INTERNATIONAL STANDARD

ISO 23807

First edition
2023-03

Ships and marine technology — General requirements for the asynchronous time-insensitive ship-shore data transmission

Reference number
ISO 23807:2023(E)

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Published in Switzerland

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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 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

Sharing data between ships and the shore to ensure the safe and efficient operation of ships is becoming increasingly common.

Progress has been made in establishing data sharing between ships and the shore, related to ports, cargo and shipping routes. This includes the development of and discussions around standards related to Maritime Single Window and e-Navigation, which help to share some stylized data safely and in a timely manner between ships and shore.

On the other hand, the ship-shore communication environment is still narrower than those on land, and its connection is unstable. Therefore, a method for stably and efficiently sharing files of any format with a relatively large file size, such as various data and image files used in ship operation business applications, between ships and shore has not yet been standardized.

For example, in ship operations, onboard and on-shore application users determine the timing of data transmission and reception in relation to the connection status and communication quality of ship-shore communication each time, and perform data retransmission processing independently for each application.

In order to further promote the safe and efficient operation of ships, it is increasingly important to be able to send and receive files between ships and shore in a stable and efficient manner asynchronously without being affected by the ship-shore communication status.

In this document, asynchronous communication means the communication and/or application processing perspective, such as time-insensitive data transmission for non-real-time applications where the timing of the data generating and consuming can be different.

Although ISO 19847 and ISO 19848 provide standardized processes for efficient collection and storage of data for ship equipment systems, the method of asynchronously transmitting and receiving a large amount of ship equipment data accumulated on board between ships and shore has not been standardized yet. In order to promote shore support for ship operation and maintenance of onboard equipment systems, there is a need for a stable and efficient method for transmitting and receiving such onboard field data asynchronously between ships and shore.

This document specifies the functional requirements but does not intend to specify technical protocols.

See Annex A for more information on the correlation between the different relevant standards.

Ships and marine technology — General requirements for the asynchronous time-insensitive ship-shore data transmission

1 Scope

This document describes the requirements involved in ship to shore data communication between the shipboard data servers and the on-shore data servers. It provides information on:

— asynchronous communication;

— a method to measure end-to-end communication quality;

— transport integrity;

— transport security (e.g. encryption, authentication and authorization);

— management of data transmission (e.g. prioritization, logging, carrier awareness/management);

— communication optimization (e.g. deduplication, compression, resume, multiplexing);

— compliance with the data communication protocols, including but not limited to ISO 19847.

This document does not cover:

— the security of the data producer/consumer (e.g. identity management);

— communication equipment requirements;

— carrier performance requirements (e.g. bandwidth and latency).

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 20922, *Information technology — Message Queuing Telemetry Transport (MQTT) v3.1.1*

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
asynchronous communication
time-insensitive data transmission for onboard applications that transmit ship data and/or non-real-time applications where the timing of the data generating and consuming can be different

Note 1 to entry: This definition is not from the data protocol perspective.

Note 2 to entry: ISO 19847 is an example of an onboard application.

Note 3 to entry: The scope of the definition of asynchronous communication in this document covers messaging services such as message queueing telemetry transport and similar protocols but not streaming using datagram protocol.

Note 4 to entry: Table 1 compares the definition of synchronous and asynchronous communication.

Table 1 — Intentions regarding synchronous/asynchronous in this document

	Communication/application perspective
Synchronous	The receiver sends a response, and the sender waits for the response before sending the next data.
Asynchronous	The receiver sends a response, and the sender sends the next data without waiting for the response.

3.2
data transport agent
software installed on a ship or shore that interfaces with peripheral devices and systems

Note 1 to entry: The data transport agent collects and sends data to the *asynchronous data management agent* (3.3), or receives data from the asynchronous data management.

