Appendix Revisions

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**IALA Recommendation**

**ENAV-[###] - Appendix 5**

**Interfacing Model of a service**

**[Working Towards] Edition 1**

**[2015]**

**Initial Version**

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

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| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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IALA Recommendation ENAV-[####]

Appendix 5 – Interfacing Model of a service

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Appendix 5 -

**Interfacing Model of a service**

# Introduction

What is the objective of this appendix?

One of the objectives is to attain modularity.

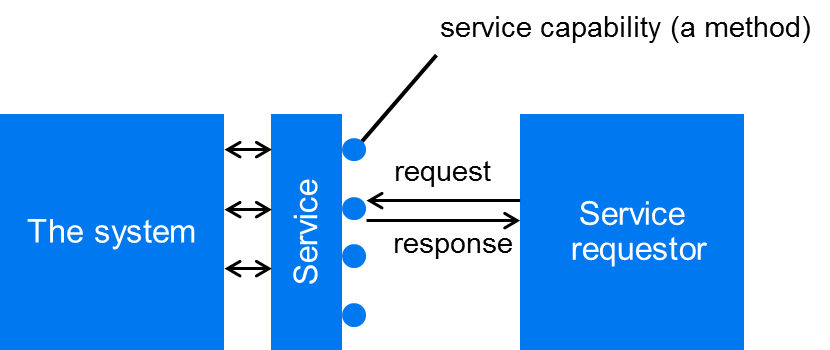
Service Description in in a Service Description Language independent of technology

We need to spell out the “Protocol Stack” What is meant by “Stack” in this context?

We need to have acknowledgement of receipt of a command beyond responses.

Following is Andre Bolles’ suggestion for an introduction of the Appendix 5”

The following figure shows the relationship between systems, services and service requestors.



A service is an interface to a system, providing capabilities of the system in controlled way to so called service-requestor.

A system can e. g. be an AIS radio, that receives AIS messages in a certain region. The service can than collect these AIS messages and for example provide them in batch. This would then be a service capability. A service requestor can be another service that needs the AIS messages or a user or an external system.

Using a service for accessing a system has some advantages:

* The service provides a controlled access to the system by means:
  + Authenticity
  + Service level agreement ensurance
* The service can provide data of the system in an architecture wide standardized way
* Proprietary protocols can be encapsulated – a service can act as a wrapper.

Having this motivation in mind, this document now focuses on the description of how to access a service. It will define the following:

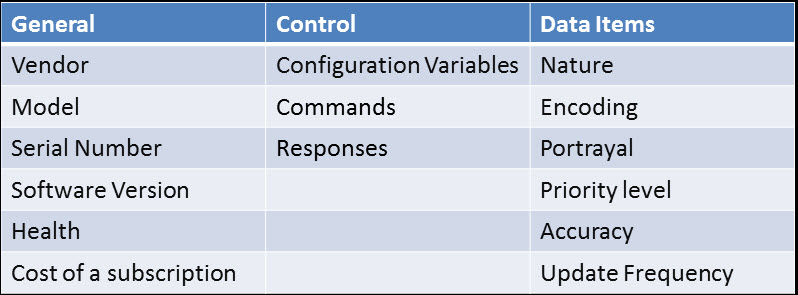
* How is a service described?
* How is a service registered in the architecture?
* How can a service be found in the architecture?
* How can a service be accessed?
* How can services be orchestrated?

**2 Service Interfacing Requirements**

* Scalable
* Interoperable
* Flexible
* Modular
* Maintainable
* Secure
* High Integrity
* Robust
* Seamless
* Extensible
* Future Proof

