International Standard

ISO 20038

# Banking and related financial services — Key wrap using advanced encryption standard (AES)

*Banque et autres services financiers — Enveloppe de clé utilisant AES (norme de chiffrement avancé)*

Second edition
2026-08

Reference number
ISO 20038:2026(en)

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Published in Switzerland

# Contents

Page

**Foreword** ..... **v**
**Introduction** ..... **vi**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms, definitions and abbreviated terms** ..... **2**
3.1 Terms and definitions ..... 2
3.2 Abbreviated terms ..... 6
**4 Notation** ..... **8**
**5 Key block elements** ..... **8**
**6 Key block format** ..... **9**
6.1 General ..... 9
6.2 Key block header (KBH) ..... 10
6.2.1 General ..... 10
6.2.2 Changing key headers ..... 13
6.3 Defined values for key block headers ..... 14
6.3.1 Key usage ..... 14
6.3.2 Algorithm ..... 19
6.3.3 Mode of use ..... 20
6.3.4 Key version number ..... 21
6.3.5 Exportability ..... 21
6.3.6 Optional block ID ..... 22
6.4 Encoding ..... 47
6.4.1 General ..... 47
6.4.2 RSA key pairs ..... 48
6.4.3 Elliptic curve cryptography (ECC) key pairs ..... 49
**7 Key block binding and validation methods** ..... **49**
7.1 General ..... 49
7.2 Key block binding method using key derivation ..... 50
7.2.1 Key block binding and encryption ..... 50
7.2.2 Key derivation ..... 51
7.2.3 Key derivation binding validation method —AES ..... 54
**8 Examples** ..... **55**
8.1 AES key block example ..... 55
8.1.1 General ..... 55
8.1.2 Constructing the key block header ..... 55
8.2 AES key block with optional blocks ..... 61
8.2.1 General ..... 61
8.2.2 Keys used in the example ..... 61
8.2.3 Constructing the key block header ..... 62
8.3 RSA key block example with CT optional block ..... 64
8.3.1 General ..... 64
8.3.2 Keys used in the example ..... 64
8.3.3 Constructing the key block header ..... 65
8.3.4 Constructing the binary key data ..... 67
8.3.5 Constructing the complete key block ..... 68
8.4 ECC key block example with CT certificate chain optional block ..... 70
8.4.1 General ..... 70
8.4.2 Keys used in the example ..... 70
8.4.3 Constructing the key block header ..... 71
8.4.4 Constructing the binary key data ..... 73
8.4.5 Constructing the complete key block ..... 74
8.5 CTR mode without padding ..... 75

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**Annex A** (informative) **GBIC scheme for directed key diversification** ..... **76**
**Annex B** (informative) **Operational challenges and examples with exportability** ..... **83**
**Bibliography** ..... **92**

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 68, *Financial services*, Subcommittee SC 2, *Financial services, security*.

This second edition cancels and replaces the first edition (ISO 20038:2017), which has been technically revised.

The main changes are as follows:

— updated for compatibility with ANSI X9.143-2022.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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# Introduction

The secure management of cryptographic keys requires that their values and usage constraints be protected for both confidentiality and integrity.

This document provides a method of wrapping cryptographic keys in order to provide confidentiality and integrity protection for the keys when being transmitted or stored. The mechanism is designed to use advanced encryption standard (AES) specified in FIPS 197 as the wrapping cipher.

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# Banking and related financial services — Key wrap using advanced encryption standard (AES)

## 1 Scope

This document defines a method for packaging cryptographic keys for transport. This method can also be used for the storage of keys under an advanced encryption standard (AES) key. The method uses the block cipher AES as the wrapping cipher algorithm.

