Standard Archive Format for Europe

Control Book
Volume 2

Recommendation for specialisations

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Preface

The present document provides the general recommendations for specializing SAFE specifications to a specific context, content or purpose. This recommendations have been developed by the European Space Agency in the framework of its Earth Observation ground segment activities.

SAFE product format has been designed to be an opened shell capable of holding as many type of Earth Observation data as reasonably feasible at the time of writing. SAFE inherits its main structure from XFDU packaging format and defines high level constraints and new rules coping with most of Earth Observation data products currently archived and exchanged across ESA and cooperating organizations. These high level definitions provides all SAFE with a common interface making easier their manipulation and exchange across various facilities, systems and environments. For defining more complete products with specific constraints, rules and specific types of data, it is, however, necessary to design a so called "SAFE Specialisation" and possibly to write a corresponding SAFE Specialisation Control Book and produce the accompanying XML Schema's and examples.

This book provides rules and guidelines for designing and implementing a SAFE Specialisation and intends to provide the necessary guidance to assure a consistent and homogeneous development of SAFE Specialisation across projects and organizations.

1. This Book Audience

This book is primarily dedicated to technical managers or developers involved in the design of a SAFE Specialisation. It is also recommended for SAFE implementers or users desiring to improve their skill about the format. In particular, this book provides explanations regarding technical solutions selected in the [SAFE-CORE] specifications, because this latter does not intend to act as a guideline document.

It is expected that most readers will have some familiarity with OAIS concepts as well as with XFDU and XML technologies.

However, although many information regarding [SAFE-CORE] specifications is provided, this book does not suffice as tutorial about SAFE standard. It is highly recommended to reach at least a basic skill with respect to SAFE from the [SAFE-CORE] document before reading this book.

2. Organisation of This Book

Chapter 1:	Provides an overview of a SAFE Specialisation.
Chapter 2:	Provides recommendations for a SAFE Product to be well structured.
Chapter 3:	Provides recommendations for manipulation of all Manifest Types.
Chapter 4:	Provides recommendations for the Representation Information of Components.
Chapter 5:	Provides recommendations for identification of a SAFE Product.
Chapter 6:	Provides recommendations for namespaces used in SAFE.
Chapter 7:	Provides recommendations to define filename of Components, name of different entities gathered by a SAFE Product.
Appendix A:	A complete example of ERS AMI SAR Level 0 Product SAFE Manifest document.

Appendix B: GNU Free Documentation License.

Appendix C: A standard form for proposing improvements to the present book.

Book Index: An alphabetical list of the specific information included in the book. It is prepared to help the reader find information quickly and easily.

3. SAFE Specification Volume Set

Although SAFE Recommendations for specialisations are fully defined in the present book, this latest is part of a consistent set of books defining *official* specialisations dedicated to various kind of data.

The following list references these related documents with their revision status at the time of writing. It, however, does not significate that other specialisations are not available or in the pipeline of the development of any other party.

[SAFE-CORE] *Standard Archive Format for Europe Control Book - Volume 1 - Core Specifications*-PGSI-GSEG-EOPG-FS-05-0001- Issue 1 , Revision 14-2010-11-12-Copyright © 2006,2007,2008 European Space Agency (ESA)GAEL Consultant-

4. Bibliography

[OAIS-RM] *Reference Model for an Open Archival Information System (OAIS)* -650.0-B-1-January 2002-Blue Book-Copyright © 2002 Consultative Committee for Space Data Systems (CCSDS) -

[SI] *The International System of Units (SI)* -1998-7th edition- Bureau International des Poids et Mesures -Copyright © 1998 Organisation Intergouvernementale de la Convention du Mètre -

[SI-SUP2000] *The International System of Units (SI)*- Supplement 2000: addenda and corrigenda of the 7th edition (1998) -1998-7th edition- Bureau International des Poids et Mesures -Copyright © 1998 Organisation Intergouvernementale de la Convention du Mètre -

