



**International
Standard**

ISO 4891

**Ships and marine technology —
Interoperability of smart
applications for ships**

*Navires et technologie maritime — Interopérabilité des
applications intelligentes pour les navires*

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Contents

	Page
Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	4
5 Smart application network	5
5.1 Overview.....	5
5.2 4891-components.....	8
5.2.1 General.....	8
5.2.2 4891-message broker.....	9
5.2.3 4891-service discovery.....	9
5.2.4 4891-unit registry.....	10
5.2.5 4891-units.....	10
5.3 4891-messages.....	11
5.3.1 General.....	11
5.3.2 Message structure.....	11
5.3.3 Header values.....	12
5.3.4 Data part encoding.....	13
5.3.5 Message type.....	14
5.3.6 Standard message types.....	14
5.4 Handling of outdated messages.....	15
5.5 Direct messaging.....	15
5.6 Message relaying.....	15
5.7 Trust and encryption.....	15
6 Compatibility implementation	16
6.1 General.....	16
6.2 JSON-encoding for value types.....	16
6.2.1 General.....	16
6.2.2 Common types.....	16
6.2.3 Dictionary type.....	17
6.2.4 Message type.....	18
6.3 HTTP-APIs.....	21
6.3.1 General.....	21
6.3.2 HTTP-requests.....	21
6.3.3 HTTP-request query parameters.....	21
6.3.4 HTTP-responses.....	22
6.3.5 HTTP-error responses.....	23
6.3.6 4891-unit authentication.....	23
6.4 UDP broadcasts.....	26
6.4.1 Sending UDP broadcasts.....	26
6.4.2 Listening to UDP broadcasts.....	27
6.5 4891-message broker.....	28
6.5.1 General.....	28
6.5.2 Client authentication.....	28
6.5.3 Connecting to MQTT-server.....	28
6.5.4 Message encoding.....	28
6.5.5 Publishing a 4891-message via MQTT.....	28
6.5.6 Subscribe to 4891-messages via MQTT.....	29
6.6 4891-service discovery.....	30
6.6.1 General.....	30
6.6.2 Service connectors.....	31
6.6.3 Service discovery API clients.....	32

ISO 4891:2024(en)

6.6.4	Service discovery API server.....	32
6.6.5	Service discovery API discovery packet.....	33
6.6.6	Service discovery API examples.....	33
6.7	4891-unit registry.....	34
6.7.1	General.....	34
6.7.2	Tracking of unit information.....	35
6.7.3	Unit registry API clients.....	35
6.7.4	Unit registry API server.....	35
6.7.5	Unit registry API examples.....	38
6.8	4891-unit.....	40
6.9	Direct messaging API.....	41
6.9.1	General.....	41
6.9.2	Direct messaging API clients.....	41
6.9.3	Direct messaging API server.....	42
6.9.4	Direct messaging API discovery packet.....	43
6.9.5	Direct messaging API examples.....	43
6.10	Trusted communication.....	44
6.10.1	General.....	44
6.10.2	Public key infrastructure.....	44
6.10.3	Root certificates.....	45
6.10.4	Unit certificates.....	47
6.10.5	Signing data (digital signatures).....	49
6.10.6	Encrypting data.....	50
6.11	Messaging.....	51
6.11.1	General.....	51
6.11.2	Error message.....	51
6.11.3	Message meta structure.....	52
6.11.4	Receiving message from another unit.....	53
6.11.5	General message processing logic.....	53
6.11.6	Message relaying logic.....	54
6.11.7	Message handling logic.....	55
7	Test methods.....	55
7.1	General.....	55
7.1.1	Manufacturable products.....	55
7.1.2	Testing and classification.....	57
7.1.3	Use of simulated equipment.....	58
7.1.4	Testing of UDP broadcasts.....	59
7.1.5	Testing of HTTP-API servers.....	59
7.1.6	Testing of HTTP-API clients.....	59
7.1.7	Inspecting 4891-messages exchanged between 4891-units.....	60
7.2	4891-compliant equipment tests.....	60
7.2.1	General.....	60
7.2.2	4891-message broker tests.....	60
7.2.3	4891-service discovery tests.....	62
7.2.4	4891-unit registry tests.....	63
7.2.5	4891-smart gateway unit tests.....	66
7.2.6	4891-I/O unit tests.....	67
7.3	Shared functionality tests.....	67
7.3.1	General.....	67
7.3.2	4891-component tests.....	68
7.3.3	4891-unit tests.....	71
7.3.4	Message broker client tests.....	75
7.3.5	Service discovery API client tests.....	76
7.3.6	Unit registry API client tests.....	77
7.3.7	Direct messaging API client tests.....	78
7.3.8	Message relaying tests.....	78
7.3.9	Root certificate properties tests.....	79
7.3.10	Unit certificate properties tests.....	79

