



# IALA RECOMMENDATION (NORMATIVE)

## R0124 (A-124) APPENDICES 9, 10 & 11 FUNCTIONAL DESCRIPTION OF THE AIS SERVICE COMPONENTS (AIS-PCU, AIS-LSS & AIS-SM)

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# 1 INTRODUCTION

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This Appendix combines the content of appendices 9, 10 and 11 into one single document for clarity.

## 1.1 INDEX OF APPENDICES TO IALA RECOMMENDATION R0124 (A-124) ON THE AIS SERVICE

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General:

Appendix 0      References, Glossary of terms and Abbreviations

Deliverables of the AIS Service to the shore-based clients:

Appendix 1      Basic AIS Services, Data model & AIS Service specific MDEF sentences

Appendix 2      **Intentionally blank**

Architecture of the AIS Service:

Appendix 3      Distribution model

Appendix 4      Interaction and data flow model

Appendix 5      Interfacing model

Appendix 6      Internal Time Latency model

Appendix 7      Internal Reliability model

Appendix 8      Test model

Functional components of AIS Service:

Appendix 9      Functional description of the AIS Logical Shore Station

Appendix 10     Functional description of the AIS PSS Controlling Unit

Appendix 11     Functional description of the AIS Service Management

Installation and life-cycle management issues of the AIS Service:

Appendix 12     Co-location issues at Physical Shore Stations (PSS) and on-site infrastructure considerations

Appendix 13     Recommendation regarding efficient operation and maintenance

Runtime configuration management of the VDL:

Appendix 14     FATDMA planning and operation

Appendix 15     Assigned mode operation

Appendix 16     DGNSS broadcast via the AIS Service

Appendix 17     Channel management

Appendix 18     VDL loading management

Appendix 19     Satellite AIS considerations

# 2 FUNCTIONAL DESCRIPTION OF THE AIS-PCU

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This section introduces the AIS Physical Shore Station Controlling Unit (AIS-PCU), its interfaces, and the functions it performs. These functions should be considered a minimum recommendation and manufacturers should provide additional functionalities over and above those described here to add value to their specific products.

## 2.1 INTRODUCTION TO THE AIS-PCU

The AIS-PCU is the AIS service interface to the VDL. Hence, the AIS-PCU is essential as part of the remote node and exists only there. The AIS-PCU encapsulates the technology dependent functions of the AIS Service and provides technology independent AIS functionality to the AIS Logical Shore Station (AIS-LSS). Thus, changes in the AIS standards do not have an impact at the interface to the AIS-LSS.

The data communication to other e-Navigation services and clients take place only via the LSS.

The data communication to the VHF Data Link takes place only via the AIS Fixed Station, which is the lowest layer of the shore based AIS Service.

The physical layer of the AIS Service is configured and controlled by the AIS Service Management (AIS-SM). The physical layer at a remote node is called the AIS Physical Shore Station (PSS).

The AIS-PCU, as the highest layer of the PSS, is directly configured and controlled by the AIS-SM and puts into action the configuration of the entire physical layer at a remote node. This applies especially to the operation of the internal Basic AIS Services (BAS). The internal BAS are controlled and configured by the AIS-SM. But the AIS-SM has no direct access to the AIS Fixed Stations; configuration of and data communication with the AIS Fixed Station is done by the AIS-PCU on behalf of the AIS-SM.

## 2.2 INTERFACES OF THE AIS-PCU

The figure below shows the interfaces available from a single AIS-PCU in relation to that single AIS-PCU. It shows that for any AIS-PCU only one AIS-SM can be interfaced, but multiple AIS-LSS and fixed stations can be interfaced. For information on data exchange and interaction on each interface, please refer to appendix 4.

