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

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

**Recommendation on closing the gap between S-100 and IVEF**

**04 January 2016, Author Approved**



Contents

[1 OVERVIEW 5](#_Toc439685623)

[1.1 Introduction 5](#_Toc439685624)

[1.2 References 5](#_Toc439685625)

[1.2.1 Normative references 5](#_Toc439685626)

[1.2.2 Informative references 5](#_Toc439685627)

[1.3 Terms, definitions and abbreviations 5](#_Toc439685628)

[1.3.1 Terms and Definitions 5](#_Toc439685629)

[1.3.2 Abbreviations 6](#_Toc439685630)

[2 SUMMARY: CLOSING THE GAP BETWEEN S-100 AND IVEF 8](#_Toc439685631)

[2.1 Fitting service/system specification into S-100 8](#_Toc439685632)

[2.2 Fitting IVEF live (meta)data into S-100 8](#_Toc439685633)

[2.3 Overall conclusion 9](#_Toc439685634)

[3 DETAILED: CLOSING THE GAP BETWEEN S-100 AND IVEF 10](#_Toc439685635)

[3.1 Fitting service/system specification into S-100 10](#_Toc439685636)

[3.1.1 J-STD-016 standard 10](#_Toc439685637)

[3.1.2 ISO standard 11](#_Toc439685638)

[3.1.3 Conclusion & recommendation 11](#_Toc439685639)

[3.2 Fitting IVEF live (meta)data into S-100 12](#_Toc439685640)

[3.2.1 IVEF metadata on service level 12](#_Toc439685641)

[3.2.2 IVEF metadata on dataset level 12](#_Toc439685642)

[3.2.3 IVEF metadata on message level 12](#_Toc439685643)

[3.2.4 Conclusion & recommendation 13](#_Toc439685644)

[ANNEX DATA SERVICE/SYSTEM SPECIFICATION 14](#_Toc439685645)

[1 PRODUCT 14](#_Toc439685646)

[1.1 FUNCTIONAL SUITABILITY 14](#_Toc439685647)

[1.1.1 Functional completeness 14](#_Toc439685648)

[1.1.2 Functional correctness 14](#_Toc439685649)

[1.1.3 Functional appropriateness 14](#_Toc439685650)

[1.2 PERFORMANCE EFFICIENCY 14](#_Toc439685651)

[1.2.1 Time-behavior 14](#_Toc439685652)

[1.2.2 Resource utilization 14](#_Toc439685653)

[1.2.3 Capacity 14](#_Toc439685654)

[1.3 COMPATIBILITY 14](#_Toc439685655)

[1.3.1 Co-existence 14](#_Toc439685656)

[1.3.2 Interoperability 14](#_Toc439685657)

[1.4 USABILITY 14](#_Toc439685658)

[1.4.1 Appropriateness recognisability 14](#_Toc439685659)

[1.4.2 Learnability 14](#_Toc439685660)

[1.4.3 Operability 14](#_Toc439685661)

[1.4.3 User error protection 14](#_Toc439685662)

[1.4.4 User interface aesthetics 14](#_Toc439685663)

[1.4.5 Accessibility 14](#_Toc439685664)

[1.5 RELIABILITY 15](#_Toc439685665)

[1.5.1 Maturity 15](#_Toc439685666)

[1.5.2 Availability 15](#_Toc439685667)

[1.5.3 Fault tolerance 15](#_Toc439685668)

[1.5.4 Recoverability 15](#_Toc439685669)

[1.6 SECURITY 15](#_Toc439685670)

[1.6.1 Confidentiality 15](#_Toc439685671)

[1.6.2 Integrity 15](#_Toc439685672)

[1.6.3 Non-repudiation 15](#_Toc439685673)

[1.6.4 Accountability 15](#_Toc439685674)

[1.6.6 Authenticity 15](#_Toc439685675)

[1.7 MAINTAINABILITY 15](#_Toc439685676)

[1.7.1 Modularity 15](#_Toc439685677)

[1.7.2 Reusability 15](#_Toc439685678)

[1.7.3 Analyzability 15](#_Toc439685679)

[1.7.4 Modifiability 15](#_Toc439685680)

[1.7.5 Testability 15](#_Toc439685681)

[1.8 PORTABILITY 15](#_Toc439685682)

[1.8.1 Adaptability 15](#_Toc439685683)

[1.8.2 Installability 15](#_Toc439685684)

[1.8.3 Replaceability 15](#_Toc439685685)

[2 USAGE 15](#_Toc439685686)

[2.1 EFFECTIVENESS 15](#_Toc439685687)