[XFDU] *XML Formatted Data Unit (XFDU) - Structure and Construction Rules* -661.0-B-1-September 2008-Blue Book -Copyright © 2008 Consultative Committee for Space Data Systems (CCSDS) -

[XML] *eXtensible Markup Language (XML) 1.0 (Fifth Edition)* -W3C Recommendation-November 26, 2008-Version 1.0-Copyright © 2008 World Wide Web Consortium (W3C) -

[XML-SCHEMA] *XML Schema: Primer Second Edition* -W3C Recommendation-October 28, 2004-Version 1.0-Copyright © 2004 World Wide Web Consortium (W3C) -

[XML-SCHEMA-STRUCT] *XML Schema: Structures Second Edition* -W3C Recommendation-October 28, 2004-Version 1.0-Copyright © 2004 World Wide Web Consortium (W3C) -

[XML-SCHEMA-TYPES] *XML Schema: Data Types Second Edition* -W3C Recommendation-October 28, 2004-Version 1.0-Copyright © 2004 World Wide Web Consortium (W3C) -

5. Glossary of Terms

5.1. General Definitions

Additional abstract XML Schema	An additional abstract XML Schema is not the XML Schema which describes a Data Component or a Metadata Component, but is included by the XML Schema which describes a Data Component or a Metadata Component. An additional abstract XML Schema is a Component of a SAFE Product.
Association	Refers to a relationship between Components in a Collection, or other Metadata related to a Component or the Collection [XFDU].
Collection	Refers to Components that are gathered together along with a Manifest. This is analogous to files on a file system [XFDU].
Component	Refers to a file that can be grouped together to be part of a Collection, or XFDU Package [XFDU], or SAFE Product. A Component may be a Data Component, a Metadata Component, an XML Schema Component, etc.
Consumer	The role played by those persons, [...], who interact with OAIS services to find preserved information of interest and to access that information in detail. This can include other OAIS, as well as internal OAIS persons or systems [OAIS-RM].
Content Unit	XML Structure that contains pointers to Data Objects and associated Metadata Objects, and possibly other Content Units [XFDU].
Data	A reinterpretable representation of Information in a formalized manner suitable for communication, interpretation, or processing. Examples of data include a sequence of bits, a table of numbers, the characters on a page, the recording of sounds made by a person speaking, or a moon rock specimen [OAIS-RM].
Data Component	A Component holding data.
Data Object	“An object composed of a set of bit sequences”. This definition has been inherited from the [OAIS-RM] discarding the case of Physical Object (e.g. Books, Pen, etc.) that is out of the scope of the present specifications. The [XFDU] document completes this definition: “Contains some file content and any data required to allow the Information Consumer to reverse any transformations that have been performed on the object and restore it to the byte stream intended for the original Designated Community and described by the Representation Information in the Content Unit”.
dataObject	A `dataObject` element of a SAFE Manifest.
Datatype	In [XML-SCHEMA-TYPES] specification, a datatype is a 3-tuple, consisting of: 1. a set of distinct values, called its Value Space,

2. a set of lexical representations, called its Lexical Space,
3. a set of Facets that characterize properties of the Value Space, individual values or lexical items.