ISO 4891:2024(en)

7.3.11	4891-message properties tests	80
7.3.12	UDP discovery broadcast sending tests.....	81
7.3.13	UDP discovery broadcast listening tests.....	81
7.3.14	HTTP-API server tests.....	82
7.3.15	HTTP-API client tests.....	83
Annex A	(normative) Smart gateway — Interface to controlled equipment.....	85
Annex B	(normative) Smart logbook — Integration with ELRB.....	121
Bibliography	130

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 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).

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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 8, *Ships and marine technology*.

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

In 2016, an exchange with ship managers and authorities was held to discuss why the digitalization of the market was behind that of other industries.

Due to new regulations and the desire to increase efficiency, the shipping industry requires ever more digital data and expertise. However, this can lead to high manual efforts and distractions.

In response to demands from stakeholders, a fast-growing digitalization process was initiated. This digitalization has nevertheless been lagging in terms of the need for fast and reliable data collection and utilization.

In 2017, the exchange was widened to cover demands from employees from ship to shore, to ensure that products and solutions are applicable also for crew members and linked maritime stakeholders. In particular, the following were addressed: data-collection, workflow support, automation and compatibility with other stakeholders, the IoT, ship equipment and other applications and standards.

The ideas and requirements that emerged from this exchange have been developed and summarized in this document in order to define a common base for the interoperability of digital devices onboard in collaboration with international experts.

In the process, a modular basis has been created to enable new applications on ships and promote the idea of preparing ship-related stakeholders for future issues, thus enabling them to work together in a secure and trustworthy manner.

In order to meet future requirements and to enable synergies between topics and stakeholders, this document aims to build on the existing technical basis and to add further mutually compatible modules or applications.

The prefix “4891” (this document's ISO number) is used for some terms throughout this document to differentiate those terms from similar terms of other documents or standards (e.g. 4891-component vs. component).

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Ships and marine technology — Interoperability of smart applications for ships

1 Scope

This document provides operational and performance requirements for smart applications on board ships. It is applicable to documentation, process management, connection and data collection through human-machine interfaces, IoT technologies and related systems.

This document defines methods to implement smart network applications, which are open to participants who implement the requirements defined in this document.

This document also describes a smart logbook application that can be used as a supplement to ISO 21745, thus this document is subject to the same security requirements as in ISO 21745 (see [Annex B](#)).

This document defines three incremental levels of equipment-classes (see [7.1.1](#)):

- a) 4891-compliant equipment (as described in [Clauses 5 to 7](#));
- b) 4891.A-compliant equipment (as described in [Clauses 5 to 7](#) and [Annex A](#));
- c) 4891.B-compliant equipment (as described in [Clauses 5 to 7](#) and [Annexes A and B](#)).