[2.2 EFFICIENCY 16](#_Toc439685688)

[2.3 SATISFACTION 16](#_Toc439685689)

[2.3.1 Usefulness 16](#_Toc439685690)

[2.3.2 Trust 16](#_Toc439685691)

[2.3.3 Pleasure 16](#_Toc439685692)

[2.3.4 Comfort 16](#_Toc439685693)

[2.4 FREEDOM FROM RISK 16](#_Toc439685694)

[2.4.1 Economic risk mitigation 16](#_Toc439685695)

[2.4.2 Health and safety risk mitigation 16](#_Toc439685696)

[2.4.3 Environmental risk mitigation 16](#_Toc439685697)

[2.5 CONTEXT COVERAGE 16](#_Toc439685698)

[2.5.1 Context completeness 16](#_Toc439685699)

[2.5.2 Flexibility 16](#_Toc439685700)

# 1 OVERVIEW

## 1.1 Introduction

In [GAP ANALYSIS] the similarities and differences between the S-100 framework and the streaming data service IVEF (Intersystem Vessel traffic image Exchange Format) has been set out. IVEF has been selected as use case to see how to make S-100 fit for streaming data services.

In this document a recommendation is given on how to extend the S-100 framework to bridge the gap between S-100 and IVEF.

## 1.2 References

### 1.2.1 Normative references

|  |  |
| --- | --- |
| [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 |
| [GAP ANALYSIS] | IVEF - S100 Gap Analysis  Author: S. Ha  Status: Author Approved  Date: 04 January 2016 |

### 1.2.2 Informative references

|  |  |
| --- | --- |
| [ISO/IEC 25010:2011] | http://www.iso.org/iso/iso\_catalogue/catalogue\_tc/catalogue\_detail.htm?csnumber=35733 |
| [ISO/IEC 12207:2008] | http://www.iso.org/iso/catalogue\_detail?csnumber=43447 |

## 1.3 Terms, definitions and abbreviations

### 1.3.1 Terms and Definitions

|  |  |
| --- | --- |
|  |  |
| J-STD-016 | Standard for Information Technology, Software Life Cycle Processes - Software Development. This standard is the demilitarized version of the military standard named MIL-STD-498. |
| Quality requirements / non-functional requirements | The term "quality requirements" is also used for "non-functional requirement". These quality or non-functional requirements, are requirements which do not address a functionality for the user. It addresses requirements on the system which are necessary to support the functionalities. Example quality requirements: requirements on maintainability, requirements on reliability, requirements on timeliness, requirements on testability and requirements on security for example. |
|  |  |
| Levels (IVEF) | For IVEF data, three levels of data have been defined:   * Message level data: Data which is exchanged in messages containing Vessel Traffic Image data. This data contains metadata as well as data. * Dataset level: Vessel Traffic Image data which is available at the IVEF service. This data is exchanged with users, using messages. * Service level data: Data which is exchanged, containing information on the IVEF service. |
|  |  |
| 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). 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. |
| Vessel Traffic Image | The consolidated information about vessels and their movements in a particular area of interest. |

### 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 SUMMARY: CLOSING THE GAP BETWEEN S-100 AND IVEF

In [GAP ANALYSIS], two main challenges have been identified, using the S-100 standard to describe the IVEF specification.

1. IVEF standard specifies a service/system, it does not specify datasets.
2. IVEF is all about live data and does not do anything with (static) datasets.

In next two sections a short recommendation is given per issue. In chapter 3, the recommendations (and explanation how we got there) are given in more detail.

## 2.1 Fitting service/system specification into S-100

Currently in the S-100 framework, there is no room for service/system specifications. If S-100 is intended to contain all information of a product such as IVEF, S-100 should be extended so service/system specifications can be addressed. The system or service which provides the dataset (dataset can already be described in the S-100 framework), can then be part of the S-100 specification too. So not only the description of the data, but also the description of the data provider should fit into the S-100 framework.

This could be achieved by adding an extra chapter/annex to the S-100 framework. A choice would be to use the ISO 25010:2011 standard for this extra chapter/annex. In chapter 3.1, some known standards have been considered for extending the S-100 framework with.

Specific location of the extra chapter/annex in [IALA S-100]: Put the service/system specification into a separate chapter, **Chapter 13: Data service/system specification**. In this chapter the system/service of the provider of the data, can be specified. This chapter 13 would be an optional chapter. The template holding the chapters of ISO 25010 could be added as **Annex F Data service/system specification**. In chapter 13 a reference to Annex F Data service/system specification should be added.

At the end of this document, an example for the Annex F Data service/system specification has been provided.

