authentication of the sender are already relying on cryptography.

The Basic Elements of a Cryptographic System

Most practical cryptographic systems combine two elements:

- A process or algorithm which is a set of rules that specify the mathematical steps needed to encipher or decipher data.
- A cryptographic key (a string of numbers or characters), or keys. The algorithm uses the key to select one relationship between plaintext and ciphertext out of the many possible relationships the algorithm provides. The selected relationship determines the composition of the algorithm's result.

ICSF supports two main types of cryptographic processes:

- Symmetric, or secret key, algorithms, in which the same key value is used in both the encryption and decryption calculations.
- Asymmetric, or public key, algorithms, in which a different key is used in the decryption calculation than was used in the encryption calculation.

Secret Key Cryptography

Secret key cryptography uses a conventional algorithm such as the Data Encryption Standard (DES) algorithm that is supported by ICSF. Another term for secret key cryptography is symmetric cryptography. To have intelligent cryptographic communications between two parties who are using a conventional algorithm, the following criteria must be satisfied:

- Both parties must use the same cryptographic algorithm.
- The cryptographic key that the sending party uses to encipher the data must be available to the receiving party to decipher the data.

Figure 2 on page 3 is a simplified illustration of the cryptographic components that are needed to encipher and decipher data in a secret key cryptographic system. In this system, Tom and Linda have established a secure communications channel by sharing a secret key. Tom enciphers the plaintext by using the algorithm and the secret key before sending it to Linda. When she receives the ciphertext, Linda deciphers it using the same algorithm and the same secret key. In a secret key system, it is critically important to maintain the secrecy of the shared key.

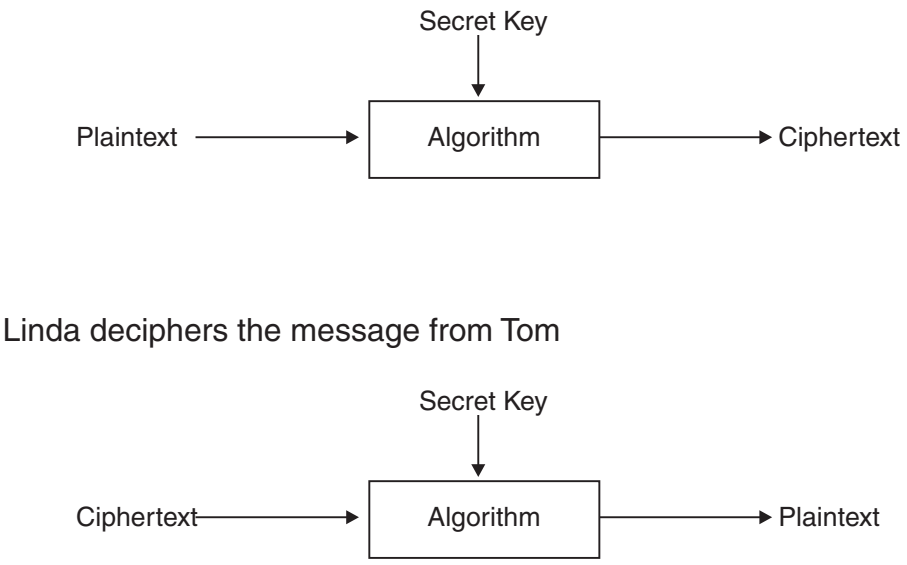

Figure 2. Enciphering and Deciphering Data in a Secret Key System

Public Key Cryptography

Each party in a public key cryptography system has a pair of keys. One key is public and is published, and the other key is private. Another term for public key cryptography is asymmetric cryptography because the public key and private key are not identical. The sending party looks up the receiving party's public key and uses it to encipher the data. The receiving party then uses its private key to decipher the data. In a public key system, it is critically important to maintain the secrecy of the private key.

Public key cryptography requires complex mathematical calculations. For this reason, these types of systems are not used for enciphering messages or large amounts of data. They are, however, used to encipher and decipher DES keys that are transported between two systems.

Public key cryptography systems are often used to generate and verify digital signatures on electronic documents. The sender uses his or her private key to generate the digital signature. The receiver then uses the sender's public key to verify the identity of the sender. On the emerging information highway, the digital signature replaces the handwritten signature as a legal proof of authenticity. Digital signatures are the principal mechanism in any system of nonrepudiation.

Figure 3 on page 4 shows an example of a nonrepudiation system that uses digital signatures. Linda sends her broker Tom an electronic order to buy 100 shares of IBM stock. The electronic transmission application on Linda's system attaches Linda's digital signature to the order before sending the order to Tom. Linda's digital signature provides Tom with proof that Linda sent the order. When Tom receives the purchase order, an acknowledgment of his receipt, including his own digital signature, is returned to Linda. This receipt serves as proof that Tom received the order. Nonrepudiation is critical for the security of electronic data interchange (EDI).

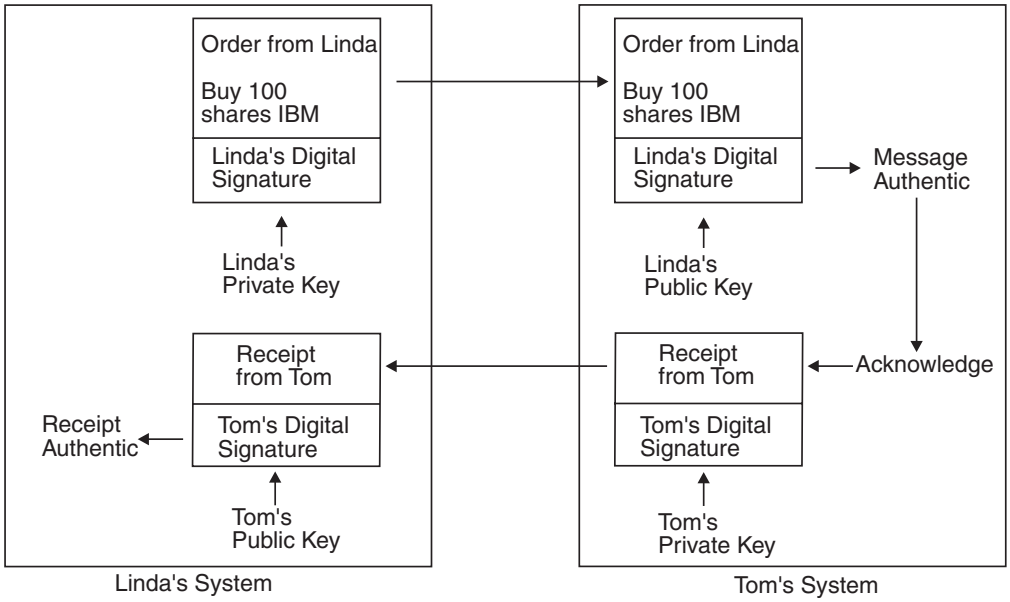

Figure 3. An Example of Nonrepudiation Using Digital Signatures

How Does ICSF Support Cryptography?

ICSF supports IBM's Common Cryptographic Architecture (CCA). The CCA is based on the ANSI Data Encryption Algorithm (DEA). DEA is also known as the U.S. National Institute of Science and Technology Data Encryption Standard (DES) algorithm. In this secret key cryptography system, two parties share secret keys that are used to protect data and keys that are exchanged on the network. Sharing secret keys establishes a secure communications channel. The only way to protect the security of the data in a shared secret key cryptographic system is to protect the secrecy of the secret key.

On some models of the S/390 G4 Enterprise Servers, and above, ICSF also supports triple DES encryption for data privacy. Triple DES uses three, single-length keys to encipher and decipher the data. This results in a stronger form of cryptography than that available with single DES encipherment.

ICSF also supports the Commercial Data Masking Facility (CDMF) on the S/390 G3 Enterprise Server, and above, and the S/390 Multiprise. CDMF uses an IBM algorithm that shortens the effective length of any cryptographic key that is used in data confidentiality services such as encryption and decryption. CDMF is an exportable version of DES cryptography.

For public key cryptography, ICSF supports both the Rivest-Shamir-Adelman (RSA) algorithm [1], and the NIST Digital Signature Standard algorithm. RSA and DSS are the most widely used public key encryption algorithms. In this system, each party establishes a pair of cryptographic keys, which includes a public key and a private key. Both parties publish their public keys in a reliable information source, and maintain their private keys in secure storage.

1. Invented in 1977 by Ron Rivest, Adi Shamir, and Leonard Adelman

Note: Public key cryptography is available only on S/390 G3 Enterprise Servers, and above, and S/390 Multiprises.

How Does ICSF Extend the Uses of Cryptography?

In addition to the encryption and decryption of data, ICSF provides application programs with a callable interface to perform the following tasks:

- Generate, install, and distribute DES cryptographic keys securely using both public and secret key cryptographic methods
- Generate, verify, and translate personal identification numbers (PINs)
- Ensure the integrity of data by using message authentication codes (MACs), hashing algorithms, digital signatures, or the VISA Card Verification Value/MasterCard Card Verification Code
- Develop ANSI X9.17 key management protocols
- Develop Secure Electronic Transaction (SET) applications at the merchant and acquirer payment gateway
- PKA-encrypt and PKA-decrypt symmetric key data that Secure Sockets Layer (SSL) applications can use to generate session keys

Key Generation and Distribution

With ICSF callable services, you can generate a variety of cryptographic keys for use on your system or distribution to other systems. You can develop key distribution protocols by using both secret key and public key cryptographic methods. With a secret key distribution system, you must first share a secret key with the system to which you intend to distribute keys. This is a major drawback with secret key distribution systems. With public key cryptography, however, you encrypt the keys you are distributing under the receiver's public key. The receiver decrypts the keys by using the receiving system's private key. Public key encryption provides methods for key distribution and authentication.

Personal Identification Numbers (PINs)

Many people are familiar with PINs, which enable them to use an automated teller machine (ATM). Financial networks use PINs primarily to authenticate users. Typically, the financial institution assigns a PIN. The user enters the PIN at automated teller machines (ATMs) to gain access to his or her accounts. It is extremely important to keep the PIN private, so that no one other than the account owner can use it.

ICSF enables your applications to generate PINs, to verify supplied PINs, to translate PINs from one format to another, and to store and transmit PINs in encrypted PIN blocks.

Message Authentication Codes (MACs)

MACs are used to authenticate and verify data that is transmitted over a network, stored on the system, or stored outside the system (for example, on removable media such as tape). The MAC is a 32-bit value that is generated by using the data itself and a DES key, as specified in the ANSI X9.9 and ANSI X9.19 standards. The MAC is sent or stored with the data. The MAC is verified when the data is received, or retrieved from storage. The MAC verification process uses the data and either a MAC verification key, a MAC generation key, or a DATA key. If the verification is successful, the data has not been altered. ICSF enables your application to generate and verify MACs.

MACs give you the following benefits:

- You can validate the authenticity of data that is transmitted over a network. You can also ensure that nothing has altered the data during transmission. For example, an active eavesdropper might tap into a transmission line, and either interject bogus messages or alter sensitive data that is being transmitted. Since the sender and the receiver share a secret key, the receiver can use a callable service to calculate a MAC on the received message. The application then compares the MAC it calculates to the MAC that was transmitted with the message. The message is accepted as genuine and unaltered only if the two MACs are identical.
- Similarly, you can store a MAC with data on tape or DASD. Then, when the system retrieves the data, an application can generate a MAC and compare it with the original MAC to detect alterations.
- In either data transmission or storage, you can use MACs in an anti-virus campaign. MACs help ensure that no unauthorized executable code has been inserted into your system.

Hashing Algorithms

The use of a hashing algorithm is another means of verifying that data has not been altered during transmission or storage. A hash, or message digest, is calculated with a public, one-way function, rather than with a secret key like a MAC. A hash, therefore, cannot be used to verify the authenticity of a message. Hashes are used in situations where it is impractical to share a secret key. For example, you can use a hash as part of a software delivery process to uncover deliberate or inadvertent modifications to software.

The originator of the data calculates the hash using the data itself and the hashing algorithm. The originator then ensures that the hash is transmitted with integrity to the intended receiver of the data. One way to ensure this is to publish the hash in a reliable source of public information. When the receiver gets the data, an application can generate a hash and compare it to the original one. If the two are equal, the data can be accepted as genuine; if they differ, the data is assumed to be bogus.

You can use the ICSF hashing algorithms to generate modification detection codes (MDCs), support the Public Key Cryptographic Standard (PKCS), and create hashes for digital signatures.

Digital Signatures

The RSA and DSS public key cryptography systems authenticate messages and their senders through the use of *digital signatures.* A digital signature on an electronically distributed document is similar to a handwritten signature on a paper document. It is not easy to forge either type of signature. Both types of signatures authenticate that the signing party either agreed to, or generated and/ agreed to, the signed document.

The originator of the data uses a hash of the data and the originator's private key to create the digital signature. The digital signature is then attached to the message. The receiver uses the originator's public key and the signed message to verify that the message was signed by the originator.

Figure 4 on page 7 is an example of using digital signatures. The sender uses a hash of the message and the private key to create the digital signature and attach it to the message before sending it to the receiving system. The receiver uses the

sender's public key to regenerate the hash value from the digital signature and compares this hash value to a hash calculated on the received message. If the two hash values match, the message is considered to be authentic.

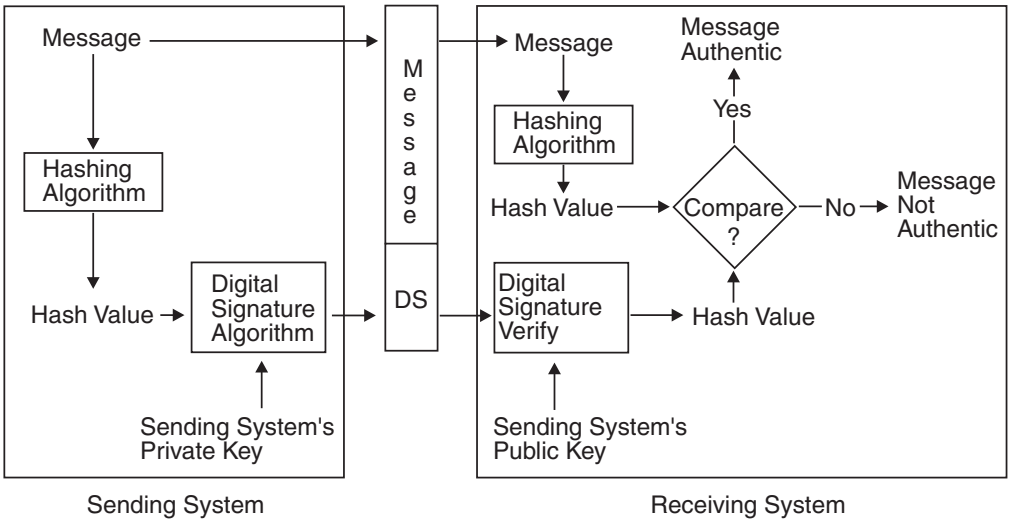

Figure 4. Creating and Verifying Digital Signatures in a Public Key System

Card-Verification Values

The Visa International Service Association (VISA) and MasterCard International, Incorporated have specified a cryptographic method to calculate a card verification value or code. This value relates to the personal account number (PAN), the card expiration date, and the service code. ICSF provides callable services to generate and verify the VISA card-verification value (CVV) and the MasterCard card-verification code (CVC) by the track-2 method.

Translation of Data and PINs in Networks

Increasingly data is being transmitted across networks in which, for various reasons, the keys that are used on one network cannot be used on another network. Encrypted data and PINs that are transmitted across these boundaries must be "translated" securely from encryption under one key to encryption under another key. For example, a traveler visiting a foreign city might wish to use an ATM to access an account at home. The PIN that is entered at the ATM might need to be encrypted there and sent over one or more financial networks to the traveler's home bank. The home bank must verify the PIN before the ATM in the foreign city allows access. On intermediate systems (between networks), applications can use the Encrypted PIN translate callable service to reencrypt a PIN block from one key to another. These applications can use ICSF to ensure that PINs never appear in the clear and that the keys for encrypting the PIN are isolated on their own networks. Further, applications that use ICSF can increase transaction rates.

ANSI X9.17 Key Management

ICSF supports the ANSI X9.17 key management standard, which defines a process for protecting and exchanging keys. Distributing keys according to this standard permits interoperability among financial institutions. It also permits interoperability between financial institutions and their wholesale customers.

SET Secure Electronic Transaction

The SET Secure Electronic Transaction standard is a global industry specification that was developed jointly by Visa International, MasterCard, and other companies. The SET protocol uses digital certificates to protect credit card transactions that are conducted over the Internet. The SET standard is a major step toward securing Internet transactions, paving the way for more merchants, financial institutions, and consumers to participate in electronic commerce.

ICSF provides callable services that support the development of SET applications that run at the merchant and acquirer payment gateway.

Secure Sockets Layer (SSL)

Secure Sockets Layer (SSL) is an industry-standard protocol that the Netscape Development Corporation designed to provide a data security layer between application protocols and TCP/IP. The SSL security protocol is widely deployed in applications on both the Internet and private intranets. SSL defines methods for data encryption, server authentication, message integrity, and client authentication for a TCP/IP connection. SSL uses public key and symmetric techniques to protect information.

SSL requires the decryption of a 48-byte SSL seed and the manipulation of this seed in the clear to produce symmetric session keys. The Common Cryptographic Architecture (CCA), however, does not permit even privacy session keys to appear in the clear in host storage. The new ICSF SSL support services permit the RSA encryption and decryption of any PKCS 1.2-formatted symmetric key data. The PKA encrypt callable service encrypts a supplied clear key under an RSA public key. Using the PKA decrypt callable service makes it possible to unwrap the RSA-encrypted SSL seed and return it to the application in the clear. The application can then use this clear key to generate session encryption keys.

Chapter 2. Solving Your Business Needs with ICSF

As more businesses automate their operations and start conducting electronic commerce over the Internet, the increased use of workstations and automated teller machines generates high transaction loads. Attacks on security are becoming more sophisticated. Criminals can gain tremendous payoffs from wiretapping and theft of data from storage.

Electronic commerce, electronic funds transfer (EFT), and electronic data interchange (EDI) applications can use ICSF callable services to secure Internet transactions. These applications can make use of cryptography to protect funds transfers, purchase orders, letters of intent, contracts, credit card information, and other sensitive data from the risks of theft, fraud, or sabotage. A business can also decrease the amount of sensitive material that is exchanged by couriers. This allows a business to provide better service, become more competitive, and potentially reduce its expenses.

ICSF provides a high level of security and integrity for your data. It can help you meet many of the current needs and the future needs of your business by solving many of the information system security problems you face. This chapter explains how you can use ICSF for data security, key exchange, and personal authentication.

Keeping Your Data Private

ICSF cryptographic functions are specifically designed for high security. ICSF uses the DES algorithm, which is widely regarded as highly secure, to encipher and decipher data. In addition, ICSF also provides the following security precautions:

- The master keys are stored in highly secure hardware.
  - Cryptographic Coprocessor Feature

    This feature is available on the S/390 G3 Enterprise Server and above, and the S/390 Multiprise. The Cryptographic Coprocessor Feature can have up to two cryptographic coprocessor chips (crypto CPs) as high-speed extensions of the central processor. Each crypto CP contains both DES and PKA cryptographic coprocessors. The Cryptographic Coprocessor Feature holds all master keys internally in Custom Static Random Access Memory (C-SRAM) that is battery-protected. The secure registers are not accessible through either internal code or scanning of the hardware. The Cryptographic Coprocessor Feature is also protected by tamper-detection circuitry.

    The Cryptographic Coprocessor Feature on S/390 G5 Enterprise Server, and above, is currently certified for Federal Information Processing Standard (FIPS) 140-1 level 4. This includes algorithmic certification under FIPS 46-2 (DES), FIPS 180-1 (Secure Hash Standard), and FIPS 186 (Digital Signature Standard).
  - PCI Cryptographic Coprocessor

    The PCI Cryptographic Coprocessor is available on the S/390 G5 Enterprise Server, S/390 G6 Enterprise Server, and the IBM @server zSeries. The PCI Cryptographic Coprocessor, which works in conjunction with the Cryptographic Coprocessor Feature, provides the capability of generating and retaining RSA keys in secure hardware. This capability meets a requirement to become a SET Certificate Authority.
  - PCI Cryptographic Accelerator

The PCI Cryptographic Accelerator is available on the IBM @server zSeries and can support any combination of PCI Cryptographic Coprocessors or PCI Cryptographic Accelerators, but the total must not exceed 16.

- DES keys and PKA private keys are encrypted under the master keys for protection.
- You can use cryptographic keys for only their intended function. For example, a program that uses a key to verify a MAC cannot use the same key to generate MACs.
- You can use IBM Resource Access Control Facility (RACF) to control access to specific ICSF callable services, to specific keys that are stored in a CKDS, or to both.
- With the optional Trusted Key Entry (TKE) workstation, you can create a logical secure channel. You can then use this channel to distribute master keys and operational keys to remote systems. The TKE workstation is particularly suited to the distributed computing environment that requires remote key management of one or more systems. For added security, you can require that multiple security officers perform critical operations. The TKE workstation is available with the S/390 G3 Enterprise Server and above, the S/390 Multiprise, and the IBM @server zSeries.

Transporting Data Securely Across a Network

You may need to protect data that is sent between two applications when the data must pass through one or more intermediate systems.

In a DES cryptographic system, if the two applications cannot share a key, you must set up an application on one or more of the intermediate systems to translate the ciphertext from encryption under the sending system's key. Translation re-encrypts the ciphertext under a new key for which the receiving system has a complementary key.

An application can use the ICSF ciphertext translate callable service to do this. ICSF prevents the recovery of plaintext on intermediate systems, because you cannot decrypt the data with the same key that is used to translate the ciphertext on the intermediate system. Figure 5 on page 11 illustrates the use of the ciphertext translate callable service.

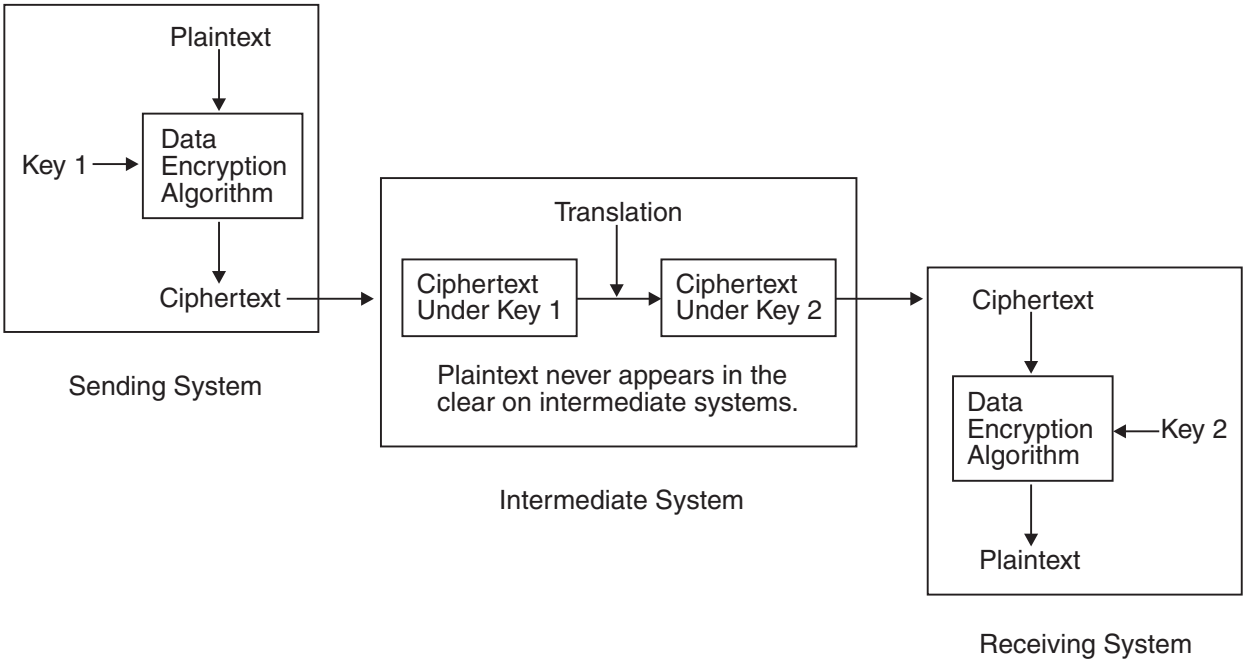

Figure 5. DES Encrypted Data Protected When Sent on Intermediate Systems

In a PKA cryptographic system, you can develop an application that does not require translation of ciphertext by the intermediate systems. The sender enciphers the message by using a DES data-encrypting key. The sender then uses the receiver's PKA public key to encipher the DES data-encrypting key. The intermediate system merely transfers the ciphertext and the enciphered key to the receiving system. The intermediate system does not have the receiver's PKA private key and, therefore, cannot decipher the enciphered data-encrypting key. Without the deciphered data-encrypting key, the intermediate system cannot decipher the message. The receiving system uses its PKA private key to decipher the DES data-encrypting key, which it then uses to decipher the message Figure 6 on page 12.

