**S-100 for the Inter-VTS Exchange Format Service**

**(S-100 for the IVEF service)**

**Gap Analysis between S-100 and IVEF**

**04 January 2015, Author Approved**

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# 1 OVERVIEW

## 1.1 Introduction

Reason for this Gap Analysis document is the analysis in [S-100 extension for streaming data service] in which is concluded the S-100 framework in its current form, does not provide support for streaming data services. But streaming data services are envisioned to be formed in various e-Navigation Maritime Service Portfolios.

To specify what exactly is needed in the S-100 framework to fit the needs of streaming data services, one of the streaming data services has been selected to make a "Gap Analysis" of, as a case study. The IVEF services (Intersystem Vessel traffic image Exchange Format services) has been picked for this purpose. The result of the case study has been put into this document.

## 1.2 References

### 1.2.1 Normative references

|  |  |
| --- | --- |
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| [IVEF] | IALA Recommendation V-145 on the Inter-VTS Exchange Format Service  Edition 1  June 2011 |
| [S-100] | S-100 IHO Universal Hydrographic Data Model  Edition 2.0.0  June 2015 |
| [IALA S-100] | IALA Guideline No. 1106 on Producing an IALA S100 Product Specification  Edition 1  December 2013 |
|  |  |

### 1.2.2 Informative references

|  |  |
| --- | --- |
| [S-100 extension for streaming data service] | ENAV17-9.9 On extending the S-100 framework for streaming data services.  Author Eivind Mong.  Version: Draft 4 |
|  |  |

## 1.3 Terms, definitions and abbreviations

### 1.3.1 Terms and Definitions

|  |  |
| --- | --- |
| Vessel Traffic Image | The consolidated information about vessels and their movements in a particular area of interest. |
| Service (IVEF) | A service is a collection of functionality which is served to its users. Users only have to know what functionality is offered and how they can make use of the services.  In this document we use "IVEF service/system", as the IVEF specification contains service as well as system specifications. |
| Software (IVEF) | Software and system are sometimes used for the same thing. Usually when we consider software, the scope is somewhat more narrow than when considering systems (for example when talking about network protocols and hardware, it is no longer software). In this document we use the term system for IVEF rather than software. |
| System (IVEF) | A system is the collection of software which together provide certain functionality (can be described in services), but also includes aspects on maintenance, modularity, efficiency, security, reliability, etc. These are not directly functionalities to users. Requirements on systems contain a part which describe functionalities and a part which describe non-functionalities, also called quality requirements.  In this document we use "IVEF service/system", as the IVEF specification contains service as well as system specifications. |
|  |  |

### 1.3.2 Abbreviations

|  |  |
| --- | --- |
| IALA-AISM | International Association of marine aids to navigation and Lighthouse Authorities |
| CRS | Coordinate Reference System |
| ECDIS | Electronic Chart Display Information System |
| EPSG | European Petroleum Survey Group |
| ENC | Electronic Navigational Chart |
| IHO | International Hydrographic Organization |
| IMO | International Maritime Organization |
| ISO | International Organization for Standardization |
| IVEF | Intersystem Vessel traffic image Exchange Format |
| VTI | Vessel Traffic Image |
| VTS | Vessel Traffic Service |
| XML | eXtensible Markup Language |

# 2 GAP GLANCE

A first look at [IVEF] and the [S-100] documents and their (mis)match.

## 2.1 IVEF specification

Long title of IVEF specification: "The Inter-VTS Exchange Format service."

First of all, according to the title, IVEF is a service, for which a specification is written. When looking through the specification in [IVEF] it is clear the specification contains not only requirements (what should it do) but also design (how should it do it). Some parts of the IVEF services are described in detail while other parts are described at high level.

The interaction part, as IVEF describes it, is the part which has been specified in high detail. In the software world, this would be described as an interface design description (description on the external user interface). This part answers the question: "How can my software communicate with yours so I can retrieve the data I want".

So, if a VTS system wants to exchange Vessel Traffic Information by using "IVEF", the software of that party must facilitate the services exactly as described in the specification and fulfill the system requirements and design as described. That way, exchange of VTS information should be possible between VTS providers.

## 2.2 S-100 specification

Long title of S-100 specification: "S-100 IHO Universal Hydrographic Data Model."

According to the title, S-100 is a standard which supports data. Specifically: contemporary, hydrographic geospatial data. When looking through the specification in [S-100], the standard seems to support "datasets". Dataset in the S-100 context, is a collection/set of data, which is static and whose content can be described by providing metadata on it. Users can look through/browse the metadata of these dataset to see which datasets are interesting for them, and can retrieve the datasets.

