

FINAL
DRAFT

INTERNATIONAL
STANDARD

ISO/IEC
FDIS
27040

ISO/IEC JTC 1/SC 27

Secretariat: DIN

Voting begins on:
2023-09-08

Voting terminates on:
2023-11-03

Information technology — Security techniques — Storage security

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/IEC FDIS 27040

<https://standards.iteh.ai/catalog/standards/sist/a55e257b-020d-4917-bdc6-967e2e5e833c/iso-iec-fdis-27040>

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.



Reference number
ISO/IEC FDIS 27040:2023(E)

© ISO/IEC 2023

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO/IEC FDIS 27040

<https://standards.iteh.ai/catalog/standards/sist/a55e257b-020d-4917-bdc6-967e2e5e833c/iso-iec-fdis-27040>



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 General	1
3.2 Terms relating to storage technology	2
3.3 Terms relating to sanitization	4
3.4 Terms relating to availability	5
3.5 Terms relating to security and cryptography	5
3.6 Terms relating to archives and repositories	6
3.7 Miscellaneous terms	8
4 Symbols and abbreviated terms	9
5 Structure of this document	11
5.1 General	11
5.2 Controls	11
6 Overview and concepts	12
6.1 General	12
6.2 Storage concepts	12
6.3 Introduction to storage security	13
6.4 Storage security risks	15
6.4.1 Background	15
6.4.2 Data breaches	16
6.4.3 Data corruption or destruction	17
6.4.4 Temporary or permanent loss of access/availability	17
6.4.5 Failure to meet statutory, regulatory, or legal requirements	18
7 Organizational controls for storage	18
7.1 General	18
7.2 Align storage and policy	18
7.3 Business continuity management	19
7.4 Compliance	20
8 People controls for storage	21
9 Physical controls for storage	21
9.1 General	21
9.2 Physically secure storage	21
9.3 Protect physical interfaces to storage	22
9.4 Isolation of storage systems	22
10 Technological controls for storage	23
10.1 General	23
10.2 Design and implementation of storage security	23
10.2.1 General	23
10.2.2 Storage security design principles	23
10.2.3 Storage system quality attributes	26
10.2.4 Retention, preservation, and disposal of data	28
10.3 Storage systems security	29
10.3.1 System hardening	29
10.3.2 Security auditing, accounting, and monitoring	29
10.3.3 Storage vulnerability management	32
10.4 Storage management	32
10.4.1 Background	32
10.4.2 Authentication and authorization	33
10.4.3 Secure the management interfaces	35

10.5	Data confidentiality.....	36
10.5.1	General.....	36
10.5.2	Encryption and key management issues.....	37
10.5.3	Encryption of storage.....	38
10.5.4	Encrypting transferred data.....	41
10.5.5	Encrypting data at rest.....	42
10.6	Storage sanitization.....	44
10.6.1	General.....	44
10.6.2	Selection of sanitization methods.....	45
10.6.3	Media-based sanitization.....	45
10.6.4	Logical sanitization.....	46
10.6.5	Cryptographic erase.....	46
10.6.6	Verification of storage sanitization.....	47
10.6.7	Proof of sanitization.....	48
10.7	Direct attached storage.....	49
10.8	Storage networking.....	50
10.8.1	Background.....	50
10.8.2	Storage area networks.....	50
10.8.3	Network Attached Storage protocols.....	56
10.9	Block-based storage.....	57
10.9.1	Fibre Channel (FC) storage.....	57
10.9.2	IP storage.....	58
10.10	File-based storage.....	59
10.10.1	General.....	59
10.10.2	NFS-based NAS.....	59
10.10.3	SMB-based NAS.....	60
10.11	Cloud computing storage.....	61
10.11.1	Securing cloud computing storage.....	61
10.11.2	CDMI security.....	61
10.12	Object-based storage.....	62
10.13	Data reductions.....	63
10.14	Data protection and recovery.....	64
10.14.1	General.....	64
10.14.2	Storage backups.....	64
10.14.3	Storage replication.....	65
10.14.4	Storage snapshots.....	65
10.15	Data archives and repositories.....	66
10.15.1	General.....	66
10.15.2	Data archives.....	66
10.15.3	Data Repositories.....	70
10.16	Virtualization.....	71
10.16.1	Storage virtualization.....	71
10.16.2	Storage for virtualized systems.....	72
10.17	Secure multi-tenancy.....	72
10.18	Secure autonomous data movement.....	73
	Annex A (informative) Storage security controls summary.....	75
	Bibliography.....	84

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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 or www.iec.ch/members_experts/refdocs).