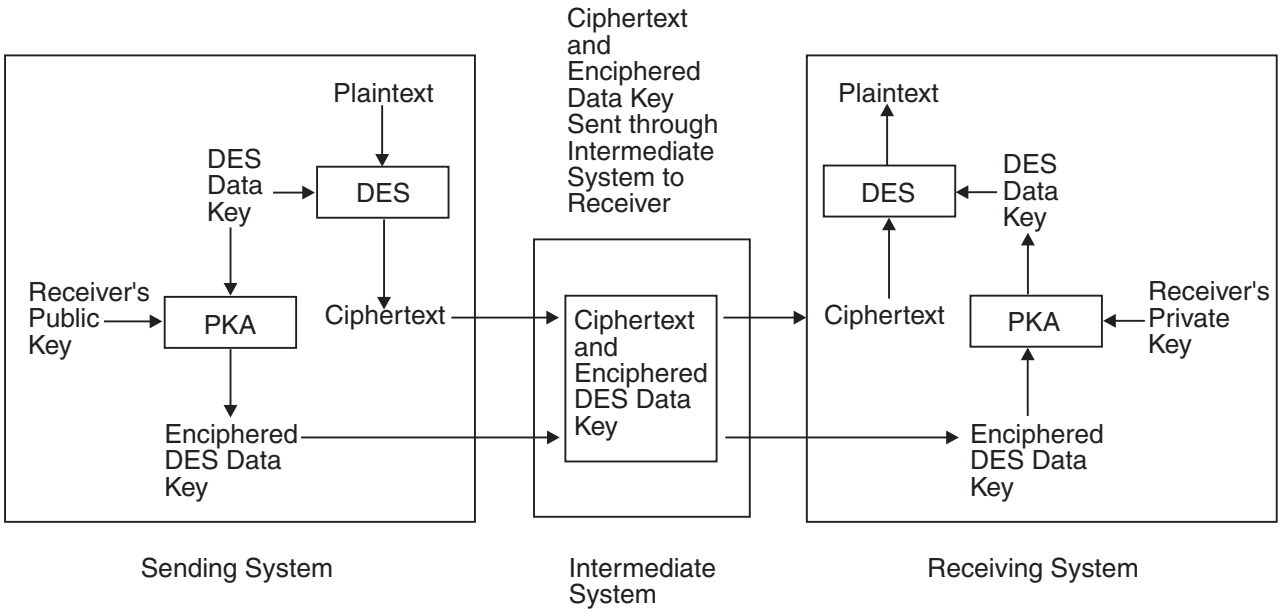

Figure 6. PKA Encrypted Data Protected When Sent on Intermediate Systems

Supporting the Internet Secure Sockets Layer Protocol

The Secure Sockets Layer (SSL) provides a data security layer between the network layer and various internet transfer protocol applications. For example, SSL can provide a secure session between the transmission control protocol/internet protocol (TCP/IP) network layer and the hypertext transfer protocol (HTTP) or file transfer protocol (FTP) application. SSL provides data encryption, message integrity, and server authentication for TCP/IP connections between clients and servers. SSL ensures that credit card numbers and other sensitive information can be sent over the Internet without fear of interception.

To begin a secure session, the server and client exchange a handshake. In this digital handshake, the client and server are authenticated and also agree on the SSL version, data compression method, and cryptographic algorithm they will use when exchanging data. They also exchange an RSA-encrypted seed key that SSL manipulates to create symmetric session keys that are used to encrypt the data that the client and server exchange. The ICSF PKA encrypt and PKA decrypt callable services provide a secure method for SSL applications to exchange this seed key.

Transacting Commerce on the Internet

The Internet is rapidly becoming a major arena of commerce. For electronic commerce to grow to its full potential, however, we need to resolve several barriers to buying and selling over the Internet. Consumers are reluctant to send their bank card data over the Internet without assurances that this information is secure. Merchants need to be able to determine the clear identities of their online customers. The SET Secure Electronic Transaction protocol can help to break down these major barriers to electronic commerce. MasterCard and Visa, with the assistance of IBM and a number of technology industry partners, cooperatively developed the SET protocol.

SET is an industry-wide, open standard for online credit card transactions. The SET protocol addresses the transaction payment phase of a transaction from the individual, to the merchant, to the acquirer (the merchant's current credit card processor). The SET protocol ensures the privacy and integrity of real time bank card payments over the Internet. In addition, with SET in place, everyone in the payment process knows the identity of everyone else. The core protocol of SET is the use of digital certificates to fully authenticate the card holder, the merchant, and the acquirer. Each participant in the payment transaction holds a certificate that validates his or her identity. Public key cryptography makes it possible to exchange, check, and validate these digital certificates for every Internet transaction. The mechanics of this operation are transparent to the application.

Under the SET protocol, a digital certificate which identifies the card-holder to the merchant must accompany every online purchase. The buyer's digital certificate serves as an electronic representation of the buyer's bank card but does not actually show the credit card number to the merchant. The merchant's SET application authenticates the buyer's identity. The application then decrypts the order information, processes the order, and forwards the still-encrypted payment information to the acquirer for processing. The acquirer's SET application authenticates the buyer's credit card information, identifies the merchant, and arranges settlement. With SET, the Internet becomes a safer, more secure environment for the use of payment cards.

Communicating Securely in a Multinational Enterprise

In today's global economy, many corporations, financial institutions, and other organizations have affiliates, subsidiaries, and customers located throughout the world. U.S. export regulations control the export of DES cryptographic devices to other countries, possibly limiting their usefulness in a multinational organization.

IBM solves these export concerns with the Commercial Data Masking Facility (CDMF), an exportable version of DES cryptography. In a CDMF system, data-encrypting keys used in confidentiality services such as enciphering and deciphering are algorithmically shortened prior to the cryptographic calculation. The key-shortening process is transparent at the application programming level. Therefore, an application that is developed to provide DES privacy functions can also support an exportable CDMF environment with no additional development cost.

Note: CDMF is available only on S/390 G3 Enterprise Server, or higher and S/390 Multiprise with the Cryptographic Coprocessor Feature.

Exchanging Keys Safely Between Networks

The practice of transmitting clear keys between networks can be a security exposure. Persons that obtain the clear keys can use them to decrypt transmitted data. ICSF offers several ways to eliminate this problem and ensure that keys are transmitted safely.

Exchanging Keys Using DES Callable Services

ICSF provides the following security measures for DES key exchange:

- Encrypting the keys to be sent between systems, so that they are not in the clear.
- Requiring that specialized transport keys protect the data-encrypting keys or key-encrypting keys. Transport keys can be used only to protect other keys; they cannot be used for other cryptographic operations.

- Requiring that the sending (exporting) and receiving (importing) of a key be by two different, complementary forms of the same transport key (for example, export and import). These two forms are complements of each other. You cannot use a key in place of its complement.
- Requiring that a key protected under a transport key be made no longer operational—that is, not usable for other cryptographic functions such as encryption, MAC verification, and PIN verification. Only the receiving system can make a protected key operational.

An “exported” key is a key that leaves your system. The transport key that is used to protect it is called an exporter key-encrypting key. When another system receives the key, the key is still protected under the same key-encrypting key. This key-encrypting key must be installed as an importer key-encrypting key on the receiving system. Before two systems can exchange keys, they must establish pairs of transport keys. The exporter key-encrypting key and the importer key-encrypting key are a complementary pair. You can set up pairs of transport keys, using the key generator utility program (KGUP) or callable services. To exchange keys in only one direction, you need a single pair of transport keys. To exchange keys in both directions, you need two pairs of transport keys. The illustration in Figure 7 shows an example of using DES transport keys to exchange keys between systems.

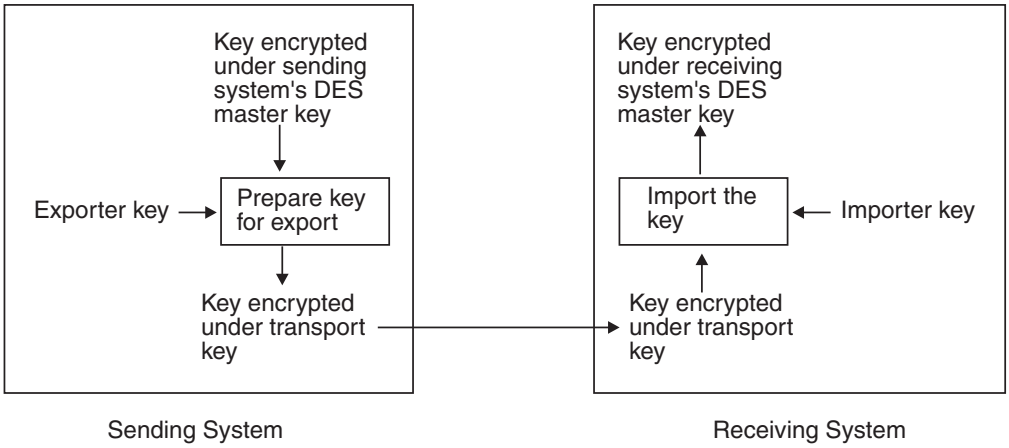

Figure 7. Key Exchange in a DES Cryptographic System

Note: In Cryptographic Unit Support Program (CUSP) and Program Cryptographic Facility (PCF) applications, transport key could only protect data-encrypting keys. In ICSF, all DES keys can be protected and securely distributed through the use of transport keys.

Exchanging DES Data-encrypting Keys Using an RSA Key Scheme

The ability to create secure key-exchange systems is one of the advantages of combining both DES and PKA support in the same cryptographic system. Because PKA cryptography uses more intensive computations than DES cryptography, it is not the method of choice for all cryptographic functions. PKA cryptography enhances the security of DES key exchange. DES data-encrypting keys that are encrypted using an RSA public key can be exchanged safely between two systems. The sending system and the receiving system do not need to share a secret key to be able to exchange RSA-encrypted DES data-encrypting keys. Figure 8 shows an example of this. The sending system enciphers the DES data-encrypting key under the receiver’s RSA public key and sends the enciphered data-encrypting key to the

receiver. The receiver deciphers the data-encrypting key by using the receiving system's RSA private key.

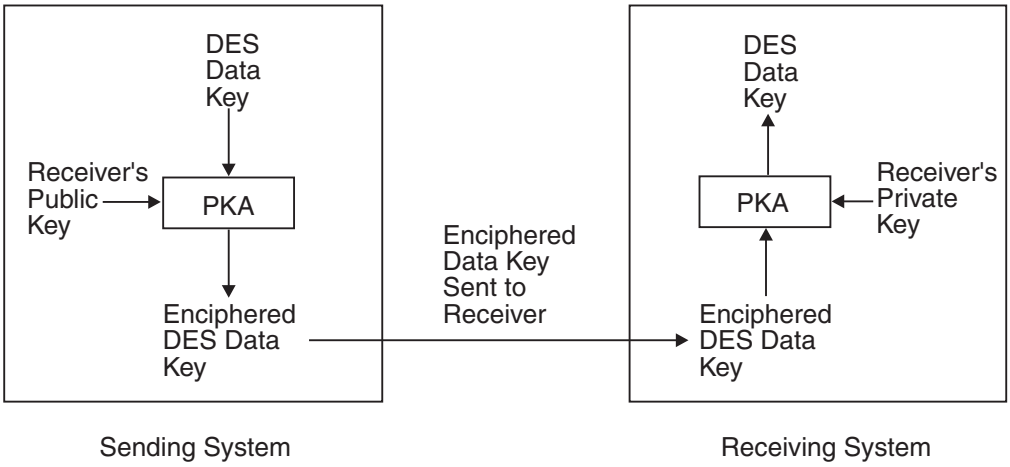

Figure 8. Distributing a DES Data-encrypting Key Using an RSA Cryptographic Scheme

Note: Only DES and CDMF data-encrypting keys can be encrypted under RSA public keys.

Developing ANSI X9.17 Key Management Standard Protocols

ICSF supports the ANSI X9.17 Financial Institution Key Management standard, which defines methods for generating, exchanging, using, storing, and destroying DES keys. ICSF callable services allow you to develop key distribution applications according to this standard.

Managing Keys Using a Trusted Key Entry Workstation

ICSF supports a Trusted Key Entry (TKE) workstation (TKE Versions 1, 2 and 3), which is available as an optional feature on S/390 G3 Enterprise Server, or higher, and the S/390 Multiprise. The TKE workstation enables the creation of a logically secure channel for master key entry and key distribution. All versions of the TKE workstation are secure. TKE workstations, TKE Version 1 and Version 2, are APPC attached. TKE workstations, TKE Version 3, are TCP/IP attached. Through TCP/IP, the TKE workstation (TKE Version 3) enables the creation of a logically secure channel for master key entry and key distribution. The TKE workstation uses a variety of public key cryptographic techniques to ensure both the integrity and the privacy of the master key transfer channel. In addition, you can use a single TKE workstation to set up master keys in all the cryptographic coprocessors to which it is APPC (TKE Version 1 or Version 2) or TCP/IP (TKE Version 3) attached without manual intervention. The TKE workstation also provides support for loading operational transport and PIN keys. TKE Version 1 and 2 supports the optional 4754 Security Interface Unit. This makes migration easier for installations that store their key parts on Personal Security cards. Personal Security cards are not supported in TKE Version 3 or higher.

Using Personal Identification Numbers (PINs) for Personal Authentication

Personal authentication is the process of validating personal identities. The personal identification number (PIN) is the basis for verifying the identity of a customer across financial industry networks. ICSF provides callable services to generate and verify PINs, and translate PIN blocks. You can use the callable services to prevent unauthorized disclosures when organizations handle PINs. Except for the Clear PIN generate callable service, PINs never appear in the clear.

ICSF provides services for handling a wide variety of PIN block formats, including:

- ISO Format 0 (same as ANSI X9.8, ECI Format 1, and VISA Format 1)
- ISO Format 1 (same as ECI Format 4)
- ISO Format 2
- VISA Format 2
- VISA Format 3
- VISA Format 4
- IBM 4704 Encrypting PINPAD Format
- IBM 3624 Format
- IBM 3621 Format (same as IBM 5906)
- ECI Format 2
- ECI Format 3

ICSF also supports the following Clear PIN generate and verification algorithms:

- IBM 3624 Institution-Assigned PIN
- IBM 3624 Customer-Selected PIN (through a PIN offset)
- IBM German Bank Pool PIN (verify through an institution key)
- IBM German Bank Pool PIN (verify through a pool key and a PIN offset)
- VISA PIN (through a VISA PIN validation value)
- Interbank PIN

For more information about PIN block formats and the ICSF callable services that support PINs, refer to *z/OS ICSF Application Programmer's Guide*.

Verifying Data Integrity and Authenticity

ICSF provides several processes for verifying the integrity of transmitted messages and stored data:

- Message authentication codes (MAC)
- Modification detection codes (MDC) or hashes
- Digital signatures
- VISA card-verification value or MasterCard Card Verification Code

These processes enable your applications to verify that a message you have received has not been altered. The message itself can be in clear or encrypted form. In addition, digital signatures also authenticate the message sender's identity. VISA card-verification values ensure the safe transmission of credit card information over a computer network.

Your choice of callable service depends on the security requirements of your environment. If the sender and receiver share a secret key, use MAC processing to ensure both the authenticity of the sender and the integrity of the data. If the sender and receiver do not share a secret key, use a digital signature to ensure both the authenticity of the sender and the integrity of the data. If the sender and the receiver do not share a secret cryptographic key and you need to ensure only the integrity of transmitted data, use a hashing process.

Using Message Authentication Codes

To use message authentication when sending a message, an application generates a MAC for it using the MAC generate callable service and one of the following methods:

- The ANSI standard X9.9, option 1 with either a single-length MAC key or a single-length DATA key
- The X9.19 optional double key MAC procedure with using a double-length MAC key.
- The EMV padding rules with using either a single-length or double-length MAC key

The originator of the message then sends the MAC with the message text.

When the receiver gets the message, an application program calls the MAC verification callable service. The service again encrypts the message text by using the same method that was used to compute the original MAC. The callable service then notifies the receiver whether the MAC has been verified or not. The callable service does not allow the receiver to have access to the MAC it generates. Because the sender and the receiver share secret cryptographic keys that are used in the MAC calculation, the MAC comparison also ensures the authenticity of the message.

Note: ICSF provides support for the use of a DATA key in the MAC generate and MAC verify callable services and the use of a MAC key in the MAC verify service. Double key MAC generation requires a double-length MAC key. Double key MAC verification requires either a double-length MAC key or a double-length MACVER key. Only the S/390 G5 Enterprise Server, or above, servers support double-length MACVER keys.

Generating and Verifying Digital Signatures

An application generates a digital signature for a message by first supplying a hash of the message to the digital signature generate callable service. The callable service then uses the signer's private key to create the signature. ICSF supports the use of both RSA and DSS RSA digital signatures. To verify the digital signature, the receiver's application supplies a hash of the message and the digital signature to the digital signature verify callable service. The callable service then uses the sender's public key to verify the signature. A return code indicates that the verification either succeeded or failed. Figure 4 on page 7 provides an example of using digital signatures.

Using Modification Detection Codes and Message Hashing

When you are sending a message, use either the MDC generate callable service, or the one-way hash generate callable service to generate a message hash. The choice depends on the cryptographic standard you are using.

The MDC is a 128-bit value that is generated by a one-way cryptographic calculation. The originator of the message transmits the MDC with integrity to the intended receiver of the file. For instance, the originator could publish the MDC in a reliable source of public information. The receiver of the message can use an application program and the same callable service to generate another MDC. If the two MDCs are identical, the receiver assumes that the message is genuine. If they differ, the receiver assumes that someone or some event altered the message.

A hash is a message digest that is generated by a one-way cryptographic calculation. ICSF supports the MD5 hash algorithm, which produces a 128-bit hash value that can be used to generate RSA digital signatures. ICSF also supports the SHA-1 hash algorithm, which generates a 160-bit hash value. Both the RSA and DSS applications can use the SHA-1 hash value and the originator's private key to generate a digital signature and attach it to the message. The receiver of the message uses the originator's public key to authenticate the digital signature.

Both MACs and hashes can be used similarly to ensure the integrity of data that is stored on the system or on removable media such as tape.

Verifying Payment Card Data

The Visa International Service Association (VISA) and MasterCard International, Incorporated have specified a cryptographic method to calculate the VISA card-verification value (CVV) and the MasterCard card-verification code (CVC). This value relates to the personal account number (PAN), the card expiration date, and the service code and is used to detect forged cards. The CVC can be encoded on either track 1 or track 2 of a magnetic-striped card. Because most online transactions use track-2, the ICSF callable services generate and verify the CVV[2] by the track-2 method.

The VISA CVV service generate callable service calculates a 1- to 5-byte CVV. This value results from using two data-encrypting keys to DES-encrypt the PAN, the card expiration date, and the service code. The VISA CVV service verify callable service calculates the CVV by the same method. The service compares the CVV it calculates to the CVV supplied by the application (which reads the credit card's magnetic stripe). The service then issues a return code that indicates whether the card is authentic.

Maintaining Continuous Operations

ICSF provides continuous cryptographic operations. Cryptographic keys stored in a cryptographic key data set (CKDS) can be reenciphered under a new master key or updated by using either the key generator utility program or the dynamic CKDS update callable services. ICSF performs these updates without disrupting applications in process. With CUSP and PCF, you need to stop cryptographic functions before changing the master key or updating the CKDS. You do not need to stop ICSF or interrupt cryptographic applications before changing the DES master key, refreshing the CKDS, or dynamically updating either the CKDS or the public key data set (PKDS).

Note: The ability to change the master key or update the CKDS without interruption requires that ICSF be running in noncompatibility mode. That is, you must

2. The VISA CVV and the MasterCard CVC refer to the same value. This information uses CVV to mean both CVV and CVC.

convert all existing CUSP and PCF applications to the new callable services. For a description of noncompatibility mode, see “Running CUSP and PCF Applications under ICSF” on page 37.

The following features and actions enhance the security of cryptographic functions:

- Performing cryptographic calculations and storing master keys within tamper-resistant hardware
- Enforcing separation of DES keys
- Controlling access to functions and keys through the use of RACF
- Generating system management facility (SMF) audit records

Use the interactive dialog panels to display the status of the cryptographic feature.

Reducing Costs by Improving Productivity

ICSF improves productivity by simplifying routine operations and providing interfaces and callable services that help you manage your enterprise's cryptographic environment.

ICSF simplifies the job of the security administrator by providing ISPF dialogs for key management and distribution. ICSF on S/390 G3 Enterprise Server, or higher, S/390 Multiprises, and the IBM @server zSeries also provides a pass phrase initialization procedure that generates and enters all needed master keys. Use pass phrase initialization to fully enable your cryptographic system in a minimum of steps. In addition, a series of Clear Master Key Entry panels simplifies the master key entry procedure. These panels permit the administrator to change the DES master key without interrupting application programs that use cryptographic functions.

In enterprises that require enhanced key-entry security, a Trusted Key Entry (TKE) workstation is available as an optional feature. The TKE workstation allows the security administrator to securely load DES and PKA master keys and operational keys (PIN keys and key-encrypting keys). The security administrator can use the TKE workstation to load keys into multiple Cryptographic Coprocessor Features and the PCI Cryptographic Coprocessor from a remote location.

ICSF provides the application programmer with a set of callable services that support cryptographic functions and key management protocols. Applications written in Assembler and several high-level programming languages can use these callable services.

ICSF provides the systems programmer with an easy method of setting and changing the ICSF installation options. The systems programmer needs only to edit an options data set rather than altering an object module. ICSF provides a sample installation options data set in member CSFPRM00 of SYS1.SAMPLIB.

Improving Cryptographic Performance

ICSF uses state-of-the-art hardware to improve performance of both DES and PKA calculations. This can remove limitations on the growth of your installation and enable it to use cryptography in high-transaction-rate applications. ICSF also improves performance by exploiting z/OS and by using an in-storage copy of the CKDS. Maintaining DES cryptographic keys in a protected data space (in addition to a data set) improves performance and availability by reducing requirements for read access to cryptographic keys.

Using RMF and SMF to Monitor z/OS ICSF Events

You can run ICSF in different configurations and use installation options to affect ICSF performance. While ICSF is running, you can use the Resource Management Facilities (RMF) and System Management Facilities (SMF) to monitor certain events. For example, ICSF records information in the ICSF SMF data set when ICSF status changes in a processor or when you enter or change the master key. ICSF also sends information and diagnostic messages to data sets and consoles.

