

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Maritime navigation and radiocommunication equipment and systems –
Cybersecurity – General requirements, methods of testing and required test
results**

**Matériels et systèmes de navigation et de radiocommunication maritimes –
Sécurité informatique – Exigences générales, méthodes d'essai et résultats
d'essai exigés**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION
EQUIPMENT AND SYSTEMS – CYBERSECURITY –
GENERAL REQUIREMENTS, METHODS OF TESTING
AND REQUIRED TEST RESULTS**

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FDIS	Report on voting
80/984/FDIS	80/989/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English

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INTRODUCTION

IMO resolution MSC.428(98) on maritime cyber risk management in safety management systems affirms the need for cyber risk management on vessels subject to the SOLAS Convention. This document addresses the basic cybersecurity requirements for shipborne navigation and radiocommunication equipment falling within that need.

Shipborne navigation and radiocommunication equipment are generally installed in restricted areas, for example at the bridge where access is defined by the IMO International Ship and Port Facility Security (ISPS) Code or in an electronic locker room or in a closed cabinet. These restricted areas are referred to as secure areas in this document. This is based on the importance of navigation and radiocommunication equipment for the safety of navigation. These restricted areas are considered as areas with implemented security and access measures. These measures are defined in the ship security plan of the individual vessel derived from ISPS code, they are not part of this document and not specified or tested in the context of this document. Accordingly, equipment installed in these physically restricted access areas are understood to benefit from these security measures. This document provides mitigation against the remaining cyber vulnerabilities for equipment installed in such areas.

Following from the above, this document includes consideration of cyber threats from unauthorized users, from removable external data sources (REDS) like USB sticks, from network segments installed outside of the restricted areas including interfaces to external networks, for example ship to shore, ship to ship.

The risk of an incident is different for each equipment/system boundary, and the mitigating security measures required should be appropriate to the identified risk of incident and proportional to the identified adverse consequences. Boundaries take the form of both physical, such as direct access to the equipment via its ports (e.g. network, USB, import of digital files, software installation) and logical (e.g. connections over a network, transfer of data, operator use). A key tenet of cyber security is authentication of who has provided the data and verification that what is being provided has not been tampered with.

To reflect the difference in cyber security risk, the needs for authentication and verification between secure and non-secure areas are illustrated in Figure 1. The methods for achieving authentication and verification are described in each module of this document.

In Figure 1, the colour red means a source requiring authentication and verification. The colour green means a source not requiring authentication and verification.

The explanation of the numbers in Figure 1 is:

- 1) external communication that requires authentication and verification as the source is not a local secure area and its provenance cannot be trusted;
- 2) local network message interfacing that does not require authentication and verification as they are part of normal operation defined by configuration in a local secure area, for example VDR binary transfer, IEC 61162 interfacing, internal proprietary data exchange;
- 3) local message and data import between networks that does not require authentication and verification as they are part of normal operation defined by configuration in local secure areas;
- 4) external data import by an operator from an external source via REDS that requires authentication and verification of data import; this applies to executable or non-executable data;
- 5) local serial interface messaging that does not require authentication and verification as it is part of normal operation defined by configuration in a local secure area;
- 6) updates applied via external data source or REDS in maintenance mode that does not require authentication and verification but does require user authentication to change configuration.