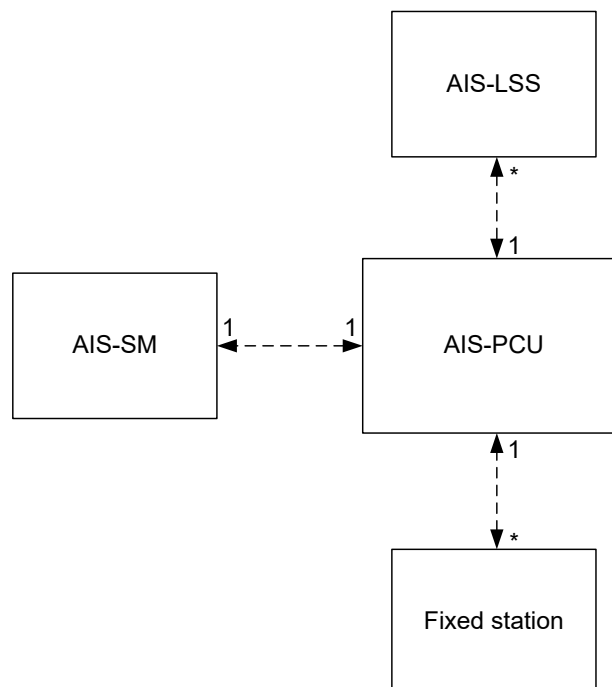


Figure 1 Interfaces of the AIS-PCU

## 2.3 FUNCTIONS OF THE AIS-PCU

### 2.3.1 Provide AIS data to and from AIS-SM, AIS-LSS and AIS fixed station(s)

The AIS-PCU is the AIS service interface to the VDL. As such, it must provide data to and from the AIS-LSS, the AIS-SM and the AIS fixed station(s) in order for these components to perform their functions. The data provided by the AIS-PCU is related to both the internal BAS and the external BAS depending on the situation.

The AIS-PCU will inevitably have to process the data received from the VDL and provide additional information on the original data. This additional information could be seen as metadata and would include such things as AIS-PCU identity (for origin of data), timestamp of reception / transmission and TDMA slot used. With Presentation Interface (PI) sentences, this metadata is carried using comment blocks.

### 2.3.2 Translate MDEF sentences to PI sentences and vice-versa

The interface used by the AIS-SM and the AIS-LSS is defined as using the IALA Maritime Data Exchange Format (MDEF) sentences. The interface used by the AIS Fixed stations is defined as using the IEC defined PI sentences. As such, the AIS-PCU must act as a translator between MDEF sentences and PI sentences in both directions. It is important to note that PI sentences are a particular implementation of MDEF sentences, hence, in some systems that use PI sentences system-wide, this translation may not be required.

### 2.3.3 Manage connected fixed stations

Since the AIS-PCU is the only interface to the AIS fixed station, the AIS-PCU must perform functions related to the management of AIS fixed stations:

- configuration of AIS fixed stations;
- transmission schedule configuration;
- monitoring of fixed stations and alarm reporting;
- management of failed units and failover;
- initial processing of data, e.g. checksum validation.

### 2.3.4 Control the transmission of the Fixed stations

One of the core real-time functions of the AIS-PCU is the control of the transmissions of the fixed stations. In order to perform this function, the AIS-PCU must maintain the:

- transmission queue and message priorities;
- run-time VDL slot map considering FATDMA / RATDMA configuration.

### 2.3.5 Management of acknowledgements

In some cases, the AIS-PCU will have to manage AIS VDL message acknowledgments. In particular, if an addressed message is sent to the MMSI of the PSS itself, the AIS-PCU should provide the acknowledgement of reception to the sender of the message before forwarding the addressed message to higher levels, i.e. the AIS-LSS.

Please refer to Appendix 4 for a detailed list of cases where the AIS-LSS may have to provide acknowledgement messages.

### 3 FUNCTIONAL DESCRIPTION OF THE AIS-LSS

This section introduces the AIS-LSS, its interfaces and the functions it performs. These functions should be considered a minimum recommendation and manufacturers should provide additional functionalities over and above those described here to add value to their specific products.

#### 3.1 INTRODUCTION TO THE AIS-LSS

An AIS Logical Shore Station (AIS-LSS) is a software process, which transforms the AIS data flow associated with one or more AIS-PCU into a different AIS-related data flow. Every individual transformation process takes into consideration operational aspects of the applications using the AIS service.

The software process of an AIS Logical shore station can run on any appropriate computer at any appropriate place. It is required, however, that there are reliable data transportation means to and from all associated AIS-PCU and to the AIS Service, which interfaces with the clients. Finally, an AIS Service should be able to manage multiple AIS-LSS simultaneously with different configurations for different clients.

#### 3.2 INTERFACES OF THE AIS-LSS

The figure below shows the interfaces available from a single AIS-LSS in relation to that single AIS-LSS. It shows that for any AIS-LSS only one AIS-SM can be interfaced, but multiple clients, AIS-LSS and AIS-PCUs can be interfaced. For information on data exchange and interaction on each interface, please refer to appendix 4.