With the availability of cryptographic hardware (PCI Cryptographic Coprocessor and PCI Cryptographic Accelerator) on an LPAR basis, RMF provides performance monitoring in the Postprocessor Crypto Hardware Activity report. This report is based on SMF record type 70, subtype 2. The Monitor I gathering options on the REPORTS control statement are CRYPTO and NOCRYPTO. Specify CRYPTO to measure cryptographic hardware activity and NOCRYPTO to supress the gathering. In addition, overview criteria is shown for the Postprocessor in the Postprocessor Workload Activity Report - Goal Mode (WLMGL) report. Refer to *RMF Programmer's Guide*, SC33-7994, *RMF User's Guide*, SC33-7990, and *RMF Report Analysis*, SC33-7991 for additional information.

For diagnosis monitoring, use Interactive Problem Control System (IPCS) to access the trace buffer and to format control blocks.

Improving Performance in a CICS Environment

ICSF supports a CICS-ICSF attachment facility that improves the performance of applications in the CICS regions when an application in the region requests a long-running ICSF service. The attachment facility consists, in part, of a CICS Task Related User Exit (TRUE) that attaches a task control block that does the actual call to the ICSF services. The CICS Resource Manager Interface allows a CICS application program to invoke code that is not written expressly for use under CICS, using the application programming interface that is native to that code. Code that is accessed in this manner is called a resource manager. In the case of the CICS-ICSF attachment facility, ICSF becomes a resource manager for CICS. This means that a CICS application desiring to use long-running ICSF services (such as PKA operations) can be placed in a CICS WAIT rather than an OS WAIT for the duration of the operation. This results in improved performance for other applications that are running in the same CICS region.

For additional information about installing the CICS-ICSF attachment facility or creating a modifiable CICS Wait List, refer to *z/OS ICSF System Programmer's Guide*. The WAITLIST parameter, an option in the Installation Options data set, points to a modifiable data set which contains the names of services that are placed in the CICS Wait List. If this option is not specified, the default ICSF CICS Wait List will be utilized by ICSF when a CICS application invokes an ICSF callable service.

Customizing ICSF to Meet Your Installation's Needs

ICSF provides the flexibility your installation needs to customize your cryptographic system.

Using ICSF Exits to Meet Special Needs

Exits are programs that your system programmer writes to meet your installation's particular needs. These exits (and installation-defined callable services) perform tasks such as tailoring, monitoring, changing, or diagnosing ICSF. Use of such

interfaces can create dependencies on the detailed design or implementation of ICSF. For this reason, use installation exits only for these specialized purposes.

ICSF exits include the following:

- Exits called when an operator command starts, stops, or changes ICSF
- An exit for each of the callable services
- Exits that are called when you access the disk copy of the CKDS
- An exit that is called when an application accesses the in-storage CKDS

For more information about ICSF exits, refer to *z/OS ICSF System Programmer's Guide*.

Creating Installation-Defined Callable Services

Your installation can define a callable service that will run in the ICSF address space and have access to selected ICSF control blocks.

Using Options to Tailor ICSF

ICSF lets your installation use different sets of options at different times in the operation of your system. Your installation can specify which options are in each set. The following are some of your choices:

- You can choose which of three migration options to use when migrating from, or coexisting with, CUSP or PCF: noncompatibility mode, compatibility mode, or coexistence mode.

  For more information on running CUSP and PCF applications with ICSF, refer to "Running CUSP and PCF Applications under ICSF" on page 37.
- You can allow processing in special secure mode, in which you can work with clear keys and clear PINs. Alternatively, you can disallow processing in that mode.
- For each exit point, you can specify the name of the exit routine and operating information.
- You can alter the REASONCODES options parameter in the Installation Options data set to determine which set of reason codes (ICSF or TSS values) are returned to application service calls. If the REASONCODES option is not specified, the default of REASONCODES(ICSF) is used. The codes will only be converted if there is a 1-to-1 correspondence.
- You can use the WAITLIST (data_set_name) options parameter in the Installation Options Data Set to point to a modifiable data set that contains the names of services that are placed into the CICS Wait List. If the WAITLIST option is not specified, the default ICSF CICS Wait List will be utilized by ICSF when a CICS application invokes an ICSF callable service.
- You can use the UDX(UDX-id,service-number,load-module name,'comment_text',FAIL(fail-option)) parameter to define a User Defined Extension (UDX) service to ICSF.
- You can use the PKDSCACHE option to define the size of the PKDS cache in records. The PKDS cache improves performance as it facilitates access to frequently used records. Specify *n* as a decimal value from 0 to 256. If *n* is zero, no cache will be implemented. If PKDSCACHE is not specified, the default value is 64. PKDSCACHE can be implemented on OS/390 V2 R10 and z/OS V1 R1 by installing APAR OW48568.

Isolating and Protecting PR/SM Partitions

If you are using the Processor Resource/Systems Manager (PR/SM) feature to run in logically partitioned mode, each PR/SM partition is able to use its own DES and PKA master keys on the Cryptographic Coprocessor Feature and symmetric-keys master key (SYM-MK) and asymmetric-keys master key (ASYM-MK) on the PCI Cryptographic Coprocessor. This allows your installation to have multiple independent cryptographic systems running on the same processor with the same degree of isolation and protection as if they were running on physically separate processors.

On S/390 G3 Enterprise Server, and above, and the S/390 Multiprise with the optional TKE workstation, you can easily set up and change the security parameters for each partition. This allows you to customize the security requirements for each partition separately.

Enabling Growth

For applications that need to protect critical data against disclosure or modification, ICSF provides callable services that enable high-level language applications to easily access the system's underlying cryptographic functions.

By providing callable services that comply with IBM's Common Cryptographic Architecture (CCA), ICSF enables application designers and programmers to extend the uses of their current applications. Most of the callable services provided by ICSF are also provided by the IBM 4753 Network Security Processor MVS Support Program (4753-HSP), program number 5706-028. This allows the development of significant applications for both CCA and ANSI X9.17 key management that will run without change on both systems.

With the introduction of the PCI Cryptographic Coprocessor, you can now generate RSA keys.

ICSF's callable services enable installations to add cryptographic functions (such as MAC generation and verification) to current applications without redesign.

The combination of the hardware cryptographic feature and ICSF provides high-performance cryptography, which removes bottlenecks on high-volume transaction applications and gives them needed protection. ICSF can support any combination of PCI Cryptographic Coprocessors or PCI Cryptographic Accelerators, but the total must not exceed 16.

An installation can use ICSF installation exits to change or extend the callable services.

Protecting Your Investment

The use of an enterprise's computing resources is improved and protected by built-in product features.

An ICSF/MVS Version 1 Release 2, or later, Cryptographic Key Data Set (CKDS) can be used in OS/390 ICSF or z/OS without change. If you are upgrading from ICSF/MVS Version 1 Release 1, use the conversion program that is provided to migrate an ICSF/MVS Version 1 Release 1 CKDS for use with later releases of ICSF. The migration program, which can run under either product version, leaves an appropriate audit trail.

ICSF also ensures that existing Cryptographic Unit Support Program (CUSP) or Program Cryptographic Facility (PCF) cryptographic applications, skills, and equipment can continue to be used effectively. This facilitates the earlier implementation of desired security applications while minimizing the disruption of existing applications.

- Existing CUSP or PCF applications can run without change and without reassembly on ICSF in compatibility mode.
- A CUSP/PCF conversion program has been provided to convert a CUSP or PCF cryptographic key data set to an ICSF format.
- ICSF applications can run concurrently on the same processor with either CUSP or PCF applications.

Chapter 3. ICSF Callable Services and Key Management

This chapter describes the ICSF callable services and some of the concepts of cryptographic key management.

Callable Services

ICSF provides access to cryptographic functions through callable services. A callable service is a routine that receives control from a CALL statement in an application language. Each callable service performs one or more cryptographic functions or a utility function. Many of these callable services comply with IBM's Common Cryptographic Architecture (CCA), while others are extensions to the CCA.

The callable services available to your applications depend on your processor or server. If you are using the Cryptographic Coprocessor Feature on a S/390 G3 Enterprise Server, or higher or a S/390 Multiprise, the callable services available depend on the server configuration. The possible configurations include:

- DES with PKA

  These servers are configured for full 64-bit DES keys (effective length 56 bits), 1024-bit PKA keys for DES key distribution, and 1024-bit PKA signature keys.
- Triple DES with PKA

  These servers are configured for 192-bit DES keys (effective length 169 bits), 1024-bit PKA keys for DES key distribution, and 1024-bit PKA signature keys. This configuration is available on S/390 G4 Enterprise Servers and higher.

If you have a PCI Cryptographic Coprocessor in addition to the Cryptographic Coprocessor Feature on a S/390 G5 Enterprise Server, or above, your configuration is the same as for the Cryptographic Coprocessor Feature.

For a list of the callable services available with each configuration, refer to "Appendix B. Summary of Callable Service Support by Hardware Configuration" on page 65.

The application programs can be written in high-level languages such as C, COBOL, FORTRAN, and PL/I, as well as in Assembler. ICSF callable services allow applications to perform the following tasks:

- Enciphering and deciphering data by using the cipher block chaining (CBC) form of the DES algorithm, with or without record chaining using a single-, double-, or triple-length key.
- Translating ciphertext from encryption under one key to encryption under another key by use of the Ciphertext translate callable service.

  This service securely deciphers the text that was enciphered under one key, and then enciphers it under another key. The service uses the cipher block chaining (CBC) form of the DES algorithm.
- Generating DES cryptographic keys of all types for use by application programs.
- Importing and exporting keys.
- Generating RSA public and private key pairs.

  On a S/390 G5 Enterprise Server, or above, application programs can use the PKA key generate callable service to generate RSA public and private keys on a PCI Cryptographic Coprocessor, if available. To support the SET Certificate

Authority requirements, the RSA private key may be retained within the secure hardware boundaries of the PCI Cryptographic Coprocessor.

- Listing and deleting retained RSA private keys.

  On a S/390 G5 Enterprise Server, or above, application programs can list and delete RSA private keys retained within the secure boundaries of a PCI Cryptographic Coprocessor.
- Generating random numbers.

  Application programs can use a callable service to generate a random number for use in cryptography or for other general use. The callable service uses the cryptographic feature to generate a random number for use in encryption. The foundation for the random number generator is a time-variant input with a very low probability of recycling.
- Encoding and decoding data through the use of clear keys and the electronic code book (ECB) form of the DES algorithm.
- Generating and verifying PINs and translating PIN blocks.

  An application program can use the callable services in generating and verifying PINs. In addition, use the Encrypted PIN translate callable service to reencrypt a PIN block from one PIN-encrypting key to another, or to reformat a PIN block.
- Generating and verifying MACs.

  An application can use single-length or double-length MAC or MACVER keys, or single-length DATA keys to generate and verify message authentication codes.
- Generating MDCs and other hash patterns.
- Generating and verifying Visa CVVs.
- Updating the CKDS and PKDS dynamically.

  ICSF provides callable services that application programs can use to create, read, write, and delete records in the CKDS and PKDS.
- Supporting the ANSI X9.17 key management standard.

  ICSF provides callable services for generating, exporting, importing, translating, and notarizing ANSI X9.17 keys.
- Distributing DATA keys enciphered under an RSA key.
- Generating and verifying digital signatures.
- Composing and decomposing SET blocks.
- PKA-encrypting and PKA-decrypting any PKCS 1.2-formatted symmetric key data.

Protecting and Controlling DES Keys

DES keys are protected by encryption under a DES master key. The DES master key always remains within the secure boundary of the cryptographic feature on the server. There is only one DES master key and it is used only to encrypt and decrypt other DES keys.

On the PCI Cryptographic Coprocessor, DES keys are protected by the SYM-MK which always remains within the secure hardware boundary of the card. Although the master key structure of the SYM-MK differs from that of the DES master, the verification pattern produced by each type of master key must be the same in order for the PCI Cryptographic Coprocessor to be active.

The cryptographic hardware controls the use of DES keys by separating them into unique types. A unique key type can be used only for a specific purpose. For example, you cannot protect a key with a key that is intended to protect data. This

hardware-enforced key separation provides better key protection than software key separation techniques. To enforce key separation, the cryptographic hardware automatically encrypts each type of key under a unique variation of the DES or SYM-MK. Each variation encrypts a different type of key. Although you enter only one DES or SYM-MK, in effect you have a unique master key to encrypt each DES key type.

Note: In CUSP and PCF, key separation applies only to keys that are encrypted under the master key. In ICSF, key separation also applies to keys that are encrypted under transport keys or key-encrypting keys. This enables the creator of a key to transmit the key to another system and to enforce its use at the other system.

DES Master Key Variant

Each key must be enciphered under the DES master key or SYM-MK before it can be used in any cryptographic function. Each key type is enciphered with a unique variation of the master key called a *Master key variant.* ICSF creates a master key variant by exclusive ORing a fixed pattern, called a *control vector,* onto the master key. For information about control vectors, refer to “Control Vectors”.

Each master key variant protects a different type of key. The effect is similar to having a unique master key to protect all the keys of a certain type. The master key, in its variants, protects keys that operate on the system. When systems want to share keys, they use transport keys to protect keys sent outside of systems.

DES Transport Key Variant

As with the master key, ICSF also creates variations of a DES transport key to encrypt a key according to its type. This allows for key separation when transporting keys off the system. A *transport key variant*, or *key-encrypting key variant*, is created in the same way as a master key variant. The transport key is exclusive ORed with a control vector that is associated with the key type of the key it protects.

Note: To exchange keys with systems that do not recognize transport key variants, ICSF allows you to encrypt selected keys under a transport key itself, not under the transport key variant.

DES Key Forms

A key that is protected under the DES or SYM-MK is in *operational form,* which means that ICSF can use it in cryptographic functions on the system.

When you store a key with a file or send it to another system, the key is enciphered under a transport key rather than the master key. When ICSF enciphers a key under a transport key, the key is not in operational form and cannot be used to perform cryptographic functions.

When a key is enciphered under a transport key, the sending system considers the key to be in the *exportable form*. The receiving system considers the key to be in the *importable form*. When a key is re-enciphered from under a transport key to under a system’s master key, it is in operational form again.

Control Vectors

For each type of DES key the master key enciphers, there is a unique control vector. The cryptographic feature exclusive ORs the master key with the control

vector associated with the type of key the master key will encipher. For example, all the different types of DATA, PIN, MAC, and transport keys are each exclusive ORed with a unique control vector. The control vector ensures that an operational key can be used in only cryptographic functions for which it is intended. For example, the control vector for an input PIN-encrypting key ensures that such a key can be used only in the PIN translation and PIN verification functions. “Types of DES Keys” describes the different DES key types.

Types of DES Keys

ICSF groups DES cryptographic keys into the following categories according to the functions they perform.

- DES Master key

  The DES master key is a double-length (128-bit) key that is used only to encrypt other DES keys. The ICSF administrator installs and changes the DES master key using the ICSF panels. Alternatively, you can use the optional TKE workstation. The master key always remains within the secure boundary of the cryptographic feature.

  The DES master key is used only to encipher and decipher operational keys. Cryptographic keys that are in exportable or importable form are not enciphered under the master key. They are enciphered under the appropriate transport key, which has itself been enciphered under the master key.

- Symmetric-Keys Master Key (SYM-MK)

  The SYM-MK is a double-length (128-bit) key that is used only to encrypt other DES keys on the PCI Cryptographic Coprocessor. The ICSF administrator installs and changes the SYM-MK using either the ICSF panels or the optional Trusted Key Entry (TKE) workstation. The master key always remains within the secure boundary of the PCI Cryptographic Coprocessor.

  As with the DES master key, the SYM-MK is used only to encipher and decipher operational keys.

- Transport keys (or key-encrypting keys)

  Transport keys are also known as key-encrypting keys. They are double-length (128-bit) keys that are used to protect keys when you distribute them from one system to another. For installations that do not support double-length 128-bit keys, ICSF supports the use of effective single-length keys. In an effective single-length key, the left half equals the right half.

  There are five types of transport keys:

  – *Exporter or OKEYXLAT key-encrypting keys* protect keys of any type that are sent from your system to another. The exporter key at the originator is the same as the importer key of the receiver. An exporter key is paired with an importer key or a IKEYXLAT key.

  – *Importer or IKEYXLAT key-encrypting keys* protect keys of any type that are sent from another system to yours. It also protects keys that you store externally in a file that you can import to your system later. The importer key at the receiver is the same as the exporter key at the originator. An importer key is paired with an exporter key or a OKEYXLAT key.

  – *ANSI X9.17 key-encrypting keys (AKEKs)* are used exclusively with the ANSI X9.17 key management callable services. AKEKs are used to transport DATA keys, AKEKs, and CCA key-encrypting keys.

  Note: Transport keys replace the local, remote, and cross keys that CUSP and PCF use.

- Data-encrypting keys

Data-encrypting (DATA) keys are single-length (64-bit), double-length (128-bit), or triple-length (192-bit) keys. DATA keys are used to encipher and decipher data. ICSF provides support for the use of single-length data-encrypting keys in the callable services that generate and verify MACs.

- Data-translation keys

  These single-length (64-bit) keys are used for the ciphertext translate callable service as either the input or the output data-translation (DATAXLAT) key.

- MAC keys

  These single-length (64-bit) (MAC and MACVER) and double-length (128-bit) (DATAM and DATAMV) keys are used for the callable services that generate and verify MACs.

- PIN keys

  The personal identification number (PIN) is a basis for verifying the identity of a customer across financial industry networks. PIN keys are double-length (128-bit) keys. The callable services that generate, verify, and translate PINs use PIN keys.

  For installations that do not support double-length 128-bit keys ICSF provides effective single-length keys. In an effective single-length key, the left key half of the key equals the right key half.

- Cryptographic variable encrypting keys

  These single or double-length keys are used to encrypt special control values in CCA DES key management. The Control Vector Translate and Cryptographic Variable Encipher callable services use cryptographic variable encrypting keys.

Protecting and Controlling PKA Keys

In a public key cryptographic system, it is a priority to maintain the security of the private key. It is vital that only the intended user or application have access to the private key. On the S/390 G3 Enterprise Server, or higher, the S/390 Multiprise, and the IBM @server zSeries ICSF and the Cryptographic Coprocessor Feature ensure this by enciphering PKA private keys under a unique PKA object protection key. The PKA object protection key has itself been enciphered under a PKA master key. Each PKA private key also has a name that is cryptographically bound to the private key and cannot be altered. ICSF uses the private key name or the PKDS key label to control access to the private key. This combination of hardware-enforced coupling of cryptographic protection and access control, through the use of SecureWay Security Sever (RACF), is unique to ICSF/MVS Version 2 Release 1, and above, and ICSF. It provides a significant level of security and integrity for PKA applications.

The PCI Cryptographic Coprocessor that is available as an option on the S/390 G5 Enterprise Server, or above, and the IBM @server zSeries, provides additional security for PKA applications. You can generate RSA public and private key pairs within the secure hardware boundary of the PCI Cryptographic Coprocessor. In addition, you can retain the RSA private key within the PCI card where it is generated, a requirement to be a SET Certificate Authority. The RSA private key is protected by the ASYM-MK on the PCI Cryptographic Coprocessor.

PKA Master Keys

The PKA master keys on the Cryptographic Coprocessor Feature are triple-length (192-bit) keys. As with the DES master key, the PKA master keys are used only to encipher and decipher PKA keys. There are two PKA master keys on the Cryptographic Coprocessor Feature. One PKA master key, the signature master key

(SMK), protects private keys that are intended for creating digital signatures. The other PKA master key, the key management master key (KMMK), protects private keys that are used in DES key distribution. Private keys that are protected by the KMMK can also be designated to be usable to generate digital signatures.

The asymmetric keys master key (ASYM-MK) on the PCI Cryptographic Coprocessor is a triple-length key used to encipher and decipher PKA keys. In order for the PCI Cryptographic Coprocessor to function, the hash pattern of the ASYM-MK must have the same value as the hash pattern of the SMK on the Cryptographic Coprocessor Feature.

The ICSF administrator installs the PKA master keys on the Cryptographic Coprocessor Feature and the ASYM-MK on the PCI Cryptographic Coprocessor by using either the ICSF pass phrase initialization panel, the clear master key entry panels, or the optional TKE workstation.

RSA Private and Public Keys

An RSA key pair includes a private and a public key. The RSA private key is used to generate digital signatures, and the RSA public key is used to verify digital signatures. The RSA public key is also used for key encryption of DES DATA keys and the RSA private key for key recovery.

The RSA public key algorithm is based on the difficulty of the factorization problem. The factorization problem is to find all prime numbers of a given number, n. When n is sufficiently large and is the product of a few large prime numbers, this problem is believed to be difficult to solve. For RSA, n is typically at least 512 bits, and n is the product of two large prime numbers. For more information about the RSA public key algorithm, refer to the ISO 9796 standard and *RSA's Frequently Asked Questions About Today's Cryptography*.

Generating RSA Keys on a Cryptographic Coprocessor Feature

The Cryptographic Coprocessor Feature does not provide the ability to generate RSA public and private keys within the secure hardware boundary. There are several ways to generate RSA key pairs and load them.

- You can use the optional TKE Workstation with Version 2.0 or higher of the TKE Workstation code to generate the RSA key pair and load them directly into the ICSF public key data set (PKDS) on the server.
- You can generate RSA key pairs in the encrypted form on a workstation with a 4755 cryptographic adapter installed. A workstation with a 4758 PCI Cryptographic Coprocessor can also be used. Use the PKA key import callable service to import the RSA key pairs in the form of an external PKA private key token.
- You can generate RSA keys in the clear on another platform or by using any suitable software program. Use the PKA Key Token Build callable service to build an external token with clear key values. Then use the PKA key import callable service to import the RSA keys into the PKA key token in the internal format.

Generating RSA Keys on a PCI Cryptographic Coprocessor

With the PCI Cryptographic Coprocessor you can use the PKA key generate callable service to generate RSA public and private key pairs within the secure boundary of the PCI card. The PCI Cryptographic Coprocessor can generate RSA keys with a modulus size of 512 to 2048 bits. The RSA private key may be retained and used within the secure boundary of the PCI card. This capability is a requirement to be a SET Certificate Authority. The public key and the key name for

the private key are stored in the ICSF public key data set (PKDS), but the value of a retained private key never appears in any form outside the PCI card.

DSS Private and Public Keys

A DSS key pair also includes a private and a public key. The DSS private key is used to generate digital signatures, and the DSS public key is used to verify digital signatures.

The difficulty of the discrete logarithm problem is the basis for the NIST Digital Signature Standard public key algorithm. The discrete logarithm problem is to find x given a large prime p, a generator g and a value y=(g**x) mod p, where ** represents exponentiation. This problem is believed to be very hard when p is sufficiently large and x is a sufficiently large random number. For DSS, p is at least 512 bits, and x is 160 bits. The NIST FIPS 186 Digital Signature Standard defines DSS.

ICSF provides a callable service to generate PKA internal key tokens for use with the DSS algorithm in digital signature services.

Exchanging Encrypted Keys and PINs on a DES System

When a system sends a DATA key to another system, the sending system encrypts the DATA key under an *exporter* key-encrypting key. The receiving system re-encrypts the DATA key from encryption under an *importer* key-encrypting key to encryption under its master key. The importer and exporter key-encrypting keys at these systems complement each other and have the same clear value.