**3 A standard for the interface of a service is required to meet requirements**

**4 Service properties that need to be defined in the standard**

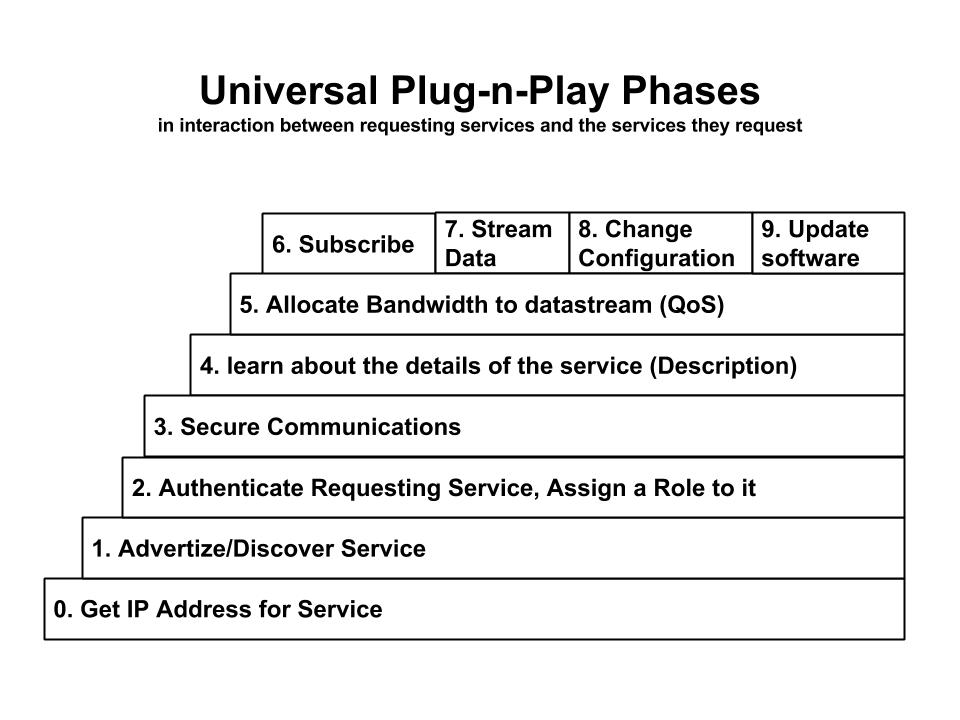
* Discovery
  + [SSDP](http://en.wikipedia.org/wiki/Simple_Service_Discovery_Protocol)
* Security
  + Authentication with security certificates
  + Setting up a encrypted connection with the service
  + Assigning a role to the requesting service
    - “Publ;ic”
    - Basic”
    - “Admin”
    - Etc.
* Description
* 
* The above is a very high level view of a service description.
* Additionally do we need Input items and Output items (beyond commands and responses?)
* Do we want to use the protocols that are available? Are the existing protocols a limitation to what service need? If not then
* OK to use XML for descriptions but not necessarily for data items.
* QoS
* Subscription
* Control

**5 Require applicable IEC 29341-x series to standardize service interfaces**

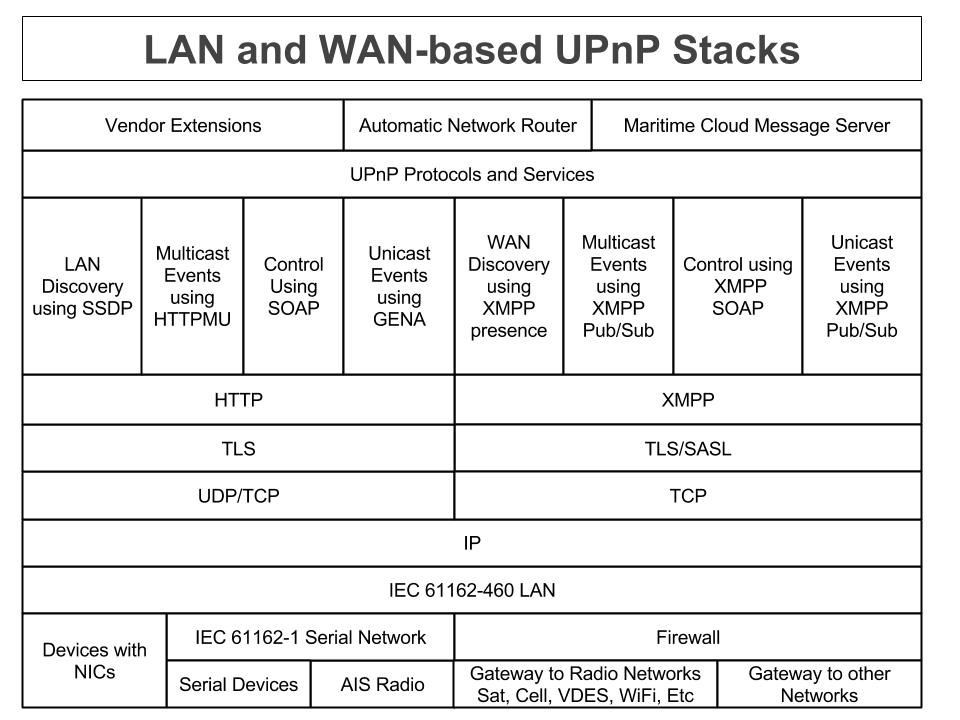
Specifically the following IEC 29341-x protocols should be used for the service interface

* Basic Device Control, Sensor Control or Custom Device Control
* Protection for individual Devices, Systems and (e-navigation and other) Services
  + Authentication and Encryption using Security Certificates
  + Access Control and Roles based on Trust Level
* Remote Maintenance
  + Configuration Management
  + (Embedded) Software Management
* Controlled allocation of available bandwidth to Data Item Streams (“QoS”) based on priority, volume, cost, etc.