Designated Community	An identified group of potential Consumers who should be able to understand a particular set of Information. The Designated Community may be composed of multiple user communities [OAIS-RM].
Facet	A facet is a single defining aspect of a Value Space. Generally speaking, each facet characterizes a Value Space along independent axes or dimensions. The Datatype of a Datatype serves to distinguish those aspects of one Datatype which differ from other Datatypes. Rather than being defined solely in terms of a prose description the Datatypes in this specification are defined in terms of the synthesis of facet values which together determine the Value Space and properties of the Datatype [XML-SCHEMA-TYPES].
Fixity Information	The Information which documents the authentication mechanisms and provides authentication keys to ensure that the [...] object has not been altered in an undocumented manner. An example is a Cyclical Redundancy Check (CRC) code for a file [OAIS-RM].
Information	Any type of knowledge that can be exchanged. In an exchange, it is represented by data. An example is a string of bits (the data) accompanied by a description of how to interpret a string of bits as numbers representing temperature observations measured in degrees Celsius (the Representation Information) [OAIS-RM].
Lexical Space	A lexical space is the set of valid *literals* for a datatype [XML-SCHEMA-TYPES].
Manifest	A document containing Metadata about Components, and the Associations between them. This Information is stored as a Component, using an XML language designed just for this purpose [XFDU].
Manifest Type	Any type provided by SAFE or any SAFE Specialisation contained in a SAFE Manifest.
Metadata	Data about other Data [OAIS-RM].
Metadata Component	A Component holding Data about other Data.
Metadata Object	A SAFE Object that is a Metadata for another SAFE Object within the same SAFE Product, or XFDU Package.
metadataObject	A `metadataObject` element of a SAFE Manifest.
Package	A collection that is bundled together, or packaged, into one file using a defined packaging scheme. All Packages are Collections, but not all Collections have been packaged, so they are not all Packages [XFDU].

Information	Information which is necessary for adequate preservation of the Content Information and which can be categorized as Provenance, Reference, Fixity, and Context information [OAIS-RM].
Provenance Information	Information that documents the history of the Content Information. This information tells the origin or source of the Content Information, any changes that may have taken place since it was originated, and who has had custody of it since it was originated. Examples of Provenance Information are the principal investigator who recorded the data, and the information concerning its storage, handling, and migration [OAIS-RM].
Representation Information	The information that maps a Data Object into more meaningful concepts. An example is the ASCII definition that describes how a sequence of bits (i.e. a Data Object) is mapped into a symbol [OAIS-RM].
Package Interchange File	A collection of files that have been bundled together into a single container that also contains a manifest describing the contained files and the relationships among those files [XFDU].
Producer	The role played by those persons, or client systems, who provide the information to be preserved.
Referenced Metadata Object	A Metadata Object stored inside *and* outside the SAFE Manifest.
SAFE Manifest	A Manifest conforming the present specifications.
SAFE Object	Either a Data Object or a Metadata Object defined by SAFE.
SAFE Product	An XFDU Package specialised for Earth Observation data purposes. The term of *Product* has been selected for historical reason but matches exactly the definition of an XFDU Package introduced above.
SAFE Specialisation	A SAFE Specialisation is a restriction of the SAFE Core specifications for a more specific type of data. Examples of SAFE Specialisation include specialisations for ENVISAT or LANDSAT Products, for CCSDS Telemetry Data, or for SPOT Measurements...
SAFE Type	Type defined in the “http://www.esa.int/safe/1.3” namespace and part of SAFE.
Value Space	A value space is the set of values for a given Datatype. Each value in the value space of a Datatype is denoted by one or more literals in its Lexical Space [XML-SCHEMA-TYPES].
Wrapped Metadata Object	A Metadata Object wrapped inside the SAFE Manifest.
XFDU Package	A Package Interchange File that contains an XFDU Manifest and is conformant to the semantics specified in the XFDU Specifications. An XFDU Package is a specialization of Package Interchange File [XFDU].
XFDU Type	Type defined in the “urn:ccsds:schema:xfdu:1” namespace and part of SAFE.

Component	A Component holding part or the entire Representation Information of another Component.
XML Schema Object	A Metadata Object holding part or the entire Representation Information of another SAFE Object.

5.2. Specialisation Definitions

New Specific Type	Manifest Type defined by any SAFE Specialisation.
SAFE Abstract Specialisation	A SAFE abstract specialisation is a specialisation that does not define by itself a single product.
SAFE Auxiliary Specialisation	A restriction of the SAFE Core specifications for a specific auxiliary product. Examples of SAFE Specialisation include a specialisation for ENVISAT Predicted Orbit State Vectors Auxiliary Products, ENVISAT UTC Time Reference and Conversion Table Auxiliary Products, ERS General Headers Auxiliary Products, etc.
SAFE Product Specialisation	A restriction of the SAFE Core specifications for a specific product. Examples of SAFE Specialisation include a specialisation for ENVISAT ASAR APC Level 0 products, Landsat MSS Level 0 products, SeaStar SeaWiFS Level 1A products, etc.
SAFE Specialisation Control Book	A book which defines the SAFE Specialisation for one or more products.