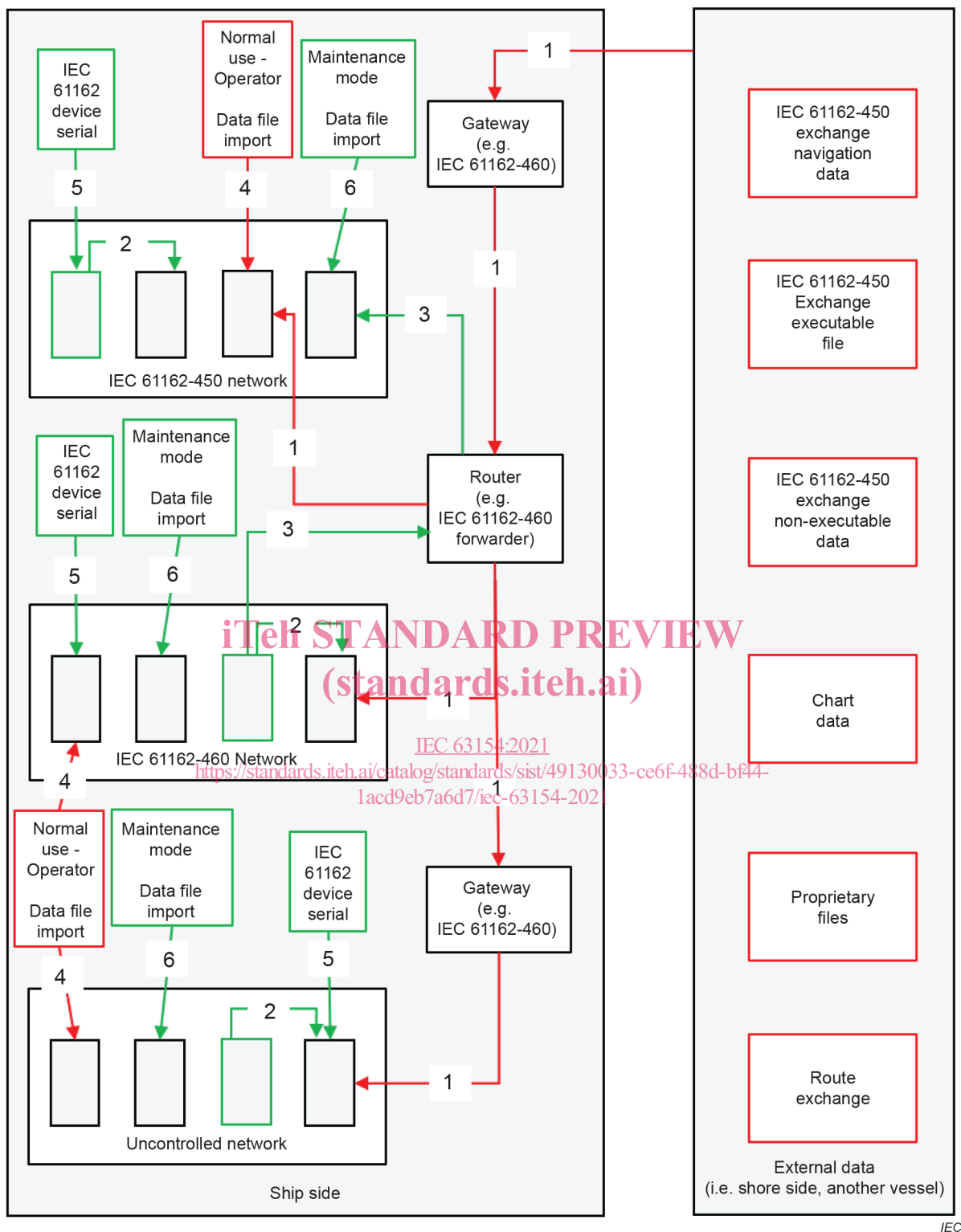


Figure 1 – Some examples of data transfer

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – CYBERSECURITY – GENERAL REQUIREMENTS, METHODS OF TESTING AND REQUIRED TEST RESULTS

1 Scope

This document specifies requirements, methods of testing and required test results where standards are needed to provide a basic level of protection against cyber incidents (i.e. malicious attempts, which actually or potentially result in adverse consequences to equipment, their networks or the information that they process, store or transmit) for:

- a) shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) mentioned in the International Convention for Safety of Life at Sea (SOLAS) as amended, and by the Torremolinos International Convention for the Safety of Fishing Vessels as amended, and to other shipborne radio equipment, where appropriate;
- b) shipborne navigational equipment mentioned in the International Convention for Safety of Life at Sea (SOLAS) as amended, and by the Torremolinos International Convention for the Safety of Fishing Vessels as amended,
- c) other shipborne navigational aids, and Aids to Navigation (AtoN), where appropriate.

The document is organised as a series of modules dealing with different aspects. The document considers both normal operation of equipment and the maintenance of equipment. For each module, a statement is provided indicating whether the module applies during normal operation or in maintenance mode.

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Communication initiated from navigation or radiocommunication equipment outside of items a), b) and c) above, for example ship side to other ship or shore side, are outside of the scope of this document.

This document does not address cyber-hygiene checks, for example anti-malware scanning, etc., performed outside of the cases defined in this document.

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.

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61162-450, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 450: Multiple talkers and multiple listeners – Ethernet interconnection*

IEC 61162-460:2018, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 460: Multiple talkers and multiple listeners – Ethernet interconnection – Safety and security*

3 Terms, definitions and abbreviated terms

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

address space layout randomization authentication

ASLR

memory-protection process for operating systems that guards against buffer-overflow attacks by randomizing the location where system executables are loaded into memory

3.1.2

authentication

provision of assurance that a claimed characteristic of an identity is correct

Note 1 to entry: Authentication is usually a prerequisite to allowing access to resources in a system.

3.1.3

authenticator

means used to confirm the identity of a user (human, software process or device)

Note 1 to entry: For example, a password or token may be used as an authenticator.

3.1.4

authenticity

property that an entity is what it claims to be

Note 1 to entry: Authenticity is typically used in the context of confidence in the identity of an entity, or the validity of a transmission, a message or message originator.

3.1.5

basic input/output system

BIOS

non-volatile firmware used to perform hardware initialization during the booting process (power-on startup), and to provide runtime services for operating systems and programs

Note 1 to entry: Examples include legacy BIOS (historical IBM PC compliant), UEFI (unified extensible firmware interface).