**6 Require interfaces to be certified by the UPnP Forum**

****

|  |  |  |  |
| --- | --- | --- | --- |
| **7. Subscribe to Service** | **8. Stream Service data** | **9. Change configuration\*** | **10. Update software\*** |
| **6. Allocate bandwidth to the Service’s data stream ([QoS](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FQuality_of_service&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNF4KXiDDdn3wO7iKlepHIx-TWzGwA))** | | | | |
| **5. Learn about the details of the Service from its [S-100 XML](http://www.google.com/url?q=http%3A%2F%2Fwww.iho.int%2Fiho_pubs%2Fstandard%2FS-100%2FS-100_Info.htm&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNHOivdJS0BaUT-fBvoHwfdmFKSDxg) description file** | | | | | |
| **4. Encrypt inter-service communications using [TLS](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FTransport_Layer_Security&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNF3e7161i72E9L5Avi0VAYTlFcWgg) (optional)** | | | | | | |
| **3. Assign a role to the Requesting Service as specified in the [ACL](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FAccess_control_list&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNHtQLO_JPHAvD1tdtHcwLGCEMr4CQ)** | | | | | | | |
| **2. Authenticate Requesting Service’s [Security Certificate](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FX.509&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNEX2Wd3k1uI2SikPdmtPiyQ1-_U2g) using [ACL](http://www.google.com/url?q=http%3A%2F%2Fwww.chicagotribune.com%2Flifestyles%2Fhealth%2Fct-acl-injury-prevention-met-20140831-story.html&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNGPDfEJAv1JT9MKiBERQyUby-VH7A)** | | | | | | | | |
| **1. Advertise / Discover available Services using [UDP](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FUser_Datagram_Protocol&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNFPjLy_sQbxqof03d7zBsgEvi6TOQ) and [SSDP](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FSimple_Service_Discovery_Protocol&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNHetrVtHs5g8_CmZZd0Z3ndyqOBNg)** | | | | | | | | | |
| **0. Obtain an IP Address for the Service using [DHCP](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FDynamic_Host_Configuration_Protocol&amp;sa=D&amp;sntz=1&amp;usg=AFQjCNH5jncortu3FJgiCDZUUL0RX4yyJQ)** | | | | | | | | | |

****

This Annex exhibits the following flow of thought, when addressing interfacing issues of the service:

* *The context of* *the service as an e-Navigation service within the shore-based e-Navigation system* is considered. Interfacing issues resulting from that are discussed. This is the bird’s eye view on the service from a shore-based e-Navigation system perspective.
* All of the interfaces of the service are identified, i.e. a *complete list of all interfaces of the service* is provided. There are both *Machine-Machine-Interfaces (M2M)* between components and *Human-Machine-Interfaces (HMI)* specifically supporting the Technical Operation Personnel. This complete list of interfaces takes into account in particular the contribution of the Distribution Model (Annex 3).
* In a next step, the *Machine-Machine-Interfaces of the service* are addressed in more detail. Issues like recommended data encoding, including in particular the relationship to the Maritime Data Exchange Format (MDEF), and recommended protocol stacks are discussed.
* Finally, the *Human-Machine-Interfaces of the service* are discussed in more detail. Information is provided for administrations as to what are best practices when setting up Human-Machine-Interfaces of the service towards their Technical Operation Personnel.[[1]](#footnote-1)

# ILLUSTRATION OF THE PLACE OF THE SERVICE IN THE CSSA with AIS as an example

An AIS Service is described in more detail below as an example of the interface to a service.

We need a “UPnP-Like” XML Description of the AIS Service. A single Radio or a database with the AIS information from all available AIS radios available on the network?

Figure A5.1 illustrates the place of the service under consideration in the shore-based e-Navigation system architecture as described by *IALA Recommendation* *on the E-Navigation Architecture – the shore perspective (IALA Recommendation eNAV-101)*. Figure 1 also applies the general architectural statements of that Recommendation to the AIS technology.

In addition, Figure 1 clearly identifies the co-operative nature of the information exchange between the shore-based AIS Service and the applications connected to it on the shore side and the mobile AIS stations and the mobile applications connected to them on the mobile side. The shore based applications connected to the AIS Service will be further explored in the next section.