5.3. Acronyms and Abbreviations

ASAR	Advanced Synthetic Aperture Radar (an instrument of ENVISAT platform).
AMI	Active Microwave Instrument (an instrument of ERS platforms).
CCSDS	Consultative Committe for Space Data Systems
ENVISAT	ENVIronment SATellite platform
ENVISAT - TIM Auxiliary Product	ENVIronment SATellite - UTC Time Reference and Conversion Table Auxiliary Product
ERS	European Remote Sensing Satellite(s)
ESA	European Space Agency
GOMOS	Global Ozone Measurement by the Occultation of Stars (an instrument of ENVISAT platform).
Landsat	A program of seven platforms
MSS	Multispectral Scanner (an instrument of Landsat 1 to 5 platforms).
OAIS	Reference Model for an Open Archival Information System
SAFE	Standard Archive Format for Europe (SAFE)
SAR	Synthetic Aperture Radar

SDF	Strutured Data File Markup Language
SeaStar	Spacecraft flying SeaWiFS
SeaWiFS	Sea-viewing Wide Field-of-view Sensor (an instrument of SeaStar platform).
UML	Unified Modeling Language
UTC	Universal Time Coordinated
XFDU	XML Fomatting Data Unit
XML	eXtensible Markup Language

Chapter 1. SAFE Specialisation Overview

1.1. What is a SAFE Specialisation?

The [SAFE-CORE] defines that:

> SAFE has been designed to “be” an instance of XFDU, restricting the generic areas of XFDU to the specific needs of Earth Observation ground segments and to provide semantic in the same domain for improving the interoperability between the ground segment facilities.

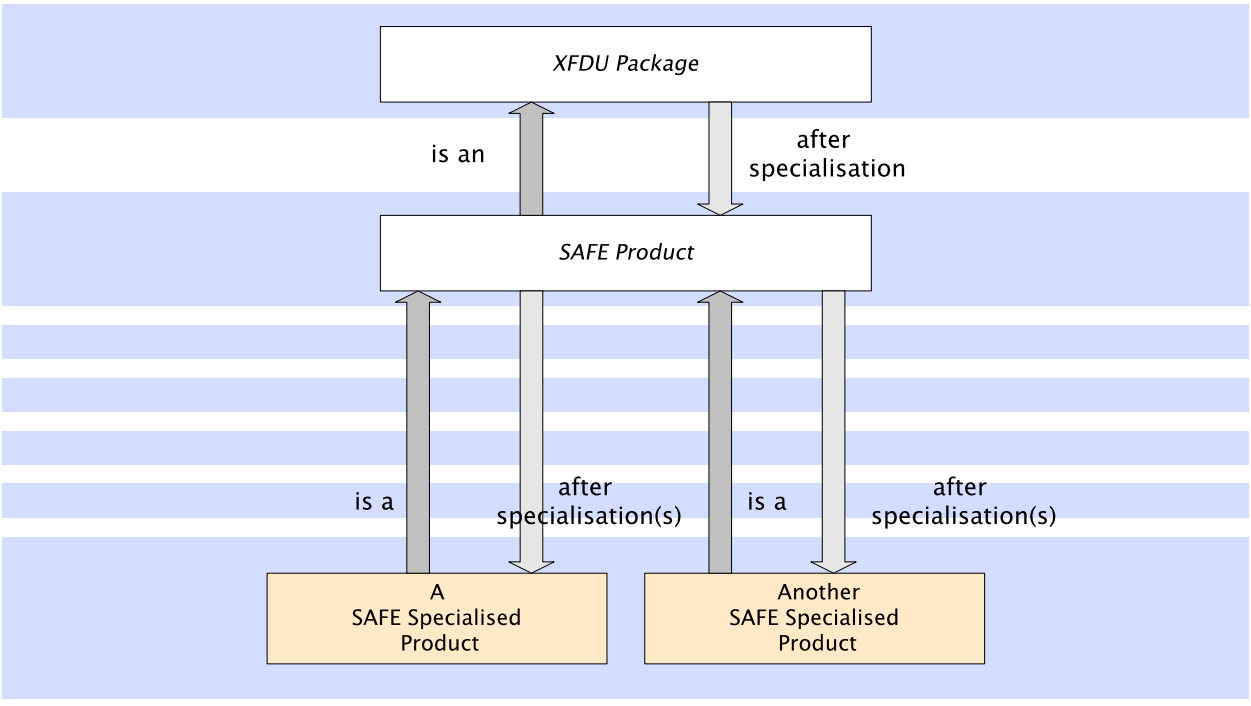
The same principle *must* apply for each specialisation of SAFE:

Any SAFE Specialisation *must* “be” an instance of SAFE.

The [SAFE-CORE] defines that:

> A critical characteristic of SAFE is that “any SAFE Product is an XFDU Package”.

In the same way, a critical characteristic of SAFE Specialisation rules is that “any SAFE Product defined by a SAFE Specialisation is a SAFE Product defined by the [SAFE-CORE]”.



SAFE Specialisation Definition

A SAFE Specialisation can be either a SAFE Abstract Specialisation, a SAFE Auxiliary Specialisation or a SAFE Product Specialisation.

To be complete, a SAFE Specialisation Specification shall respect the following requirements:

- The SAFE Product defined by a SAFE Specialisation shall be exhaustively defined in a SAFE Specialisation Control Book (SAFE Manifest and all Components content);
- Representation Information of every Component of the SAFE Product shall be described by an XML Schema following the rules defined in the [SAFE-CORE].
- The SAFE Manifest of the SAFE Product shall be validated by an xfdu.xsd XML Schema (strict *restriction* i.e. in the sense of XML Schema recommendation [XML-SCHEMA-STRUCT] of the XML Schema provided in the Appendix A of the [SAFE-CORE]);

The SAFE Manifest or the entire SAFE Product can be validated by any other method than the xfdu.xsd XML Schema validation, if the validation is more accurate.

1.2. SAFE Specialisation Control Books

A SAFE Specialisation Control Book is a book which defines the SAFE Specialisation(s) for one or more product(s). These products shall share a strong common point (for example products processed from the same platform, the same instrument, etc.).

1.2.1. Content of Specialisation Control Books

A SAFE Specialisation Control Book shall:

- Define the precise list of all components the SAFE Product(s) gather(s) (Binary, ASCII, XML, XML Schema, etc. Components);
- Define the precise list of all XML Schemas used for the validation of the SAFE Manifest of the SAFE Product(s);
- Provide in appendix the entire set of XML Schemas defined for the SAFE Specialisation(s);
- Provide the precise description of the SAFE Manifest content of the SAFE Product(s). This description includes XFDU Types, SAFE Types, New Specific Types, element occurrences, mandatory pattern values, namespaces, etc.

An example of SAFE Manifest for every SAFE Product should be provided in appendix.

The thorough description of Data and Metadata Component(s) of the SAFE Product(s) *can* be provided (since SAFE is an Archive Format, the SAFE Specialisation Control Book *does not* replace the previous product specifications).

An overview of the product(s), instrument(s), platform(s), etc. can be provided.