3.1.6

controlled network

network compliant to the controlled network requirements of IEC 61162-460

3.1.7

closed network

network which is physically isolated from other networks

Note 1 to entry: A closed network is also known as an "air gapped network".

Note 2 to entry: A closed network cannot contain equipment that connects to different networks. A closed network may be controlled or uncontrolled.

Note 3 to entry: This includes but is not limited to Ethernet networks.

3.1.8**cryptographic key**

sequence of symbols that controls the operations of a cryptographic

EXAMPLE Encipherment, decipherment, cryptographic check-function computation, signature calculation and signature verification.

3.1.9**data execution prevention**

DEP

implementation of execution space protection on Microsoft Windows operating systems

Note 1 to entry: Execution space protection technique allows memory to be marked as non-executable such that attempts to add executable code results in an error.

3.1.10**data integrity**

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

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

3.1.11**digital signature**

data appended to, or cryptographic transformation of, a data unit that allows the recipient of the data unit to prove the source and integrity of the data unit and protect against forgery e.g. by the recipient

[SOURCE: ISO 7498-2:1989, 3.3.26]

3.1.12**external data source**

EDS

network or non-network data source, including, but not limited to, REDS and SIM cards

3.1.13**hash-code**

string of bits which is the output of a hash-function

Note 1 to entry: The literature on this subject contains a variety of terms that have the same or similar meaning as hash-code. Modification Detection Code, Manipulation Detection Code, digest, hash-result, hash-value and imprint are some examples.

Note 2 to entry: NIST SP 800-63B uses message digest for this.

[SOURCE: ISO/IEC 10118-1:2016, 3.3, modified – Note 2 to entry has been added.]

3.1.14**hash-function**

function which maps strings of bits of variable (but usually upper bounded) length to fixed-length strings of bits, satisfying the following two properties:

- for a given output, it is computationally infeasible to find an input which maps to this output;
- for a given input, it is computationally infeasible to find a second input which maps to the same output

Note 1 to entry: Used as part of data authentication, integrity and non-repudiation.

[SOURCE: ISO/IEC 10118-1:2016, 3.4, modified – Note 1 to entry has been replaced by a new note.]

3.1.15

maintenance mode

mode reserved for qualified and authorized persons, or authorised remote devices for the purposes of installation, commissioning, repair or maintenance of the system

3.1.16

manufacturer's configuration

part of setup, installation or configuration parameters/selections/settings which the manufacturer has specified in their documentation as being available only in the maintenance mode

3.1.17

network storm

unplanned excessive transmission of traffic in a network causing the network to be overwhelmed and degrading the planned performance

3.1.18

normal operation

use of functionality which is described as being available for an operator by the documentation of the manufacturer

3.1.19

private key

cryptographic key of an entity's asymmetric key pair which can only be used by that entity

3.1.20

public key

cryptographic key of an entity's asymmetric key pair which can be made public

3.1.21

remote maintenance

maintenance access to equipment by any user (human, software process or device) communicating from outside the perimeter of the controlled network being addressed that can result in changes to the manufacturer's configuration and operator settings

3.1.22

removable external data source

REDS

user removable non-network data source, including, but not limited to, compact discs, memory sticks and Bluetooth¹ data storage devices

[SOURCE: IEC 61162-460:2018, 3.32, modified – The words "data storage" have been added in the definition, and the note to entry has been deleted.]

3.1.23

secret key

cryptographic key used with symmetric cryptographic techniques and usable only by a set of specified entities

¹ Bluetooth is the trademark of a product supplied by Bluetooth Special Interest Group. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

3.1.24**security strength**

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

EXAMPLE 80 bits, 112 bits, 128 bits, 192 bits, 256 bits.

Note 1 to entry: Security strength of a 2048-bit RSA key is 112 bits.

3.1.25**signer**

entity generating a digital signature

[SOURCE: ISO/IEC 13888-1:2020, 3.52]

3.1.26**session**

semi-permanent stateful and interactive information interchange between two or more communicating devices

3.1.27**trust**

relationship between two elements, a set of activities and a security policy in which element x trusts element y if and only if x has confidence that y will behave in a well-defined way (with respect to the activities) that does not violate the given security policy

3.1.28**trusted third party**

security authority, or its agent, trusted by other entities with respect to security-related activities

Note 1 to entry: In the context of ISO/IEC 13888 (all parts), a trusted third party is trusted by the originator, the recipient, and/or the delivery authority for the purposes of non-repudiation, and by another party such as an adjudicator.

3.1.29**user**

any person that is using the equipment as intended

3.2 Abbreviated terms

EUT	equipment under test
IMO	International Maritime Organization
IP	Internet protocol
LAN	local area network
MAC	media access control
TCP	transmission control protocol
UDP	user datagram protocol
USB	universal serial bus
VDR	voyage data recorder
VLAN	virtual LAN