Other methods for wrapping keys are outside the scope of this document but can use the authenticated encryption algorithms specified in ISO/IEC 19772.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8601-1, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO 9564-5, *Financial services — Personal identification number (PIN) management and security — Part 5: Methods for the generation, change, and verification of PINs*

ISO 11568, *Financial services — Key management (retail)*

ANSI X9.24-1-2017, *Retail Financial Services Symmetric Key Management Part 1: Using Symmetric Techniques*

ANSI X9.24-2-2021, *Retail Financial Services Symmetric Key Management - Part 2: Using Asymmetric Techniques for the Distribution of Symmetric Keys*

ANSI X9.24-3-2017, *Retail Financial Services Symmetric Key Management Part 3: Derived Unique Key Per Transaction*

ANSI X9.102-2020, *Symmetric Key Cryptography For the Financial Services Industry – Wrapping of Keys and Associated Data*

ANSI X9.132-xxx, *Issuer PIN Generation, Verification, and Storage Methodologies Using AES*

ANSI X9.143-2022, *Retail Financial Services Interoperable Secure Key Block Specification*

ANSI X9.139, *Retail Financial Services Interoperable Secure Key Block using Asymmetric Techniques*

ANS X9 TR-31, *Interoperable Secure Key Exchange Key Block Specification for Symmetric Algorithms*

ANS X9 TR-34, *Interoperable Method for Distribution of Symmetric Keys using Asymmetric Techniques: Part 1 – Using Factoring-Based Public Key Cryptography Unilateral Key Transport*

IETF RFC 4648, *The Base16, Base32, and Base64 Data Encodings, October 2006*

NIST SP 800-57, *Recommendation for Key Management: Part 1 – General*

NIST SP 800-108, *Recommendation for Key Derivation Using Pseudorandom Functions*

PKCS #1 v2.1:2023, *RSA Cryptography Standard*

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# 3 Terms, definitions and abbreviated terms

## 3.1 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1.1**
**active**
attribute setting for a *directed key* (3.1.9) that allows starting a cryptographic interaction

EXAMPLE MAC generate, cipher encrypt, PIN encryption, key encryption (key export).

**3.1.2**
**advanced encryption standard**
**AES**
16-byte block cipher

Note 1 to entry: This is defined in ISO/IEC 18033-3.

[SOURCE: ISO 11568:2023, 3.2]

**3.1.3**
**ASCII**
American Standard Code for Information Interchange
binary encoding of 7-bit characters defined by ISO/IEC 646

[SOURCE: ISO/IEC 18477-4:2017, 3.1.2, modified — The term "American Standard Code for Information Interchange", has been added as an admitted term.]

**3.1.4**
**authentication value**
cryptographically generated value *message authentication code* (3.1.29) derived from the key block header and confidential data that can be used to validate the integrity of the data contained in the key block

**3.1.5**
**CBC**
cipher block chaining
confidentiality mode whose encryption process features the combining (i.e. "chaining") of the plaintext blocks with the previous ciphertext blocks

[SOURCE: NIST SP 800-38A:2001]

**3.1.6**
**cryptographic domain**
set of one or more *secure cryptographic devices (SCDs)* (3.1.32) that contain or can use the same set of keys

Note 1 to entry: All *SCDs* (3.1.32) in the domain are considered to be "equivalent" in that a key that can be used in one *SCD* (3.1.32) in the domain is also available for use by any other *SCD* (3.1.32) in the domain.

Note 2 to entry: A cryptographic domain is often defined for host processing to provide load balancing of hardware security modules (HSMs).

Note 3 to entry: The keys are typically structured in a hierarchy where higher-level keys are used to provide protection for lower-level keys.

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**3.1.7**
**CTR**
counter mode of encryption
confidentiality mode that features the application of the forward cipher to a set of input blocks, called counters, to produce a sequence of output blocks that are exclusive-ORed with the plaintext to produce the ciphertext, and vice versa

[SOURCE: NIST SP 800-38A:2001, modified — The admitted term “counter mode” has been changed to “counter mode of encryption”.]

**3.1.8**
**DEA**
data encryption algorithm
cryptographic algorithm, previously specified in FIPS 46 which became effective July 1977, now withdrawn.