3.3
asynchronous data management agent
software used for the control and transport of data between ship and shore *data transport agent* (3.2)

4 Abbreviated terms

AES	advanced encryption standard
AES-CCM	AES-counter with cipher block chaining-message authentication code
AES-GCM	AES-galois/counter mode
API	application programming interface
BIZ-LAN	business local area network
ChaCha20	a stream cipher specified in RFC 8439
ChaCha20-Poly1305	a cryptographic algorithm that combines ChaCha20 and Poly1305
DH	Diffie-Hellman key exchange algorithm
DHE	Diffie-Hellman Ephemeral key exchange algorithm
DMZ	DeMilitarized Zone
ECDH	elliptic curve Diffie–Hellman key exchange algorithm
ECDHE	elliptic curve Diffie–Hellman ephemeral key exchange algorithm
ECDSA	elliptic curve digital signature algorithm
F/W	firewall
GraphQL	query language and runtime designed for APIs
HTTP	hypertext transfer protocol

IoT	Internet of things
LAN	local area network
MQTT	message queueing telemetry transport
OT	operational technology
Poly1305	a cryptographic message authentication mode specified in RFC 8439
PSEC-KEM	provably secure elliptic curve encryption with key encapsulation mechanisms
REST	REpresentational state transfer
RSASSA-PKCS1-v1_5	a digital signature algorithm specified in RFC 8017
RSASSA-PSS	a digital signature algorithm specified in RFC 8017
SHA-256	secure hash algorithm-256
SHA-384	secure hash algorithm-384
SHA-512	secure hash algorithm-512
TCP	transmission control protocol
TLS1.3	transport layer security version 1.3
UDP	user datagram protocol
UR E22	International Association of Classification Societies (IACS) Unified Requirement Electrical and Electronic Installations 22
UTM	unified threat management
VSAT	very small aperture terminal

5 General requirements

5.1 General

Communication between shore and ship are usually initiated from the vessel side. The vessel in most cases has a random IP address and it is difficult to change the firewall rules to allow traffic from shore sites. It is both easier and safer to initiate the communication link from behind the firewall, meaning that the vessel shall initiate the contact with shore. The same is true for shore sites, such as ship managers office locations. These locations should be considered a client side location, and should be responsible for initiating the communication link to a common centre resource such as the cloud server or the on-premises.

Figure 1 shows the overall picture of this document.

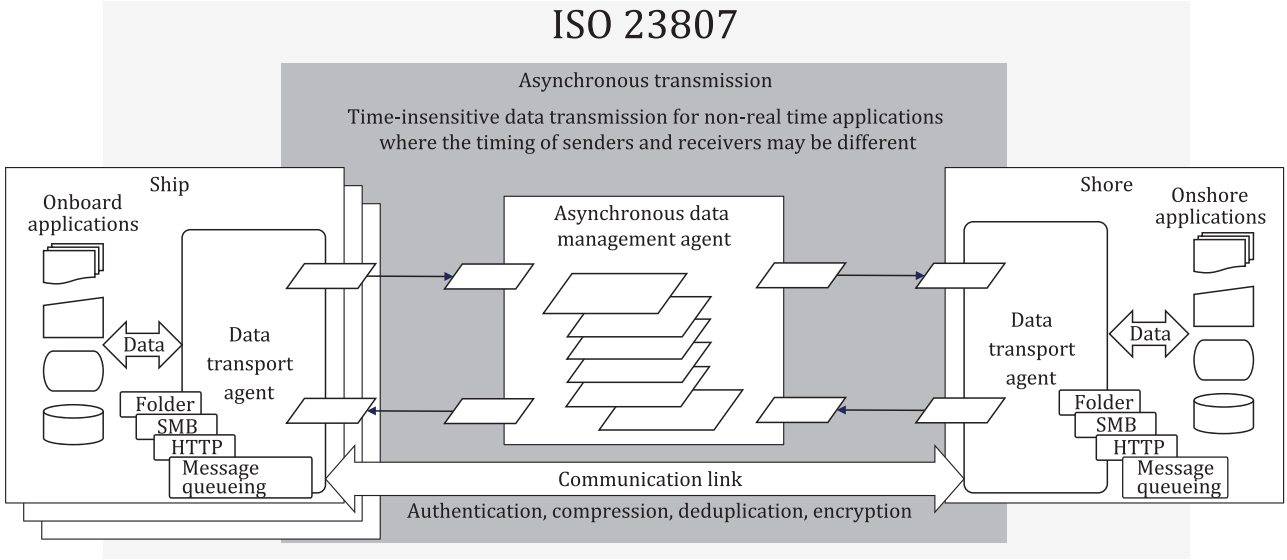

Figure 1 — Image of asynchronous transmission

Asynchronous communication is used on all communication where data can be transmitted intermittently.