An example of precise description of the SAFE Manifest content of a SAFE Product (Landsat MSS Level 0 Product) follows:

ENTITY / ATTRIBUTE	VALUE	OCC.
`informationPackageMap`		

ENTITY / ATTRIBUTE	VALUE	OCC.
. xfdu:contentUnit		1
. . *@ID*	“packageUnit”	0..1
. . *@textInfo*		0..1
. . *@pdiID*	“processing”	1
. . *@dmdID*	In any order: “acquisitionPeriod” “platform”	1
. . xfdu:contentUnit		1
. . . *@ID*	“measurementUnit”	0..1
. . . *@textInfo*		0..1
. . . *@dmdID*	In any order: “measurementOrbitReference” (mandatory) “measurementIndex” (mandatory) “measurementQualityInformation” (non-mandatory)	1
. . . *@repID*	In any order: “measurementSchema” “landsatMeasurementSchema”	1
. . . dataObjectPointer		1
. . . . *@ID*		0..1
. . . . *@dataObjectID*	“measurementData”	1
. . xfdu:contentUnit		1
. . . *@ID*	“measurementIndexUnit”	0..1
. . . *@textInfo*		0..1
. . . *@repID*	“measurementIndexSchema”	1
. . . dataObjectPointer		1
. . . . *@ID*		0..1
. . . . *@dataObjectID*	“measurementIndexData”	1

Table 1.1. Landsat MSS Level 0 Specialisation informationPackageMap Entity

1.2.2. Development and Maintenance

SAFE is a long-term preservation format. Accuracy and stability in time of a SAFE Specialisation Control Book is a *critical* need.

For the creation of a SAFE Specialisation Control Book, it is *very strongly* recommended to use advanced technologies in order to avoid any integrity error in the definition of a SAFE Specialisation.

Exemple of technologies used to create the entire set of ESA official SAFE Specialisation Control Books as the [SAFE-CORE] are:

- DocBook;

- XSLT;
- XSL-FO;
- XQuery;
- Java;
- Maven;
- etc.

Chapter 2. Product Structure

2.1. Introduction

A SAFE Product contains information. Every information is a “Data”. Some “Data” are mesured by an instrument, some are calculated by a processor, some are added by a man. SAFE classifies information in two categories: *Data* and *Metadata*.

For a SAFE Product, Data is:

“All stored information, cause of the existence of the product”.

For a SAFE Product, Metadata is:

“All other stored information”.

Such different information as the platform identification, a Component index, a Component Representation Information are considered as Metadata.

2.2. Data

SAFE is designed to manage any Data. A SAFE Product can gather only one data file or multiple data files. Cause of multiple files can be:

- there are “meaning-different” data files
- a single file has been split into several ones.

Although the SAFE primary goal is to handle product levels close to the usually called “level 0”, no particular limitation exists regarding the handling of higher level products.

Even if each SAFE Specialisation shall be different, the following recommendation can be provided.

- For Level 0 Products, there shall be only one Data Component.
- For higher than Level 0 Products, there shall be as many Data Components as required.

For higher than Level 0 Products, number of Data Components shall be defined for each SAFE Product depending on the nature of the Data.

A little file size for a Data Component should not be a reason for wrapping the Data instead of reference it (to wrap Data is anyway not allowed by SAFE, only Metadata can be wrapped).

2.3. Metadata

2.3.1. Mandatory Metadata

As defined in the [SAFE-CORE], any SAFE Product must contain at least two Metadata Objects (dedicated to the processing history and to platform information).