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and <https://patents.iec.ch>. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 27, *Information security, cybersecurity and privacy protection*.

This second edition cancels and replaces the first edition (ISO/IEC 27040:2015), which has been technically revised.

The main changes are as follows:

- the scope has been expanded to cover requirements;
- the clause structure has been more closely aligned with ISO/IEC 27002:2022;
- requirements have been added in [Clauses 7, 9, and 10](#);
- adjustments have been made regarding the storage technologies which are covered;
- a new controls labelling scheme has been added;
- former [Annex A](#), which provided guidance on sanitizing specific types of media, has been removed and text has been added in [Clause 10](#), recommending IEEE 2883 for this purpose;
- former Annex B, which included table to help prioritize the adoption of recommendation, has been replaced with [Annex A](#) that summarizes the requirements and guidance contained in this document;
- former Annex C, which provided tutorial oriented material, has been removed and references to appropriate materials have been added in [Clause 10](#).

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 and www.iec.ch/national-committees.

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO/IEC FDIS 27040

<https://standards.iteh.ai/catalog/standards/sist/a55e257b-020d-4917-bdc6-967e2e5e833c/iso-iec-fdis-27040>

Information technology — Security techniques — Storage security

1 Scope

This document provides detailed technical requirements and guidance on how organizations can achieve an appropriate level of risk mitigation by employing a well-proven and consistent approach to the planning, design, documentation, and implementation of data storage security. Storage security applies to the protection of data both while stored in information and communications technology (ICT) systems and while in transit across the communication links associated with storage. Storage security includes the security of devices and media, management activities related to the devices and media, applications and services, and controlling or monitoring user activities during the lifetime of devices and media, and after end of use or end of life.

Storage security is relevant to anyone involved in owning, operating, or using data storage devices, media, and networks. This includes senior managers, acquirers of storage product and services, and other non-technical managers or users, in addition to managers and administrators who have specific responsibilities for information or storage security, storage operation, or who are responsible for an organization's overall security programme and security policy development. It is also relevant to anyone involved in the planning, design, and implementation of the architectural aspects of storage network security.

This document provides an overview of storage security concepts and related definitions. It includes requirements and guidance on the threats, design, and control aspects associated with typical storage scenarios and storage technology areas. In addition, it provides references to other international standards and technical reports that address existing practices and techniques that can be applied to storage security.

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/IEC 27000, *Information technology — Security techniques — Information security management systems — Overview and vocabulary*

3 Terms and definitions

3.1 General

For the purposes of this document, the terms and definitions given in ISO/IEC 27000 and the following 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/>

3.2 Terms relating to storage technology

3.2.1

block

unit in which data is *stored* (3.2.17) and retrieved on *storage devices* (3.2.14) and *storage media* (3.2.16)

3.2.2

compression

reduction in the number of bits used to represent an item of data

Note 1 to entry: For *storage* (3.2.12), lossless compression (i.e. compression using a technique that preserves the entire content of the original data, and from which the original data can be reconstructed exactly) is used.

3.2.3

data at rest

data recorded on stable, *non-volatile storage* (3.2.11)

3.2.4

data in motion

data being transferred from one location to another

Note 1 to entry: These transfers typically involve interfaces that are accessible and do not include internal transfers (i.e. never exposed outside of an interface, chip, or device).

3.2.5

deduplication

method of reducing *storage* (3.2.12) needs by eliminating redundant data, which is replaced with a pointer to the unique data copy

Note 1 to entry: Deduplication is sometimes considered a form of data reduction.

3.2.6

device

mechanical, electrical, or electronic contrivance with a specific purpose

[SOURCE: ISO/IEC 14776-372:2011, 3.1.10]

3.2.7

Fibre Channel

serial input/output interconnect capable of supporting multiple protocols, including access to open system *storage* (3.2.12), access to mainframe storage, and networking

Note 1 to entry: Fibre Channel supports point to point, arbitrated loop, and switched topologies with a variety of copper and optical links running at speeds from 1 gigabit per second to over 128 gigabits per second.