It should be noted, that the AIS and the AIS Service share the dependencies of the e-Navigation architecture, i.e. the dependency on GNSS for position fixing and/or timing and the dependency on infrastructure.

**Figure 1: Place of the AIS Service within the e-Navigation architecture**

**World Wide Radionavigation System (WWRS) of IMO, including GNSS, GNSS augmentation and terrestrial backup**

Shore-based  
users

**AIS Service**

**Ship technology   
environment**

mariner



other

**ships**

**other**

**ships**

AIS VHF  
Data Link  
(AIS VDL)

Application-to-  
application   
(peer-to-peer)

**functional  
connection**

**INS**

**Shipboard**

**Applications**

**Ship’s**

**sensors**

**mobile AIS station**

**Application 4**

**Application 3**

**Application 2**

**Appli-cation 1**

**IBS**

**AIS Technology   
= encapsulated   
link technology**

**Shore-based e-Nav system**

## The AIS Service within the shore-based e-Navigation system architecture

*IALA Recommendation on the common shore-based e-Navigation system architecture”* (eNAV-201, Edition [2008]) defines the relative place of the AIS Service within that system architecture. It identifies the AIS Service as a shore based e-Navigation service within the so called *“Data Collection and Data Transfer services*” of the common shore-based e-Navigation system architecture (compare Figure 2).

**Figure 2: Place of the AIS Service within the shore-based e-Navigation system architecture**



In particular the need to provide a functional interface between the AIS Service and other requesting services within the shore-based e-Navigation system is identified.

Since the “Data Collection and Data Transfer services” of the shore-based e-Navigation system will be requested by other e-Navigation services within that system, there can be identified multiple client-server-relationships. Those can be combined to a hierarchy within the shore-based e-Navigation system as indicated by Figure 3 (following page).

**Figure 3: Client-server relationships of the AIS Service with other shore-based e-Navigation services – resulting hierarchy of shore-based e-Navigation services and the place of the AIS Service**



Figure 3 shows, that the AIS Service can / will be requested by

* *the Value-added Data Processing Services:* The AIS Service is requested as an information source on traffic objects (mainly ships) for data correlation and combination purposes (“data mining”);
* *the User Interaction Service:* The AIS Service is requested as an information source on traffic objects (mainly ships). The received data is then displayed to shore-based users by a Human Machine Interface. Also the AIS Service is requested for transparent communications via the AIS VHF Data Link.
* *the Gateway Service:* The AIS Service is requested as an information source on traffic objects (mainly ships); information is forwarded to shore-based external systems by appropriate Machine Machine Interfaces.
* *other Data Collection and Data Transfer Services:* The AIS Service is requested as an information source in some cases (e. g. for received Aids-to-Navigation data to be forwarded to the Visual Aids Service) but mainly for transparent communications via AIS (e.g. for setting up synthetic/virtual visual aids-to-navigation on behalf of the Visual Aids Service or for DGNSS correction data transmission via AIS).

Hence, in these cases the AIS Service will act as *a requested service (server).* The (other) requesting services act as clients to the AIS Service.

There are (few) cases, where the AIS Service will act as a *requesting service (client)* to other e-Navigation services within the shore based e-Navigation system, e.g. when initiating DSC channel management via the DSC Service.

Note, that the need for *data transmission via e.g. a data transfer network* due to the geographical distribution of components of the AIS Service *is encapsulated within the AIS Service* and therefore “not visible” at this level.

[System ID - issue

Note also, that the so called *„System or Virtual MMSI“* (00MID9xxx) for addressed information exchange via AIS would allow to address specific services and/or users within the shore-based e-Navigation system (refer to *Recommendation ITU-R M.585-3 “Assignment and use of maritime mobile service identities”*).]

## The functional interface of the AIS Service to shore-based applications

### Introduction

The above figures indicated the functional interfaces between the AIS Service ***within*** the shore-based e-Navigation system by arrows. The primary concern is with the *information exchanged between the AIS Service and other shore-based e-Navigation services*. The functional interface thereby *facilitates the integration of the AIS Service into shore-based applications.*

Since *information is abstract*, the functional interfaces need first and foremost to be considered in *functional terms* of information delivery and only later from a technological point of view. The functional interface *encapsulates* the technical details of both the AIS technology and of the layout and local configuration of AIS Service.[[2]](#footnote-2)

### The AIS Service as a “requested service”

Due to the hierarchy shown in the previous section where the AIS Service has been identified as a requested service (compare Figure 3), *it is the AIS Service which provides the functional interface description*: the requesting services (clients of the AIS Service) need to comply with the interfaces provided by the AIS Service. They can do so e.g. by using an *“AIS Service driver”* which is common practise in IT. Thereby they encapsulate the details of their interfacing to the AIS Service and make their own functionality / software independent of smaller changes of the interface of the AIS Service.