`safe:platform` element definition shall be as restricted as possible. An example of complete restriction follows:

```
[...]

   <xs:complexType name="platformType">
      <xs:complexContent>
         <xs:restriction base="safe:platformType">
            <xs:sequence>
               <xs:element name="nssdcIdentifier"
                           type="safe:nssdcIdentifierType"/>
               <xs:element name="familyName"
                           type="safe:platformFamilyNameType"/>
               <xs:element name="number"
                           type="safe:platformNumberType"/>
               <!-- instrument element mandatory -->
               <xs:element name="instrument"
                           type="safe:instrumentType"/>
               <!-- Wild Card not allowed -->
            </xs:sequence>
         </xs:restriction>
      </xs:complexContent>
   </xs:complexType>

   <xs:simpleType name="platformFamilyNameType">
      <xs:restriction base="safe:platformFamilyNameType">
         <xs:enumeration value="Landsat"/>
      </xs:restriction>
   </xs:simpleType>

   <xs:simpleType name="nssdcIdentifierType">
      <xs:restriction base="safe:nssdcIdentifierType">
         <xs:enumeration value="1972-058A"/>
         <xs:enumeration value="1975-004A"/>
         <xs:enumeration value="1978-026A"/>
         <xs:enumeration value="1982-072A"/>
         <xs:enumeration value="1984-021A"/>
      </xs:restriction>
   </xs:simpleType>

   <xs:simpleType name="platformNumberType">
      <xs:restriction base="safe:platformNumberType">
         <xs:enumeration value="1"/>
         <xs:enumeration value="2"/>
         <xs:enumeration value="3"/>
         <xs:enumeration value="4"/>
         <xs:enumeration value="5"/>
      </xs:restriction>
   </xs:simpleType>

   <xs:simpleType name="completeInstrumentFamilyNameType">
      <xs:restriction base="safe:completeInstrumentFamilyNameType">
         <xs:enumeration value="Multispectral Scanner"/>
      </xs:restriction>
   </xs:simpleType>

   <xs:simpleType name="abbreviationType">
      <xs:restriction base="safe:abbreviationType">
         <xs:enumeration value="MSS"/>
      </xs:restriction>
   </xs:simpleType>

[...]
```

Example 2.1. Restriction of safe:platform for Landsat MSS Level 0 Products

2.3.2. Wrapped Metadata or Metadata Component?

SAFE allows to wrap Metadata and to reference any number of Metadata Components. The [SAFE-CORE] provides several type definitions. Regarding Metadata which doesn't match the definition of any SAFE Type, the following recommendation can be provided.

- Metadata repeated such as records shall be stored as Metadata Components and referenced by the SAFE Manifest.
- Any other Metadata shall be wrapped into the SAFE Manifest.

A little file size for a Metadata Component should not be a reason for wrapping the Metadata instead of reference it.

2.3.3. Data Index

Each Data Component can be completed by an index for access efficiency. Nevertheless it is recommended to be very careful to the Data Component file size before adding an index to a Data Component. SAFE is a long-term preservation format; a today big file size could become a tomorrow litte file size.

2.3.4. Representation Information

SAFE defines that every Component (except XML Schema Component) must be accompanied by a Representation Information (standard XML Schemas). There can be more than one XML Schema for the Representation Information of a Component. Each XML Schema shall be an XML Schema Component.

2.4. Case of Auxiliary Products

Although the SAFE primary goal is to handle product levels close to the usually called “level 0”, no particular limitation exists regarding the handling of Auxiliary Products.

Auxiliary Products contain Data which are Metadata for other products. In fact, auxiliary products “are Metadata products for products”. Data stored in an auxiliary product are sometimes present in another product as Metadata.