3.2.8

Fibre Channel Protocol

Serial Small Computer System Interface (SCSI) transport protocol used on *Fibre Channel* (3.2.7) interconnects

3.2.9

over provision

technique used by *storage devices* (3.2.14) in which a subset of the available *storage medium* (3.2.16) is exposed through the interface

Note 1 to entry: Storage medium is used internally and independently by the storage device to improve performance, endurance, or reliability.

3.2.10

network attached storage

storage device (3.2.14) or system that connects to a network and provides file access services to computer systems

3.2.11**non-volatile storage**

storage (3.2.12) that retains its contents after power is removed

3.2.12**storage**

device (3.2.6), function, or service supporting data entry or retrieval

3.2.13**storage area network**

network whose primary purpose is the transfer of data between computer systems and *storage devices* (3.2.14) and among storage devices

Note 1 to entry: A storage area network consists of a communication infrastructure, which provides physical connections, and a management layer, which organizes the connections, storage devices, and computer systems so that data transfer is secure and robust.

3.2.14**storage device**

component or aggregation of components made up of one or more *devices* (3.2.6) containing *storage media* (3.2.16), designed and built primarily for the purpose for accessing *non-volatile storage* (3.2.11)

3.2.15**storage ecosystem**

system of interdependent components that work together to enable *storage* (3.2.12) services and capabilities

Note 1 to entry: The components often include *storage devices* (3.2.14), storage networks, storage management, and other information and communications technology (ICT) infrastructure.

3.2.16**storage medium**

material on which digital data are, or can be, recorded or retrieved

3.2.17**store**

record data on *volatile storage* (3.2.20) or *non-volatile storage* (3.2.11)

3.2.18**target data**

information subject to a given process, typically including most or all information on *storage* (3.2.12)

3.2.19**virtualized storage****logical storage**

abstraction of physical *storage devices* (3.2.14) or *storage media* (3.2.16) that masks the characteristics and boundaries of the physical *storage* (3.2.12)

Note 1 to entry: Virtualized storage can employ multiple levels of virtualization prior to presenting the virtualized storage to a system or an application.

3.2.20**volatile storage**

storage (3.2.12) that fails to retain its contents after power is removed

3.3 Terms relating to sanitization

3.3.1

clear

sanitize (3.3.12) using logical techniques on user data on all user-addressable storage locations for protection against simple non-invasive data recovery techniques using the same host interface available to the user

3.3.2

degauss

render magnetically stored data unreadable by applying a strong magnetic field to the *storage medium* (3.2.16) with an organizationally approved field strength

3.3.3

destruct

sanitize (3.3.12) using physical techniques that make recovery of *target data* (3.2.18) infeasible using state of the art laboratory techniques and results in the subsequent inability to use the *storage medium* (3.2.16) for *storage* (3.2.12)

Note 1 to entry: *Disintegrate* (3.3.5), *incinerate* (3.3.6), *melt* (3.3.7), *pulverize* (3.3.9), and *shred* (3.3.13) are destruct forms of *media sanitization* (3.3.16).

Note 2 to entry: If the storage medium cannot be removed, then the *storage device* (3.2.14) can be subjected to the destruct technique; a storage device can contain multiple storage media.

3.3.4

destruction

result of *destruct* (3.3.3) actions taken to ensure that the *storage medium* (3.2.16) cannot be reused as originally intended and that user data is virtually impossible or prohibitively expensive to recover

3.3.5

disintegrate

destruct (3.3.3) by separating *storage medium* (3.2.16) into its component parts

3.3.6

incinerate

destruct (3.3.3) by burning *storage medium* (3.2.16) completely

3.3.7

melt

destruct (3.3.3) by changing *storage medium* (3.2.16) from a solid to a liquid state generally by the application of heat

3.3.8

cryptographic erase

method of sanitization in which the encryption key for the encrypted *target data* (3.2.18) is *sanitized* (3.3.12), making recovery of the decrypted target data infeasible

3.3.9

pulverize

destruct (3.3.3) by grinding *storage medium* (3.2.16) to a powder or appropriately small particles

3.3.10

purge

sanitize (3.3.12) using physical or logical techniques that make recovery of *target data* (3.2.18) infeasible using state of the art laboratory techniques, but which preserves the *storage media* (3.2.16) and *storage device* (3.2.14) in a potentially reusable state