## 2.2 Fitting IVEF live (meta)data into S-100

At first the live IVEF data does seem to fit badly into the S-100 framework, especially for metadata. It is quite confusing which fields in S-100 should be filled in and with what data, since IVEF is live system and has different data on different levels.

But by separating the different data levels which are contained in the IVEF services, it seems providing metadata is not that impossible. The following levels have been specified: IVEF message level, IVEF dataset level, IVEF service level. Most of the mandatory fields of the minimal metadata set can be filled in for the IVEF dataset level, with a slight redefinition of "dataset".

The dataset level is described as the follows: The Vessel Traffic Image data which is available at the IVEF service. This is an ever changing (continuously updated) "dataset". Users get updates via messages when the dataset is updated or can request a snapshot (of an intersection) of the dataset at that moment.

More problematic was the metadata information which are provided by IVEF but do not fit the fields of the ISO 19115 standard. For this metadata, it seems to be better to describe each of the metadata fields in the DATA QUALITY chapter. From there a reference can be made to chapter 13 "Data service/system specification" in which it should be described how to retrieve this metadata.

What to do with metadata per level:

1. On message level the fields containing quality information can be described in chapter 6 "DATA QUALITY" of S-100. This chapter need not to be extended. The description on how to retrieve the fields containing quality data is to be described in chapter 13 "Data service/system specification" (to be added to S-100). With a reference from chapter 6 to the specific parts in chapter 13, a link can be made between the explanation of the data and the description on how to retrieve the data.

1. On dataset level a static metadata document with the minimal fields which have to be filled in can be provided. Chapter 12 can be used for this purpose and need not to be extended. It is recommendable to add a description to chapter 12 which explains the IVEF definition of "dataset" (a live dataset rather than a static dataset).
2. On service level the fields containing quality information can be described in chapter 6 "DATA QUALITY" of S-100. This chapter need not to be extended. The description on how to retrieve the fields containing quality data is to be described in chapter 13 "Data service/system specification" (to be added to S-100). With a reference from chapter 6 to the specific parts in chapter 13, a link can be made

## 2.3 Overall conclusion

By separation on what and how, it seems we **can** fit IVEF into S-100.

* **What** data do we have (description of metadata fields in chapter 6 and chapter 12)
* **How** we can retrieve the data (chapter 13 Data service/system specification and references to it from chapter 6)

A prerequisite is that the new chapter 13, Data service/system specification **is** added to S-100. What standard is used exactly as a standard for chapter 13 (Annex F) is less important, but as earlier said: ISO 25010 seems to be quite a good fit. See chapter 3.1 for more details on standards which can hold service/system specifications.

# 3 DETAILED: CLOSING THE GAP BETWEEN S-100 AND IVEF

In [GAP ANALYSIS], two main challenges have been identified fitting IVEF standard into the S-100 standard.

1. IVEF standard specifies a service/system, it does not specify datasets.
2. IVEF is all about live data and does not do anything with (static) datasets.

In the next two sections a detailed recommendation is given per issue.

## 3.1 Fitting service/system specification into S-100

As stated in [GAP ANALYSIS], the S-100 Product Specification is meant for specifying a data product/dataset while the IVEF specification describes a system/service.

The parts of the IVEF specification which currently cannot be fit into the S-100 standard can be described as service/system specifications. [IVEF] contains interface specification, design aspects of the system and many more other system requirements.

Currently the S-100 specification incorporates the ISO 19100-series, which handle data standards. To be able to address the service/system specifications of IVEF, the S-100 standard should be extended with an annex or a chapter in which service/system specifications can be addressed.

Also noticed in [GAP ANALYSIS], the IVEF specification actually specifies more than services alone, it contains system specifications. So we need a template which can hold the system specifications and service specifications. In the world of Information Technology, a service specification is best described as "interface specification". This interface specification is that part of the system which other systems need to know of in order to communicates with it. An interface specification is often part of a systems specification.

### 3.1.1 J-STD-016 standard

In the software standard "J-STD-016" (a well known standard in the Information Technology), interface specifications can be addressed in an "Interface Requirements Specification" document. Other system specifications can be addressed in a document such as the "System/Subsystem Specification". Design aspects can be addressed in a "System/Subsystem Design Description". For each place in the software lifecycle a document is available.

The J-STD-016 standard can be somewhat too large for embedding into the S-100 specification. J-STD-016 has strict separation of specification (requirements), design, interface, user manual, install manual, etc. [IVEF] contains specifications, context designs, detailed designs, interface descriptions and more. In order to specify IVEF properly, we would have to use multiple documents from the J-STD-016 standard.