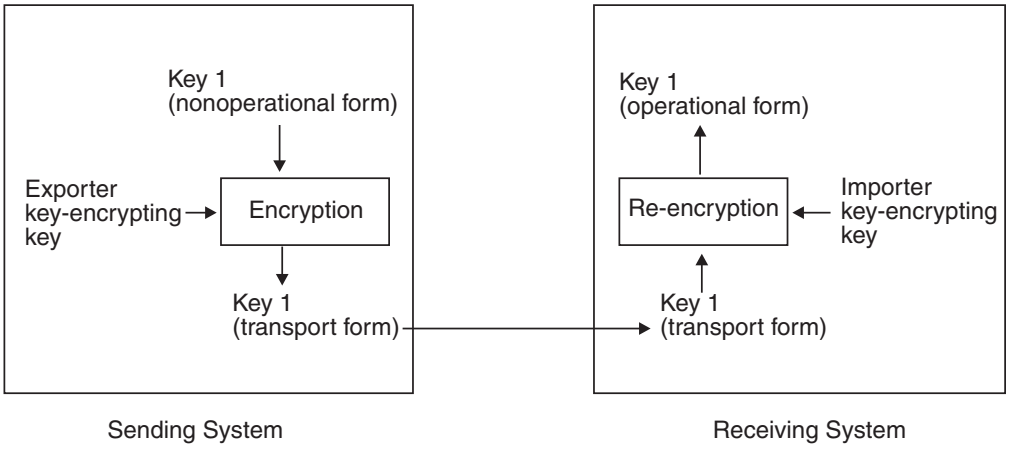

Figure 9. Using Transport Keys to Exchange Keys

In ICSF, you work with the following complementary keys:

- Importer key-encrypting key and exporter key-encrypting key
- Importer key-encrypting key and OKEYXLAT key-encrypting key
- Exporter key-encrypting key and IKEYXLAT key-encrypting key
- Input PIN-encrypting key and output PIN-encrypting key
- PIN-generation key and PIN-verification key
- MAC-generation key and MAC-verification key

Your installation can use the key generator utility program (KGUP) or the callable services to generate and maintain complementary pairs of keys.

When KGUP generates a key, it also generates a KGUP control statement to create the complement of that key. You can send the control statement to the system with which you are exchanging keys or PINs.

Exchanging RSA-Encrypted Data Keys

In an RSA cryptographic system, the sending system and the receiving system do not need to share complementary importer and exporter key pairs to exchange DATA keys. The sender enciphers the DATA key by using the receiver's public key. The receiver deciphers the DATA key by using his or her own private key. Refer to "Exchanging DES Data-encrypting Keys Using an RSA Key Scheme" on page 14 for a more detailed explanation.

Using Multiple Encipherment to Protect Keys and Data

The Cryptographic Coprocessor Feature and PCI Cryptographic Coprocessor use multiple encipherment whenever they encipher a key under a key-encrypting key like the master key or a transport key. In addition to protecting and retrieving cryptographic keys, the Cryptographic Coprocessor Feature uses multiple encipherment and decipherment to protect or retrieve 64-bit PIN blocks in the area of PIN applications. Multiple encipherment is superior to single encipherment because it is much harder to break. The actual process to encipher a key depends on the type of key that is being enciphered and the type of key-encrypting key that is being used to encipher it. Figure 10 shows an example of multiple encipherment. In this example, the left half of the enciphering key is used to encrypt the key in the first step. The result is then decrypted under the right half of the enciphering key. Finally, this result is encrypted under the left half of the enciphering key again.

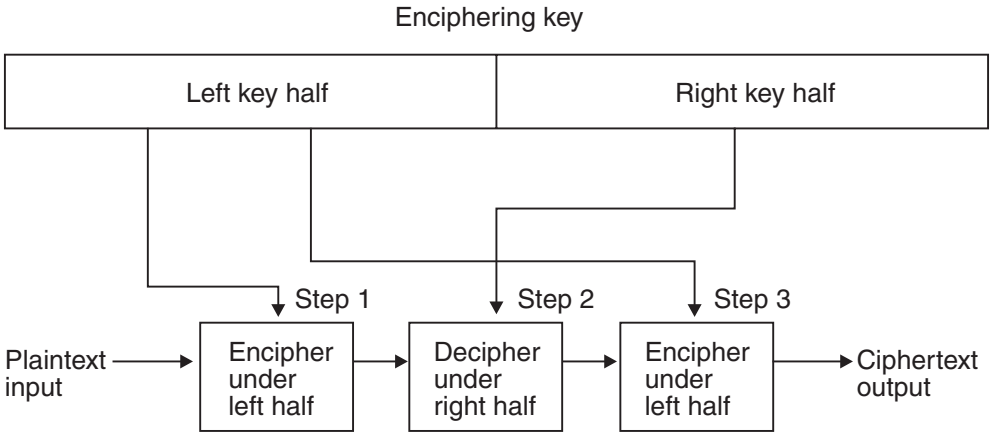

Figure 10. An Example of Multiple Encipherment

Triple DES data encryption uses multiple encipherment with either double-length or triple-length DATA keys to protect data. For this procedure the data is first enciphered using the first DATA key. The result is then deciphered using the second DATA key. When using a triple-length key, this second result is then enciphered using the third DATA key. When using a double-length key, the first DATA key is reused to encrypt the second result.

Note: Multiple decipherment is the inverse of multiple encipherment (decipher-encipher-decipher).

Running in Special Secure Mode

Special secure mode is a special processing mode for the entry of clear keys. To perform the following tasks, you must enable Special secure mode:

- Use the secure key import or multiple secure key import callable service, which work with clear keys.
- Use the Clear PIN generate or Clear PIN generate alternate callable service, which work with clear PINs.
- Use the symmetric key generate callable service with the IM keyword. Special Secure Mode is not required if a PCI Cryptographic Coprocessor is available and the modulus bit length is greater than or equal to 512 bits.
- Use KGUP to enter clear keys into the CKDS.

On the S/390 G3 Enterprise Server, or higher, the S/390 Multiprise, and the IBM @server zSeries, special secure mode can be entered only if the hardware is enabled for special secure mode, and if the installation options data set allows it. With the optional TKE workstation, you can access the environmental control mask to enable or disable special secure mode.

Cryptographic Key Data Set (CKDS)

ICSF stores all DES keys in a specialized data set called a cryptographic key data set (CKDS). ICSF maintains both a disk copy and an in-storage copy of the CKDS. This makes it possible to refresh the cryptographic keys without interrupting the application programs. For information on managing and sharing the CKDS in a sysplex environment, see *z/OS ICSF Administrator's Guide*, SA22-7521.

ICSF updates the CKDS at the following times:

- When you use KGUP to generate keys or enter keys into the system, ICSF updates the disk copy, rather than the in-storage copy. ICSF does not require that you stop cryptographic functions before updating the CKDS, unlike CUSP and PCF.
- When you change the master key, ICSF enables you to reencipher the disk copy of the CKDS. ICSF then automatically refreshes the in-storage copy of the CKDS with the re-enciphered keys.
- When you convert a CUSP or PCF CKDS to an ICSF CKDS, the CUSP/PCF conversion program updates the disk copy of the ICSF CKDS.
- When an application uses the dynamic CKDS update callable services, both the disk copy and in-storage copy of the CKDS are dynamically updated.

ICSF allows these operations without interrupting cryptographic functions that are used by application programs.

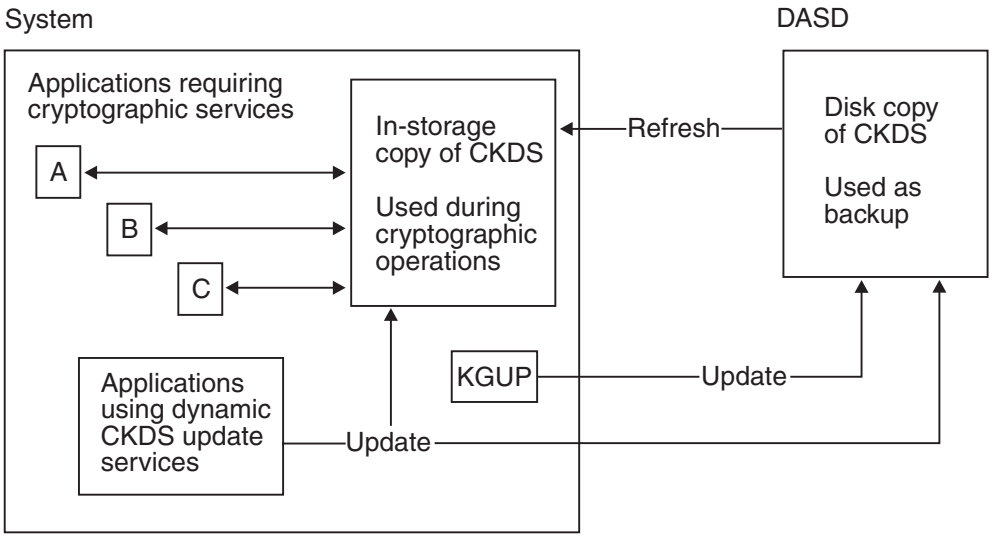

Figure 11. How the Cryptographic Key Data Set Is Maintained and Used

Callable services use the in-storage copy of the CKDS. For example, in Figure 11 applications A, B, and C might make many calls for services that require the CKDS. Having the CKDS in storage avoids time-consuming I/O to a data set that is stored on DASD.

KGUP updates the disk copy rather than the in-storage copy. The ICSF administrator can then use the ICSF panel dialog or a batch job to refresh the in-storage CKDS with the updated disk copy of the CKDS. Cryptographic functions do not have to stop while KGUP updates the CKDS.

The dynamic CKDS update callable services permit an application to perform dynamic update of both the disk copy and the in-storage copy of the CKDS.

Dynamic CKDS Update Callable Services

The dynamic CKDS update callable services allow applications to directly manipulate both the in-storage copy and the DASD copy of the CKDS. These callable services have the identical syntax as the 4753-HSP *verbs* of the same name. Key management applications that use these common callable services, or verbs, can be run on either system without change. Cryptographic functions do not have to stop while the dynamic CKDS update callable services update the CKDS.

PKA Cryptographic Key Data Set

You can store RSA and DSS public and private keys in a specialized external VSAM data set that is called a public key data set (PKDS). For information on managing and sharing the PKDS in a sysplex environment, see *z/OS ICSF Administrator's Guide*, SA22-7521.

PKDSCACHE, an installation option, defines the size of the PKDS Cache in records. The PKDS cache improves performance as it facilitates access to frequently used records. Specify *n* as a decimal value from 0 to 256. If *n* is zero, no cache will be implemented. If PKDSCACHE is not specified, the default value is 64. PKDSCACHE can be implemented on OS/390 V2 R10 and z/OS V1 R1 by installing APAR OW48568.

Dynamic PKDS Update Callable Services

ICSF provides dynamic PKDS update callable services that permit an application to create, read, write, and delete PKDS records. You do not need to stop cryptographic functions while applications use these services to update the PKDS.

Key Generator Utility Program and Key Generate Callable Service

With ICSF, you can use either the key generator utility program (KGUP) or the key generate callable service to generate DES keys.

With KGUP, you can generate key-encrypting keys, PIN keys, data-encrypting keys, data-translation keys, and MAC keys. A master key variant enciphers each type of key that KGUP creates. After this program generates a key, it stores it in the CKDS where it can be saved and maintained.

The key generate callable service creates all types of DES keys. It generates a single key or a pair of keys. Unlike KGUP, however, the key generate service does not store DES keys in the CKDS but returns them to the application program that called it.

ANSI X9.17 Key Management Callable Services

ICSF supports the ANSI X9.17 key management standard, which defines a process for protecting and exchanging DES keys. The ANSI X9.17 standard uses the processes of notarization and offset to create a key identifier for both the sender and the receiver of a key. The key identifier includes a sequence number, and an ASCII-coded origin and destination identifier. The key identifier is cryptographically coupled with the key. In addition to providing callable services that support these functions, ICSF also defines and permits a process of partial notarization. You can use these callable services to develop ANSI X9.17 key management applications that exploit the offset, notarization, and partial notarization processes.

Offsetting combines an ANSI key-encrypting key (AKEK) with a counter by exclusive ORing the two values. The application initializes the counter the first time the key is used and increments the counter with each use. By checking the counter, applications can detect if a message has been transmitted out of sequence and take the appropriate action.

Notarization involves the coupling of an AKEK with ASCII character strings that contain identifiers for both origin and destination, and then offsetting the AKEK with a counter.

Partial notarization involves coupling the AKEK with the origin and destination ASCII character strings without offset. A partially notarized AKEK may be offset at a later time to form a fully notarized key.

Composing and Decomposing SET Blocks

ICSF provides callable services for developing SET applications that make use of the cryptographic hardware at the merchant and acquirer payment gateway. The SET Block Compose callable service performs DES encryption of data, OAEP-formatting through a series of SHA-1 hashing operations, and the RSA-encryption of the Optimal Asymmetric Encryption Padding (OAEP) block. The SET Block Decompose callable service decrypts both the RSA-encrypted and the DES-encrypted data.

Exchanging Secure Sockets Layer Session Key Seed

OS/390 V2 R6 ICSF provides two new callable services that make it possible to exchange the seed key that the SSL application needs to generate session keys. The PKA encrypt callable service encrypts a supplied clear key value under an RSA public key. Currently, these services support only the PKCS 1.2 format. The PKA decrypt callable service decrypts the supplied key value using the corresponding RSA private key and returns the seed key value to the application in the clear. The SSL application can then use the clear key value to generate symmetric session keys.

Chapter 4. Using ICSF with Other Cryptographic Products

This chapter describes how ICSF works with other cryptographic products.

Using IBM's Common Cryptographic Architecture

ICSF provides callable services that comply with IBM's Common Cryptographic Architecture (CCA). This allows application programs written in high-level languages such as C, COBOL, FORTRAN, and PL/I, as well as in Assembler, to be used under more than one cryptographic product.

Another family of products that provide these services is the IBM Transaction Security System. The Transaction Security System includes the IBM 4753 Network Security Processor MVS Support Program (4753-HSP), the IBM 4755 Cryptographic Adapter, and the IBM 4754 Security Interface Unit.

Coexisting with Other IBM Cryptographic Products

ICSF can coexist simultaneously with other IBM cryptographic products within the same operating system image. This protects your installation's investment in programming skills and user applications, and provides a framework for migrating to ICSF.

Running CUSP and PCF Applications under ICSF

If your installation uses CUSP or PCF, you can run CUSP or PCF applications on ICSF. Your applications can benefit from the enhanced performance and availability of ICSF. Running CUSP and PCF applications on ICSF allows you to test ICSF. ICSF also helps you migrate CUSP and PCF applications. As soon as you can, you should convert these applications to use ICSF callable services rather than the CUSP and PCF macros. This will permit you to change the master key without interrupting the converted applications.

ICSF continues to support the CUSP and PCF macros (GENKEY, RETKEY, EMK, and CIPHER). If an application uses these CUSP or PCF macros, you can run the application on ICSF. The CIPHER macro will use the DES algorithm on a Cryptographic Coprocessor Feature that is configured for DES. The CIPHER macro will use the CDMF algorithm on a Cryptographic Coprocessor Feature that is configured for CDMF. If exits exist for either the GENKEY or the RETKEY macro, you should evaluate their applicability to ICSF. If your applications still need these exits, you must rewrite them for ICSF.

You can run CUSP and PCF applications on systems with ICSF installed. How they run depends on the mode in which ICSF is running. You can run ICSF in any of the following modes:

- In **compatibility mode**, you can run CUSP and PCF applications on ICSF without reassembling them, because ICSF supports the CUSP and PCF macros.

  You cannot start CUSP or PCF at the same time as ICSF on the same operating system.
- In **coexistence mode**, you can run a CUSP or PCF application on CUSP or PCF, or you can reassemble it to run on ICSF. ICSF provides coexistence macros for this purpose.

  You can start CUSP or PCF at the same time as ICSF on the same operating system.

- In **noncompatibility mode**, you can run CUSP or PCF applications only on CUSP or PCF, and you can run ICSF applications only on ICSF. You cannot run CUSP or PCF applications on ICSF, because ICSF does not support the CUSP and PCF macros in this mode.

  You can start CUSP or PCF at the same time as ICSF on the same operating system.

An application that is running under CUSP or PCF may use a key in a CKDS managed by CUSP or PCF. Before you run such an application on ICSF, you should convert the key to an ICSF format. ICSF provides a program to do this conversion.

You should use noncompatibility mode unless you are migrating from CUSP or PCF to ICSF.

Running 4753-HSP Applications under ICSF

You can run both 4753-HSP and ICSF applications on the same z/OS operating system. This allows your installation to take advantage of the flexibility in PIN and key management systems provided by 4753-HSP and the high-volume throughput and bulk data-encryption available with ICSF.

The key management callable services available in ICSF are identical to the key management *verbs* that are supported by the 4753-HSP. These common extensions beyond the CCA make it possible to develop significant key management applications that run without change on both systems. If your installation currently uses the 4753-HSP, you may be able to run your key storage management applications on ICSF without change if you have used these common verbs.

With the optional PCI Cryptographic Coprocessor feature, ICSF has the flexibility to route cryptographic functions to the PCI Cryptographic Coprocessor for processing. In OS/390 V2 R10 ICSF, ICSF provides support for new callable services which are supported by 4753-HSP (CSNBCPE, CSNBCVG, CSNBCVT, CSNBCVE, CSNBDKM, CSNBEPG, CSNBKTR, CSNBPEX) and enhances existing ICSF callable services to provide suppport for additional key types which are supported by 4753-HSP. This ICSF support will allow many 4753-HSP applications to run without change on ICSF.

There are some restrictions when running both ICSF and the 4753-HSP in the same operating system environment. Although both applications are capable of running in CUSP/PCF compatibility mode, only one system can provide this service at any time. Because both ICSF and the 4753-HSP support the CCA callable services, applications need to be linked with the appropriate library routines to access the intended service. Note that internal key tokens are not interchangeable between the two products.

There are also some differences between the PKA implementations on z/OS ICSF and the 4753-HSP. The Transaction Security System family of products has two implementations of PKA: PKA92 and PKA96. Applications that are written to one PKA implementation will not run on the other, and techniques that use RSA keys for DEA key distribution are incompatible between the two PKA versions. ICSF supports only the PKA96 and APIs are the same for the services that ICSF and the 4753-HSP have in common, with the following exceptions:

- The 4753-HSP does not support the Digital Signature Standard (DSS)

You can exchange RSA digital signatures between the two products if the digital signatures use ISO9796 formatting.

Managing Keys with the Distributed Key Management System (DKMS)

The Distributed Key Management System provides a general key management facility to ICSF as well as to the Transaction Security System. DKMS automates the key management process, and exchanges and replaces keys on demand. Further, DKMS enforces key separation and maintains backup copies of all critical keys. DKMS provides key management support for a broad range of external devices with which cryptographic applications communicate, such as automated teller machines (ATMs) and point-of-sale terminals.

Encrypting and Decrypting Information from Other Products

ICSF can exchange encrypted information with other cryptographic products. The only limitation is the form of DES encryption used. Some examples:

- MACs: ICSF supports both the ANSI standard X9.9, option 1, and the X9.19 optional double-MAC procedure for generating message authentication codes (MACs). Therefore, if a MAC has been generated with another product that uses either of these standards, ICSF can verify that MAC. ICSF provides support for the use of data-encrypting keys in both the MAC generating and verifying services. This support allows these services to interface more smoothly with non-CCA key distribution systems, including those that follow the ANSI X9.17 protocol.
- PINs: ICSF supports a wide variety of PIN block formats, as is shown in “Using Personal Identification Numbers (PINs) for Personal Authentication” on page 16.
- Data: ICSF can exchange encrypted data with other products that use the cipher block chaining (CBC) form of the DES algorithm.
- Keys: ICSF can exchange encrypted keys with other products that conform to the IBM’s Common Cryptographic Architecture. If you need to exchange keys with systems that do not recognize transport key variants, ICSF enables you to encrypt selected keys under the transport key rather than under the transport key variant. You can use either an application program or KGUP to do this. ICSF can exchange RSA-encrypted data-encrypting keys with systems that format the key according to the PKCS 1.2 Standard.
- Digital Signatures: ICSF can exchange digital signatures with systems that support any of the following standards:
  - DSS
  - RSA signatures with MDC, SHA-1, or MD5 hashes and ISO-9796 formatting
  - RSA signatures with MD5 hashes and PKCS 1.0 or PKCS 1.1 formatting

Virtual Telecommunications Access Method (VTAM) Session-Level Encryption

ICSF supports VTAM session-level encryption, which provides protection for messages within SNA sessions—that is, between pairs of logical units. When this method of protection is in effect, only the originating logical unit can encipher the data, and only the destination logical unit can decipher the data. Thus, the data never appears in the clear while passing through the network.

ICSF places no restrictions on the addressing mode of calling programs. In particular, when VTAM session-level encryption is used with ICSF, VTAM can use storage above 16 megabytes.

For information on setting up VTAM session-level encryption, refer to *VTAM Programming for LU 6.2*.

Access Method Services Cryptographic Option

ICSF supports the Access Method Services Cryptographic Option. The option enables the user of the Access Method Services REPRO command to encipher data by using the Data Encryption Algorithm. The Access Method Services user can use REPRO to encipher data, write it to a data set, and then store the enciphered data set offline. When the user needs the enciphered data set, he or she can retrieve it and use REPRO to decipher it. The user can decipher the data either on the host processor where it was enciphered or on another host processor that contains the Access Method Services Cryptographic Option and the cryptographic key needed.

With the exception of catalogs, all data set organizations that are supported for input by REPRO are eligible as input for enciphering. Similarly, and with the same exception, all data set organizations supported for output by REPRO are eligible as output for deciphering. The resulting enciphered data sets are always sequentially organized (SAM or VSAM entry-sequenced data sets).

Cryptographic keys can either be created by ICSF or be supplied by the Access Method Services user.

Using ICSF with BSAFE

ICSF works in conjunction with RSA Security, Inc.'s BSAFE toolkit (BSAFE 3.1 or later). If you are currently using applications developed with BSAFE, you may want to take advantage of the increased security and performance available with the OS/390 Cryptographic Coprocessor Feature and ICSF.

For increased security, you can use ICSF to generate and protect DES cryptographic keys. The keys are encrypted under the DES master key and stored in the Cryptographic Key Data Set. The DES encryption and decryption processes take place within the secure hardware boundary of the Cryptographic Coprocessor Feature.

You can also take advantage of the high transaction rates available with the cryptographic solution to increase the performance of DES encryption and decryption and hashing operations.

Chapter 5. Planning for the Integrated Cryptographic Service Facility

This chapter contains guidelines and suggestions to help you plan the installation and operation of ICSF.

System Requirements

The following sections describe the environment you need to use ICSF.

Operating System

ICSF is an element of z/OS, so there are no additional operating system requirements.

Machine

z/OS runs on processors that support the Cryptographic Coprocessor Feature, the PCI Cryptographic Coprocessor, and the PCI Cryptographic Accelerator. Functions that are supported in prior releases of ICSF will continue to run on hardware that supports the Cryptographic Coprocessor Feature. Beginning with OS/390 V2 R10 ICSF, ICSF will no longer support water cooled processors with ICRF (Integrated Cryptographic Feature). You will, however, need the following levels of hardware to support all the software functions available with ICSF:

- IBM S/390 Parallel Enterprise Server - Generation 3 or the IBM S/390 Multiprise 2000 with Cryptographic Coprocessor Feature (feature 0800 with one of the following features: 0801, 0802, 0803, 0804, 0805), the IBM S/390 Parallel Enterprise Server - Generation 4, Generation 5, or Generation 6 (with feature 0800 and one of the following features: 0811, 0812, 0813, 0814, 0815, 0832, 0833, 0834, 0835), to use:
  - Trusted Key Entry workstation or the Clear Master Key Entry panels
  - CDMF
  - PKA
  - Key test
  - Prohibit export
  - Interbank PIN generate and verify
  - Clear PIN generate alternate
  - SET block compose and decompose
  - Dynamic PKDS update callable services
- A IBM S/390 Parallel Enterprise Server - Generation 4 (with LIC level driver 98) or a IBM S/390 Parallel Enterprise Server - Generation 5 (with feature 0800 and one of the following features: 0832, 0833, 0834, 0835) to use triple-length keys for data encryption and decryption.
- IBM S/390 Parallel Enterprise Server - Generation 5, or higher, to use the following:
  - A double-length MACVER key
- A IBM S/390 Parallel Enterprise Server - Generation 5 or the IBM S/390 Parallel Enterprise Server - Generation 6, to use the following:
  - The optional PCI Cryptographic Coprocessor
  - The PKA key generate callable service to generate RSA public and private keys on a PCI Cryptographic Coprocessor
  - The retained key list and retain key delete callable services on a PCI Cryptographic Coprocessor

  - The new callable services available with OS/390 V2 R10 ICSF and the enhancements to existing services require a PCI Cryptographic Coprocessor.
- IBM @server zSeries 900 with feature codes 0861 and 0865.
  - The PCI Cryptographic Accelerator
  - A PCI Cryptographic Coprocessor is required for the customer-written UDX capability

In addition, the data confidentiality services available to your applications depend on the configuration of the Cryptographic Coprocessor Feature on your S/390 G3 Enterprise Server, or higher, S/390 Multiprise, or IBM @server zSeries 900. For a complete list of callable services and the hardware configurations that support them, refer to "Appendix B. Summary of Callable Service Support by Hardware Configuration" on page 65.