3.3.11

sanitization

process or method to *sanitize* (3.3.12)

3.3.12**sanitize**

render access to *target data* (3.2.18) on *storage* (3.2.12) infeasible for a given level of effort

3.3.13**shred**

destruct (3.3.3) by cutting or tearing *storage medium* (3.2.16) into small particles

3.3.14**storage sanitization**

logical storage sanitization (3.3.15) or *media sanitization* (3.3.16)

3.3.15**logical storage sanitization**

virtual storage sanitization

sanitization (3.3.11) of virtual storage

Note 1 to entry: *Clear* (3.3.1) and *purge* (3.3.10) are actions that can be taken to *sanitize* (3.3.12) virtual storage.

Note 2 to entry: Logical storage sanitization is a subset of *storage sanitization* (3.3.14).

3.3.16**media sanitization**

sanitization (3.3.11) of *storage media* (3.2.16)

Note 1 to entry: *Clear* (3.3.1), *purge* (3.3.10), and *destruct* (3.3.3) are actions that can be taken to *sanitize* (3.3.12) *storage media* (3.2.16).

Note 2 to entry: Media sanitization is a subset of *storage sanitization* (3.3.14).

3.4 Terms relating to availability**3.4.1****resilience**

ability to anticipate and adapt to, resist or quickly recover from a potentially disruptive event, whether natural or man-made

[SOURCE: ISO 15392:2019, 3.21]

3.5 Terms relating to security and cryptography**3.5.1****cryptoperiod**

defined period of time during which a specific cryptographic key is authorized for use or during which the cryptographic keys in a given system may remain in effect

[SOURCE: ISO 16609:2022, 3.6]

3.5.2**data breach**

compromise of security that leads to the accidental or unlawful *destruction* (3.3.4), loss, alteration, unauthorized disclosure of, or access to protected data transmitted, *stored* (3.2.17), or otherwise processed

3.5.3**data integrity**

property that data has not been altered or destroyed in an unauthorized manner

[SOURCE: ISO 7498-2:1989, 3.3.21]

3.5.4

multi-factor authentication

authentication using two or more of the following factors:

- knowledge factor, something an individual knows;
- possession factor, something an individual has;
- biometric factor, something an individual is or is able to do.

[SOURCE: ISO 19092:2008, 4.42]

3.5.5

malware

malicious software designed specifically to damage or disrupt a system, attacking confidentiality, integrity, and/or availability

Note 1 to entry: Viruses and Trojan horses are examples of malware.

[SOURCE: ISO/IEC 27033-1:2015, 3.22]

3.5.6

point of encryption

location within the information and communications technology infrastructure where data are encrypted on its way to *storage* (3.2.12) and, conversely, where data are decrypted when accessed from storage

Note 1 to entry: The point of encryption is only applicable for *data at rest* (3.2.3).

3.5.7

security strength

number associated with the amount of work that is required to break a cryptographic algorithm or system

3.5.8

storage security

application of physical, technical, and administrative controls to protect storage systems and infrastructure as well as the data *stored* (3.2.17) within them

Note 1 to entry: Storage security is focused on protecting data (and its storage infrastructure) against unauthorized disclosure, modification, or destruction while assuring its availability to authorized users.

Note 2 to entry: These controls can be preventive, detective, corrective, deterrent, recovery, or compensatory in nature.

3.5.9

strong authentication

authentication by means of cryptographically derived multi-factor credentials

[SOURCE: ISO 22600-1:2014, 3.23.]

3.6 Terms relating to archives and repositories

3.6.1

archive

<organization> organization or part of an organization responsible for selection, acquisition, *preservation* (3.6.5), and availability of one or more *archives* (3.6.2)

[SOURCE: ISO 5127:2017, 3.2.3.01, modified — Notes to entry 1 to 4 have been omitted; term changed to singular from plural “archives”; domain <organization> has been added.]

3.6.2**archive**

<holdings> materials, items, *records* (3.6.6) or documents created or received by a person, family or organization, public or private, in the conduct of their affairs and preserved because of the enduring value contained in them or as evidence of the functions and responsibilities of their creator, especially those materials maintained using the principles of provenance, original order and collective control

[SOURCE: ISO 5127:2017, 3.6.1.03, modified — "items, records or documents" have been included at the start of the definition; Note 1 to entry has been omitted; term changed to singular from plural "archives"; domain <holdings> has been added.]