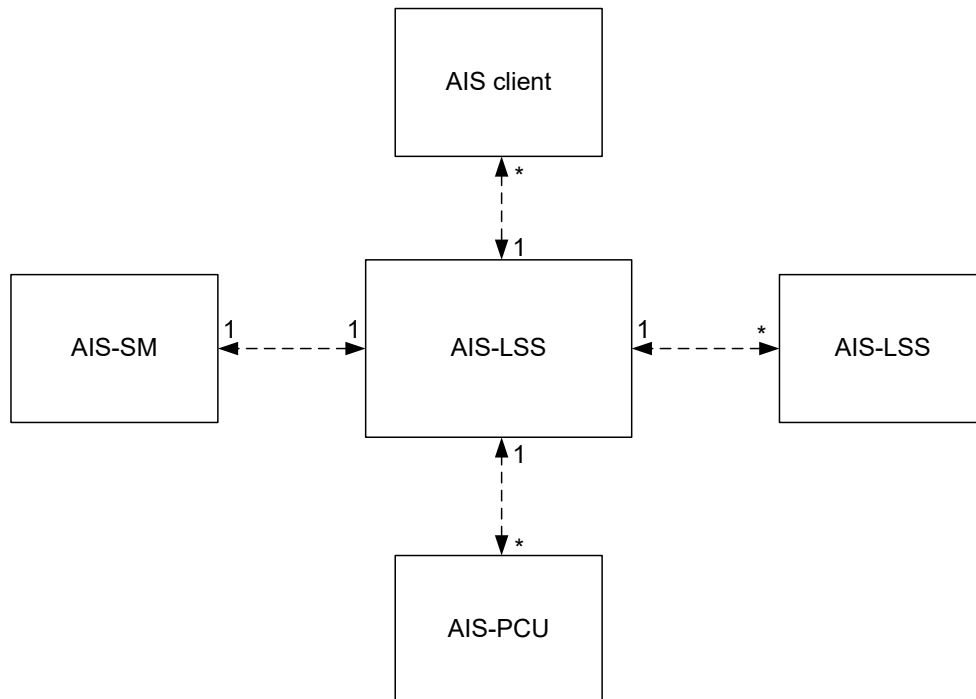


Figure 2 Interfaces of the AIS-LSS

## 3.3 FUNCTIONS OF THE AIS-LSS

### 3.3.1 Routing of data

The AIS-LSS acts as a software router for AIS data going to and from the clients and the AIS-PCUs. The AIS-LSS has to maintain a table of connected clients with their VDL identities (MMSI) and be able to route appropriate data to the client, in particular, addressed messages.

The AIS-LSS must also maintain a table of current AIS participants (class A, class B, AtoN, etc.) and the appropriate AIS-PCU for use in routing addressed messages from the clients to the targeted participant.

### 3.3.2 Filtering of data

The major functionality of the AIS-LSS is the real-time filtering of AIS data sent to clients. As a minimum an AIS-LSS should be able to provide the following filters:

- provide or deny access to any clients to any external BAS;
- duplicate removal between AIS-PCU received data;
- geographical filter of AIS data by defining a polygon of interest.

Additional AIS-LSS filters may include:

- time-sampling of AIS data to reduce data flow (report rate reduction);
- MMSI;
- IMO number;
- ITU-R M.1371 messages;
- IEC messages / MDEF sentences;
- type of ships.

### 3.3.3 Management of connections

Since one of the functions of the AIS-LSS is to act as a software router at the core of the AIS Service, it becomes important for the AIS-LSS to be able to manage its different connections to the other components of the AIS Service. For example, the AIS-LSS should be able to detect a failed connection to AIS-PCU and use redundant / standby AIS components if available.

### 3.3.4 Management of acknowledgements

In some cases, the AIS-LSS will have to manage AIS VDL message acknowledgments. In particular, if an addressed message is sent to the MMSI of one of the clients of the AIS-LSS, the AIS-LSS should provide the acknowledgement of reception to the sender of the message before forwarding the addressed message to higher levels, i.e., the client. To maintain the integrity of the AIS Service, the AIS-LSS cannot rely on its client to acknowledge the addressed message.

Please refer to Appendix 4 for a detailed list of cases where the AIS-LSS may have to provide acknowledgement messages.



## 4 FUNCTIONAL DESCRIPTION OF THE AIS-SM

This section introduces the AIS-SM, its interfaces and the functions it performs. These functions should be considered a minimum recommendation and manufacturers should provide additional functionalities over and above those described here to add value to their specific products.