### Use case description and Entity-relationship-description

There are at least two relevant angles of perspective regarding the functional interface of the AIS Service:

* the *use case model*, which allows to *seamlessly derive use cases of the AIS Service from user requirements;*
* the *entity relationship model*, which focuses on *relevant associations* between abstract and/or physical entities within the AIS Service and abstract and/or physical entities outside the AIS Service.

Both views complement each other:

* The *use case model* answers the question: “What is the AIS Service good for?” and thus directly supports application design once the service use cases of the AIS Service have been identified and described.
* The *entity relationship model* answers the question: “What aspects does a competent administration need to consider, when setting up and running its AIS Service?” It is particular important for life-cycle management.

### The functional interface of the AIS Service in terms of use cases

The functional interface of the AIS Service in terms of use cases can be determined when correlating the following aspects:

* What fundamental functionalities *would be expected from the shore-based AIS Service*. This is the top-down requirement derivation, eventually starting at user requirements and business processes. Figure 4 shows application of that the seamless derivation process regarding the AIS Service (compare IALA Recommendation on shore-based e-Navigation architecture – the shore perspective).



**Figure 4: Seamless derivation of service use cases and component requirements from system level requirements**

* What fundamental functionalities *could be delivered by the shore-based AIS Service* taking into account the engineering knowledge regarding the *capabilities and limitations of the AIS technology*? This is the bottom-up approach.

Both point of view meet in the definition of what has been called the external Basic AIS Services (BAS). Hence, the functional interface in terms of service use cases of the AIS Service is defined as a set of *external* *BAS*.

### Functional interfaces in terms of entity relationships

Figure 5 (which is Figure 1 of the Main Body) shows highlighted the associations or interactions of the AIS Service with external entities, both abstract and physical. Associations which cross the boundary of the AIS Service require *external interfacing* of the AIS Service in most[[3]](#footnote-3) cases.

In addition, there are *internal interfaces* *between the functional components* of the AIS Service, which eventually will materialize physically within an IT environment.

It should be noted, that the *content of the Human Machine Interfaces (HMI)* of the AIS Service to the Technical Operation Personnel (TOP) and to the Technical Development Personnel (TDP) is *determined by the tasks* *the AIS Service requires over its full life-cycle from that personnel* (compare **Annex 13** – “Efficient operation and maintenance of the AIS Service”). Hence, this relationship is highlighted in the Figure 5. The *actual physical implementation* of the Human Machine Interfaces will be done by the appropriate functional components as shown below.

It should also be noted, that certain abstract models of the AIS Service which were developed previously have a strong bearing on the Interface Model, namely

* the Basic AIS Service definitions and the definitions of other use cases
* the Data Model of the AIS Service
* the Structure Model of the AIS Service
* the Interaction Model and the Data Storage Model of the AIS Service

**Figure 5: Entities which require interfacing of the AIS Service (highlighted)** 

# Identification of the individual interfaces of the service

As a first step, it is helpful to re-consider the Figure 10 of the Main Body of this recommendation. In this Figure, the *tasks of the functional components* were identified within the service and in relationship to the external shore-based e-Navigation system or the Physical Link(s). Figure A5.1 is now used to *highlight* the tasks of many functional interfaces due to the tasks of the functional components they connect.

**Figure A5.1: Identification of the tasks of the functional interfaces (highlighted/shaded) in relationship to the functional component’s tasks they connect**



Note: The Human Machine Interfaces to the Technical Operation Personnel have not been included in Figure A5.1.

The tasks highlighted in the Figure A5.1 above have already been taken into account when developing the Structure Model of the service (compare Main Body of this Recommendation). Figure A5.2 on the following page now ***highlights the interfaces between the functional components of the Structure Model***.

Figure A5.3 then goes on to *specifically identify* *all interfaces of the service,* *both internal and external*, *both Machine-to-Machine and Human Machine interfaces* (bold lines). Figure A5.3 asserts completeness in regard to the various interfaces of the service. Figure A5.3 *constitutes the core of the Interfacing model* of the service.