The Cryptographic Coprocessor Feature can have up to two cryptographic coprocessor chips (crypto CPs) as high-speed extensions of the central processor. Each crypto CP contains both DES and PKA cryptographic processing units. The Cryptographic Coprocessor Feature holds the cryptographic master keys internally in C-SRAM with battery power unit. The secure registers are not accessible through either Licensed Internal Code or scanning of the hardware. In addition, the Cryptographic Coprocessor Feature is protected by tamper-detection circuitry that is designed to react to attacks by clearing all secure keys.

A S/390 G5 Enterprise Server or the S/390 G6 Enterprise Server can be equipped with up to eight PCI Cryptographic Coprocessors.

The IBM @server zSeries 900 can support any combination of PCI Cryptographic Coprocessors or PCI Cryptographic Accelerators, but the total must not exceed 16.

Using Different Configurations

The Cryptographic Coprocessor Feature includes two crypto CPs, each of which is attached to a central processor complex. You can configure the processor complex to run in either single-image mode or logical partition mode.

If the Cryptographic Coprocessor Feature is in single-image mode, the same master keys must be installed on both crypto CPs. If you bring a second crypto CP online, ICSF verifies that the master keys are the same. If the DES master keys are different, ICSF will not use the second Coprocessor. The PKA master keys must be the same on both Coprocessors in order to enable the PKA services.

A S/390 G5 Enterprise Server or the S/390 G6 Enterprise Server can be equipped with up to eight PCI Cryptographic Coprocessors. The PCI cards are in addition to the Cryptographic Coprocessor Feature. In order for the PCI Cryptographic Coprocessor to operate, the verification pattern for the SYM-MK master key must match the verification pattern of the DES master key on the server's Cryptographic Coprocessor Feature. Before you can use the PKA services of the PCI Cryptographic Coprocessor, you must install both the KMMK and the SMK on the Cryptographic Coprocessor Feature and the ASYM-MK master key on the PCI Cryptographic Coprocessor. The hash pattern on the ASYM-MK master key must match the hash pattern on the SMK in order to use the PCI Cryptographic Coprocessor.

Note: For new installations, it is recommended that the installation enter the KMMK equal to the SMK master key.

You can divide your processor complex into PR/SM logical partitions (LPARs) by assigning crypto CP master key registers or domains to each LPAR. When running in LPAR mode, use system symbols in the installation options data set to define different domains. You can assign one or more domains to an LPAR. Beginning in z/OS V1 R2, the DOMAIN parameter is an optional parameter in the installation options data set. It is required if more than one domain is specified as the usage domain on the PR/SM panels or if running in native mode. If you assign multiple domains to an LPAR, you can have separate master keys for different purposes. For instance, you might have one master key for production operations and another master key for test operations.

Programming

To use the SecureWay Security Server (RACF) with ICSF, you will need the Security Server option. You can use the SecureWay Security Server (RACF), or an equivalent product to control access to services and keys, and provide auditing services for ICSF.

DASD Storage

For information on the sizes of the distribution library and target library, refer to *z/OS Program Directory*, GI10-0669.

Security

In reviewing your installation security plan before installing ICSF, consider the following points:

- **Controlling Access to Disk Copies of the CKDS**

  You should determine which users and applications should have access to each copy of the CKDS on your system.

  Note: The in-storage copy of the CKDS can be accessed only through ICSF functions such as callable services, KGUP, or the panel dialog. To protect the in-storage copy of the CKDS, control who can use these services.

- **Controlling Access to the PKDS**

  You should determine which users and applications should have access to the PKDS on your system.

- **Controlling Access to the Key Generator Utility Program (KGUP)**
- **Controlling Access to Services and Keys**

  Anyone who is running the KGUP can read and change an unprotected CKDS. To prevent unauthorized persons from using the KGUP, store the program in an APF-authorized library that is protected by the SecureWay Security Server (RACF).

  Users of the SecureWay Security Server (RACF) can use the CSFSERV and CSFKEYS classes to perform access checking and auditing of services and keys, respectively. The audit records that are produced by these routines are SMF type 80 records.

- **Scheduling Changes for Cryptographic Keys**

  To reduce the possibility of exposing a key value, you may want to change the value of cryptographic keys, including the DES master key, from time to time:

  – You can use the panel dialog to change the DES master key.

  – If you have an optional Trusted Key Entry (TKE) workstation installed, you can use it to change DES and PKA master keys for both the Cryptographic Coprocessor Feature and the PCI Cryptographic Coprocessors.

- You can use KGUP or the panel dialog to change the CKDS.
- You can develop applications that use the dynamic CKDS update callable services to change both the in-storage and DASD copies of the CKDS.

You can perform all of these operations without interrupting cryptographic functions.

- **Allowing or Preventing Clear Cryptographic Keys**

  With ICSF, keys exist in the clear only in the following cases:

  - If you specifically allow special secure mode *and* actually set special secure mode during operations, applications can use the secure key import callable service and the Clear PIN generate callable service.
  - If ICSF is not in special secure mode, all keys in the system are encrypted except DATA keys that a user may enter through the use of the clear key import callable service.

    Note: The clear key import callable service is equivalent to the CUSP and PCF EMK macro.
  - The encode callable service can use a clear key to encipher data.
  - If you use the Clear Master Key Entry panels to enter the key parts of a DES master key or a PKA master key on the S/390 G3 Enterprise Server, or higher, and the S/390 Multiprise, the key parts appear briefly in the clear in host storage.
  - When an application calls the symmetric key generate callable service to generate a DATA key, the DATA key appears briefly in the clear in host storage. The DATA key is then quickly encrypted under the DES master key and the RSA public key.
  - When an application calls the symmetric key import callable service to transfer a DATA key from encryption under an RSA public key to encryption under the host DES master key, the DATA key appears briefly in the clear in host storage.
  - When an application calls the symmetric key export callable service to transfer a DATA key from encryption under the host DES master key to encryption under an RSA public key, the DATA key appears briefly in the clear in host storage.
  - When an application calls the SET block compose and SET block decompose callable services, the DATA key exists briefly in the clear in host storage.

  With PCI Cryptographic Coprocessor, the following services will be routed to the PCI Cryptographic Coprocessor if one is available: CSNDSYG, CSNDSYX, CSNDSBC, CSNDSYI, CSNDSBD, CSNBSKY, and CSNBSPN. If no PCI Cryptographic Coprocessor is available, then keys will appear briefly in the clear as stated above.

- **Sending Cryptographic Keys to Other Installations**

  To eliminate the need to have a courier deliver clear keys between installations, you can use either or both of the following options:

  - DES transport keys to encrypt keys for network distribution
  - The receiving installation's RSA public key to encrypt a DES DATA key prior to electronic distribution

  Both of these methods make key distribution more secure.

- **SMF Records Generated by ICSF**

ICSF generates type 82 records in the SMF data set when the following conditions occur:
- ICSF starts
- ICSF status changes on a processor
- When you enable or disable special secure mode
- When you enter either a DES or PKA clear master key part through the use of the TSO panels on an S/390 G3 Enterprise Server, or higher, or an S/390 Multiprise
- When you enter a key part
- When the in-storage CKDS is refreshed
- When an application uses any of the dynamic services that write to the CKDS
- When ICSF handles error conditions or tampering
- When you issue a command from the TKE workstation to the Cryptographic Coprocessor Feature
- When an application uses any of the dynamic services that write to the PKDS
- When you use the Clear Master Key Entry panels to enter a master key in the PCI Cryptographic Coprocessor
- When you create or delete a retained key on a PCI Cryptographic Coprocessor
- When you use the TKE workstation to communicate with the PCI Cryptographic Coprocessor
- To capture measurements of timing and configuration for the PCI Cryptographic Coprocessor

You can also use the SecureWay Security Server (RACF) or an equivalent product to record attempts to use protected cryptographic keys or functions.

- **SMF Records Generated by CUSP and PCF Macros**

  When you use the GENKEY and RETKEY macros on CUSP and PCF, the System Management Facilities (SMF) create SMF type 82 records. However, ICSF does not record SMF type 82 records during GENKEY and RETKEY macro processing. If you need to audit the use of these services, specify auditing in the resource profiles that protect them. If you run the CUSP or PCF macros on ICSF, SMF records are *not* recorded, because ICSF does not record those SMF records for any macro or callable service.

  Profiles can protect the GENKEY and RETKEY macros.

Operating Considerations

Before operating a computing system that has ICSF installed, you should consider certain items.

ICSF Initialization Options

Your system operator can use the START and STOP operator commands to start and stop ICSF. Also, your system programmer can set up different sets of options such as a PARMLIB member that the operator can specify on the START command. This enables you to set ICSF up to run differently at different times. For more information, see “Using Options to Tailor ICSF” on page 21.

Note: To make such changes, CUSP and PCF require system programming skills to alter bits in an object module. ICSF is much easier. First, the system programmer creates alternative sets of options in data sets (such as PARMLIB members). The system operator can then use the STOP and START operator commands and these option data sets to change the ICSF operating mode.

Effect of Multiple Records on Performance

If you add more than 10,000 records to a CKDS, and Local Shared Resource (LSR) is installed on your system, you should consider using the batch LSR subsystem with the VSAM deferred-write option. You should also plan to do sequential additions rather than insertions. This can greatly improve the performance of this operation.

Converting from CUSP or PCF to ICSF

If your installation is currently using another IBM cryptography product, there are some topics you should consider when planning your migration to ICSF.

If your installation currently uses CUSP or PCF, and you are migrating to ICSF, consider the following:

- **Programs**

  When ICSF is in compatibility mode, you can use CUSP and PCF applications on ICSF without reassembling. This is because ICSF continues to support the CUSP and PCF macros (EMK, CIPHER, GENKEY, and RETKEY).
- **Installation exits**

  If you have exits for the CUSP and PCF macros (EMK, CIPHER, GENKEY, and RETKEY), you need to decide whether you still need these macros under ICSF. If you determine that you still need these macros, rewrite the exits for ICSF.
- **CUSP and PCF applications in coexistence mode**

  If some application programs in your installation use ICSF and some use CUSP or PCF, you should run ICSF in coexistence mode. Use the coexistence macros (CSFCIPH, CSFEMK, CSFGKY, and CSFRKY) that are shipped in SYS1.SAMPLIB. If you want an application to run in ICSF, you must reassemble it against the coexistence macros.
- **CUSP or PCF Cryptographic Key Data Set**

  During migration, you may need to convert a CUSP or PCF CKDS into ICSF CKDS format if you use any of the keys on ICSF.

  ICSF provides a conversion program that converts a CUSP or PCF CKDS into a ICSF CKDS. Using the CUSP/PCF conversion program, you can convert all the entries in a CUSP or PCF CKDS, or select which entries to convert. Also, you can convert CUSP and PCF key-encrypting keys into ICSF key-encrypting keys or into ICSF PIN block protection keys.

  Note: Keys from a CUSP CKDS are converted by default into importer and exporter key-encrypting keys, and optionally into PIN block protection keys.

Common Migration Activities for z/OS ICSF, OS/390 ICSF and ICSF/MVS Version 2 Release 1

The following sections describe common activities and considerations that should be considered when you migrate from:

- OS/390 V2 R6 ICSF and higher
- OS/390 V2 R4 ICSF
- ICSF/MVS Version 2 Release 1

Note: For a list of specific OS/390 V2 R4 migration activities, see “Migrating from V2 R4 ICSF” on page 53. For a list of specific ICSF/MVS Version 2 Release 1 migration activities, see “Migrating from ICSF/MVS Version 2 Release 1” on page 53.

Access to Callable Services

Access to services that are executed on the PCI Cryptographic Coprocessor is through Access Control Points in the DEFAULT Role. To execute callable services on the PCI Cryptographic Coprocessor, access control points must be enabled for each service in the DEFAULT Role. The ability to enable/disable access control points in the DEFAULT Role was introduced on OS/390 V2 R10 through APAR OW46381 for the Trusted Key Entry Workstation. For systems that do not use the optional TKE Workstation, all access control points (current and new) are enabled in the DEFAULT Role with the appropriate microcode level on the PCI Cryptographic Coprocessor. New TKE users and non-TKE users have all access control points enabled. This is also true for brand new TKE V3.1 users (not converting from TKE V3.0).

Note: Access control point DKYGENKY-DALL is always disabled in the DEFAULT Role for all customers (TKE and Non-TKE). A TKE Workstation is required to enable this access control point for the Diversified Key Generate service.

For existing TKE V3.0 users, upgrading to TKE V3.1 (APAR OW46381 and its corresponding ECA), current access control points in the DEFAULT Role are enabled. Any new access control points are disabled in the DEFAULT Role and must be enabled through TKE if the service is required.

Notes:

1. APAR OW46381 will update the TKE Host Code
2. ECA 186 will update the TKE Workstation Code
3. MCL006 and MCL007 required for PCI Cryptographic Coprocessor microcode for the S/390 G5 Enterprise Server or the S/390 G6 Enterprise Server
4. MCL001 and MCL002 required for PCI Cryptographic Coprocessor microcode for the IBM @server zSeries 900

All of the above components are required for complete access control point support.

Access to services which execute on the Cryptographic Coprocessor Feature is through SAF. Disablement through SAF is sufficient to prevent execution of a service by either the Cryptographic Coprocessor Feature or the PCI Cryptographic Coprocessor. For functions which can be executed on the PCI Cryptographic Coprocessor, enablement of the function requires that the function be enabled through SAF and through the access control point in the DEFAULT Role.

If you are on OS/390 V2 R10, using a TKE V3.0 workstation, access control points for new services (requiring APARs OW46380 and OW46382) will be disabled. Existing access control points will be enabled in the DEFAULT Role. APAR OW46381 must be installed to enable the OS/390 V2 R10 interface. This will allow the TKE Administrator to enable any new access control points for ICSF services that execute in the PCI Cryptographic Coprocessor under the DEFAULT Role.

Access Control Points (requiring APARs OW46380 and OW46382) for OS/390 V2 R10 are:

- DATAM Key Management Control

Note: For existing TKE installations (upgrading to TKE V3.1), it is required that this access control point be enabled. Failure to do so will result in processing errors for Double MAC keys in Key Import, Key Export, and Key Generate.

- Diversified Key Generate - Single length or same halves
- Diversified Key Generate - CLR8-ENC
- Diversified Key Generate - TDES-ENC
- Diversified Key Generate - TDES-DEC
- Diversified Key Generate - SESS-XOR
- Diversified Key Generate - DKYGENKY-DALL

Note: This access control point is always disabled in the DEFAULT Role for all customers (TKE and Non-TKE). A TKE Workstation is required to enable the function.

- MAC Generate - For existing TKE installations, it is recommended that this access control point be enabled.
- MAC Verify - For existing TKE installations, it is recommended that this access control point be enabled.

Access Control Points for z/OS V1 R2 are:

- PKA Key Token Change
- Secure Messaging for Keys
- Secure Messaging for PINs

Callable Services

- Control Vector Generate (CSNBCVG) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support new key types KEYGENKY, DKYGENKY, and SECMSG. The following *rule_array* keywords are also supported: CLR8-ENC, DALL, DDATA, DEXP, DIMP, DKYL0, DKYL1, DKYL2, DKYL3, DKYL4, DKYL5, DKYL6, DKYL7, DMAC, DMKEY, DMPIN, DMV, DPVR, SMKEY, and SMPIN.
- Digital Signature Generate (CSNDDSG) - Beginning with OS/390 V2 R9 ICSF, if you specify ZERO-PAD in the *rule_array parameter*, the input hash length is limited to 32 bytes (256 bits). APAR OW48511 (for OS/390 V2 R9 and OS/390 V2 R10) changes the hash length limit to 256 bytes when ZERO-PAD is specified for signature use only keys. It also increases the hash length limit for all other keys when ZERO-PAD is specified to 36 bytes.

  Beginning in OS/390 V2 R10, ANSI X9.31 formatting for a digital signature is supported. New *rule_array* keywords are: X9.31, SHA-1, and RPMD-160.
- Digital Signature Verify (CSNDDSV) - Beginning in OS/390 V2 R10, ANSI X9.31 formatting for a digital signature is supported. New *rule_array keyword* X9.31 has been added.
- Diversified Key Generate (CSNBDKG) - This is a new service in OS/390 V2 R10. This service generates a key based on the key-generating key, the processing method, and the parameter supplied.
- Key Generate (CSNBKGN) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support KEYGENKY and DKYGENKY key types through the TOKEN key type keyword and the specification of the proper control vector in the *target_key_identifier* field.
- Key Export (CSNBKEX) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support the source key being specified as a label.

- Key Token Build (CSNBKTB) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support new key types: KEYGENKY, DKYGENKY, and SECMSG.
- One-Way Hash Generate (CSNBOWH) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support the RIPEMD-160 hash algorithm.
- PCI Interface (CSFPCI) - Beginning in OS/390 V2 R10, this callable service has been enhanced to query a list of enabled/disabled access control points.
- PKA Decrypt (CSNDPKD) - Beginning in OS/390 V2 R10, this callable service has been enhanced to support a clear RSA modulus-exponent or Chinese Reminder key.
- PKA Encrypt (CSNDPKE) - A new *rule_array* parameter, ZERO-PAD, has been added in OS/390 R2 R10 (APAR OW48132). The key value will be padded on the left with binary zeros to the length of the PKA key modulus.
- PKA Key Generate (CSFDPKG) - Beginning with OS/390 V2 R9 ICSF, CSFDPKG supports writing the *generated_key* directly to the PKDS. This means that the *generated_key_token* field is now an INPUT as well as an OUTPUT field. If a PKDS label name is not being supplied, then a value less than a blank X'40' must be supplied in the first byte of the parameter or else the service fails with a return code 8 reason code X'2AF8'.

  Beginning in OS/390 V2 R10, this service was enhanced to support the XPORT *rule_array* parameter.
- PKA Key Import (CSNDPKI) - Beginning with OS/390 V2 R9 ICSF, CSFDPKI supports writing the *target_key_identifier* directly to the PKDS. This means that the *target_key_identifier* field is now an INPUT as well as an OUTPUT field. If a PKDS label name is not being supplied, then a value less than a blank X'40' must be supplied in the first byte of the parameter or else the service fails with a return code 8 reason code X'2AF8'.
- PKA Key Token Change (CSNDKTC) - This service is new in z/OS V1 R2. It changes PKA private key tokens (RSA and DSS) from encipherment with the old PCI Cryptographic Coprocessor ASYM-MK to encipherment with the current PCI Cryptographic Coprocessor ASYM-MK. PKA private keys encrypted under the KMMK cannot be reenciphered using this service unless the KMMK has the same value as the SMK.
- Public Key Extract (CSNDPKX) - Beginning with OS/390 V2 R9 ICSF, this service must be in task mode, not SRB mode. It was also enhanced to support PKDS labels as well as tokens. This requires a change to the stub module CSNDPKX. Existing applications that have been link edited with the old stub module will still run without change. Access to this service can also be RACF controlled.
- Secure Messaging for Keys (CSFBSKY) - This is a new service for z/OS V1 R2. It encrypts a text block, including a clear key value decrypted from an internal or external DES token.
- Secure Messaging for PINs (CSFBSPN) - This is a new service for z/OS V1 R2. It encrypts a text block, including a clear PIN block recovered from an encrypted PIN block. The clear PIN block can be self encrypted before it is included in the text block.
- Symmetric Key Import (CSNDSYI) - Beginning with OS/390 V2 R9 ICSF, the *target_key_identifier_length* parameter size must be 64 bytes.
- Beginning in z/OS V1 R2, MAXLEN parameter checking has been eliminated for the following services:
  - Encipher (CSNBENC and CSNBENC1)
  - Decipher (CSNBDEC and CSNBDEC1)

– MAC generate (CSNBMGN and CSNBMGN1)
– MAC verify (CSNBMVR and CSNBMVR1)
– Ciphertext translate (CSNBCTT and CSNBCTT1)
– MDC generate (CSNBMDG and CSNBMDG1)

The MAXLEN parameter is also no longer enforced in the CUSP compatibility CIPHER service. The MAXLEN parameter may still be specified in the options data set, but only the maximum value limit will be enforced (2147483647). If a value greater than this is specified, an error will result and ICSF will not start.

CICS Attachment Facility

If you have the CICS Attachment Facility installed with OS/390 V2 R4 ICSF and above (including z/OS), and you have ICSF CICS TRUE enabled, install APAR OW40011 on HCRP210 and APAR OW43444 on HCRP220 and HCRP230 and relink your applications that invoke the following ICSF services to pick up the updated service stubs.

Note: If you have previously installed these APARs and relinked your applications at that time, no action is required.

- HCRP210 (ICSF/MVS V2 R1, OS/390 V2 R4 ICSF, OS/390 V2 R5 ICSF): CSNBKRC, CSNBKRW, CSNBKRD, CSNDDSG, CSNDDSV, CSNDPKG, CSNDPKI, CSNDSYX, CSNDSYG, CSNDSYI, CSNDKRC, CSNDKRW, CSNDKRD, CSNDKRR, CSNDSBC, CSNDSBD
- HCRP220 (OS/390 V2 R6 ICSF, OS/390 V2 R7 ICSF, OS/390 V2 R8 ICSF): CSNBKRC, CSNBKRW, CSNBKRD, CSNDDSG, CSNDDSV, CSNDPKG, CSNDPKI, CSNDSYX, CSNDSYG, CSNDSYI, CSNDKRC, CSNDKRW, CSNDKRD, CSNDKRR, CSNDSBC, CSNDSBD, CSNDPKD, CSNDPKE
- HCRP230 (OS/390 V2 R9 ICSF): CSNBKRC, CSNBKRW, CSNBKRD, CSNDDSG, CSNDDSV, CSNDPKG, CSNDPKI, CSNDSYX, CSNDSYG, CSNDSYI, CSNDKRC, CSNDKRW, CSNDKRD, CSNDKRR, CSNDSBC, CSNDSBD, CSNDPKD, CSNDPKE, CSNDPKX, CSNDRKD, CSNDRKL

CKDS

If you are migrating from ICSF/MVS Version 2 Release 1, see “Migrating from V2 R4 ICSF” on page 53 for a specific CKDS migration information. The following applies if you are migrating from OS/390 V2 R4 ICSF or OS/390 V2 R6 and higher ICSF.

Once new key types are added to the CKDS, the following considerations apply when sharing the CKDS with non-R10 or non-z/OS systems:

- once keys with non-CCF control vectors are added to the CKDS, a CKDS reencipher operation must be invoked from a system which has a PCI Cryptographic Coprocessor installed.
- once keys of type IMPORTER, EXPORTER, PINGEN, PINVER, IPINENC, or OPINENC which have non-CCF control vectors are added to the CKDS, a toleration APAR OW43926 must be installed on the non-OS/390 V2 R10 ICSF systems. The APAR ensures that ICSF services will fail a request to use a key which contains a non-CCF control vector.

Installation Options Data Set

PKDSCACHE, an installation option, defines the size of the PKDS Cache in records. The PKDS cache improves performance as it facilitates access to

frequently used records. Specify *n* as a decimal value from 0 to 256. If *n* is zero, no cache will be implemented. If PKDSCACHE is not specified, the default value is 64. PKDSCACHE can be implemented on OS/390 V2 R10 and z/OS V1 R1 by installing APAR OW48568.