### 4.1 INTRODUCTION TO THE AIS-SM

Since the AIS Service of a competent authority will, in most cases, comprise more than one AIS-LSS, AIS-PCU and AIS fixed station, there is a need for a top layer to act as a controlling entity for the whole of the AIS Service. Specifically, the AIS-SM:

- "owns" all the AIS-LSS and AIS-PCU, i.e. it invokes, initializes, configures, and terminates them at run-time;
- determines the network communication relationships between AIS-PCU and their associated AIS-LSS for them to use during run-time; and
- determines the communication relationships between the AIS-LSS and the applications associated with them, i.e. this top level acts as a "switch-board" for the data exchange relationships between the different processes.

The AIS-SM manages the AIS service by controlling the data flow in the system and configuring the different entities in order to fulfil system requirements.

### 4.2 INTERFACES OF THE AIS-SM

The figure below shows the interfaces available from a single AIS-SM in relation to that single AIS-SM. It shows that for any AIS-SM multiple technical personnel interfaces, AIS-LSS and AIS-PCUs can be interfaced. For information on data exchange and interaction on each interface, please refer to Appendix 4.

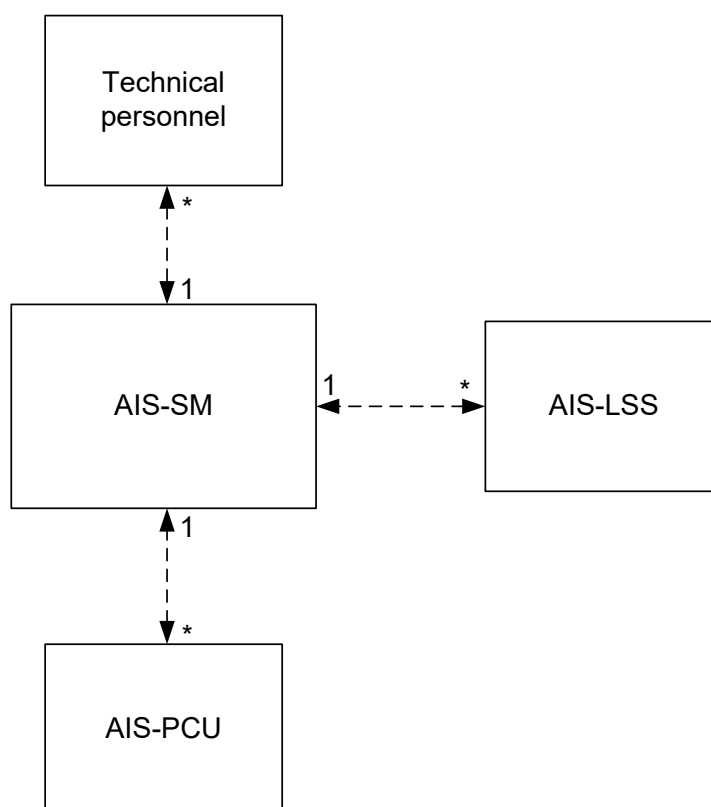


Figure 3 Interfaces of the AIS-SM

## 4.3 FUNCTIONS OF THE AIS-SM

### 4.3.1 Manage the configuration of the AIS service and its components

The AIS-SM is responsible for the configuration of AIS components. In particular it must provide:

- the configuration of internal BAS such as channel management, FATDMA scheme, slot reservations, DGNSS corrections, etc.;
- AIS components identification configuration.

Both VDL identification (MMSI) and network (unique-ID) identification must be considered. LSS clients will need an identification if they want to participate in the AIS service (as opposed to being listeners only).

- Configuration of AIS-LSS;

For example, assignment of AIS-PCUs to AIS-LSS, configuration of AIS-LSS filters and external BAS provided by each AIS-LSS should be done via the AIS-SM;

- Creation and termination of AIS-LSS for clients.

### 4.3.2 Monitor the AIS service and its components

The AIS-SM must also provide an integrated monitoring function of the AIS service and its components. The AIS-SM `gathers` all system alarms and status and provides a complete view of the system health.

### 4.3.3 Provide an interface to the AIS Service for technical personnel

The AIS-SM is responsible to provide a technical configuration, maintenance and support interface for the whole of the AIS service to the technical personnel in charge of supporting the service.