IALA RECOMMENDATION (NORMATIVE)

R0124 (A-124) APPENDIX 5
INTERFACING MODEL OF THE AIS SERVICE

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DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

Date	Details	Approval
December 2011	First issue	
September 2020	Edition 1.1 Editorial corrections.	

APPENDIX CONTENTS

List of Tables

List of Figures

1 INTRODUCTION

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

General:

Appendix 0	References, Glossary of terms and Abbreviations – to be developed

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 – to be developed
Appendix 4	Interaction and data flow model
Appendix 5	Interfacing model
Appendix 6	Internal Time Latency model – to be developed
Appendix 7	Internal Reliability model – to be developed
Appendix 8	Test model – to be developed

Functional components of AIS Service:

Appendix 9	Functional description of the AIS Logical Shore Station – to be developed
Appendix 10	Functional description of the AIS PSS Controlling Unit – to be developed
Appendix 11	Functional description of the AIS Service Management – to be developed

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 – to be developed
Appendix 13	Recommendation regarding efficient operation and maintenance – to be developed

Runtime configuration management of the VDL:

Appendix 14	FATDMA planning and operation
Appendix 15	Assigned mode operation – to be developed
Appendix16	DGNSS broadcast via the AIS Service
Appendix 17	Channel management
Appendix 18	VDL loading management
Appendix 19	Satellite AIS considerations

1.2 PURPOSE OF THE APPENDIX

This appendix expands on the description of the AIS Service regarding the Interfacing Model. It exhibits the following flow of thought, when addressing interfacing issues of the AIS Service:

1 All of the interface points of the AIS Service are identified, i.e., a *complete list of all interface points of the AIS Service* is provided. There are both *Machine-Machine-Interfaces (M2M)* between components and *Human-Machine-Interfaces (HMI)* specifically supporting the Technical Operation Personnel.

2 In a next step, the *Machine-Machine-Interfaces of the AIS Service* are described in more detail including the encodings recommended to achieve these interfaces.

3 Finally, the *Human-Machine-Interfaces of the AIS Services* are discussed in more detail. Information is provided for administrations as to what are best practices when setting up Human-Machine-Interfaces of the AIS Service towards their Technical Operation Personnel.[1]

Throughout the document, it is important to remember that the objective of this document is to recommend the minimum interfaces required for an AIS service. A particular implementation may use/offer additional interfaces to meet specific user requirements.

2 IDENTIFICATION OF THE INDIVIDUAL INTERFACES OF THE AIS SERVICE

2.1 INTERFACING MODEL OF THE AIS SERVICE

The Interfacing model of the AIS Service describes:

1 The relationship of the AIS Service with its clients (called external interfaces), and

2 The interfaces between the components of the AIS Service (called internal interfaces), described in this appendix of R0124 (A-124).

3 The encoding to be used for all identified interfaces.

The internal/external interfaces of the AIS Service should match the internal/external Basic AIS Services interactions respectively as described in appendix 4 (Interaction and Data Flow Model).

As a first step, it is helpful to re-consider Figure 6 of the Main Body of the Recommendation (which is reproduced here as Figure 1). In this Figure, the *tasks of the functional components* were identified within the AIS Service and in relationship to the external shore-based e-Navigation system or the AIS VDL. Figure 1 is now used to *highlight* the interface points throughout the AIS Service indicated by small empty dots.

[1] It should be noted, that the AIS Service as such does not provide a direct user interface; refer to main body of this Recommendation.