Figure A5.2: Structure model of the service with highlighted interfaces (bold lines / boxes)

Technical Operation Personnel (master control)

**HMI**

**Logical Layer -**

**Logical Shore Station (LSS)**



**HMI**

**Net Data**

**Status**

**Service  
Management Layer**

**HMI**

**Physical Shore Station (PSS)**

**HMI**

**Physical Link Terminal Equipment (PLTE) Layer**

**HMI**

**Physical Link Couplers   
(PLC) Layer**

**Physical Link   
( = Medium)**







**Technical Operation Personnel**(there are tasks for each layer in principle)

**Configuration**

**Physical  
Layer /  
Remote**

**Shore**

**Station**

\* Note: This symbolic representation does not imply any inference as to the amount of required personnel for the technical operation of the service. This symbolic representation aims at indicating that human interaction with the largely automated service is required as the last resort - and in some cases possibly on a regular basis - on all layers of the service.

**Boundary of shore-based e-Nav system**

**Figure A5.3: Complete identification of functional interfaces of the service (external/internal; not including interfaces of infrastructure components)**



# Application data encoding and protocol stacks for the Machine-to-Machine interfaces of the service

## Introduction

### Bundle of application data encoding and protocol stacks

This chapter recommends certain application data encoding techniques and protocol stacks (ISO/OSI layered model stack) for the Machine-to-Machine interfaces of the service, which were identified above. By the same token, certain other options for application data encoding are discouraged.

The recommendation always comes together as a *bundle* of at least one application data encoding technique and one IT protocol stack. The reason is that some application data encoding techniques are fit to certain IT protocol stacks, while this may not be true of different combinations.

### Data Model of the service and the impact of the UMDM

When designing the application data encoding, the Data Model of the service has a strong bearing: It is these data objects and data properties (also referred to as data types) which need to be encoded so that a data exchange may take place between machines. Since, the Data Model of the service is a subset of the (emerging) Universal Maritime Data Model, the application data encoding technique should provide for abstract data encoding, sufficient flexibility to cater for future changes and in particular for the Universal Data Object Identifier (U.DOI) as one fundamental ingredient.

### Open System Philosophy

Also, the application data encoding and IT protocol stacks recommendations should be in keeping with the open system philosophy of the common shore-based e-Navigation system architecture. Hence, IT protocol stacks compatible with the ISO/Open System Interconnection (OSI) protocol stack should be recommended.

### The eNAV-61162 encoding technique and its use of the UMDM/UDOI concepts

Combining these requirements with the nature of the data flow to and from the service, it appears that an application data encoding technique would be best suited, which would combine *sentence-orientation* with *abstract* and *flexible* data encoding capabilities. Also it should be based on *well established maritime standards*.

Already many years ago, the “traditional” IEC 61162 was created to fulfill these requirements. *All* data objects are *represented as abstract data in ASCII characters* with field delimiters. However, the “traditional” IEC 61162 sentence structure *rigidly implied the meaning of certain fields by order of appearance*. This made the exchange of single data objects cumbersome, because “empty” fields would be exchanged as well.

The *notion of a binary encoded field* in IEC 61162 (the so-called VDM-sentences) was introduced due to the specific interfacing needs of the AIS technology. This notion was initially considered alien to the original philosophy of the IEC 61162, and therefore rightly caused some concern. Today, a co-existence between the traditional abstract data encoding and the binary encoding within the framework of the IEC 61162 has been achieved. However, *it was not created for the dissemination of AIS-derived or even any data in highly integrated and sophisticated shore-based IT systems*, such as the shore-based e-Navigation system. This proliferation of the intricacies of the AIS technology would *tie those systems to the development of the AIS radio specification for all time*. From a system engineering point of view, this close connection carries *many disadvantages*. This gave rise to the notion to use XML extensively. This application data encoding technique provides maximum flexibility for abstract data, but introduces substantial overhead.

To *combine the advantages of the traditional IEC 61162 data encoding technique*, i.e. the abstract data encoding, the sentence-oriented structure and its wide recognition in the maritime field, *with the current need for even more elaborate abstract data encoding and flexibility*, the so-called “eNAV-61162” derivative of the IEC 61162 was developed, using the UMDM/UDOI concept extensively: *The UDOI as a leading designator for the data fields of a sentence would provide the flexibility in terms of the concrete meaning of the individual data fields,* thus overcoming the rigidity of the traditional approach. This approach would be compatible with the philosophy of the traditional IEC 61162 while introducing one a little overhead both in terms of transmission bandwidth and parsing compared to XML. The details are developed in Annex 2.

### The XML encoding technique and its use of the UMDM/UDOI concept

--- to be described ---

### Encoding of Data Container content transparently forwarded by a service

--- maybe this paragraph needs to be moved /copied to a place where the different roles of different services of the shore-based e-Nav system are discussed.