Key Tokens

- Existing DES internal key tokens can be used on either the Cryptographic Coprocessor Feature or the PCI Cryptographic Coprocessor.
- An existing PKA internal token created for the Cryptographic Coprocessor Feature cannot be used on the PCI Cryptographic Coprocessor unless you recreate it by reimporting the key. Since the Cryptographic Coprocessor Feature cannot generate PKA keys (these tokens were all generated on another platform and imported for use with the Cryptographic Coprocessor Feature), you'll need to reimport them to use them on the PCI Cryptographic Coprocessor. For maximum flexibility, you should install the SMK to be equal to the KMMK. Existing PKA tokens should then be reimported.

PCI Cryptographic Accelerator

If you have a PCI Cryptographic Accelerator online, toleration APAR OW49402 is required on lower levels of ICSF (OS/390 V2 R9, OS/390 V2 R10 and z/OS V1 R1). Without this APAR, ICSF will abend with an X'18F' reason code 50.

PKA Public Key Storage

You need to create a PKDS in order to do the following:

- Start V2 R9 ICSF or higher.
- Use the PKDS update callable services.

  These callable services will not work with any public key storage mechanisms other than the PKDS. Therefore, you will need to migrate any existing public keys to the PKDS.
- Use key labels for PKA keys instead of tokens on certain callable services.
- A PKDS is required to generate and use RSA private keys that are retained within a PCI Cryptographic Coprocessor.

PKDS

Beginning with OS/390 V2 R9, the PKDS is required.

Beginning in z/OS V1 R2, support to REENCIPHER PKDS and ACTIVATE PKDS has been added to the Master Key Management Panels and to the new CSFPUTIL utility. CSFPUTIL is a new utility that performs the same functions as REENCIPHER PKDS and ACTIVATE PKDS. These functions allow you to reencipher the PKDS from the old asymmetric-keys master key to the current master key and activate the reenciphered PKDS. Other systems with lower levels of ICSF which are sharing the PKDS would disable PKDS read and PKDS write and activate the reeniciphered PKDS. For information on managing and sharing the PKDS in a sysplex environment, see *z/OS ICSF Administrator's Guide*, SA22-7521. Toleration APAR OW49386 is required on the following systems in order to activate the PKDS:

- HCRP210 (standalone), HCRP220 (OS/390 V2 R6, OS/390 V2 R7, OS/390 V2 R8), HCRP230 (OS/390 V2 R9), and HCR7703 (OS/390 V2 R10 and z/OS V1 R1)

With OS/390 V2 R6 ICSF and above (including z/OS), if you share the PKDS with lower level releases of ICSF, the following APARS must be installed:

- HCRP210 (ICSF/MVS V2 R1, OS/390 V2 R4 ICSF, OS/390 V2 R5 ICSF) must have APARS OW33234 and OW37623 installed. If you are running OS/390 V2 R9 ICSF, you must also have APAR OW43275 installed on HCRP210. New OS/390 V2 R9 ICSF tokens on previous releases of ICSF will be handled as follows. For additional information on ME and CRT tokens, see diagnosis reference information in *z/OS ICSF System Programmer's Guide*.
  - Retained key tokens contain a public key token. These public key tokens may be used in public key services such as Digital Signature Verify (CSNDDSV). These tokens may not be updated or deleted through the PKDS Record Write (CSNDKRW) or PKDS Record Delete (CSNDKRD) callable services.
  - All modulus-exponent form RSA internal key tokens imported or created on an OS/390 V2 R9 ICSF or OS/390 V2 R10 ICSF system with PCI Cryptographic Coprocessor will have a private section identifier of X'06'. These tokens will be converted where possible to internal tokens with a private section of X'02' for use on previous levels of ICSF without a PCI Cryptographic Coprocessor. Modulus-exponent tokens with a private section identifier of X'06' which are signature-use only tokens can be converted since these tokens are encrypted under the ASYM-MK of the PCI Cryptographic Coprocessor (which is the same as the SMK of the Cryptographic Coprocessor Feature). Modulus-exponent tokens with a private section identifier of X'06' which are designated as key-management usage can only be converted for use on previous levels of ICSF if the KMMK on the Cryptographic Coprocessor Feature is the same as the SMK.
  - CRT tokens are not supported on previous levels of ICSF.
- HCRP220 (OS/390 V2 R6 ICSF, OS/390 V2 R7 ICSF, OS/390 V2 R8 ICSF) must have APAR OW37623 installed. If you are running OS/390 V2 R9 ICSF, you must also have APAR OW43275 installed on HCRP220. New OS/390 V2 R9 ICSF tokens on previous releases of ICSF will be handled as follows. For additional information on ME and CRT tokens, see diagnosis reference information in *z/OS ICSF System Programmer's Guide*.
  - Retained key tokens contain a public key token. These public key tokens may be used in public key services such as Digital Signature Verify (CSNDDSV). These tokens may not be updated or deleted through the PKDS Record Write (CSNDKRW) or PKDS Record Delete (CSNDKRD) callable services.
  - All modulus-exponent form RSA internal key tokens imported or created on an OS/390 V2 R9 ICSF or OS/390 V2 R9 ICSF system with PCI Cryptographic Coprocessor will have a private section identifier of X'06'. These tokens will be converted where possible to internal tokens with a private section of X'02' for use on previous levels of ICSF without a PCI Cryptographic Coprocessor. Modulus-exponent tokens with a private section identifier of X'06' which are signature-use only tokens can be converted since these tokens are encrypted under the ASYM-MK of the PCI Cryptographic Coprocessor (which is the same as the SMK of the Cryptographic Coprocessor Feature). Modulus-exponent tokens with a private section identifier of X'06' which are designated as key-management usage can only be converted for use on previous levels of ICSF if the KMMK on the Cryptographic Coprocessor Feature is the same as the SMK.
  - CRT tokens are not supported on previous levels of ICSF.

Special Secure Mode

Use of some ICSF services (CSNBSKI, CSNBSKM, CSNBPGN, CSNBCPA, CSNDSYG with the IM keyword) requires that ICSF be in special secure mode.

Note: If a PCI Cryptographic Coprocessor is available and the modulus bit length of the RSA public key is greater than or equal to 512 bits, than special secure mode is not required for SYG IM form.

TKE Workstation

The TKE workstation (Version 3 or later) uses the IBM 4758 card. The TKE workstation (Version 1 and 2) uses the IBM 4755 card. There are many changes to the TKE workstation and software. If you have a TKE workstation (Version 3 or higher) that connects to a host system running OS/390 V2 R8 ICSF or lower, install APAR OW43276 on the system(s) running releases prior to OS/390 V2 R9 ICSF to ensure proper communication between the TKE workstation and ICSF. For detailed information on these changes, refer to *z/OS ICSF TKE Workstation User's Guide 2000*.

Migrating from V2 R4 ICSF

The following sections describe activities and considerations that should be considered when migrating from V2 R4 ICSF. For a list of other migration activites, see "Common Migration Activities for z/OS ICSF, OS/390 ICSF and ICSF/MVS Version 2 Release 1" on page 46.

Installation Exits

The following differences in installation exits occurred between OS/390 V2 R4 ICSF and OS/390 V2 R5 ICSF and should be considered if upgrading from OS/390 V2 R4 ICSF or previous releases of ICSF. If you have already applied APAR OW31961 to OS/390 V2 R4 ICSF, you already have these changes.

- An additional parameter in the Single-record, Read-write installation exit identifies the accessed key data set as either the CKDS or the PKDS.
- The Key Generation Utility Program Exit Parameter Block (KGXP) contains a new subfield to hold the third key part for triple-length DATA keys.
- Any installation with either a Single-record, Read-write exit or a KGUP exit should recompile the exit.

Migrating from ICSF/MVS Version 2 Release 1

The following sections describe activities and considerations that should be considered when migrating from ICSF/MVS Version 2 Release 1. For a list of other migration activites, see "Common Migration Activities for z/OS ICSF, OS/390 ICSF and ICSF/MVS Version 2 Release 1" on page 46.

z/OS ICSF supports all versions of the cryptographic feature hardware. Customers who have OS/390 Enterprise Servers, OS/390 Multiprise servers or the IBM @server zSeries with the Cryptographic Coprocessor Feature can migrate to z/OS ICSF across their entire installation.

CKDS

A Version 1 Release 2 customer who shares a CKDS among multiple instances of ICSF need not migrate all instances of ICSF at the same time. Although, once new key types are added to the CKDS, the following considerations apply when sharing the CKDS:

- After you change a CKDS to contain the ANSI X9.17 enablement keys, all instances of ICSF/MVS Version 1 Release 2 that share that CKDS must have

PTF UW90181 installed. This PTF was shipped against ICSF/MVS Version 1 Release 2 and was rolled up into Version 2 Release 1.

- You can share a CKDS that contains a limited authority importer key. However, OS/390 ICSF or ICSF/MVS 2.1 running on S/390 Enterprise Servers and S/390 Multiprise servers must perform any CKDS reencipherment.
- once new system keys, double-length MAC keys, IMP-PKA keys, etc. (introduced in ICSF/MVS 2.1) are added to the CKDS, it is sharable with instances of ICSF/MVS which do not support these keys. A CKDS reencipher operation must be performed on a system which supports these key types.
- once keys with non-CCF control vectors are added to the CKDS, a CKDS reencipher operation must be invoked from a system which has a PCI Cryptographic Coprocessor installed.
- once keys of type IMPORTER, EXPORTER, PINGEN, PINVER, IPINENC, or OPINENC which have non-CCF control vectors are added to the CKDS, a toleration APAR OW43926 must be installed on the non-OS/390 V2 R10 ICSF systems. The APAR ensures that ICSF services will fail a request to use a key which contains a non-CCF control vector.

Installation Exits

The following differences in installation exits occurred between OS/390 V2 R4 ICSF and OS/390 V2 R5 ICSF and should be considered if upgrading from OS/390 V2 R4 ICSF or previous releases of ICSF. If you have already applied APAR OW31961 to OS/390 V2 R4 ICSF, you already have these changes.

- An additional parameter in the Single-record, Read-write installation exit identifies the accessed key data set as either the CKDS or the PKDS.
- The Key Generation Utility Program Exit Parameter Block (KGXP) contains a new subfield to hold the third key part for triple-length DATA keys.
- Any installation with either a Single-record, Read-write exit or a KGUP exit should recompile the exit.

Migrating from ICSF/MVS Version 1

The following sections describe activities and considerations that should be considered when migrating from ICSF/MVS Version 1 Release 2 and Version 1 Release 1.

The following differences in installation exits occurred between OS/390 V2 R4 ICSF and OS/390 V2 R5 ICSF and should be considered if upgrading from ICSF/MVS Version 1.

- An additional parameter in the Single-record, Read-write installation exit identifies the accessed key data set as either the CKDS or the PKDS.
- The Key Generation Utility Program Exit Parameter Block (KGXP) contains a new subfield to hold the third key part for triple-length DATA keys.
- Any installation with either a Single-record, Read-write exit or a KGUP exit should recompile the exit.

Depending on which release of ICSF/MVS Version 1 you are migrating from, you will have different options to consider.

Migrating from ICSF/MVS Version 1 Release 2

You can use ICSF/MVS Version 1 Release 2 applications on ICSF without reassembling or relinking. This includes CUSP or PCF applications if you are running in compatibility mode.

If your installation is currently using ICSF/MVS Version 1 Release 2, consider the following:

- **CKDS**

  If you share a CKDS among multiple instances of ICSF/MVS you do not have to migrate all instances of ICSF/MVS at the same time. Although, once new key types are added to the CKDS, the following considerations apply when sharing the CKDS:

  – After you change a CKDS to contain the ANSI X9.17 enablement keys, all instances of ICSF/MVS that share that CKDS must have PTF UW90181 installed. This PTF was shipped against ICSF/MVS Version 1 Release 2 and was rolled up into Version 2 Release 1.

  – once a CKDS is modified to contain the ANSI X9.17 enablement keys, all instances of ICSF/MVS that share the CKDS must have APAR OW13633 installed.

  – once new system keys (double-length MAC keys, IMP-PKA keys, etc) introduced in ICSF/MVS 2.1 are added to the CKDS, it is sharable with instances of ICSF/MVS which do not support these keys. A CKDS reencipher operation must be performed on a system which supports these key types.

  – once keys with non-CCF control vectors are added to the CKDS, a CKDS reencipher operation must be invoked from a system which has a PCI Cryptographic Coprocessor installed.

  – once keys of type IMPORTER, EXPORTER, PINGEN, PINVER, IPINENC, or OPINENC which has non-CCF control vectors are added to the CKDS, a toleration APAR OW43926 must be installed on the non-OS/390 V2 R10 ICSF or non-z/OS systems. The APAR ensures that ICSF services will fail a request to use a key which contains a non-CCF control vector.

- **ICSF/MVS Version 1 Release 2 Cryptographic Key Data Set**

  An ICSF/MVS Version 1 Release 2 CKDS will work on ICSF with no changes.

- **Installation exits**

  The following differences in installation exits occurred between OS/390 V2 R4 ICSF and OS/390 V2 R5 ICSF and should be considered if upgrading from ICSF/MVS Version 1 Release 2.

  – An additional parameter in the Single-record, Read-write installation exit identifies the accessed key data set as either the CKDS or the PKDS.

  – The Key Generation Utility Program Exit Parameter Block (KGXP) contains a new subfield to hold the third key part for triple-length DATA keys.

  – Any installation with either a Single-record, Read-write exit or a KGUP exit should recompile the exit.

  If you have user exits for ICSF/MVS Version 1 Release 2, they will work with ICSF with no modification.

  Since the RACF Security Access Facility (SAF) interface fully supports ICSF, OS/390 ICSF does not include the security exit routines that were provided with the previous release of ICSF. If you are using these security exit routines with ICSF/MVS Version 1 Release 2, you will need to migrate to the full SAF/RACF support. This support is available as a part of the Security Server option.

- **Master Key Entry**

  With ICSF on S/390 G3 Enterprise Server, or higher and the S/390 Multiprise, there are several options for master key entry. The option that is right for your application depends on the security requirements of your installation. The options include:

  – Pass Phrase Initialization allows the casual user to enter a pass phrase on the ICSF panels to set both DES and PKA master keys and initialize the CKDS. The value of the master keys is a repeatable function of the pass phrase. For this reason, the security of the pass phrase is critical to the security of the system.

  – The Clear Master Key Entry process allows the user to enter master key parts directly into the Cryptographic Coprocessor Feature through the use of ISPF panels. In this procedure, the key parts appear briefly in the clear in host storage within the address space of the TSO user who is entering the keys and within the ICSF address space. When the master keys are stored in the secure Cryptographic Coprocessor Feature, these address spaces are cleared.

  – The optional Trusted Key Entry (TKE) workstation (feature code 0806) replaces the physically secure hardware master key entry path available on bipolar processors with a logically secure channel implemented through an APPC (TKE Version 1 and Version 2) attachment. Installations that require this level of security need the TKE workstation, which comes fully configured by IBM Customized Solutions.

Migrating from ICSF/MVS Version 1 Release 1

You can use ICSF/MVS Version 1 Release 1 applications on ICSF without reassembling or relinking. This includes CUSP or PCF applications if you are running in compatibility mode.

Note: One exception to this is that ICSF/MVS Version 1 Release 1 key labels with a non-zero qualifier need to be RENAMED to an ICSF supported key label. Because the new label differs from the ICSF/MVS Version 1 Release 1 label, the applications need to be changed.

Note that once you create a CKDS that contains the ANSI enablement keys, all instances of ICSF/MVS that share that CKDS must have PTF UW90181 installed. This PTF was shipped against Version 1 Release 2 and was rolled up into Version 2.

If your installation is currently using ICSF/MVS Version 1 Release 1 and you are migrating to ICSF, consider the following:

- **ICSF/MVS Version 1 Release 1 Cryptographic Key Data Set**

  ICSF provides a conversion program to migrate an ICSF/MVS Version 1 Release 1 CKDS to an ICSF compatible CKDS. You can run the CKDS conversion program from either ICSF/MVS Version 1 Release 1 or OS/390 ICSF.

- **Installation exits**

  If you have user exits for ICSF/MVS Version 1 Release 1, they will work with OS/390 ICSF or z/OS with no modification.

- **Key labels**

  ICSF/MVS Version 1 Release 1 supports a key label of up to 8 bytes and multiple key types per label in the CKDS. ICSF/MVS Version 1 Release 2 introduced support for an extended key label of up to 64 bytes and required unique key labels for data-encrypting, data-translating, MAC-generating, and

MAC-verifying keys. ICSF continues to support the 64-byte key label. The ICSF CKDS and KGUP will continue to support multiple key types per label for importer and exporter key-encrypting keys and PIN keys under the following conditions. You must use either KGUP or the KEU to enter the keys, and the key label cannot conflict with other unique label restrictions.

RACF and security exit key protection in ICSF/MVS Version 1 Release 2 are by *label* rather than *label.type*. You need to rewrite any current RACF or security exit profiles that are based on *label.type*.

Converting a Version 1 Release 1 CKDS to z/OS ICSF Format

z/OS ICSF provides a conversion program, CSFCVR1, that converts a Version 1 Release 1 CKDS to the z/OS ICSF format. You can run the conversion program from either Version 1 Release 1 or from z/OS ICSF if you ensure that the system meets the following conditions:

- If you are running the CSFCVR1 conversion program on a Version 1 Release 1 system, you must fully initialize the Version 1 Release 1 system to the point of enabling application services.

  The job control language for CSFCVR1 **must** STEPLIB to the entire z/OS ICSF load library. Running the conversion program in Version 1 Release 1 does not involve loading a new master key or initializing a new CKDS (as in z/OS ICSF). For these reasons, it is the recommended conversion option.
- If you are running the CSFCVR1 conversion program on a z/OS ICSF system, you must fully initialize the z/OS ICSF system to the point of enabling application services.

  This means that you must first load a new master key and then complete the initialization of a z/OS ICSF CKDS. ICSF uses this new CKDS during the conversion process, but it is not the target of the conversion.

The next two sections describe how the conversion program runs and how to start it.

How the Conversion Program Works

The conversion program remaps each record in the Version 1 Release 1 CKDS to the new format. With the exception of the label and qualifier fields, the conversion program copies these records identically. During the conversion, ICSF calculates a new authentication code for each converted CKDS record. The conversion program does not call any exits and does not support the use of an override file.

Converting to the New Label Format

The conversion program remaps the 8-byte Version 1 Release 1 label field to the 64-character label field, padded on the right with blanks. If the input CKDS record contains nonzero information in the key qualifier field, the program converts the entire 8-byte hexadecimal field to a 16-byte EBCDIC character field. It appends 16-byte EBCDIC character field to the right of the new key label preceded by a single period (.).

For example, suppose you have a Version 1 Release 1 input record that contains a label of METOYOU, a type of EXPORTER, and a qualifier of X'1102920000000000'. This is converted to a ICSF label of METOYOU.1102920000000000, padded on the right with blanks to the full 64-byte label field.

Existing applications that use the old 8-byte label and count on the CKDS Retrieval Exit to select a key based on a nonzero qualifier do not work with the OS/390 ICSF or z/OS CKDS. You can use the KGUP RENAME verb to rename these changed labels to a valid 64-byte label.

Running the Conversion Program

You run the conversion program by submitting a batch job. On the EXEC statement, specify PGM=CSFCVR1.

The following example is the job control language that runs the conversion program:

```
//DAFRANK3 JOB
//CONVERT  EXEC PGM=CSFCVR1
//CSFVSRC  DD   DSN=ICSFR1.HCRP100.CKDS,DISP=SHR
//CSFVNEW  DD   DSN=ICSFV2.HCRP210.CKDS,DISP=SHR
//CSFVRPT  DD   SYSOUT=*
//
```

All the data sets necessary to run the conversion program are specified using DD statements.

The conversion program uses the following data sets:

CSFVSRC
: The ICSF/MVS Version 1 Release 1 CKDS containing entries that you want to convert into the z/OS ICSF format and place in the output CKDS. This is the source CKDS for the conversion.

CSFVNEW
: An empty disk copy of an ICSF CKDS. This is the z/OS ICSF CKDS into which the conversion program places key entries. The data set must be defined and empty before you run the conversion program.

CSFVRPT
: The activity report that the conversion program creates. The report contains a summary of the conversion process and includes error messages. The report lists only changed labels by their converted OS/390 ICSF label. The report provides the following counts:
  - The total labels processed, including system labels
  - The labels processed, where the qualifier was not binary zeros and was appended to the existing label

Attention: If a conversion program run ends prematurely, the results of the job are unpredictable. You should not read a CKDS involved in the conversion into storage for use. For a description of the conversion program return codes, see the explanation of message CSFV0026 in *z/OS ICSF Messages*.

When you run the conversion program, the program produces information about the conversion in an activity report. The activity report lists each record with a changed label and any error messages. The activity report also lists the data sets that were used in the conversion and a summary of processing. The summary of processing contains totals of the number of records that were processed and the number of labels that were changed.

Figure 12 on page 59 is an example of an activity report with two changed label conversions.

```
CRYPTOGRAPHIC CONVERSION ACTIVITY REPORT                                    DATE: 2001/06/01 (YYYY/MM/DD) TIME: 10:13:09 PAGE: 1
>>>CSFV0402 DAVE001.1993111200000000 PINGEN CREATED FROM A RELEASE 1 RECORD WITH A NON-ZERO QUALIFIER FIELD.
>>>CSFV0402 EXPN0E.1993111200000000 EXPORTER CREATED FROM A RELEASE 1 RECORD WITH A NON-ZERO QUALIFIER FIELD.
>>>CSFV0012 CONVERSION PROCESSING COMPLETED.  RETURN CODE = 0.

  CKDS DDNAME      Dataset Name
  ------------     -------------
  CSFVSRC          ICSFR1.HCRP100.CKDS
  CSFVNEW          ICSFO4.HCRP210.CKDS

Total number of CKDS record conversions processed    =        153
Total number of modified label conversions processed =          2
```

Figure 12. Example of a Version 1 Release 1 to ICSF z/OS Conversion Activity Report

In this example, ICSF converted 153 CKDS records. Two of the Version 1 Release 1 records contain nonzero qualifier fields, so the conversion program changed the labels for these records. The report shows the new labels. In this conversion, a Version 1 Release 1 record with a label of DAVE001 and a type of PINGEN contained the nonzero qualifier field X'1993111200000000'. The resulting OS/390 ICSF label and type for this record are DAVE001.1993111200000000 PINGEN. Similarly, the Version 1 Release 1 EXPORTER key with the label EXPN0E and a qualifier field of X'1993111200000000' was converted to EXPN0E.1993111200000000. You can use the KGUP RENAME verb to rename these changed labels to a valid 64-byte label.

After listing the changed key labels, the activity report lists the data sets the conversion program used in the conversion. ICSFR1.HCRP100.CKDS is the Version 1 Release 1 CKDS the program converted. ICSFO4.HCRP210.CKDS is the output z/OS ICSF CKDS where the conversion program placed the converted entries.

The activity report ends with the conversion processing completed message and a return code.

Migrating from 4753-HSP

ICSF provides key management callable services that are identical to the 4753-HSP verbs of the same name. Key management applications that are developed for the 4753-HSP and use these common verbs can be run on OS/390 ICSF or z/OS ICSF without reassembly. You will, however, need to relink them.