After retrieval of the datasets, users can use them for their own purpose. They can plot the data, analyze it, compare the data with other data, use the data in a map, etc.

S-100 focuses on standardization of this data and the standardization of the description of the data. This way, data can be interchanged and mixed more easily.

## 2.3 Differences and similarities

At a first glance, [IVEF] and [S-100] seem to focus on different aspects of hydrographical data. [IVEF] describes the **mechanism** for exchanging data while [S-100] looks at the **content**. In other words: Service/software standardization versus data standardization.

What the two have in common is they both handle hydrographic data and define standards on the exchange of data. Using standards to facilitate exchange of data is in both standards the main goal.

In the next chapter the differences and similarities are summed. A more detailed comparison can be found in chapter 4.

# 3 CONCLUSIONS GAP ANALYSIS

To detect the gap, the two standards are compared in two directions: In 3.1 we look at the content (chapters) of [IVEF] and see which parts of the specification we can fit into S-100 and which we cannot. In 3.2 we look at the template [IALA S-100] and see whether we can fill in each chapter decently/usefully.

In chapter 4 comparison given in more detail. In this chapter we give a summary of the comparison.

Below a summary of the parts which are incorporated in the IVEF specification.

* Usage, context, purpose and scope description of the IVEF **service** as a whole.
  + Description of context of IVEF service in e-Navigation (VTS centers and User of authorities)
  + Description of Vessel Traffic Image data exchange service (main IVEF service, client/server model)
* Description of the service models in the individual IVEF **services** (components description, detailed design specification, recommendations)
  + Data Model
    - Description of IVEF service in e-Navigation (as shore-based gateway service)
    - Description of context of IVEF data model in IALA Universal Maritime Data Model (IALA UMDM)
  + Interfacing Model
    - Description of scope of IVEF in OSI model (technical scope)
    - Requirement usage of XML
  + Interaction Model
    - Requirement which parameters can be used in the communication (external user interface)
    - Description scope of IVEF in OSI and recommended layers (TCP/IP, ZLIP)
    - Description of the most common use cases (activity diagrams)
    - Requirements on interaction with IVEF such as login/logout, ping/pong
    - Requirements on features of the service
    - Description on usage, risk and operational characteristics per service (which is given per interface)
    - Requirements on timing and priorities of messages (what to do when resource of software runs out)
  + Security Model
    - Description of scope of security measures covered by IVEF specification
    - Requirements which security measures have to be in place
  + Test Model
    - Requirements on messages and data (well formed and valid).
  + Administration Model
    - Description on which administration tasks could be possible for the service
    - Description on which maintenance tasks could be performed for the service
    - Recommendation on using a GUI.
  + Quality Parameters
    - Description on quality parameters of an IVEF service (Domain of Interest, Domain of Responsibility, Domain of Cooperation) which could be provided.
    - Description of possible additional functionalities which can provide quality information on the services and integrity

## 3.1 What parts in IVEF do not fit in S-100

It seems to be easier to describe the parts of the IVEF specification which **can** fit into S-100 first, rather than the other way around.

The parts of the IVEF specification which do fit into S-100 would be the specification parts in which the data structure of a message is defined (described as a part in Interaction model - Requirements on interaction with IVEF - Data structure). This part describes the exact format of the data which is interchanged and a description of the meaning of each of the fields in a message. So: Appendix 1 of [IVEF] which contains a description of the elements and attributes, can be converted into the application scheme and feature catalogue according to [S-100].

The other chapters of the IVEF specification define or describe the IVEF system/service. These chapters contain hard requirements or recommendations on IVEF systems or contain a more informative description on the context and scope of an IVEF system. Some requirements and recommendations are highly technical and on a very low level (detailed design) such as the parts on the OSI model and network. These would belong in a context description of a system.

Use cases describe functionality such as log in, log out, do administration, are all functionalities which are not part of data, but part of a system/service. These functionality are for security purpose, maintenance etc and has nothing to do with the content of the (Vessel Traffic Image) data.

Other parts define requirements on the system/service such as the interaction in the interaction model part. These would be interface requirements. These parts describe how what protocol you have to use in order to retrieve the data.

All these sections which describe the system/services would fit into a system specification (how should my IVEF system behave and work in order to serve as a compliant IVEF service), but not a data specification.