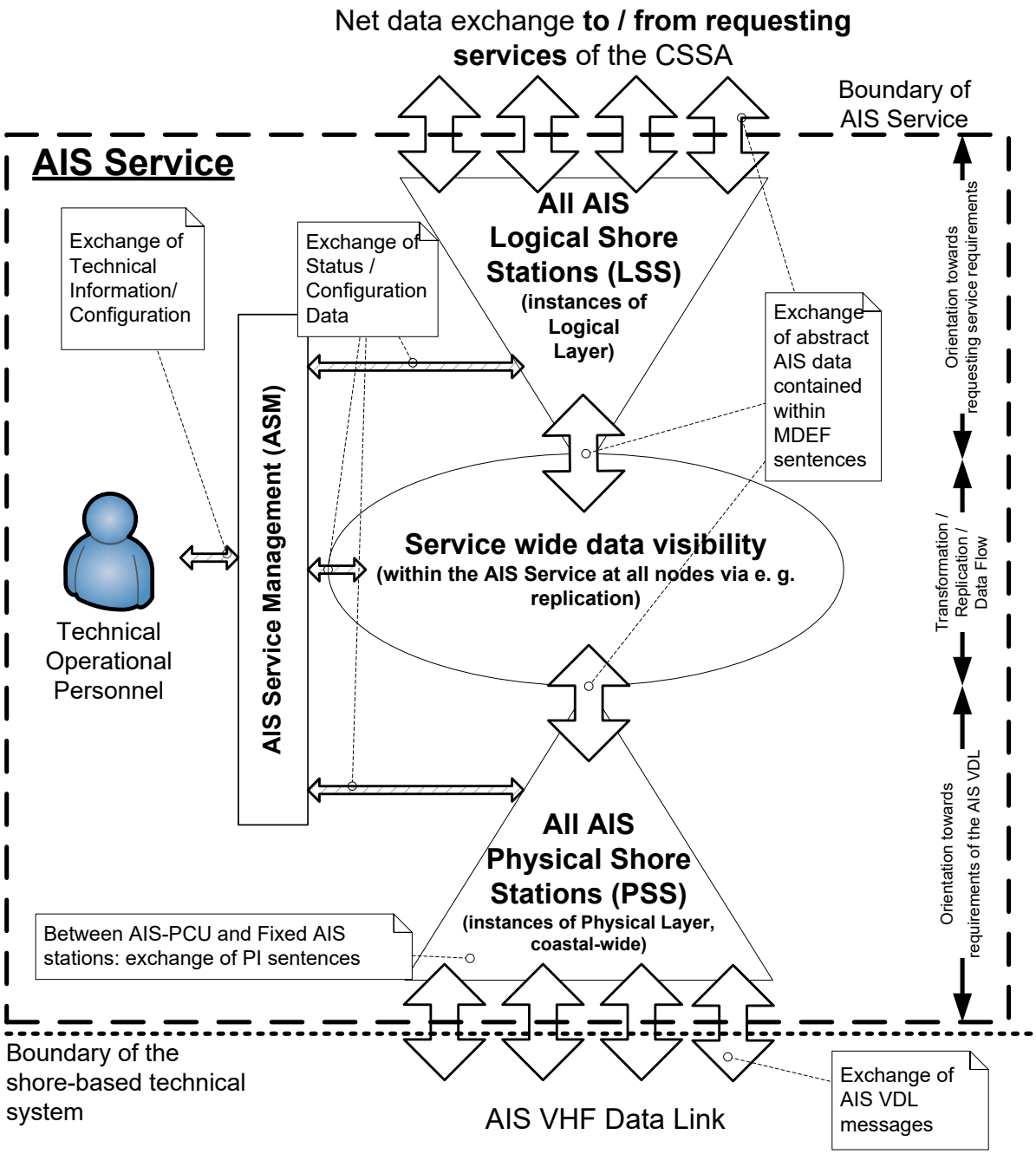

Figure 1 Identification of the functional interfaces in relationship to the functional component's tasks they connect

Based on Figure 1, Table 1 goes on to specifically identify all interfaces of the AIS Service, both internal and external, both Machine-to-Machine and Human Machine interfaces. Figures 2 - 5 assert completeness in regard to the various interfaces of the AIS Service. Figures 2 - 5 constitutes the core of the Interfacing model of the AIS Service.