If your installation is currently using the 4753-HSP and you are migrating to OS/390 ICSF or z/OS ICSF, consider the following:

- **4753-HSP cryptographic key storage**

  Internal key tokens for ICSF and the 4753-HSP are not interchangeable. Key token migration for the 4753 exists through the optional TKE Version 3 Workstation. TKE Version 3 supplies a 4753 Migration Utility. It allows you to migrate internal DES key tokens from the 4753 to ICSF. Key exchange between the two systems is through the external key token. To migrate keys from the 4753-HSP to ICSF, you must first establish an exporter/importer key relationship between the 4753-HSP and ICSF. You can then write an application to export keys from the 4753-HSP key storage and import them into the ICSF CKDS. You can perform this type of key exchange only with CCA-defined keys, which have the same control vectors on key-encrypting keys. If your 4753-HSP installation includes non-CCA key types in key storage, you need to generate a special exporter/importer key-encrypting key pair on the 4753-HSP. The exporter

key-encrypting key nullifies the CV value that is used on the 4753-HSP, and the importer key-encrypting key includes the CV value that is needed at ICSF.

- **Callable Services**

  If you are migrating to OS/390 V2 R10 ICSF, the following differences should be considered. For more information on individual callable services, refer to *z/OS ICSF Application Programmer's Guide*, SA22-7522.

  – Clear Key Import - This service produces an internal DATA token with a control vector usable on the Cryptographic Coprocessor Feature. If a valid internal token is supplied as input to the service in the target *key_identifier* field, that token's control vector will not be used in the encryption of the clear key value.

  – Control Vector Generate - supports a subset of the TSS control vector key-usage keywords.

  – Control Vector Translate - if the *kek_key_identifier* parameter is specified as a label, and the identified token has a key type of IMPORTER or EXPORTER, then the label must be unique in the CKDS.

  – Clear PIN Generate Alternate, Clear PIN Generate and Encrypted PIN Verify do not provide support for the GBP-PINO calculation method when these services are routed to the PCI Cryptographic Coprocessor for execution.

  – Data Key Import - Data Key Import does not support direct write of the target token to the ICSF CKDS.

  – Key Generate - will not support the following *key_type_1* and *key_type_2* combinations for any *key_form*.

```
CIPHER      CIPHERXI
CIPHER      CIPHERXL
CIPHER      CIPHERXO
DECIPHER    CIPHERXO
ENCIPHER    CIPHERXI
CIPHERXI    CIPHER
CIPHERXL    CIPHER
CIPHERXO    CIPHER
CIPHERXO    DECIPHER
CIPHERXI    ENCIPHER
CIPHERXL    CIPHERXL
CIPHERXI    CIPHERXO
CIPHERXO    CIPHERXI
DATAXLAT    Null-CV
```

    In addition, the following *key_type_1* and *key_type_2* combinations which are supported by 4753 have slightly different support with OS/390 V2 R10 ICSF. These pairs will be supported only for the OPEX, EXEX, and IMEX key forms, and the only allowable control vectors will be those supported by the Cryptographic Coprocessor Feature.

```
DATA        DATAXLAT
DATAXLAT    DATAXLAT
```

    Key Generate does not support direct write of the target token to the ICSF CKDS.

  – Key Import - Key Import does not support direct write of the target token to the ICSF CKDS.

  – Key Token Build - Key types ADATA, AMAC, CIPHERXI, CIPHERXL, CIPHERXO, UKPTBASE are not supported. Rule array keywords KEY-REF, ADAPTER, READER, CARD, ACTIVE, INACTIVE, CLEAR-IV, NO-IV, CBC, X9.23, IPS, CUSP, X9.9-1, MACLEN4, MACLEN6, and MACLEN8 are not supported. The *master_key_verification_number* parameter has been replaced

by the *master_key_version_number* parameter. The *master_key_version_number* parameter is examined only if the KEY keyword is specified, and in this case must be zero. If KEY and INTERNAL are both specified in the rule array, the service will check for the existence of the rule array keyword MKVP. If MKVP is specified, the service will make use of the last parameter specified. The *key_register_number*, *secure_token*, and *initialization_vector* parameters are ignored. The *pad_character* parameter must have a value of zero.

- Multiple Clear Key Import - This service produces an internal DATA token with a control vector usable on the Cryptographic Coprocessor Feature. If a valid internal token is supplied as input to the service in the target *key_identifier* field, that token's control vector will not be used in the encryption of the clear key value.
- PKA Key Token Build - RSA-OPT rule array keyword is not supported. Optimized (Chinese Remainder Theorem) RSA keys are built using the RSA-CRT rule array keyword.
- PIN services do not support the OEM-1 PIN block format.
- Prohibit Export service - does not support DATA, MAC, or MACVER keys which have standard control vectors (for example, control vectors supported by the Cryptographic Coprocessor Feature).

  Prohibit Export does not support direct write of the target token to the ICSF CKDS.
- Secure Key Import - does not adjust key parity or support double-length DATA keys. Use the Multiple Secure Key Import service to process double-length DATA keys.
- It is not possible to migrate use of CIPHER keys from the 4753. CIPHER key types are not supported on the Cryptographic Coprocessor Feature.
- CVARPINE key can be built, generated, imported, or exported. They cannot be used since the Encrypted PIN Generate Alternate service is not supported.
- The following CCA services are not supported by ICSF:
  - Key Record List
  - Key Token Change
  - Key Token Parse
  - Clear PIN Verify
  - Cryptographic Variable Decipher
  - Encrypted PIN Generate Alternate
- Support for the following key types is not supported by ICSF: ACIPHER, ADATA, AMAC, CIPHERXI, CIPHERXL, CIPHERXO, and UKPTBASE.
- Support for the UDF/UDP control vector bit is not supported by ICSF.
- Chinese Remainder Theorem optimized key tokens with private key section identifier of X'05' are not supported by OS/390 V2 R10 ICSF. ICSF supports CRT tokens with a private key section identifer of X'08'.
- If PBVC is specified in the format control parameter of the PIN profile for the Clear PIN Generate Alternate service, the PIN Translate service, or the Encrypted PIN Verify service, only control vectors and extraction methods valid for the Cryptographic Coprocessor Feature may be used.
- Key management services such as Key Generate, Key Import, Data Key Import, and Prohibit Export do not support direct write of the target key token to the ICSF CKDS.
- During initialization of a PCI Cryptographic Coprocessor, an Environment Identification, or EID, of zero will be set in the card. This will be interpreted by

the PKA Symmetric Key Import service to mean that environment identification checking is to be bypassed. Thus, it is possible for a key-encrypting key RSA-enciphered at a node (EID) to be imported at the same node.

- **Key labels**

  ICSF/MVS Version 1 Release 2 and above supports an extended key label of up to 64 bytes. Although the 4753-HSP also supports a 64-byte key label, there are additional key label formatting restrictions that do not apply to ICSF. The 4753-HSP key label consists of one to five name tokens that are separated by periods. Each name token includes one to eight alphanumeric or national string characters. ICSF, therefore, can accept all 4753-HSP key labels, but the 4753-HSP cannot accept all ICSF key labels. For more information on key label formatting restrictions, refer to *IBM Transaction Security System: Concepts and Programming Guide: Volume I, Access Controls and DES Cryptography*.

  ICSF/MVS Version 1 Release 2 and above, like the 4753-HSP, requires unique key labels for data-encrypting keys, data-translation keys, and MAC keys. To maintain compatibility with ICSF/MVS Version 1 Release 1, however, KGUP will continue to allow multiple key types per label for importer, exporter, and PIN keys under the following conditions. Use either KGUP or the KEU to enter the keys, and ensure that the key labels do not conflict with other unique label restrictions.

- **UDX (User Defined Extension) support**

  Beginning with OS/390 V2 R10 ICSF, ICSF support is provided for UDX capabilities. UDX routines are developed by special contract with IBM and are only distributed to authorized customers.

  The UDX function is invoked by a ″installation-defined″ or generic callable service. The callable service is defined in the Installation Options data set (UDX parameter) and the service stub is link-edited with the application. The application program calls the service stub which accesses the UDX installation-defined service. There is a one-to-one correspondence between a specific generic service in ICSF and a specific UDX command processor in the PCI Cryptographic Coprocessor. The administrator, through TSO panels, performs UDX authorization processing on each PCI Cryptographic Coprocessor. Authorization is not LPAR specific. See *z/OS ICSF Administrator's Guide*, SA22-7521, for additional information on authorizing User Defined Extensions.

  Beginning in z/OS V1 R2, support for writing your own UDX has been added. See the *UDX Reference and Guide* and the *4758 Custom Software Developer's Toolkit Guide* for additional information. These, and other publications related to the IBM 4758 Coprocessor can be obtained in PDF format from the Library page located at http://www.ibm.com/security/cryptocards.

  See *z/OS ICSF System Programmer's Guide*, SA22-7520, for details on installation-defined callable services and a description of the UDX parameter in the installation options data set.

Appendix A. Standards

The Cryptographic Coprocessor Feature, PCI Cryptographic Coprocessor, and ICSF provide support for the following International and USA standards (at least in part):

ISO 8730
Banking—Requirements for Standard Message Authentication (Wholesale)

ISO 8731
Banking—Approved Algorithms for Message Authentication—Part 1: DES-1 algorithm

ISO 8732
Information Processing: Modes of Operation for a 64-bit Cipher Algorithm

ISO 9564
Personal Identification Number Management and Security Part 1—PIN Protection Principles and Technique

ISO 9796
Information Technology — Security Techniques — Digital Signature Scheme Giving Message Recovery

FIPS 46-2
Data Encryption Standard

FIPS 180-1
Secure Hash Standard

FIPS 186
Digital Signature Standard

ANSI X3.92 - 1981
Data Encryption Algorithm

ANSI X3.106 - 1983
Modes of DEA Operation

Two modes specified in this standard are supported:
1. Electronic Code Book (ECB) mode
2. Cipher Block Chaining (CBC) mode

ANSI X9.8 - 1982
Personal Identification Number (PIN) Management and Security

ANSI X9.9 - 1986
Financial Institution Message Authentication (Wholesale)

ANSI X9.17 - 1985 (Reaffirmed 1991)
Financial Institution Key Management (Wholesale)

ANSI X9.19
Optional Double-MAC Procedure

ANSI X9.23 - 1988
Encryption of Wholesale Financial Messages

Appendix B. Summary of Callable Service Support by Hardware Configuration

The Cryptographic Coprocessor Feature on an S/390 G3 Enterprise Server, or higher, or on an S/390 Multiprise, and the PCI Cryptographic Coprocessor on a S/390 G5 Enterprise Server, a S/390 G6 Enterprise Server, or a IBM @server zSeries, can be configured in several ways. The callable services available to your applications depend on this configuration. The configuration of the Cryptographic Coprocessor Feature and PCI Cryptographic Coprocessor is dependent on U.S. Export Regulations. For information on the configurations available in your country, contact your IBM Marketing Representative.

In Table 1, letters represent various configurations according to the following table:

- A — S/390 G3, G4, or G5 Enterprise Servers or S/390 Multiprise configured for full DES with PKA (feature code 0804 on the G3 and Multiprise, 0814 or 0815 on the G4 and G5) or

  S/390 G3, G4, or G5 Enterprise Servers or S/390 Multiprise configured for DES with exportable PKA (feature code 0802 on the G3 and Multiprise, 0812 or 0813 on the G4 or G5)
- B — S/390 G3, G4, or G5 Enterprise Servers or S/390 Multiprise configured for CDMF with exportable PKA (feature code 0801 on the G3 and Multiprise, 0811 on the G4 or G5)
- C — S/390 G5 Enterprise Servers, and S/390 G6 Enterprise Servers - with feature code 860 (PCI Cryptographic Coprocessor)
- D — IBM @server zSeries 900 with feature code 800 plus one of the following feature codes (0874 or 0875)

Note: Support for the PCI Cryptographic Accelerator has been added in z/OS V1 R2 on the IBM @server zSeries. In this release, the only ICSF service exploiting the PCICA is the PKA Decrypt (CSNDPKD) callable service.

Table 1. Summary of ICSF Callable Services Support

Service Name	Function	A	B	C	D
ANSI X9.17 EDC generate	Generates an ANSI X9.17 error detection code on an arbitrary length string using the special MAC key (x'0123456789ABCDEF').	X	X	X	X
ANSI X9.17 key export	Uses the ANSI X9.17 protocol to export a DATA key or a pair of DATA keys with or without an AKEK. Supports the export of a CCA IMPORTER or EXPORTER KEK. Converts a single DATA key or combines two DATA keys into a single MAC key.	X	X	X	X
ANSI X9.17 key import	Uses the ANSI X9.17 protocol to import a DATA key or a pair of DATA keys with or without an AKEK. Supports the import of a CCA IMPORTER or EXPORTER KEK. Converts a single DATA key or combines two DATA keys into a single MAC key.	X	X	X	X
ANSI X9.17 key translate	Uses the ANSI X9.17 protocol to translate, in a single service call, either one or two DATA keys or a single KEK from encryption under one AKEK to encryption under another AKEK. Converts a single DATA key or combines two DATA keys into a single MAC key.	X	X	X	X
ANSI X9.17 transport key partial notarize	Permits the preprocessing of an AKEK with origin and destination identifiers to create a partially notarized AKEK.	X	X	X	X

Table 1. Summary of ICSF Callable Services Support (continued)

Service Name	Function	A	B	C	D
Character/nibble conversion	Converts a binary string to a character string or vice versa.	X	X	X	X
Ciphertext translate	Translates the user-supplied ciphertext from one key and enciphers the ciphertext to another key.	X		X	X
Clear key import	Imports a clear DATA key, enciphers it under the master key, and places the result into an internal key token.	X	X	X	X
Clear PIN encrypt	Formats a PIN into a PIN block format (IBM 3621, IBM3624, ISO-0, ISO-1, ISO-2, IBM 4704 encrypting PINPAD, VISA 2, VISA 3, VISA 4, ECI 2, ECI 3) and encrypts the results.			X	X
Clear PIN generate	Generates a clear personal identification number (PIN), a PIN verification value (PVV), or an offset using one of the following algorithms: Interbank PIN (INBK-PIN) IBM 3624 (IBM-PIN or IBM-PINO) IBM German Bank Pool (GBP-PIN or GBP-PINO) VISA PIN validation value (VISA-PVV)	X	X	X	X
Clear PIN generate alternate	Generates a clear VISA PIN validation value (PVV) from an input encrypted PIN block.	X	X	X	X
Code conversion	Converts EBCDIC data to ASCII data or vice versa.	X	X	X	X
Control vector generate	Builds a control vector from keywords specified as input to the service.	X	X	X	X
Control vector translate	Changes the control vector used to encipher an external key.			X	X
Cryptographic variable encipher	Encrypts plaintext using the Cipher Block Chaining (CBC) method.			X	X
Data key export	Converts a DATA key from operational form into exportable form.	X	X	X	X
Data key import	Imports an encrypted single-length or double-length DES data key and creates or updates a target internal key token with the master key-enciphered source key.			X	X
Decipher	Deciphers data using the cipher block chaining mode of the DES. **Note:** Triple DES decipherment is available only on the S/390 G4 Enterprise Server (with LIC level driver 98), or higher (with feature codes 0832, 0833, 0834, or 0835).	X		X	X
Decipher	Deciphers data using the CDMF mode of the DES.	X	X	X	X
Decode	Decodes an 8-byte string of data using the electronic code book mode of the DES.	X		X	X
Digital signature generate	Generate a digital signature using a supplied hash and a private key.	X	X	X	X
Digital signature verify	Verifies a digital signature using the same supplied hash that was used to generate the signature and the public key that corresponds to the private key used to generate the signature.	X	X	X	X
Diversified key generate	Generates a key based on the key-generating key, the processing method, and the parameter supplied. The control vector of the key-generating key also determines the type of target key that can be generated.			X	X

Table 1. Summary of ICSF Callable Services Support (continued)

Service Name	Function	A	B	C	D
Encipher	Enciphers data using the cipher block chaining mode of the DES. **Note:** Triple DES encipherment is available only on the S/390 G4 Enterprise Server (with LIC level driver 98), or higher (with feature codes 0832, 0833, 0834, or 0835).	X		X	X
Encipher	Enciphers data using the CDMF mode of the DES.	X	X	X	X
Encode	Encodes an 8-byte string of data using the electronic code book mode of the DES.	X		X	X
Encrypted PIN generate	Generates and formats a PIN and encrypts the PIN block.			X	X
Encrypted PIN translate	Reenciphers a PIN block from one PIN-encrypting key to another and, optionally, changes the PIN block format.	X	X	X	X
Encrypted PIN verify	Verifies a supplied PIN using one of the following algorithms: Interbank PIN (INBK-PIN) IBM 3624 (IBM-PIN or IBM-PINO) IBM German Bank Pool (GBP-PIN or GBP-PINO) VISA PIN validation value (VISA-PVV)	X	X	X	X
Key export	Converts any key from operational form into exportable form.	X	X	X	X
Key generate	Generates a 64-bit or 128-bit odd parity key, or a pair of keys, and returns them in encrypted forms.	X	X	X	X
Key import	Converts any key from importable form into operational form.	X	X	X	X
Key part import	Combines the clear key parts of an AKEK and returns the combined key value in an internal key token or an update to the CKDS.	X	X	X	X
Key record create	Adds a key record containing a key token set to binary zeros to both the in-storage and DASD copies of the CKDS.	X	X	X	X
Key record delete	Deletes a key record from both the in-storage and DASD copies of the CKDS.	X	X	X	X
Key record read	Copies an internal key token from the in-storage copy of the CKDS to application storage.	X	X	X	X
Key record write	Writes an internal key token to the CKDS record specified in the key label parameter. Updates both the in-storage and DASD copies of the CKDS currently in use.	X	X	X	X
Key test	Generates or verifies a secure verification pattern for keys. CSNBKYT requires the tested key to be in the clear or encrypted under the master key. CSNBKYTX also allows the tested key to be encrypted under a key-encrypting key.	X	X	X	X
Key token build	Builds an internal token from the supplied parameters.	X	X	X	X
Key translate	Uses one key-encrypting key to decipher an input key and then enciphers this using another key-encrypting key.			X	X
MAC generation	Generates a 4-, 6-, or 8-byte message authentication code (MAC) for a text string that the application program supplies. The MAC can be computed using either the ANSI X9.9-1 algorithm, the ANSI X9.19 optional double-MAC algorithm, or the EMV padding rules.	X	X	X	X

Table 1. Summary of ICSF Callable Services Support (continued)

Service Name	Function	A	B	C	D
MAC verification	Verifies a 4-, 6-, or 8-byte message authentication code (MAC) for a text string that the application program supplies. The MAC is computed using either the ANSI X9.9-1 algorithm, the ANSI X 9.19 optional double-MAC algorithm, or the EMV padding rules and is compared with a user-supplied MAC.	X	X	X	X
MDC generation	Generates a 128-bit modification detection code (MDC) for a text string that the application program supplies.	X	X	X	X
Multiple Clear Key Import	Imports a clear DATA key of one, two, or three parts, enciphers it under the master key, and places the result into an internal key token.	X	X	X	X
Multiple Secure Key Import	Enciphers a clear key under the master key or an IMPORTER KEK, and places the result into an internal or external key token as any key type. Permits the import of double-length DATA, MAC and MACVER keys and triple-length DATA keys.	X	X	X	X
One-way hash generate	Generates a one-way hash on specified text using the SHA-1 or MD5 method.	X	X	X	X
PCI Interface	Trusted Key Entry (TKE) workstation interface to the PCI Cryptographic Coprocessor.			X	X
PKA decrypt	Decrypts an RSA-encrypted key value and returns it to the application in the clear.	X	X	X	X
PKA encrypt	Encrypts a PKCS 1.2 formatted clear key value under an RSA public key to support Secure Sockets Layer (SSL) applications.	X	X	X	X
PKA key generate (DSS)	Generate a PKA internal token for use with the DSS algorithm in digital signature services.	X	X	X	X
PKA key generate (RSA)	Generate a PKA internal token for use with the DSS algorithm in digital signature services.			X	X
PKA key import	Import a PKA key token.	X	X	X	X
PKA key token build	Create an external PKA key token containing an unenciphered private key.	X	X	X	X
PKA key token change	Changes PKA key tokens (RSA and DSS) from encipherment with the old PCI Cryptographic Coprocessor asymmetric-key master key to encipherment with the current signature/PCI Cryptographic Coprocessor asymmetric-key master key.			X	X
PKA public key extract	Extract a PKA public key from a supplied PKA internal or external private key token.	X	X	X	X
PKDS Record Create	Writes a new record to the PKDS	X	X	X	X
PKDS Record Write	Writes over an existing record in the PKDS	X	X	X	X
PKDS Record Read	Reads a record from the PKDS and returns the content of the record.	X	X	X	X
PKDS Record Delete	Deletes an existing record from the PKDS	X	X	X	X
PKSC interface	Trusted Key Entry (TKE) workstation interface.	X	X	X	X
Prohibit export	Modifies an operational key so that it cannot be exported.			X	X
Prohibit export extended	Changes the external token of a key in exportable form so that it can be imported at the receiver node but not exported from that node.	X	X	X	X
Random number generate	Generates an 8-byte random number. The output can be specified in three forms of parity: RANDOM, ODD, and EVEN.	X	X	X	X

Table 1. Summary of ICSF Callable Services Support (continued)

Service Name	Function	A	B	C	D
Retained key delete	Deletes a key that has been retained within a PCI Cryptographic Coprocessor.			X	X
Retained key list	Lists the key labels of keys that have been retained within the PCI Cryptographic Coprocessor.			X	X
Secure key import	Enciphers a clear key under the master key or an IMPORTER KEK, and places the result into an internal or external key token as any key type.	X	X	X	X
Secure messaging for keys	Encrypts a text block, including a clear key value decrypted from an internal or external DES token.			X	X
Secure messaging for PINs	Encrypts a text block, including a clear PIN block recovered from an encrypted PIN block.			X	X
SET block decompose	Compose the RSA-OAEP block and the DES-encrypted data block in support of the SET protocol.	X	X	X	X
SET block compose	Decompose the RSA-OAEP block and the DES-encrypted data block in support of the SET protocol.	X	X	X	X
Symmetric key generate	Generates a symmetric (DATA) key and returns it in two forms: encrypted under the DES master key and encrypted under a PKA public key.	X	X	X	X
Symmetric key import	Imports a symmetric (DATA) key enciphered under an RSA public key and enciphers it under the DES master key.	X	X	X	X
Symmetric key export	Transfers a symmetric (DATA) key from encryption under the DES host master key to encryption under an RSA public key.	X	X	X	X
Transform CDMF key	Changes a CDMF DATA key in an internal or external token to a transformed shortened DES key.	X	X	X	X
User Derived Key	Generates a single- or double-length SESSION MAC key or updates an existing user derived key.	X	X	X	X
VISA CVV generate	Generates a Card Verification Value (CVV) or Card Verification Code (CVC).	X		X	X
VISA CVV verify	Verifies a Card Verification Value (CVV) or Card Verification Code (CVC).	X		X	X
X9.9 data editing	Edits an ASCII text string according to the editing rules of ANSI X9.9-4.	X	X	X	X

Appendix C. Notices

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Glossary

This glossary defines terms and abbreviations used in Integrated Cryptographic Service Facility (ICSF). If you do not find the term you are looking for, refer to the index of the appropriate Integrated Cryptographic Service Facility manual or view *IBM Glossary of Computing Terms* located at: http://www.ibm.com/ibm/terminology

This glossary includes terms and definitions from:

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Definitions specific to the Integrated Cryptographic Services Facility are labeled “In ICSF.”

A

access method services (AMS). The facility used to define and reproduce VSAM key-sequenced data sets (KSDS). (D)

American National Standard Code for Information Interchange (ASCII). The standard code using a coded character set consisting of 7-bit characters (8 bits including parity check) that is used for information exchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters.

ANSI key-encrypting key (AKEK). A 64- or 128-bit key used exclusively in ANSI X9.17 key management applications to protect data keys exchanged between systems.

ANSI X9.17. An ANSI standard that specifies algorithms and messages for DES key distribution.