## 3.2 What parts in S-100 do not suit IVEF

While datasets as described in S-100 (and ISO 19115) are datasets containing "historic" and "static" data, the IVEF services only know live, continuous changing data. Historic data of the Vessel Traffic Image data are not part of the IVEF specification, only the distribution of the live data is relevant. This has consequences on how the metadata should be filled, since the current metadata description seem to be made to describe static datasets.

IVEF currently has (meta)data on different "levels".

1. (Meta)data on service level. This data tells something about the availability of the main IVEF service. This data is also live data as it adapts itself to reflect the current situation on an IVEF system. This data is send periodically or on request by an IVEF system/service. Since it is data on the (availability of the) Vessel Traffic Image data on an IVEF system/service, it could be called metadata.
2. (Meta)data on message level. A message contains data and metadata. The metadata tells who is the source of the message and how accurate certain values in the message are.
3. (Meta)data on dataset level. IVEF currently does not has (meta)data on "dataset" level as S-100/ISO 19115 describes it, but with a slight different interpretation of a dataset, it is possible to provide metadata at this level. An IVEF dataset we describe as the "Vessel Traffic Image" which exists at the IVEF service. Since this data is changing continuously, this dataset is thus a continuously changing dataset instead of a static dataset.

With these three levels of IVEF, we took the sections of [IALA S-100] and checked if we could fill in the section with useful information from [IVEF]. It seems that per section, it can differ which level we should take to fill in the information.

It seems most chapters can be filled with [IVEF] data, but sometimes only if we make concessions or use a slightly different interpretation of the description (such as for dataset).

Most notable would be the metadata. The metadata on service and message level for example, are interwoven in the messages. This metadata is not static data but live data, as of all the rest of IVEF. This live part of the metadata cannot be put in a static metadata description (ISO 19115). More suitable would be a description of the metadata fields and where to find it instead of putting in the metadata itself. Static metadata such a "point of contact" and coordinate reference system **can** be put into ISO 19115 format.

## 3.3 Overall conclusion

It seems there are two main challenges in fitting the IVEF services specification into the S-100 framework:

1. IVEF is a service and the IVEF specification is therefore a description of the system/service.  
   S-100 framework on the other hand is made to describe data.  
   System/service versus data. As the most part of [IVEF] are descriptions of the system/service and not a description of its dataset content. These parts currently cannot fit into [IALA S-100]. The only part which could fit into [IALA S-100] is the Data structure description of the messages (Appendix 1 of [IVEF]).
2. The data which is exchanged in IVEF format and which lives at the IVEF services is "live data". IVEF does not provide data which is "historic" or in the past.   
   S-100 on the other hand, is made to describe a dataset, static data. By dividing the IVEF data in three levels, most of the sections of [IALA S-100] can be filled in (by checking which level of IVEF is relevant for that section. A slight redefinition of "dataset" seems to be necessary to be able to describe the Vessel Traffic Image data of IVEF.

Static metadata such as "point of contact", can be provided in ISO 19115 format. But the live metadata of IVEF on message and service levels cannot be put into S-100/ISO 19115 directly since this data is continuously changing (as of the rest of IVEF). Even if we manage to map the live metadata to the ISO 19115 metadata format, there would be one metadata file for each message. On message level this would really mean be a lot. What seems to be more sensible is to describe the metadata fields are to be found in the messages.

# 4 GAP ANALYSE DETAILS

To analyze what problems exactly arise when using the S-100 framework to describe the IVEF services, the information needed for each of the two standards have been compared to each other.

The documents which have been used for this comparison are [IVEF] and [IALA S-100].

## 4.1 Mapping IVEF to S-100

First a check has been performed to see which sections in [IVEF] can be incorporated in which section in the [IALA S-100]. This has been done for each section in [IVEF]. The result has been put in the table below.

When the information in [IVEF] could not be matched to a section in [IALA S-100], the cell under column S-100 has been colored red.

When only a part of the information in [IVEF] could be matched to sections in [IALA S-100], the cell under column S-100 has been colored orange.

When the information in [IVEF] could be matched to a section in [IALA S-100], the cell under column S-100 has been colored green.