[SOURCE: NIST SP 800-67 Rev. 2]

**3.1.9**
**directed key**
key K in a cryptographically bilateral protocol between two parties A and B for direction A to B, if and only if, there exist keys $K_A$, with key value of K and key attributes for *active* (3.1.1) on the cryptographic system of an entity A and $K_B$, with key value of K and the corresponding key attribute for *passive* (3.1.29) on the cryptographic system of an entity B

**3.1.10**
**diversification data**
derivation data for *key diversification* (3.1.20), containing information on the key attributes to be assigned to the derived key by the HSM

**3.1.11**
**diversification scheme**
cryptographic scheme implemented in an HSM that specifies how *diversification data* (3.1.10) is processed during *key diversification* (3.1.20), ensuring that different key attributes lead to cryptographically independent key values

**3.1.12**
**diversification scheme for directed keys**
*diversification scheme* (3.1.11) to obtain *directed keys* (3.1.9) for a cryptographically bilateral protocol between two parties identified as A and B, based on a common *key diversification key (KDK)* (3.1.21), which differs for the parties in the party identifier key attribute and on a tag in the *diversification data* (3.1.10), indicating the direction of the *directed key* (3.1.9) that determines whether the key derived from KDK party identifier type A has the *active* (3.1.1) role and the key derived from KDK party identifier type B has the *passive* (3.1.29) role or vice versa

**3.1.13**
**hex-ASCII**
number in base 16 expressed as *American Standard Code for Information Interchange* (*ASCII)* (3.1.3) characters

EXAMPLE The 32-bit *message authentication code* (3.1.28) result 0x12345678 (4 binary bytes) is encoded as eight hex-ASCII characters that reads “12345678” but is stored or transmitted as 0x3132333435363738.

**3.1.14**
**initialization vector**
**IV**
binary value used as a starting point for the encryption of a data sequence to increase security by introducing additional cryptographic variance and to synchronize cryptographic equipment

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**3.1.15**
**key block**
result of performing a cryptographic process over a key and its associated data to produce a key block header, ciphertext and *authentication value* (3.1.4) – the *message authentication code* (3.1.28)

[SOURCE: ANSI X9.143:2022, 3.15]

**3.1.16**
**key block encryption key**
**KBEK**
key that is derived from the *key block protection key* (3.1.18) and that is used solely for enciphering the *key block* (3.1.15)

[SOURCE: ANSI X9.143:2022, 3.16]

**3.1.17**
**key block authentication key**
**KBAK**
key that is derived from the *key block protection key* (3.1.18) and that is used solely for calculating the *message authentication code* (3.1.28) over the *key block* (3.1.15)

[SOURCE: ANSI X9.143:2022, 3.17]

**3.1.18**
**key block protection key**
**KBPK**
*key wrapping key (KWK)* (3.1.26) that is used as a derivation key from which the *key block encryption key* (3.1.16) and the *key block authentication key* (3.1.17) are derived

Note 1 to entry: This key is used for no other purpose.

[SOURCE: ANSI X9.143:2022, 3.18]

**3.1.19**
**key derivation function**
**KDF**
function to derive a key from a key generation key (KGK) using a *pseudorandom function* (3.1.31) with the KGK as seed and derivation or diversification data as input

**3.1.20**
**key diversification**
*key derivation function* (3.1.19) using *diversification data* (3.1.10) in a *diversification scheme* (3.1.11)

**3.1.21**
**key diversification key**
**KDK**
key used in a hardware security module (HSM) function implementing a diversification scheme for *key diversification* (3.1.20)

**3.1.22**
**key encrypting key**
**KEK**
key used exclusively to encrypt and decrypt other keys

[SOURCE: ANSI X9.143:2022, 3.19]

**3.1.23**
**key export**
*secure cryptographic device (SCD)* (3.1.32) operation that

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a) unwraps a key and its attributes from a storage *key encrypting key* (3.1.22) or the *master file key (MFK)* (3.1.27) and re-encrypts that key under a *key wrapping key* (3.1.26) shared with another entity or internal system; or

b) wraps a clear key and its attributes that is stored within an *SCD* (3.1.32) using a *key wrapping key* (3.1.26) shared with another entity or internal system

[SOURCE: ANSI X9.143:2022, 3.20]

**3.1.24**
**key import**
*secure cryptographic device (SCD)* (3.1.32) operation that unwraps a key and its attributes using a *key wrapping key* (3.1.26) shared with another entity or system and then stores the key and its attributes from the key block within one or more related *SCDs* (3.1.32) or re-wraps the key and its attributes using a storage *key encrypting key* (3.1.22) or the *master file key (MFK)* (3.1.27)

[SOURCE: ANSI X9.143:2022, 3.21]

**3.1.25**
**key type vector**
**KTV**
set of attributes formatted according to the *diversification scheme* (3.1.11) used in the *diversification data* (3.1.10) for defining the attributes of a key derived from a *key diversification key (KDK)* (3.1.21)

