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Ships and marine technology — Interoperability of smart applications for ships

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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 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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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.

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 initated. This digitalization has nevertheless been lagging in terms of the need for fast and reliant data collection and utilization.

In 2017, the exchange was widened to cover demands from of 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).

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/0 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.

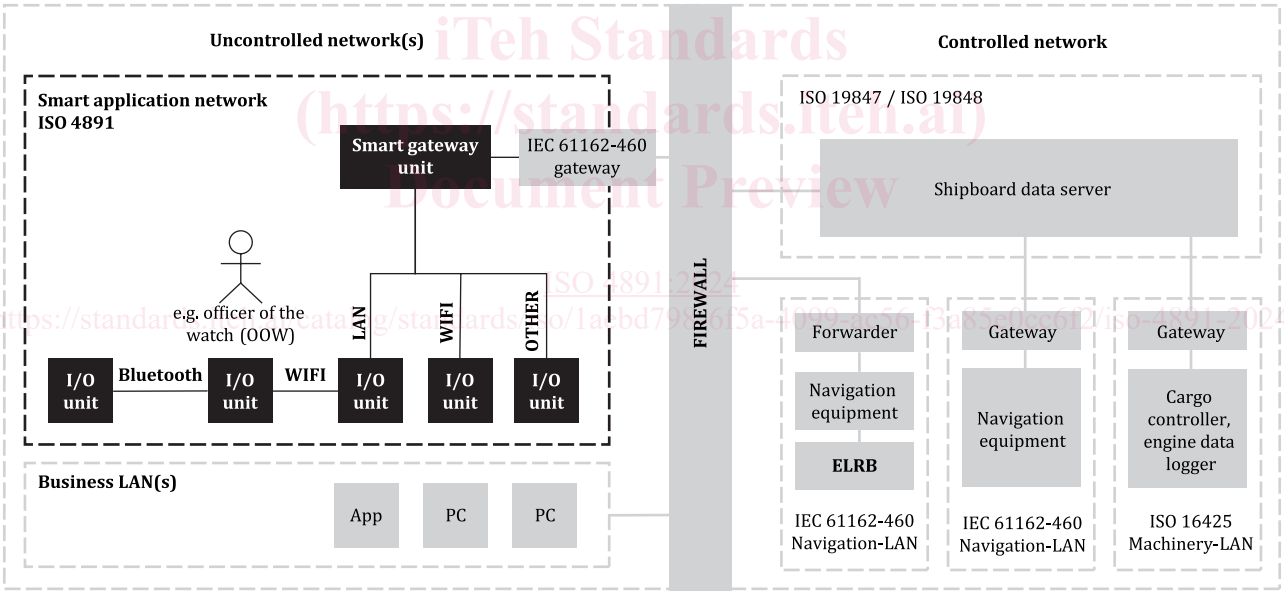
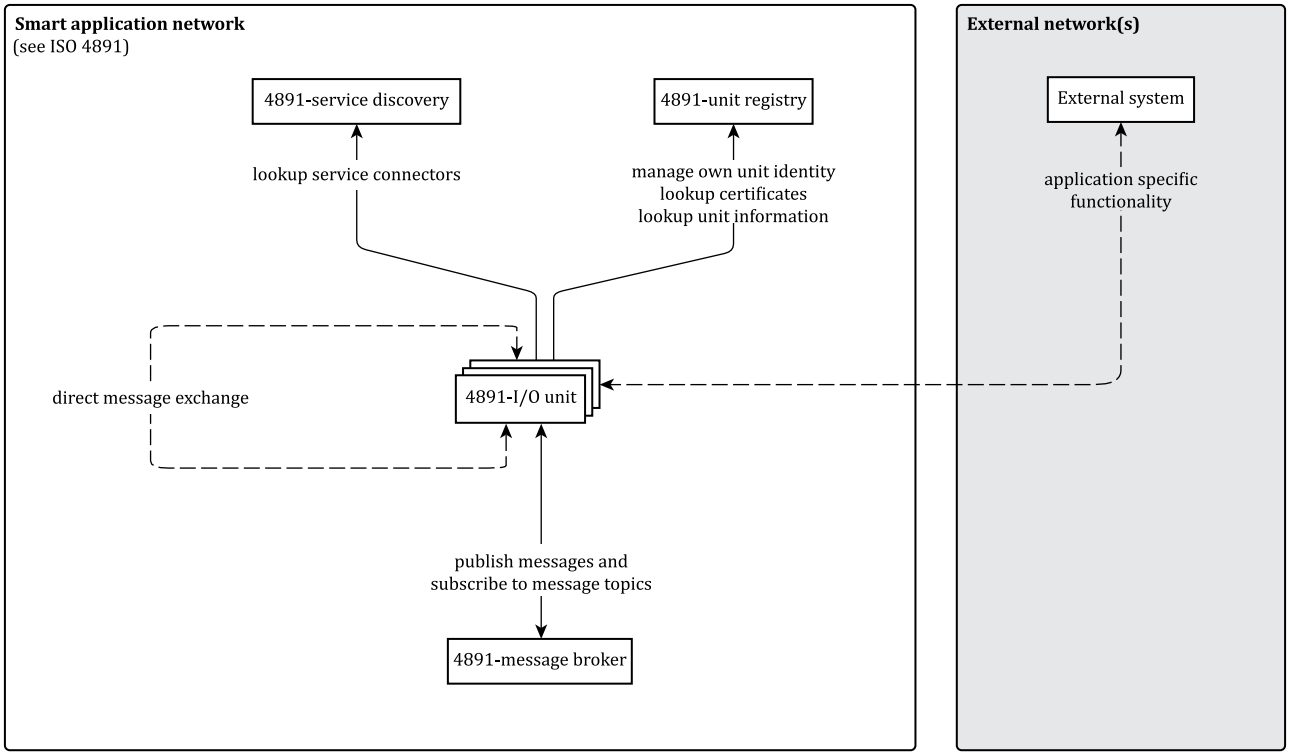


Figure 1 — Connectivity of 4891-network with other existing vessel networks



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