A description of the mismatch/gap is given in column "Gap Analysis" in case the cell has not been colored green.

|  | **IVEF** | **S-100** | **Gap** |
| --- | --- | --- | --- |
| 1 | 1 Introduction | 1.1 Introduction | No S100 section on introducing the IVEF service (only introducing of the data) |
| 2 | 2 The IVEF service as described by other IALA recommendations |  | No S100 section found for introducing the main IVEF Service "Vessel Traffic Image Data Exchange Service".  There should be a S100 section which describes the usage of services of a product. |
| 3 | 3 Service Model of the IVEF Service |  | No S100 section found for description of the main IVEF service "Vessel Traffic Image Data Exchange Service". and how it fits in the e-Navigation.  There should be a S100 section which describes within which context a service is to be used. (Context Diagram) |
| 4 | 3.1 Overview  Data Model  Interfacing Model  Interaction Model  Security Model  Quality Parameters  Test Model  Administration Model | Data Model:  Can be described in section 4.4 Data Product Types  Interfacing Model:  Can be described in chapter  10 Data product format (encoding)  Interaction Model:  Can be described in sections  4 Data Content and Structure  4.1 Introduction  4.2 Application Schema  4.3 Feature Catalogue  Security Model:  Can be described in chapter  11 Data Product Delivery | Quality Parameters:  See point 23.  Test Model:  See point 24  Administration Model:  See point 25  Stakeholders:  No S100 section found for the description of the different types of stakeholders of the service (IVEF user and IVEF Service Administrator).  There should be a section in S100 in which the different users/stakeholders of the service are described. |
| 5 | 3.2 Capabilities of the IVEF Service for the Shore-based e-Navigation System |  |  |
| 6 | 3.2.1 Introduction |  |  |
| 7 | 3.2.2 Basic IVEF Services (BIS) |  | No S100 section found on description of the main Basic IVEF service "Vessel Traffic Image Data Exchange Service".  The messages (format) of the services itself can be described in S100 in chapter 4. But the purpose of the IVEF service "Vessel Traffic Image Data Exchange" not.  There should be a chapter in which the main IVEF service and it's "subservices" can be described. |
| 8 | 3.2.3 General Use Cases |  | No S100 section found on interaction between users and the main IVEF service "Vessel Traffic Image Data Exchange Service". |
| 9 | 3.3 Data Model of the IVEF Service |  | See point 11 |
| 10 | 3.3.1 Introduction |  | See point 11 |
| 11 | 3.3.2 The place of the IVEF Service in the e-Navigation Architecture |  | Scope and boundaries of system.  No S100 section found in which the context of the product is described. IVEF is a part of e-Navigation.  Context diagram.  There should be a section in S100 in which the context of the product is described. (in 1.1 Overview - Introduction?) |
| 12 | 3.4 Interaction Model of the IVEF Services | 4.2 Application Schema  4.3 Feature Catalogue | Partly, the description of the messages, can be described in S100 section 4.2 and 4.3.  No S100 section found in which the interaction (request response) can be described.  There should be a section in S100 in which the interaction (interface) of a user with the IVEV services can be described. |
| 13 | 3.4.1 Context |  | No S100 section found in which the product in system context is described.  There should be a section in S100 in which is made clear what the scope is of the IVEF service in the complete system.  (System context diagram, OSI reference model) |
| 14 | 3.4.2 Service Negotiation |  |  |
| 15 | 3.4.2.1 Introduction |  | No S100 section found in which the interaction (user with the service) can be described.  There should be a section in S100 in which the interaction (interface) of a user with the IVEV services can be described. |
| 16 | 3.4.2.2 Service parameters |  | No S100 section found in which the interaction (user with the service) can be described.  There should be a section in which it is explained how to subscribe to data. In the current S100 standard there seems to be only fixed datasets which can be retrieved. No choice on filtering.  Could be a new section in:  11 Data Product Delivery |
| 17 | 3.4.2.3 Information flow dynamics | Can be described in sections  4 Data Content and Structure  4.1 Introduction  4.2 Application Schema  4.3 Feature Catalogue | There should be a place to fill in for each message the origination and the destination. Currently there is no possibility to describe interaction or request/response in S100. |
| 18 | 3.4.2.4 Timing and priorities |  | These are solutions (how to handle) to establish a reliable system (design on handling reliability requirements).  There should be a section in which design constraints can be addressed. |
| 19 | 3.4.3 Part I: Primary service use cases of the BIS |  | No S100 section found in which the interaction (user with the service) can be described.  There should be a section in which the most important use cases of a IVEF Service can be described. |
| 20 | 3.4.4 Part II: Secondary service use cases of the BIS |  | See point 19 |
| 21 | 3.5 Security Model of the IVEF Service |  | No S100 section found in which security of a service can be described.  There should be a section in which the security design of the IVEF service can be described. |
| 22 | 3.6 Interfacing Model of the IVEF Service |  | No S100 section found in which the place of the IVEF service in the OSI Reference Model can be described.  There should be a section in which the context and scope of the IVEF service can be described. |
| 23 | 3.7 Quality Parameters of the IVEF Service |  | No S100 section found for description of the quality of a service. In S100 there is only a chapter on quality of the Vessel Traffic Image Data.  The quality parameter of a IVEF Service differs per IVEF Service implementation.  Nor in the S100 framework nor in IVEF specification these quality parameters can be given.  The fields which are expected to be filled in per IVEF Service provider, can be described.  Description if it is a realtime service, near-realtime, non-realtime for example. |
| 24 | 3.8 Test model of the IVEF Service |  | No S100 section found for the description of a test service.  There should be a section in S100 in which services and it's interfaces can be described. |
| 25 | 3.8.1 Well formed messages |  | See point 24 |
| 26 | 3.8.2 Valid message |  | See point 24 |
| 27 | 3.8.3 Valid data |  | See point 24 |
| 28 | 3.8.4 Interaction behavior |  | No S100 section found in which the interaction (user with the service) can be described.  There should be a section in S100 in which the interaction (interface) of a user with the IVEV services can be described. |
| 29 | 3.9 Administration Model of the IVEF Service |  | No S100 section found for the description of the technical administration aspects / maintenance of a service. (Only a section on maintenance of (meta) data).  There should be a section in S100 in which the administration service can be described. |
|  |  |  |  |