ANSI X9.19. An ANSI standard that specifies an optional double-MAC procedure which requires a double-length MAC key.

application program. (1) A program written for or by a user that applies to the user’s work, such as a program that does inventory control or payroll. (2) A program used to connect and communicate with stations in a network, enabling users to perform application-oriented activities. (D)

application program interface (API). (1) A functional interface supplied by the operating system or by a separately orderable licensed program that allows an application program written in a high-level language to use specific data or functions of the operating system or the licensed program. (D) (2) In ICSF, a callable service.

asymmetric cryptography. Synonym for public key cryptography. (D)

authentication pattern. An 8-byte pattern that ICSF calculates from the master key when initializing the cryptographic key data set. ICSF places the value of the authentication pattern in the header record of the cryptographic key data set.

authorized program facility (APF). A facility that permits identification of programs authorized to use restricted functions. (D)

C

callable service. A predefined sequence of instructions invoked from an application program, using a CALL instruction. In ICSF, callable services perform cryptographic functions and utilities.

CBC. Cipher block chaining.

CCA. Common Cryptographic Architecture.

CCF. Cryptographic Coprocessor Feature.

CDMF. Commercial Data Masking Facility.

CEDA. A CICS transaction that defines resources online. Using CEDA, you can update both the CICS system definition data set (CSD) and the running CICS system.

checksum. (1) The sum of a group of data associated with the group and used for checking purposes. (T) (2) In ICSF, the data used is a key part. The resulting checksum is a two-digit value you enter when you use the key-entry unit to enter a master key part or a clear key part into the key-storage unit.

Chinese Remainder Theorem (CRT). A mathematical theorem that defines a format for the RSA private key that improves performance.

CICS. Customer Information Control System.

cipher block chaining (CBC). A mode of encryption that uses the data encryption algorithm and requires an initial chaining vector. For encipher, it exclusively ORs the initial block of data with the initial control vector and then enciphers it. This process results in the encryption both of the input block and of the initial control vector that it uses on the next input block as the process repeats. A comparable chaining process works for decipher.

ciphertext. (1) In computer security, text produced by encryption. (2) Synonym for enciphered data. (D)

CKDS. Cryptographic Key Data Set.

clear key. Any type of encryption key not protected by encryption under another key.

CMOS. Complementary metal oxide semiconductor.

coexistence mode. An ICSF method of operation during which CUSP or PCF can run independently and simultaneously on the same ICSF system. A CUSP or PCF application program can run on ICSF in this mode if the application program has been reassembled.

Commercial Data Masking Facility (CDMF). A data-masking algorithm using a DES-based kernel and a key that is shortened to an effective key length of 40 DES key-bits. Because CDMF is not as strong as DES, it is called a masking algorithm rather than an encryption algorithm. Implementations of CDMF, when used for data confidentiality, are generally exportable from the USA and Canada.

Common Cryptographic Architecture: Cryptographic Application Programming Interface. Defines a set of cryptographic functions, external interfaces, and a set of key management rules that provide a consistent, end-to-end cryptographic architecture across different IBM platforms.

compatibility mode. An ICSF method of operation during which a CUSP or PCF application program can run on ICSF without recompiling it. In this mode, ICSF cannot run simultaneously with CUSP or PCF.

complementary keys. A pair of keys that have the same clear key value, are different but complementary types, and usually exist on different systems.

console. A part of a computer used for communication between the operator or maintenance engineer and the computer. (A)

control-area split. In systems with VSAM, the movement of the contents of some of the control intervals in a control area to a newly created control area in order to facilitate insertion or lengthening of a data record when there are no remaining free control intervals in the original control area. (D)

control block. (1) A storage area used by a computer program to hold control information. (I) Synonymous with control area. (2) The circuitry that performs the control functions such as decoding microinstructions and generating the internal control signals that perform the operations requested. (A)

control interval. A fixed-length area of direct-access storage in which VSAM stores records and creates distributed free space. Also, in a key-sequenced data set or file, the set of records pointed to by an entry in the sequence-set index record. The control interval is the unit of information that VSAM transmits to or from direct access storage. A control interval always comprises an integral number of physical records. (D)

control interval split. In systems with VSAM, the movement of some of the stored records in a control interval to a free control interval to facilitate insertion or lengthening of a record that does not fit in the original control interval. (D)

control statement input data set. A key generator utility program data set containing control statements that a particular key generator utility program job will process.

control statement output data set. A key generator utility program data set containing control statements to create the complements of keys created by the key generator utility program.

control vector. In ICSF, a mask that is exclusive ORed with a master key or a transport key before ICSF uses that key to encrypt another key. Control vectors ensure that keys used on the system and keys distributed to other systems are used for only the cryptographic functions for which they were intended.

cross memory mode. Synchronous communication between programs in different address spaces that permits a program residing in one address space to access the same or other address spaces. This synchronous transfer of control is accomplished by a calling linkage and a return linkage.

CRT. Chinese Remainder Theorem.

cryptographic adapter (4755 or 4758). An expansion board that provides a comprehensive set of

cryptographic functions for the network security processor and the workstation in the TSS family of products.

cryptographic coprocessor. A microprocessor that adds cryptographic processing functions to specific OS/390 Enterprise Servers, the OS/390 Mutliprise and higher processors, and the IBM @server zSeries. The Cryptographic Coprocessor Feature is a tamper-resistant chip built into the processor board. The combination of the Cryptographic Coprocessor Feature and ICSF/MVS Version 2 Release 1, or higher, provides secure high-speed cryptographic services in the OS/390 and z/OS environment.

cryptographic key data set (CKDS). (1) A data set that contains the encrypting keys used by an installation. (D) (2) In ICSF, a VSAM data set that contains all the cryptographic keys. Besides the encrypted key value, an entry in the cryptographic key data set contains information about the key.

cryptography. (1) The transformation of data to conceal its meaning. (2) In computer security, the principles, means, and methods for encrypting plaintext and decrypting ciphertext. (D) (3) In ICSF, the use of cryptography is extended to include the generation and verification of MACs, the generation of MDCs and other one-way hashes, the generation and verification of PINs, and the generation and verification of digital signatures.

CUSP (Cryptographic Unit Support Program). The IBM cryptographic offering, program product 5740-XY6, using the channel-attached 3848.

CUSP/PCF conversion program. A program, for use during migration from CUSP or PCF to ICSF, that converts a CUSP or PCF cryptographic key data set into a ICSF cryptographic key data set.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user written application programs. It includes facilities for building, using, and maintaining databases.

CVC. Card verification code used by MasterCard.

CVV. Card verification value used by VISA.

D

data encryption algorithm (DEA). In computer security, a 64-bit block cipher that uses a 64-bit key, of which 56 bits are used to control the cryptographic process and 8 bits are used for parity checking to ensure that the key is transmitted properly. (D)

data encryption standard (DES). In computer security, the National Institute of Standards and Technology (NIST) Data Encryption Standard, adopted by the U.S. government as Federal Information Processing Standard (FIPS) Publication 46, which allows only hardware implementations of the data encryption algorithm. (D)

data key or data-encrypting key. (1) A key used to encipher, decipher, or authenticate data. (D) (2) In ICSF, a 64-bit encryption key used to protect data privacy using the DES algorithm or the CDMF algorithm.

data set. The major unit of data storage and retrieval, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access. (D)

data-translation key. A 64-bit key that protects data transmitted through intermediate systems when the originator and receiver do not share the same key.

DEA. Data encryption algorithm.

decipher. (1) To convert enciphered data in order to restore the original data. (T) (2) In computer security, to convert ciphertext into plaintext by means of a cipher system. (3) To convert enciphered data into clear data. Contrast with encipher. Synonymous with decrypt. (D)

decode. (1) To convert data by reversing the effect of some previous encoding. (I) (A) (2) In ICSF, to decipher data by use of a clear key.

decrypt. See decipher.

DES. Data Encryption Standard.

diagnostics data set. A key generator utility program data set containing a copy of each input control statement followed by a diagnostic message generated for each control statement.

digital signature. In public key cryptography, information created by using a private key and verified by using a public key. A digital signature provides data integrity and source nonrepudiation.

Digital Signature Standard (DSS). A standard describing the use of algoritms for digital signature purposes. The algorithm specified is DSA (Digital Signature Algorithm).

domain. (1) That part of a network in which the data processing resources are under common control. (T) (2) In ICSF, an index into a set of master key registers.

double-length key. A key that is 128 bits long. A key can be either double- or single-length. A single-length key is 64 bits long.

DSA. Digital Signature Algorithm.

DSS. Digital Signature Standard.

E

ECB. Electronic codebook.

ECI. Eurochèque International S.C., a financial institution consortium that has defined three PIN block formats.

EID. Environment Identification.

electronic codebook (ECB) operation. (1) A mode of operation used with block cipher cryptographic algorithms in which plaintext or ciphertext is placed in the input to the algorithm and the result is contained in the output of the algorithm. (D) (2) A mode of encryption using the data encryption algorithm, in which each block of data is enciphered or deciphered without an initial chaining vector. It is used for key management functions and the encode and decode callable services.

electronic funds transfer system (EFTS). A computerized payment and withdrawal system used to transfer funds from one account to another and to obtain related financial data. (D)

encipher. (1) To scramble data or to convert data to a secret code that masks the meaning of the data to any unauthorized recipient. Synonymous with encrypt. (2) Contrast with decipher. (D)

enciphered data. Data whose meaning is concealed from unauthorized users or observers. (D)

encode. (1) To convert data by the use of a code in such a manner that reconversion to the original form is possible. (T) (2) In computer security, to convert plaintext into an unintelligible form by means of a code system. (D) (3) In ICSF, to encipher data by use of a clear key.

encrypt. See encipher.

exit. (1) To execute an instruction within a portion of a computer program in order to terminate the execution of that portion. Such portions of computer programs include loops, subroutines, modules, and so on. (T) (2) In ICSF, a user-written routine that receives control from the system during a certain point in processing—for example, after an operator issues the START command.

exportable form. A condition a key is in when enciphered under an exporter key-encrypting key. In this form, a key can be sent outside the system to another system. A key in exportable form cannot be used in a cryptographic function.

exporter key-encrypting key. A 128-bit key used to protect keys sent to another system. A type of transport key.

F

file. A named set of records stored or processed as a unit. (T)

G

GBP. German Bank Pool.

German Bank Pool (GBP). A German financial institution consortium that defines specific methods of PIN calculation.

H

hashing. An operation that uses a one-way (irreversible) function on data, usually to reduce the length of the data and to provide a verifiable authentication value (checksum) for the hashed data.

header record. A record containing common, constant, or identifying information for a group of records that follows. (D)

I

ICSF. Integrated Cryptographic Service Facility.

importable form. A condition a key is in when it is enciphered under an importer key-encrypting key. A key is received from another system in this form. A key in importable form cannot be used in a cryptographic function.

importer key-encrypting key. A 128-bit key used to protect keys received from another system. A type of transport key.

initial chaining vector (ICV). A 64-bit random or pseudo-random value used in the cipher block chaining mode of encryption with the data encryption algorithm.

initial program load (IPL). (1) The initialization procedure that causes an operating system to commence operation. (2) The process by which a configuration image is loaded into storage at the beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs. (D)

input PIN-encrypting key. A 128-bit key used to protect a PIN block sent to another system or to translate a PIN block from one format to another.

installation exit. See exit.

Integrated Cryptographic Service Facility (ICSF). A licensed program that runs under MVS/System Product 3.1.3, or higher, or OS/390 Release 1, or higher, or z/OS, and provides access to the hardware cryptographic feature for programming applications. The

combination of the hardware cryptographic feature and ICSF provides secure high-speed cryptographic services.

International Organization for Standardization. An organization of national standards bodies from many countries, established to promote the development of standards to facilitate the international exchange of goods and services and to develop cooperation in intellectual, scientific, technological, and economic activity. ISO has defined certain standards relating to cryptography and has defined two PIN block formats.

ISO. International Organization for Standardization.

J

job control language (JCL). A control language used to identify a job to an operating system and to describe the job's requirements. (D)

K

key-encrypting key (KEK). (1) In computer security, a key used for encryption and decryption of other keys. (D) (2) In ICSF, a master key or transport key.

key generator utility program (KGUP). A program that processes control statements for generating and maintaining keys in the cryptographic key data set.

key output data set. A key generator utility program data set containing information about each key that the key generator utility program generates except an importer key for file encryption.

key part. A 32-digit hexadecimal value that you enter for ICSF to combine with other values to create a master key or clear key.

key part register. A register in the key storage unit that stores a key part while you enter the key part.

L

linkage. The coding that passes control and parameters between two routines.

load module. All or part of a computer program in a form suitable for loading into main storage for execution. A load module is usually the output of a linkage editor. (T)

LPAR mode. The central processor mode that enables the operator to allocate the hardware resources among several logical partitions.

M

MAC generation key. A 64-bit or 128-bit key used by a message originator to generate a message authentication code sent with the message to the message receiver.

MAC verification key. A 64-bit or 128-bit key used by a message receiver to verify a message authentication code received with a message.

magnetic tape. A tape with a magnetizable layer on which data can be stored. (T)

master key. (1) In computer security, the top-level key in a hierarchy of key-encrypting keys. (2) In ICSF, there are three types of master keys on the Cryptographic Coprocessor Feature: the 128-bit DES master key, the 192-bit signature master key, and the 192-bit key management master key. On the PCI Cryptographic Coprocessor there are two types of master keys: the 192-bit Symmetric master key and the 192-bit Asymmetric master key. Master keys are known only to the ICSF hardware and maintained in the cryptographic enclosure in a secure fashion. All keys in operational form in the system are enciphered under a master key. Master keys are used only to encrypt other keys.

master key concept. The idea of using a single cryptographic key, the master key, to encrypt all other keys on the system.

master key register. A register in the Cryptographic Coprocessor Feature that stores the master key that is active on the system.

master key variant. A key derived from the master key by use of a control vector. It is used to force separation by type of keys on the system.

MD4. Message Digest 4. A hash algorithm.

MD5. Message Digest 5. A hash algorithm.

message authentication code (MAC). (1) The cryptographic result of block cipher operations on text or data using the cipher block chain (CBC) mode of operation. (D) (2) In ICSF, a MAC is used to authenticate the source of the message, and verify that the message was not altered during transmission or storage.

modification detection code (MDC). (1) A 128-bit value that interrelates all bits of a data stream so that the modification of any bit in the data stream results in a new MDC. (2) In ICSF, an MDC is used to verify that a message or stored data has not been altered.

multiple encipherment. The method of encrypting a key under a double-length key-encrypting key.

N

new master key register. A register in the key storage unit that stores a master key before you make it active on the system.

NIST. U.S. National Institute of Science and Technology.

NOCV processing. Process by which the key generator utility program or an application program encrypts a key under a transport key itself rather than a transport key variant.

noncompatibility mode. An ICSF method of operation during which CUSP or PCF can run independently and simultaneously on the same z/OS, OS/390 or MVS system. You cannot run a CUSP or PCF application program on ICSF in this mode.

nonrepudiation. A method of ensuring that a message was sent by the appropriate individual.

notarization. The ANSI X9.17 process involving the coupling of an ANSI key-encrypting key (AKEK) with ASCII character strings containing origin and destination identifiers and then exclusive ORing (or offsetting) the result with a binary counter.

O

OAEP. Optimal asymmetric encryption padding.

offset. The process of exclusively ORing a counter to a key.

old master key register. A register in the key storage unit that stores a master key that you replaced with a new master key.

operational form. The condition of a key when it is encrypted under the master key so that it is active on the system.

output PIN-encrypting key. A 128-bit key used to protect a PIN block received from another system or to translate a PIN block from one format to another.

P

PAN. Personal Account Number.

parameter. Data passed between programs or procedures. (D)

parmlib. A system parameter library, either SYS1.PARMLIB or an installation-supplied library.

partial notarization. The ANSI X9.17 standard does not use the term partial notarization. IBM has divided the notarization process into two steps and defined the term partial notarization as a process during which only the first step of the two-step ANSI X9.17 notarization process is performed. This step involves the coupling of an ANSI key-encrypting key (AKEK) with ASCII character strings containing origin and destination identifiers.

partitioned data set (PDS). A data set in direct access storage that is divided into partitions, called members, each of which can contain a program, part of a program, or data. (D)

Personal Account Number (PAN). A Personal Account Number identifies an individual and relates that individual to an account at a financial institution. It consists of an issuer identification number, customer account number, and one check digit.

PCI Cryptographic Coprocessor. The 4758 model 2 standard PCI-bus card supported on the field upgraded IBM S/390 Parallel Enterprise Server - Generation 5, the IBM S/390 Parallel Enterprise Server - Generation 6 and the IBM @server zSeries.

PCICA. PCI Cryptographic Accelerator.

PCICC. PCI Cryptographic Coprocessor.

personal identification number (PIN). The 4- to 12-digit number entered at an automatic teller machine to identify and validate the requester of an automatic teller machine service. Personal identification numbers are always enciphered at the device where they are entered, and are manipulated in a secure fashion.

Personal Security card. An ISO-standard “smart card” with a microprocessor that enables it to perform a variety of functions such as identifying and verifying users, and determining which functions each user can perform.

PIN block. A 64-bit block of data in a certain PIN block format. A PIN block contains both a PIN and other data.

PIN generation key. A 128-bit key used to generate PINs or PIN offsets algorithmically.

PIN key. A 128-bit key used in cryptographic functions to generate, transform, and verify the personal identification numbers.

PIN offset. For 3624, the difference between a customer-selected PIN and an institution-assigned PIN. For German Bank Pool, the difference between an institution PIN (generated with an institution PIN key) and a pool PIN (generated with a pool PIN key).

PIN verification key. A 128-bit key used to verify PINs algorithmically.

PKA. Public Key Algorithm.

PKCS. Public Key Cryptographic Standards (RSA Data Security, Inc.)

PKDS. Public key data set (PKA cryptographic key data set).

plaintext. Data in normal, readable form.

primary space allocation. An area of direct access storage space initially allocated to a particular data set or file when the data set or file is defined. See also secondary space allocation. (D)

private key. In computer security, a key that is known only to the owner and used with a public key algorithm to decrypt data or generate digital signatures. The data is encrypted and the digital signature is verified using the related public key.

processor complex. A configuration that consists of all the machines required for operation.

Processor Resource/Systems Manager. Enables logical partitioning of the processor complex, may provide additional byte-multiplexer channel capability, and supports the VM/XA System Product enhancement for Multiple Preferred Guests.

Programmed Cryptographic Facility (PCF). (1) An IBM licensed program that provides facilities for enciphering and deciphering data and for creating, maintaining, and managing cryptographic keys. (D) (2) The IBM cryptographic offering, program product 5740-XY5, using software only for encryption and decryption.

PR/SM. Processor Resource/Systems Manager.

public key. In computer security, a key made available to anyone who wants to encrypt information using the public key algorithm or verify a digital signature generated with the related private key. The encrypted data can be decrypted only by use of the related private key.

public key algorithm (PKA). In computer security, an asymmetric cryptographic process in which a public key is used for encryption and digital signature verification and a private key is used for decryption and digital signature generation.

public key cryptography. In computer security, cryptography in which a public key is used for encryption and a private key is used for decryption. Synonymous with asymmetric cryptography.

R

RACE Integrity Primitives Evaluatiuon Message Digest. A hash algorithm.

RDO. Resource definition online.

record chaining. When there are multiple cipher requests and the output chaining vector (OCV) from the previous encipher request is used as the input chaining vector (ICV) for the next encipher request.

Resource Access Control Facility (RACF). An IBM licensed program that provides for access control by identifying and verifying the users to the system, authorizing access to protected resources, logging the detected unauthorized attempts to enter the system, and logging the detected accesses to protected resources. (D)

retained key. A private key that is generated and retained within the secure boundary of the PCI Cryptographic Coprocessor.

return code. (1) A code used to influence the execution of succeeding instructions. (A) (2) A value returned to a program to indicate the results of an operation requested by that program. (D)

Rivest-Shamir-Adleman (RSA) algorithm. A process for public key cryptography that was developed by R. Rivest, A. Shamir, and L. Adleman.

RMI. Resource Manager Interface (CICS).

RSA. Rivest-Shamir-Adleman.

S

SAF. Security Authorization Facility.

save area. Area of main storage in which contents of registers are saved. (A)

secondary space allocation. In systems with VSAM, area of direct access storage space allocated after primary space originally allocated is exhausted. See also primary space allocation. (D)

Secure Electronic Transaction. A standard created by Visa International and MasterCard for safe-guarding payment card purchases made over open networks.

Secure Sockets Layer. A security protocol that provides communications privacy over the Internet by allowing client/server applications to communicate in a way that is designed to prevent eavesdropping, tampering, or message forgery.

sequential data set. A data set whose records are organized on the basis of their successive physical positions, such as on magnetic tape. (D)

SET. Secure Electronic Transaction.

SHA-1. Secure Hash Algorithm 1, a hash algorithm required for use with the Digital Signature Standard.

single-length key. A key that is 64 bits long. A key can be single- or double-length. A double-length key is 128 bits long.

special secure mode. An alternative form of security that allows you to enter clear keys with the key generator utility program or generate clear PINs.

SSL. Secure Sockets Layer.

supervisor state. A state during which a processing unit can execute input/output and other privileged instructions. (D)

System Authorization Facility (SAF). An interface to a system security system like the Resource Access Control Facility (RACF).

system key. A key that ICSF creates and uses for internal processing.

System Management Facilities (SMF). An optional control program feature of OS/VS that provides the means for gathering and recording information that can be used to evaluate system usage. (D)

T

TDEA. Triple Data Encryption Algorithm.

TKE. Trusted key entry.

Transaction Security System. An IBM product offering including both hardware and supporting software that provides access control and basic cryptographic key-management functions in a network environment. In the workstation environment, this includes the 4755 Cryptographic Adapter, the Personal Security Card, the 4754 Security Interface Unit, the Signature Verification feature, the Workstation Security Services Program, and the AIX Security Services Program/6000. In the host environment, this includes the 4753 Network Security Processor and the 4753 Network Security Processor MVS Support Program.

transport key. A 128-bit key used to protect keys distributed from one system to another. A transport key can either be an exporter key-encrypting key, an importer key-encrypting key, or an ANSI key-encrypting key.

transport key variant. A key derived from a transport key by use of a control vector. It is used to force separation by type for keys sent between systems.

TRUE. Task-related User Exit (CICS). The CICS-ICSF Attachment Facility provides a CSFATRUE and CSFATREN routine.

U

UAT. UDX Authority Table.

UDF. User-defined function.

UDK. User-derived key.

UDP. User Developed Program.

UDX. User Defined Extension.

V

verification pattern. An 8-byte pattern that ICSF calculates from the key parts you enter when you enter a master key or clear key. You can use the verification pattern to verify that you have entered the key parts correctly and specified a certain type of key.

Virtual Storage Access Method (VSAM). (1) An IBM licensed program that controls communication and the flow of data in an SNA network. It provides single-domain, multiple-domain, and interconnected network capability. (D) (2) An access method for indexed or sequential processing of fixed and variable-length records on direct-access devices. The records in a VSAM data set or file can be organized in logical sequence by means of a key field (key sequence), in the physical sequence in which they are written on the data set or file (entry-sequence), or by means of relative-record number.

VISA. A financial institution consortium that has defined four PIN block formats and a method for PIN verification.

VISA PIN Verification Value (VISA PVV). An input to the VISA PIN verification process that, in practice, works similarly to a PIN offset.

Numerics

3621. A model of an IBM Automatic Teller Machine that has a defined PIN block format.

3624. A model of an IBM Automatic Teller Machine that has a defined PIN block format and methods of PIN calculation.

4753. The Network Security processor. The IBM 4753 is a processor that uses the Data Encryption Algorithm and the RSA algorithm to provide cryptograpic support for systems requiring secure transaction processing (and other cryptographic services) at the host computer. The NSP includes a 4755 cryptographic adapter in a workstation which is channel attached to a S/390 host computer.

4758. The IBM PCI Cryptographic processor provides a secure programming and hardware environment where DES and RSA processes are performed.

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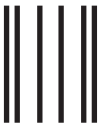

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