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 61162-450:2018, *Maritime navigation and radiocommunication equipment and systems — Digital interfaces — Part 450: Multiple talkers and multiple listeners - Ethernet interconnection*

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

ISO 21745:2019, *Electronic record books for ships — Technical specifications and operational requirements*

3 Terms and definitions

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

4891-component

functional part of the *smart application network* ([3.26](#)), such as the *4891-unit registry* ([3.8](#)), the *4891-service discovery* ([3.6](#)), the *4891-message broker* ([3.5](#)) or any *4891-unit* ([3.7](#))

3.2

4891-smart gateway unit

optional *4891-unit* (3.7) that acts as central gateway and integration point between the *smart application network* (3.26) and *controlled equipment* (3.15)

3.3

4891-I/O unit

optional *4891-unit* (3.7) that acts as input, output and processing device implementing use case specific functionality

Note 1 to entry: I/O units support manual input or automatic collection via sensors of any kind and may provide additional functions.

3.4

4891-message

structured piece of data that is exchanged between *4891-units* (3.7) and used in communication with *controlled equipment* (3.15)

3.5

4891-message broker

central *4891-component* (3.1) that can be used by *4891-units* (3.7) to publish and subscribe to *4891-messages* (3.4)

3.6

4891-service discovery

central *4891-component* (3.13) that provides connectivity information about the other *central 4891-components* (3.13)

3.7

4891-unit

4891-smart gateway unit (3.2) or *4891-I/O unit* (3.3) that exchanges *4891-messages* (3.4) with other *4891-units* (3.7) or communicates with *controlled equipment* (3.15)

3.8

4891-unit registry

central *4891-component* (3.13) that acts as certificate authority and participant lookup of *4891-units* (3.7)

3.9

administrator

admin

authorized person, who has the capability to setup and configure the *central 4891-components* (3.13) via administration interfaces (e.g. admin web interfaces)

3.10

API endpoint

single part of an API that is addressed via a URL for accessing data or triggering a functionality

3.11

asymmetric cryptography

digitally encrypting data and verifying signatures with *public key* (3.23) information and decrypting and signing data with *private key* (3.22) information

3.12

base URL

URL that is used as a prefix when constructing URLs to reach *API endpoints* (3.10)

3.13

central 4891-component

4891-component (3.1), that is not a *4891-I/O unit* (3.3)

EXAMPLE *4891-message broker* (3.5), *4891-service discovery* (3.6), *4891-unit registry* (3.8) or *4891-smart gateway unit* (3.2).

3.14
certificate

data structure containing a *public key* (3.23) and identity information (e.g. an identifier or name) that is digitally signed by another trusted party, binding the key to the identity

3.15
controlled equipment

security and safety related equipment, i.e. equipment according to IEC 61162-450/ IEC 61162-460

EXAMPLE The electronic record book.

3.16
data encryption

transformation of original data with the intention that the original data can only be transformed back by its designated recipient

3.17
instrumentation

running of software in a special mode that allows measuring of performance and tracing of code execution and information

3.18
key-pair

pair of related *public keys* (3.23) and *private keys* (3.22) used in *asymmetric cryptography* (3.11)

3.19
message relaying

receiving a *4891-message* (3.4) that is targeted to a different *4891-unit* (3.7) with the intention of forwarding that message to that unit in some way

3.20
mobile device

non-stationary data processor that can be moved around

EXAMPLE Smartphones and tablets.

3.21
PEM encoding

common format for serializing cryptographic components such as *private keys* (3.22), *public keys* (3.23), and *certificates* (3.14)

3.22
private key

secret part of a cryptographic *key-pair* (3.18) that should be kept a secret and is used for *signing data* (3.24) or decrypting data

3.23
public key

public part of a cryptographic *key-pair* (3.18) that can be shared and is used for validating signed data or *data encryption* (3.16)

3.24
signing data

attaching an additional signature data to an original data with the purpose that any modification of the original data is discoverable

3.25
smart application

function for mobile devices which makes it possible to confidentially collect data directly on board ships, evaluate it and control procedures

3.26

smart application network

SAppNet

sappnet

4891-network

set of *central 4891-components* (3.13) and all registered *4891-units* (3.7) that communicate via the exchange of *4891-messages* (3.4)

3.27

X.509 certificate

common format for storing and exchanging digital *certificates* (3.14)

Note 1 to entry: For further information on X.509, see RFC 5280.