Table 1 Complete identification of functional interfaces of the AIS Service (external/internal; not including interfaces of infrastructure components)

Interface Name	Interface Type	Interface Actors		Recommended Interface
		Actor A	Actor B	
Clients	External - MMI	AIS-LSS	All AIS Service clients	MDEF sentences
Technical Operational personnel	External - HMI	ASM	Technical Operational Personnel	None
ASM	Internal - MMI	ASM	AIS-PCU & AIS-LSS	MDEF sentences
AIS-LSS	Internal - MMI	AIS-LSS	AIS-LSS	MDEF sentences
AIS-PCU	Internal - MMI	AIS-PCU	AIS-LSS	MDEF sentences
AIS Fixed station	Internal - MMI	AIS Fixed Station	AIS-PCU	PI sentences IEC 61162 IEC 62320
VDL	Internal - MMI	AIS Fixed Station	Other AIS stations on VDL	ITU-R M.1371

2.2 INTERNAL AND EXTERNAL INTERFACES OF THE AIS SERVICE

As listed in Table 1, there are only 2 recommended external interfaces for an AIS Service. The first external interface is between the AIS Service and the Common Shore Based System Architecture (CSSA) introduced in the main body of this document as a general term for clients of the AIS Service, for example, a VTMIS. This Machine to Machine Interface should be identical to all the other internal MMI in terms of data encoding and protocol stack.

The second external interface is a Human Machine Interface for the Technical Operational Personnel to allow monitoring and configuration of the AIS Service. There are no recommendations on data encoding and protocol stack for this interface. It is left to the design of the AIS Service to decide which method of providing these functionalities to the Technical Operational Personnel is best fitted. Design considerations for this HMI are discussed in Section 4 of this appendix.

All the other interfaces are Internal MMI and the recommended data encoding and protocol stack will be discussed in the next section.

3 APPLICATION DATA ENCODING AND PROTOCOL STACKS FOR THE MACHINE-TO-MACHINE INTERFACES OF THE AIS SERVICE

3.1 MDEF SENTENCES

As stated previously in the IALA Recommendation A-124 and other Appendices to it, MDEF sentences are the preferred Machine-to-Machine interface for AIS information. It is important to understand that MDEF sentences are an abstract representation of the data objects that need to be exchanged between actors of the AIS. For example, MDEF sentences will define what information is required to define an Aid to Navigation in the AIS domain.

They will define the 'fields' required and metadata attached to those 'fields' such as metric or imperial measurement system. MDEF sentences will not define how to encode these fields, i.e., should they be exchanged in binary, XML, CSV or other types of encoding techniques.

At the time of writing of this document, MDEF sentences for AIS had still not been defined. Once they are defined, there will be many different ways to 'encode' MDEF sentences. The recommended encodings of MDEF sentences for the AIS Service will be explained in this section of this appendix. AIS implementations should support as many MDEF sentences encodings as possible to ensure BAS compatibility between different components.

For the moment, only PI sentences defined by IEC 61162-1 and IEC 62320-1 are recommended for encodings of MDEF sentences. As mentioned earlier, it is recommended that all AIS components support, as a basis, PI sentences for data exchange. If additional functionalities are needed above the BAS, then it is up to the designer of that AIS Service to add extra sentences (proprietary) or interfaces to meet the requirements of these extra functionalities. Please refer to section on proprietary sentences. Support for the standard PI sentences should remain in all components.

One important observation is that PI sentences are not particularly well adapted for a full AIS network environment. These limitations should be overcome by the use of comment blocks as defined in IEC 62320-1.

3.2 PI SENTENCES & COMMENT BLOCKS

In an AIS network, it might be of interest for the AIS components and/or clients to have access to metadata on the origin of the sentences. It is also important to be able to address a particular message to a particular component. In order to fulfil this requirement, the unique identifier of the AIS component can be appended to the PI sentence using comment blocks as defined in IEC 62320-1.