It should be noted, that the Data Model also accommodates such data items (“data containers”), which are forwarded by a service *transparently* between the requesting service and its Physical Link(s) in either direction *without changing or recognizing their content in any way*. The encoding of these data containers is *completely and exclusively determined by the requesting service*, i.e. the encoding of the content of those data containers is described *within the documentation of the requesting service,* ***only***. The own service does *not* need to know this encoding used.

Examples for transparent forwarding of these data containers and for encoding description of those data container’s content hosted exclusively at the requesting service are:

* *transparent reception/transmission of application-specific (“binary”) data:* any other e-Navigation service may hold the encoding description for its application-specific data.
* *differential correction data:* the encoding description for this data is maintained exclusively in the DGNSS Correction Service of the shore-based e-Navigation system architecture.

## Interfacing the service under consideration to other services

--- continue here ---

### Net data exchange interfacing to requesting services

Table 1 (overleaf) shows the recommended application encoding and IT protocol stacks for the Machine-to-Machine interface of the LSS to the requesting services of the shore-based e-Navigation system.

Some rationale and explanations to the Table are as follows:

* The *rationale for the asymmetry regarding XML recommended only as an output data* *encoding technique* from the LSS to the requesting e-Navigation service is as follows: While the XML may be useful for the requesting shore-based e-Navigation service and while it is relatively easy to compile XML files as output data, the AIS Service as such does not benefit from XML usage internally but would require a parsing process for incoming XML messages.
* All of the above interfacing techniques *can be implemented concurrently at the LSS interface*, thus providing a portfolio of data access options to the designer of the requesting service of the shore-based e-Navigation system and hence some flexibility over life-cycle.
* Alternatively, only some of the above interfacing techniques can be implemented at the discretion of the authority.

**Table 1: Recommended application encoding and IT protocol stacks for Machine-to-Machine interface of the LSS to the requesting services of the shore-based e-Navigation system**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **External Basic Service** | eNav-61162 + SMTP | eNav-61162 + TELNET/SSH | XML + HTTP/FTP | eNav-61162+ SQL | Remarks  Refer to Annex 2 regarding details on the eNav-IEC 61162 encoding method and to Annex 3 on the recommended protocol stacks. |
| **External**  **BS Cat. I** | X | X | X | - | Push, dynamically: service under consideration to requesting service |
| **External**  **BS Cat. II** | X | X | - | - | Push, dynamically: Requesting service to service under consideration |
| **External**  **BS Cat. III** | X | X | - | - | Triggered once and autonomously performed by service under consideration for the requested period of time; Requesting service prompts service under consideration. |
| **External**  **BS Cat. IV** | X | X | Q: - (1)  A: X | X | Triggered once and autonomously performed by service under consideration for the requested period of time; service under consideration prompts requesting service. |
| **Replay** | X | X | Q: - (1)  A: X | X | Replay of recorded data by service under consideration based on selection of the requesting service; requesting service prompts service under consideration; once initiated replay push by service under consideration. |

Legend:

**Q** Query of requesting service of the shore-based e-Navigation system

**A** Answer/reply of the service under consideration (“own service”)

**X** Recommended

**-**  Discouraged

(1) Use either eNav-61162 or SQL sentences for query.

### Management interface of AIS Service to requesting e-Navigation services

The Management Interface of the AIS Service to the requesting e-Navigation services serves to exchange configuration and status data between the AIS Service Management and the Service Management Layer of the requesting service.

This interface is by nature a query and answer interface. Queries are in particular the configurations or re-configurations regarding the Basic AIS Services by the requesting service and requests for specific status information from requesting service. Answers are in particular the acknowledgments or status alerts given by the AIS Service Management to the requesting service.

Hence, the *following recommendation appears to be the best practice:*

* IEC 61162-***derived*** + SQL + TELNET/SSH and/or
* IEC 61162-***derived*** + SMTP and/or
* IEC 61162-***derived*** + TELNET/SSH

All of the above interfacing techniques *can be implemented concurrently at the LSS interface*, thus providing a portfolio of configuration and status-access options to the designer of the requesting service of the shore-based e-Navigation system and hence some flexibility over life-cycle.

Alternatively, *only some* of the above interfacing techniques can be implemented at the discretion of the authority. XML encoding is possible theoretically but is *discouraged* due to the lack of advantage for encoding configuration and status data on one hand and the massive overhead on the other hand when using it.

## Internal Interfaces of the AIS Service

The following Table 2 shows the recommended options for application encoding and IT protocol stack for the internal interfaces of the AIS Service. For descriptions of the application encoding methods and for the IT protocol stacks refer to the Attachments to this Annex.