4 Abbreviated terms

API	application programming interface
CA	certification authority
DSA	digital signature algorithm
ECDSA	elliptic curve digital signature algorithm
ELRB	electronic record book (see ISO 21745)
EUT	equipment under test
HTTP	hypertext transfer protocol (see RFC 2616)
IDE	integrated development environment
IoT	Internet of Things
JSON	JavaScript® object notation (see RFC 8259)
LAN	local area network
MQTT	message queuing telemetry transport (see ISO/IEC 20922:2016)
PEM	privacy-enhanced mail
PKI	public key infrastructure
RSA	RSA cryptosystem (Rivest–Shamir–Adleman)
SCRAM	salted challenge response authentication mechanism (see RFC 5802)
SAppNet	smart application network
SHA	secure hash algorithm
OOW	officer of the watch
UDP	user datagram protocol
URL	uniform resource locator
USB	universal serial bus
UTC	coordinated universal time

UUID universally unique identifier

5 Smart application network

5.1 Overview

A smart application network (see [Figures 1](#) to [4](#)), is an uncontrolled network focusing on uncritical interactions and contents. Each device may join the network at any time, and disconnect and reconnect as necessary. Communication between the network participants is done by passing messages in specified ways.

The network consists of the message exchange semantics between its various participants. The document defines the message structure as a common language to be used.

To ensure compatibility between different manufacturers, an implementation based on the interfaces described in [Clause 6](#) shall be fulfilled.

If controlled equipment is connected to the smart application network via a 4891-smart gateway unit, then that controlled equipment shall be implemented in accordance with the requirements of [Annex A](#). If that controlled equipment represents an ELRB, then that controlled equipment shall furthermore be implemented in accordance with [Annex B](#) (see [Figures 3](#) to [4](#)).

[Figure 1](#) illustrates the positioning of this new network in relation to other existing onboard networks and standards. [Figures 2](#) to [4](#) give examples of three different configurations and show how the smart application network connects with other existing networks and systems.