Other data such as a timestamp can also be inserted in the comment blocks if required. Due to the limited number of characters available in the comment blocks, it is not recommended to duplicate information already available in a PI sentence or the rest of the protocol stack in the comment blocks, the appropriate PI sentence or protocol stack parameter should be used if that information is required. For example, VDL Rx/Tx slot is already included in the VSI/TFR sentences and should not be duplicated to comment blocks. The same applies to source/destination IP addresses which are already included in the TCP/IP protocol stack.

The presence of comment blocks and the information they contain should be detected by other AIS components and processed/forwarded appropriately. All AIS components should support to send/receive sentences with or without comment blocks at all times. Hence, it should not be necessary to enable comment blocks for them to be recognized by the AIS components. However, it is recommended that the contents of the comment blocks be configurable with each component.

For compatibility issues, it is not recommended to use proprietary parameters inside comment blocks. A separate proprietary sentence should be used. If required, the additional proprietary sentence can be linked to the standard PI sentence using the comment blocks 'line linking' feature. AIS components should be able to ignore linked proprietary sentences that they cannot decode.

3.3 PROPRIETARY SENTENCES & INTERFACES

As mentioned above, it is possible to define a set of proprietary sentences to complement existing MDEF sentences in order to provide additional functionalities or additional AIS services beyond and above the BAS. It is also possible to define new interfaces to exchange these proprietary sentences although it is recommended to re-use the same interfaces as much as possible in order to support both MDEF and proprietary sentences on the same interface.

All AIS components should always remain compatible with MDEF sentences and standard interfaces. Furthermore, it is not recommended to duplicate information already available in an MDEF sentence or the rest of the protocol stack inside proprietary sentences, the appropriate MDEF sentence or protocol stack parameter should be used if that information is required.

3.4 PROTOCOL STACKS

The TCP/IP socket client-server protocol is the recommended protocol stack for Machine-to Machine Interfaces (MMI) in an AIS network. For a secure connection, TLS/SSL is recommended.

Additional standard protocol stacks can be supported in different environments for different interfaces, such as serial RS-232 and RS-422, although they are not recommended for an AIS network.

4 HUMAN MACHINE INTERFACE DESIGN CONSIDERATIONS

4.1 INTRODUCTION

In-depth consideration should be given to the Human Machine Interface design of the components of the AIS Service. Ergonomic requirements need to be fulfilled by default. Also, the HMIs determine to a large degree the efficiency of the Technical Operation Personnel over the full life-cycle of the AIS Service. Hence integrated comfortable remote control functionalities and decision support should be considered.

4.2 INTERFACING THE AIS SERVICE TO TECHNICAL OPERATION PERSONNEL WITH HUMAN-MACHINE-INTERFACES

The following minimum HMI's are recommended for functional components of the AIS Service. They should provide an internet technology based machine-machine-interface, which would support the *'HMI locally dispatched' and the 'Remote HMI':*

- AIS-LSS
- AIS-PCU
- Fixed AIS Stations
- ASM

When the above functional components are implemented as integral components consisting of both hardware and firmware, i.e. as physical black boxes delivering the required functionality at their interfaces, there should be in addition appropriate 'HMI direct' and/or 'Local HMI'. In any case, the Fixed AIS Stations should have an appropriate 'HMI direct' and/or 'Local HMI'.

4.3 METHODS OF DELIVERY OF HUMAN MACHINE INTERFACES

Different methods of HMI can be identified as follows.

1 HMI direct.

2 Local HMI.

3 HMI locally dispatched.

4 Remote HMI.

The following explanations are given:

1 **HMI direct**

The 'HMI direct' comprises all signalling, displays and input devices which are mounted on the machine and form an integral part of it, i.e., on-/off-switches, reset keys, LED indications, etc. The 'HMI direct' is always at the site where the machine is located, i.e., at the ***Remote site*** and at the ***Node site***. These interfaces regularly are intended for quick access to the most important information regarding the current status of a machine, but don't serve for comfortable Technical Operation.