If, for practical reasons, we would want to fit the service/system part of IVEF into one J-STD-016 document, this could be possible using the Software Requirements Specification (SRS). This document holds the specifications of a system (whose purpose is to serves certain services). For some parts of the IVEF system, a design has been given. These (detailed) designs parts in the IVEF specification would in that case be design restrictions/design requirements in the specification document. The interface part of IVEF can be put into the interface specification part of the Software Requirements Specification.

The System/Subsystem Design Description (SSDD) would be a candidate too, in holding the service/system part of the IVEF specification. This is a lower level document in the J-STD-016 standard compared to the Software Requirements Specification. In this Design Description document, the subsystems are described together with their interfaces. But this is somewhat too low level for IVEF. In [IVEF], models are described, but these don't have to be actual subsystems (likely it would, but this is not required by the IVEF specification).

Hence the choice for Software Requirements Specification (SRS) in case J-STD-016 standard is to be used for holding IVEF service/system specifications.

### 3.1.2 ISO standard

ISO/IEC 12207:2008 is the ISO variant of J-STD-016 and is called: " Systems and software engineering - Software life cycle processes". ISO/IEC 12207 describes the system analysis, phase and the systems architectural design phase. In ISO/IEC 12207 it seems the system requirements analysis phase, which results in system requirements specifications, the place where the [IVEF] specification can be placed into.

ISO also defines the ISO 25000 series which is called: "Software engineering - Product quality". ISO/IEC 25010:2011, "System and Software Quality Requirements and Evaluation (SQuaRE)". So which of the ISO standards would fit best? The content of ISO 12207 "Systems Requirements specification" and the ISO 25000 "Systems Quality Requirements " seem to have a lot of overlap.

So we look at the names of the standards: "ISO 12207 system and software engineering - software life cycle" versus "ISO 25010 system quality requirements and evaluation".

* The latter focuses more on the quality (non-functional) requirements (but has space for functional requirements), while the first contains systems requirements (thus functional and quality requirements).
* ISO 12207 is a very extensive standard (just as J-STD-016) where the system requirements are only part of, while ISO 25010 seems to be a standard which can be used by itself.
* The ISO/IEC 25010:2011 seems to be suitable for usage from different perspectives according to its description. Its purpose is also more wide than the document of the J-STD-016 standard, so it gives more space to use it according to our needs (fit in the IVEF specification).

### 3.1.3 Conclusion & recommendation

If S-100 is intended to contain all information of a product such as IVEF, there should be an extra chapter/annex in S-100 in which the IVEF service/system specifications can be addressed. A choice would be to use the ISO 25010:2011 standard for this chapter/annex. It is possible to use a template from another standard (J-STD-016 or ISO 12207), but those are made to be part of that other standard. The ISO 25010:2011 standard seems not to have that problem and can be used as a separate document/specification standard.

Recommendation: Use ISO 25010 to describe service/system specifications of [IVEF].

The service/system specification should be put in a new chapter in S-100: **Chapter 13: Data service/system specification**. In this chapter, the system/service which provides the described datasets can be specified, according to ISO 25010. This chapter 13 would be an optional chapter. The template holding the chapters of ISO 25010 should be added as **Annex F Data service/system specification** and referred to from chapter 13.

## 3.2 Fitting IVEF live (meta)data into S-100

Currently the S-100 standard is most suitable in describing (meta)data on dataset level. S-100 does indicate more levels such as series and service, but does not provide details on those levels.

In IVEF there is actually no such thing as a "dataset" such as described in ISO 19115/S-100. The IVEF services deliver pieces of the Vessel Traffic Image data (in a message) to the users who have subscribed to this data. After that, the data is "gone". A user cannot retrieve previous/historic data from an IVEF system.

For IVEF the metadata on three levels is filled at three levels: Message level, dataset level (the Vessel Traffic Image data which is available at an IVEF service) and service level. The IVEF dataset is somewhat different than a classic "dataset" as described in S-100.

The dataset level is described as the follows: The Vessel Traffic Image data which is available at the IVEF service. This is an ever changing (continuously updated) "dataset". Users get updates when the dataset is updated or can request a snapshot (of an intersection) of the dataset at that moment.

### 3.2.1 IVEF metadata on service level

The service level of IVEF does not say anything on the Vessel Traffic Image data. The metadata is therefore the metadata on the services (software) which provide the data. Most metadata fields seem to be NOT APPLICABLE, so at this level, it seems not very useful to describe the metadata according to ISO 19115.