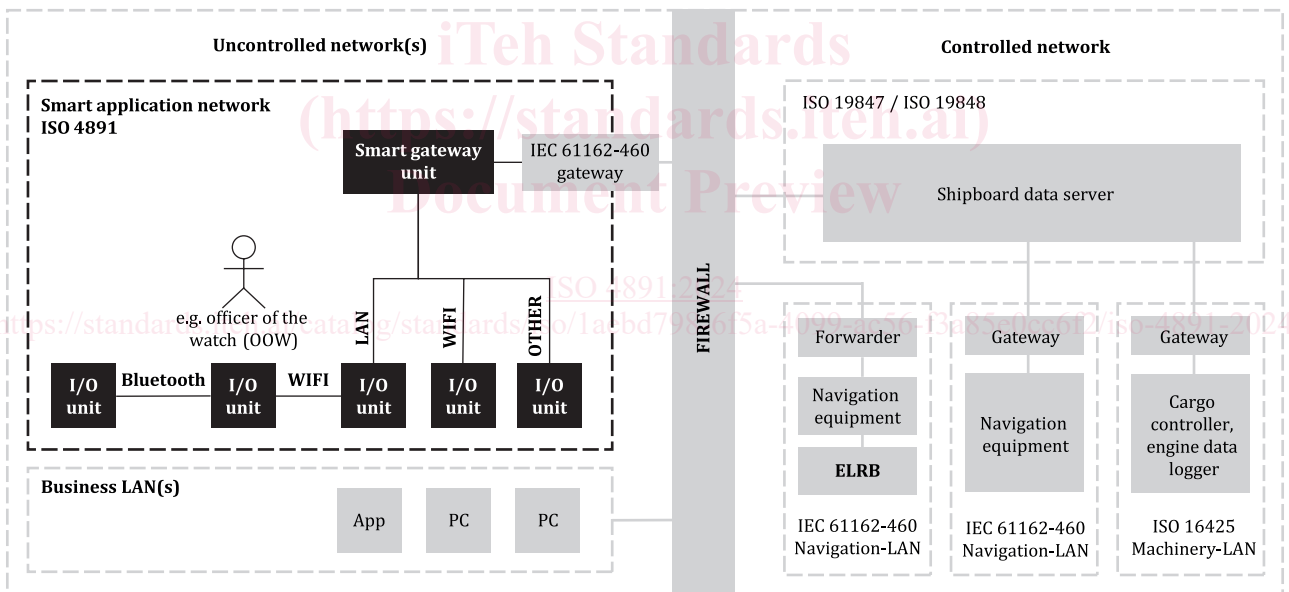
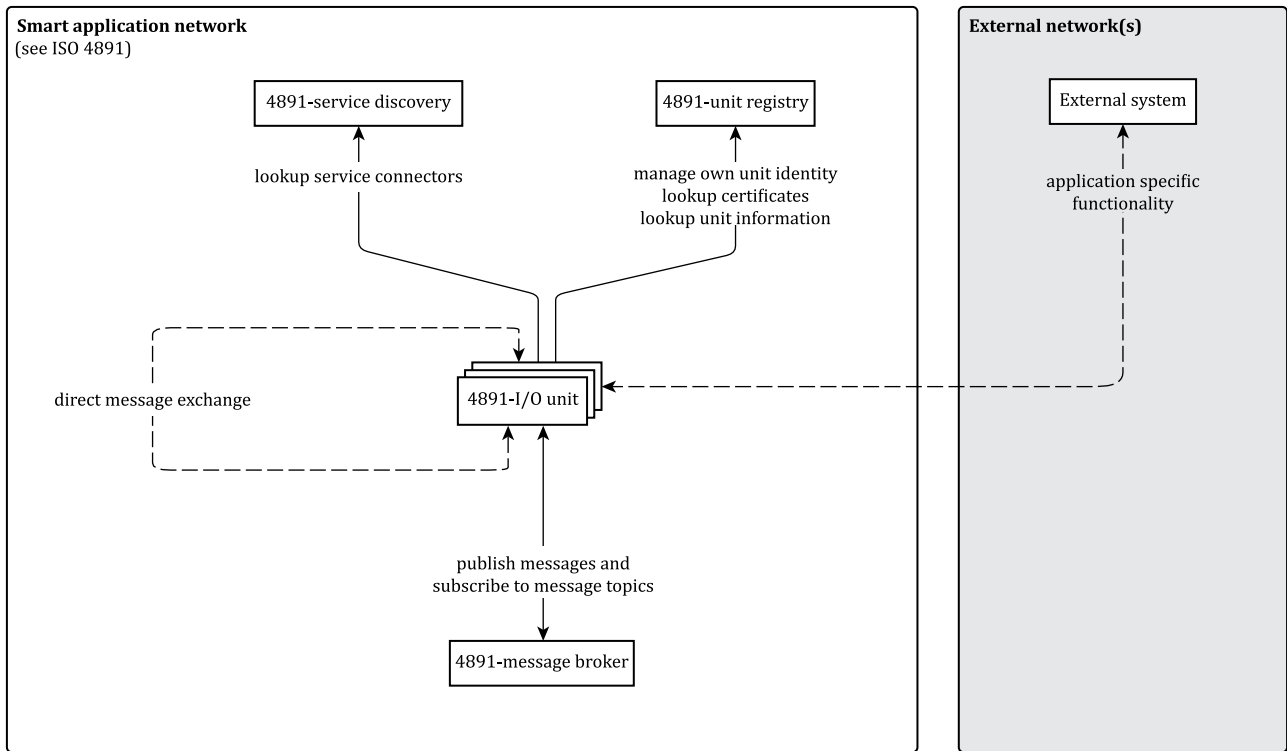


Figure 1 — Connectivity of 4891-network with other existing vessel networks



Key

- data communication (e.g. via ethernet, wifi, bluetooth)
- - - - -→ optional data communication

NOTE This configuration uses the equipment specified in this document, excluding the equipment specified in [Annex A](#) and [Annex B](#).

Figure 2 — Configuration example — Basic smart applications setup

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