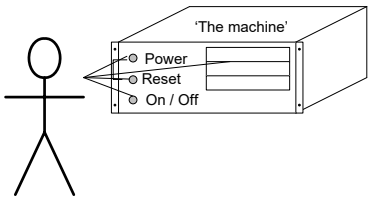

Figure 2 The 'HMI direct'

2 **Local HMI**

Similar to 'HMI direct'. The difference is: The 'Local HMI' comprises all *separate* signalling, displays and input devices which are connected to the machine but which are wholly dependent on that machine for their functionality. Examples are computer peripherals such as mouse, keyboard and display.

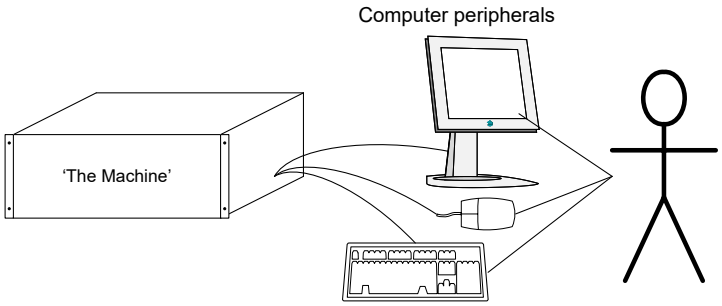

Figure 3 The 'local HMI'

3 **HMI locally dispatched**

The 'HMI locally dispatched' is a human interaction device at the site of the machine, i.e. at ***Remote site*** or ***Node site***, which is connected to the machine by a *Local Area Network, i.e. it is on the same premise as the machine it connects to,* and which runs independent of the machine as far as the basic human interaction functionalities are concerned, but depends on the machine regarding the information as such.

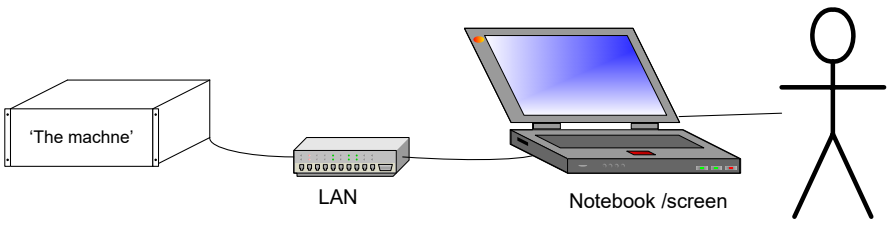

Figure 4 The 'HMI locally dispatched'

4 Remote HMI

The ‘Remote HMI’ is a human interaction device at the **Technical Operation Personnel site** (either the fixed regular working place or mobile working place), which is connected to the machine by a Wide Area Network, i.e. it is not on the same premise as the machine it connects to, and which runs independent of the machine as far as the basic human interaction functionalities are concerned, but depends on the machine regarding the information as such. The provision of **Remote HMI alone allows for centralized** Technical Operation Personnel site(s); compare Distribution Model.

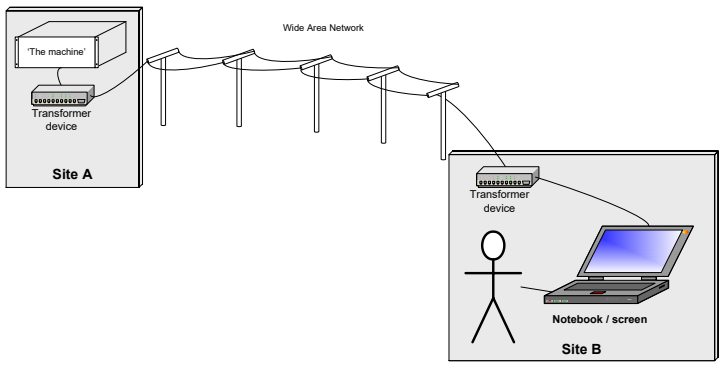

Figure 5 The ‘Remote HMI’