The IVEF services do provide data which tells something about the services themselves (whether it is available or not and who is the party to contact). It seems more useful to address those fields as metadata of an IVEF service, instead of defining a static metadata document for the service level data. This way, metadata exists per IVEF service, albeit not according to the ISO 19115 standard.

### 3.2.2 IVEF metadata on dataset level

The metadata of the Vessel Traffic Image data which exists on the IVEF service. At this level, we treat the IVEF dataset as if it was a "classic" dataset. A metadata document according to ISO 19115 standard can be provided at this level.

### 3.2.3 IVEF metadata on message level

This metadata of the messages. A message contains a part of/an intersection of the Vessel Traffic Image data at that moment. The content of a message is dependent on the query/request of a user. For this level it seems difficult to write down the metadata. Some fields are NOT APPLICABLE or it has the same content as the metadata field on dataset level.

In the messages themselves, metadata on the data in the messages is available. This metadata is should be described in the section "Data Quality". It seems more useful to address those fields as metadata of a message, instead of defining a static metadata document for the message level data. This way, metadata exists per message, albeit not according to the ISO 19115 standard.

### 3.2.4 Conclusion & recommendation

By a separation of the different data levels which are contained in the IVEF services, it seems like providing metadata is not that impossible, although IVEF is a live service. Most of the mandatory fields of the minimal set can be filled in.

More problematic is the metadata information which are provided by IVEF but cannot be put in ISO 19115 standard. But for this metadata, it is better to describe each field in the DATA QUALITY chapter. A reference can made to chapter 13, Data service/system specification, in which it is described how to retrieve this data.

Recommendations:

1. On message level the fields containing quality information can be described in chapter 6 "DATA QUALITY" of S-100. This chapter need not to be extended. The description on how to retrieve the fields containing quality data is to be described in chapter 13 "Data service/system specification" (to be added to S-100). With a reference from chapter 6 to the specific parts in chapter 13, a link can be made between the explanation of the data and the description on how to retrieve the data.

1. On dataset level a static metadata document with the minimal fields which have to be filled in can be provided. Chapter 12 can be used for this purpose and need not to be extended. It is recommendable to add a description to chapter 12 which explains the IVEF definition of "dataset" (a live dataset rather than a static dataset).
2. On service level the fields containing quality information can be described in chapter 6 "DATA QUALITY" of S-100. This chapter need not to be extended. The description on how to retrieve the fields containing quality data is to be described in chapter 13 "Data service/system specification" (to be added to S-100). With a reference from chapter 6 to the specific parts in chapter 13, a link can be made between the explanation of the data and the description on how to retrieve the data.

# ANNEX DATA SERVICE/SYSTEM SPECIFICATION

# 1 PRODUCT

## 1.1 FUNCTIONAL SUITABILITY

### 1.1.1 Functional completeness

### 1.1.2 Functional correctness

### 1.1.3 Functional appropriateness

## 1.2 PERFORMANCE EFFICIENCY

### 1.2.1 Time-behavior

### 1.2.2 Resource utilization

### 1.2.3 Capacity

## 1.3 COMPATIBILITY

### 1.3.1 Co-existence

### 1.3.2 Interoperability

## 1.4 USABILITY

### 1.4.1 Appropriateness recognisability

### 1.4.2 Learnability

### 1.4.3 Operability

### 1.4.3 User error protection

### 1.4.4 User interface aesthetics

### 1.4.5 Accessibility

## 1.5 RELIABILITY

### 1.5.1 Maturity

### 1.5.2 Availability

### 1.5.3 Fault tolerance

### 1.5.4 Recoverability

## 1.6 SECURITY

### 1.6.1 Confidentiality

### 1.6.2 Integrity

### 1.6.3 Non-repudiation

### 1.6.4 Accountability

### 1.6.6 Authenticity

## 1.7 MAINTAINABILITY

### 1.7.1 Modularity

### 1.7.2 Reusability

### 1.7.3 Analyzability

### 1.7.4 Modifiability

### 1.7.5 Testability

## 1.8 PORTABILITY

### 1.8.1 Adaptability

### 1.8.2 Installability

### 1.8.3 Replaceability

# 2 USAGE

## 2.1 EFFECTIVENESS

## 2.2 EFFICIENCY

## 2.3 SATISFACTION

### 2.3.1 Usefulness

### 2.3.2 Trust

### 2.3.3 Pleasure

### 2.3.4 Comfort

## 2.4 FREEDOM FROM RISK

### 2.4.1 Economic risk mitigation

### 2.4.2 Health and safety risk mitigation

### 2.4.3 Environmental risk mitigation

## 2.5 CONTEXT COVERAGE

### 2.5.1 Context completeness

### 2.5.2 Flexibility