**3.1.26**
**key wrapping key**
**KWK**
symmetric key that determines the *wrapping* (3.1.36) and *unwrapping* (3.1.35) functions of a symmetric key authenticated encryption mechanism that is intended for the protection of cryptographic keys and other specialized data

[SOURCE: ANSI X9.143:2022, 3.22]

**3.1.27**
**master file key**
**MFK**
key used to encrypt other keys for storage

Note 1 to entry: Storage can be internal to the *secure cryptographic device (SCD)* (3.1.32) housing the MFK or can pertain to external storage (e.g. on a host system).

[SOURCE: ANSI X9.143:2022, 3.24]

**3.1.28**
**message authentication code**
**MAC**
cryptographic value, which is the result of passing a financial message through the message authentication algorithm using a specific key

[SOURCE: ANSI X9.143:2022, 3.25]

**3.1.29**
**passive**
attribute setting for a directed key that allows only reacting on a cryptographic interaction

EXAMPLE MAC verify only, cipher decrypt, PIN verify, key decryption (key import)

**3.1.30**
**PIN**
personal identification number
numeric code used to authenticate an identity or to verify access authorization

[SOURCE: ISO/IEC 19790:2025, modified — added “or to verify access authorization” to the definition.]

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**3.1.31**
**pseudorandom function**
**PRF**
function that can be used to generate output from a random seed and a data variable such that the output is computationally indistinguishable from truly random output

Note 1 to entry: The PRF is specified in the NIST SP 800–108r1-upd1.

**3.1.32**
**secure cryptographic device**
**SCD**
device that provides physically and logically protected cryptographic services and storage (e.g. *personal identification number (PIN)* (3.1.30) entry device or hardware security module (HSM)), and which can be integrated into a larger system, such as an automated teller machine (ATM) or point of sale terminal

[SOURCE: ISO 13491-1:2024, 3.18, modified — the example "(e.g. *PIN* entry device or HSM)" has been merged with the definition.]

**3.1.33**
**subkey**
cryptographic key that is used internally in a cryptographic algorithm, such as cipher-based message authentication code (CMAC), and not chosen by or exposed to the user of the algorithm

**3.1.34**
**TDEA**
triple data encryption algorithm
symmetric algorithm

Note 1 to entry: The TDEA is specified in the ISO/IEC 18033 series.

[SOURCE: ISO 11568:2023, 3.87, modified — the term "triple data encryption algorithm" has been changed to an admitted term, and the abbreviated term "TDEA" has been changed to the preferred term.]

**3.1.35**
**unwrapping**
function in a key wrap mechanism that either produces the key data from the ciphertext or indicates that either the ciphertext or the associated data is invalid

[SOURCE: ANSI X9.143:2022, 3.32]

**3.1.36**
**wrapping**
function in a key wrap mechanism that produces the ciphertext from and creates a validity check for the key and associated data

[SOURCE: ANSI X9.143:2022, 3.33]

## 3.2 Abbreviated terms

AAC application authentication cryptogram

ARQC authorization request cryptogram

BDK base derivation key

CMAC cipher-based message authentication code

DAC data authentication code

DD derivation data

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| | |
|---|---|
| DER | distinguished encoding rules |
| ECC | elliptic curve cryptography |
| ECDSA | elliptic curve digital signature algorithm |
| ECIES | elliptic curve integrated encryption scheme |
| EMV | Europay, Mastercard, Visa |
| GBIC | German banking industry committee |
| HMAC | keyed-hash message authentication code |
| HSM | hardware security module |
| ID | identifier |
| IKID | initial key identifier |
| KBH | key block header |
| KCV | key check value |
| KDH | key distribution host |
| KLD | key loading device |
| KRD | key receiving device |
| KEK | key encryption key |
| KMS | key management system |
| KSI | key set identifier |
| KWK | key wrapping key |
| MFK | master file key |
| PAN | personal account number |
| PED | PIN encryption device |
| PVK | PIN verification key |
| PVV | PIN verification value |
| SHA | secure hash algorithm |
| RD | random data |
| RSA | Rivest, Shamir and Adleman |
| TC | transaction certificate |
| TLS | transport layer security |

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