It shall be applied to narrow-band and unstable ship-shore communication to exchange various types of data such as documents, media files, sensor data and machine-to-machine communication, and shall be applied to transferring the onboard server data. Best effort, variable bit rate and communication at regular intervals utilize spare capacity on an available carrier. Such communication shall comply with the requirements in 5.2, 5.3, 5.4, 5.5 and 5.6.

A single agent, or multiple agents, can be used to service multiple data formats.

5.2 Encryption

All traffic shall use appropriate encryption as dictated by the sensitivity of the data.

5.3 Compression

The content shall be compressed whenever the compressed size is significantly smaller than the raw data. The compression algorithm used shall be optimal for the intended use of the data, and not necessarily what provides the highest compression.

5.4 Deduplication

Transferring a large amount of data can have significant bandwidth savings by using proper deduplication. The deduplication protocol divides sending data into chunks and tracks their progress. The chunk size used in deduplication is not a fixed size and can be from 2K to 32K in size. For small data transfers, the overhead for the control traffic for deduplication can be bigger than the data itself. In such cases, deduplication should be avoided and any file below 2KB in size shall not be split into parts. Files larger than 2KB can be split into parts for deduplication, depending on the structure of the file. The deduplication protocol recognizes data blocks already available on the destination client, and only sends blocks not already on the client. This is true even for binary encoded data whenever the content can be shared among other communication data. For example, binary docker images greatly benefit from deduplication due to the layers inherent in such an image. These layers are shared between multiple docker images.

5.5 Distribution

In many cases, the data to transport shall be transported to multiple destinations (such as fleet-wide documentation). In other cases, there exist multiple sources of data that shall be transported to a single destination (such as IoT sensor data from a fleet of vessels). Due to this complexity, the communication system should be able to configure tasks with multiple sources or multiple destinations.

5.6 Recovery

Satellite communication is prone to disconnections that interrupt any ongoing data transfers. The data transfer agent shall keep track of transferred data so that a recovery from signal outage does not retransmit a huge amount of data. The shore side and the data transport agent on the vessel shall agree on the point of recovery. Transporting chunks of data and keeping track of the progress of chunks makes it easy for both sides to recover from an outage.

6 Data transport agent — vessel side interface

6.1 General

A data interface on the vessel side shall be flexible enough to accommodate a wide array of applications. Asynchronous data transfers are used for document exchanges as well as machine-to-machine communication such as IoT sensor data. Vessel side should include some of the interfaces shown in 6.2, 6.3, 6.4, 6.5 and 6.6, or other interfaces.

6.2 Transportation folders

A transportation folder is where either data transmissions from shore are stored as files or where the data transmission picks up files for transportation to shore. Separate folders can be used for separate transportation tasks. If the folder is used as a destination for many sources there is a risk of naming collisions. In such cases, the system shall support the creation of subfolders for every source.

6.3 File move and sync

6.3.1 Moving files

When moving files, the semantic is that whenever the files have been transferred, they should disappear from the sending folder. The sending folder shall be monitored for any new files, and whenever they occur, they should be moved at a schedule defined by a move policy.

6.3.2 Synchronizing folders

When synchronizing folders, the semantic is that whenever a file changes in the source folder, the same change shall appear in the destination folder. This is also true for deleting files in the source folder. The destination folder is a mirror of the source folder.

6.4 Server message block

The server message block (SMB) file sharing protocol allows computers to read and write files to a remote host over a local area network. The folders on the remote host are called “shares”, and for all practical purposes behave similar to a normal folder. For data transport, this means that the agent responsible for the transportation of data shall support handling remote shares just the same as local folders. The local client shall support SMB v.2.1 or higher, to be able to store and fetch files from SMB shares.