Note: Only internationally fully described methods for application encoding and IT protocol stacks are recommended in keeping with the open system philosophy.

**Table 2: Recommended application encoding and IT protocol stacks for Machine-to-Machine interfaces internal to the AIS Service**

|  |  |  |  |
| --- | --- | --- | --- |
| **Machine-Machine-Interface (M2M)** | **Recommended Option** | **Alternative for individual interface** | **Remarks** |
| **AIS net data interface PSS to Logical Layer**  (to IDS and to LSS) | * *Application encoding:*  **IEC 61162 *derived*** * *IT protocol stack:* **SMTP** | Not recommended | - |
| **Status/Configuration interface LSS to ASM-Node** | * *Application encoding:*  **IEC 61162 *derived*** * *IT protocol stack:* **SMTP** | Not recommended | - |
| **Status/Configuration interface PSS to ASM-RS** | * *Application encoding:*  **IEC 61162 *derived*** * *IT protocol stack:* **SMTP** | Not recommended | - |
| **Status/Configuration interface ASM-RS to ASM-Master** | * *Application encoding:*  **IEC 61162 *derived*** * *IT protocol stack:* **SMTP** | * *Application encoding:* like recommended option * *IT protocol stack:* **TELNET** or **SSH** | - |
| **Status/Configuration interface ASM-Node to ASM-Master** | * *Application encoding:*  **IEC 61162 *derived*** * *IT protocol stack:* **SMTP** | * *Application encoding:* like recommended option * *IT protocol stack:* **TELNET** or **SSH** | - |
| **Interface AIS Base Station to PSS** | * *Application encoding:* **IEC 61162 as amended by IEC 62320-1** * *IT protocol stack:* **TCP-Socket** | * *Application encoding:* like recommended option * *IT protocol stack:* **RS-232 or equivalent** | - |

# Human Machine Interface design considerations

## 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 comfortable remote control functionalities and decision support should be considered.

## Options for delivering Human Machine Interfaces

Different classes 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 9: 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 10: 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 11: 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 12: The „Remote HMI“

## Interfacing the AIS Service to Technical Operation Personnel with Human-Machine-Interfaces

### *Recommended minimum HMIs for functional components*

The following functional components of the AIS Service should provide a internet technology based machine-machine-interface, which would support the *“HMI locally dispatched” and the “Remote HMI”:*

* **LSS**
* **PSS**
* **Fixed AIS Stations**
* **ASM Master**
* **ASM Node**
* **ASM RS**

When the above functional components are materialized 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”. The Fixed AIS Stations should have in addition an appropriate “HMI direct” and/or “Local HMI” in any case.

### *Recommended IT protocols*

For “HMI locally dispatched” and the “Remote HMI” the following interfacing setup is recommended:

**Session of the Technical Operation Personnel with the machine under consideration:**

* **to initiate a session on a HMI:**

A user enters the IP address of the machine into a standard internet browser. The *standard browser* connects to the machine via *HTML* (including use of *internationally standardized script languages*) and *HTTP*. The machine acts as a web server to the standard browser and presents a HTML screen and also functionality, which allows to automatically start a separate TELNET or SSH session window.

* **during the session:** The session is continued by using the *TELNET or SSH* session window. Note: During the session the data exchanged *may be proprietarily* encoded.

**Requirements for the HTML usage:**

The version of the HTML should be selected conservatively in order to allow a large variety of browsers to run the session. No browser specific HTML dialects or functionalities should be used. The HTML script should be checked by an appropriate testing tool for rigidly conforming to the international HTML specification chosen.

The current version of HTML, which fulfils these requirements, is HTML3, --- standard --- .

**Requirements for the optional use of script languages:**

--- similar statements apply

1. It should be noted, that no service of the common shore-based e-Navigation system architecture except the User Interaction Service (UIS) provides a direct user interface; refer to main body of this Recommendation. [↑](#footnote-ref-1)
2. This is a state-of-the-art engineering principle. It protects application software from unnecessary changes due to configuration or technology improvements within the AIS Service. [↑](#footnote-ref-2)
3. Note: In Figure 5 the relationship to the AIS VHF Data Link is not highlighted. That is due to the fact, that the “interface” of the AIS VDL is provided externally to the individual AIS Service and even the individual shore-based e-Navigation system. The AIS VDL exists without them. Thus, the AIS VDL conception-wise provides the “interface” in the form of a “signal-in-space” description, and every individual AIS Service must adhere to that “interface”. [↑](#footnote-ref-3)