3.6.3**disposition**

range of records processes associated with implementing *records* (3.6.6) *retention* (3.6.9), *records destruction* (3.6.7) or transfer decisions which are documented in disposition authorities or other instruments

[SOURCE: ISO 30300:2020, 3.4.8, modified — "destruction" has been changed to "records destruction"]

3.6.4**evidence**

information that can be used either by itself or in conjunction with other information, to establish proof about an event or action

[SOURCE: ISO 30300:2020, 3.2.6, modified — Note 1 to entry has been omitted; "could" has been changed to "can"]

3.6.5**preservation**

measures taken to maintain the *usability* (3.6.10), authenticity, reliability and integrity of *records* (3.6.6) over time

Note 1 to entry: Measures include principles, policies, rules, strategies, processes and operations.

[SOURCE: ISO 30300:2020, 3.4.11]

3.6.6**record**

information created or received and maintained as *evidence* (3.6.4) and as an asset by an organization, in pursuit of legal obligations or in the course of conducting business

Note 1 to entry: Records are normally used in plural.

Note 2 to entry: In a management system standard (MSS) implementation, the records created to conduct and direct the management system and to document its implementation are called documented information.

[SOURCE: ISO 30300:2020, 3.2.10]

3.6.7**records destruction**

eliminating or deleting a *record* (3.6.6), beyond any possible reconstruction

[SOURCE: ISO 30300:2020, 3.4.7, modified — changed the term "destruction" to "records destruction".]

3.6.8**records requirement**

requirement for *evidence* (3.6.4) of a business function, activity or transaction and for records processes including how, and how long, *records* (3.6.6) need to be kept

[SOURCE: ISO 30300:2020, 3.3.2]

3.6.9 retention

keeping a *record* (3.6.6) according to *records requirements* (3.6.8)

[SOURCE: ISO 30300:2020, 3.4.14]

3.6.10 usability

property of being able to be located, retrieved, presented and understood

Note 1 to entry: Usability may also refer to the extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.

[SOURCE: ISO 30300:2020, 3.2.12]

3.7 Miscellaneous terms

3.7.1 in-band

communication or transmission that occurs within a previously established communication method or channel

Note 1 to entry: The communications or transmissions often take the form of a separate protocol, such as a management protocol over the same medium as the primary data protocol.

3.7.2 metadata

data that defines and describes other data

[SOURCE: ISO/IEC 11179-1:2023, 3.2.26]

3.7.3 multi-tenancy

allocation of physical or virtual resources such that multiple tenants and their computations and data are isolated from and inaccessible to one another

[SOURCE: ISO/IEC 22123-1:2023, 3.4.3]

3.7.4 out-of-band

communication or transmission that occurs outside of a previously established communication method or channel

3.7.5 secure multi-tenancy

type of *multi-tenancy* (3.7.3) that employs security controls to explicitly guard against *data breaches* (3.5.2) and provides validation of these controls for proper governance

Note 1 to entry: Secure multi-tenancy exists when the risk profile of an individual tenant is no greater than in a dedicated, single-tenant environment.

Note 2 to entry: In very secure environments even the identity of the tenants is kept secret.

4 Symbols and abbreviated terms

ACL	access control list
AES	Advanced Encryption Standard
API	application programming interface
BCM	business continuity management
BMC	baseboard management controller
CCM	counter with cipher block chaining message authentication code
CDMI	Cloud Data Management Interface
CHAP	Challenge Handshake Authentication Protocol
CLI	command line interface
CNA	converged network adaptor
DAS	direct attached storage
DDoS	distributed denial of service
DH-CHAP	Diffie Hellman – Challenge Handshake Authentication Protocol
DNS	domain name system
DoS	denial of service
DRAM	dynamic random access memory
ESP	encapsulating security payload
FC	fibre channel
FC-SP	fibre channel – security protocol
FCIP	fibre channel over TCP/IP
FCP	fibre channel protocol
GCM	Galois/Counter Mode
HBA	host bus adapter
HDD	hard disk drive
HMAC	hash-based message authentication code
HTTPS	hypertext transfer protocol secure
IB	InfiniBand™
ICT	information and communications technology
ID	identifier
IEEE	Institute of Electrical and Electronics Engineers