## 4.2 Filling S-100 with IVEF service data

In this section a check has been performed whether a section in [IALA S-100], can be filled with data from [IVEF].

When [IVEF] cannot be used to fill in a section in [IALA S-100], the cell under IVEF has been colored red.

When [IVEF] can only partly fill in a section in [IALA S-100], the cell under IVEF has been colored orange.

When [IVEF] can fill in a section in [IALA S-100], the cell under IVEF has been colored green.

A description of the mismatch/gap is given in column "Gap Analysis" in case the cell has not been colored green.

|  | **S100** | **IVEF service** | **Gap** |
| --- | --- | --- | --- |
| 1 | 1 Overview | Take over the references, definitions, abbreviations described in IVEF and fill in who maintains the IVEF-S100 document. | - |
| 2 | 2 Specification Scopes | IVEF service has (meta) data description on service level (the services and their interface), on dataset level (Vessel Traffic Information) and on message level (Per message). | Although the data of services, dataset and message can be described in this section, the interaction should be added for a complete understanding of the IVEF services. |
| 3 | 3 Data Product Identification | On dataset level (Vessel Traffic Information), this chapter can be filled. | - |
| 4 | 4 Data Content and Structure | Description on message level | - |
| 5 | 4.1 Introduction | Description on message level | - |
| 6 | 4.2 Application Schema | Appendix 1 - 1 Element Definitions  This is a description on message level. | - |
| 7 | 4.3 Feature Catalogue | Appendix 1 - 2 Attribute Definitions  This is a description on message level. | - |
| 8 | 5 Co-ordinate Reference Systems | IVEF uses WGS84 |  |
| 9 | 6 Data Quality | Message level:  IVEF data contains fields in the messages which contain information of accuracy. | Service level: With IVEF functionality a user can check the service status. But this is not "Data Quality" but rather "Service Quality".  Dataset level (Vessel Traffic Information data):  Per VTS provider this data should be available. In on IVEF specification level this is not specified (and cannot be specified). |
| 10 | 7 Data Capture and Classification | - | - |
| 11 | 8 Data Maintenance | - | - |
| 12 | 9 Portrayal | - | - |
| 13 | 10 Data Product Format | The data which is exchanged according to IVEF specification is in XML.  The schema definition of the XML is described in:  Appendix 1 Data Definition.  (See also point 6 and 7). | - |
| 14 | 11 Data Product Delivery | Data is delivered to subscribers of the data.  Description of the services and the interaction.  3.4 Interaction Model of the IVEF Service | - |
| 15 | 12 Metadata | IVEF service has metadata description on service level (the services and their interface), on dataset level (Vessel Traffic Information) and on message level.  The minimal metadata set can be filled in for each of these levels (with redefinition of dataset). If a field is not applicable for that level will be stated as such. But it seems the static metadata on all three levels are quite similar. Metadata on dataset level seems to fit best. | Metadata which are provided by IVEF in the messages, cannot be mapped to the metadata in ISO 19115.  On message level, IVEF has metadata such as "estimated accuracy" and "standard deviation of the calculated position".  Metadata on message and service level are "live" metadata. This metadata is provided inside the messages by IVEF. This would mean one metadata file per message if one would provide only metadata. |