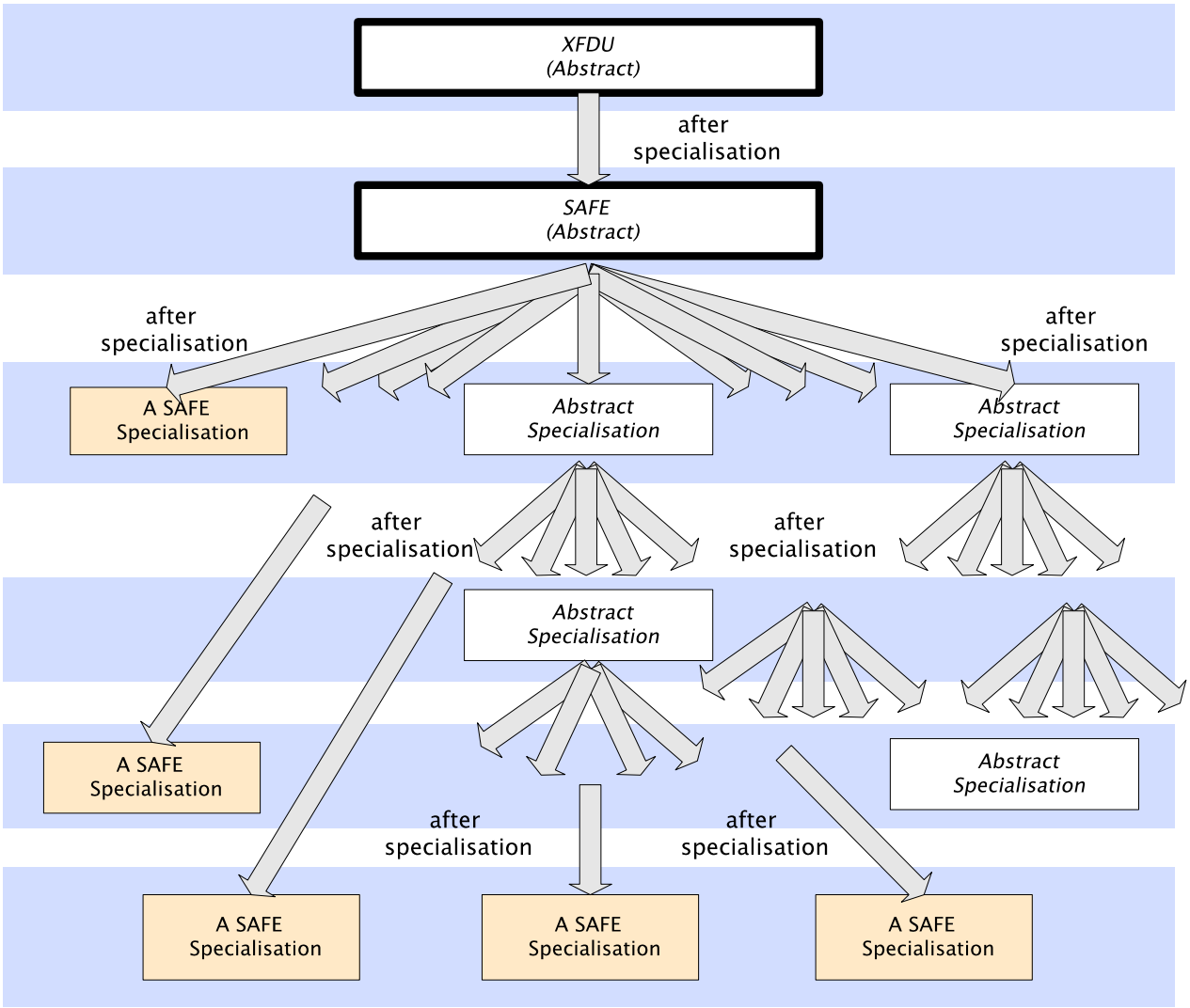
Even if there can be a confusion between the nature of Data of an auxiliary data (Data/Metadata), the following recommendation can be provided.

For a product (auxiliary or not), Data is “all stored information, cause of the existence of the product”.

For example, for an ENVISAT - TIM Auxiliary Product, Data is the UTC Time Reference, the satellite binary clock and the clockstep (for a given time validity). Even if these Data are considered “Metadata” for a Telemetry Product, for a ENVISAT - TIM Auxiliary Product it's Data.

Chapter 3. Manifest Types

3.1. Abstract Specialisations



Abstract Specialisations

As said in Section 1.2, some SAFE Products share some strong common points. As an example, for ENVISAT platform there are 25 different Level 0 Products.

Some Manifest Types do not need to be redefined and restricted as many times as number of products. As an example, the following redefinition of `platformFamilyNameType` shall restrict the authorised `xs:string` to value “ENVISAT” once for all ENVISAT products:

```
<xs:simpleType name="platformFamilyNameType">
   <xs:restriction base="safe:platformFamilyNameType">
```

```
        <xs:enumeration value="ENVISAT"/>
      </xs:restriction>
    </xs:simpleType>
```

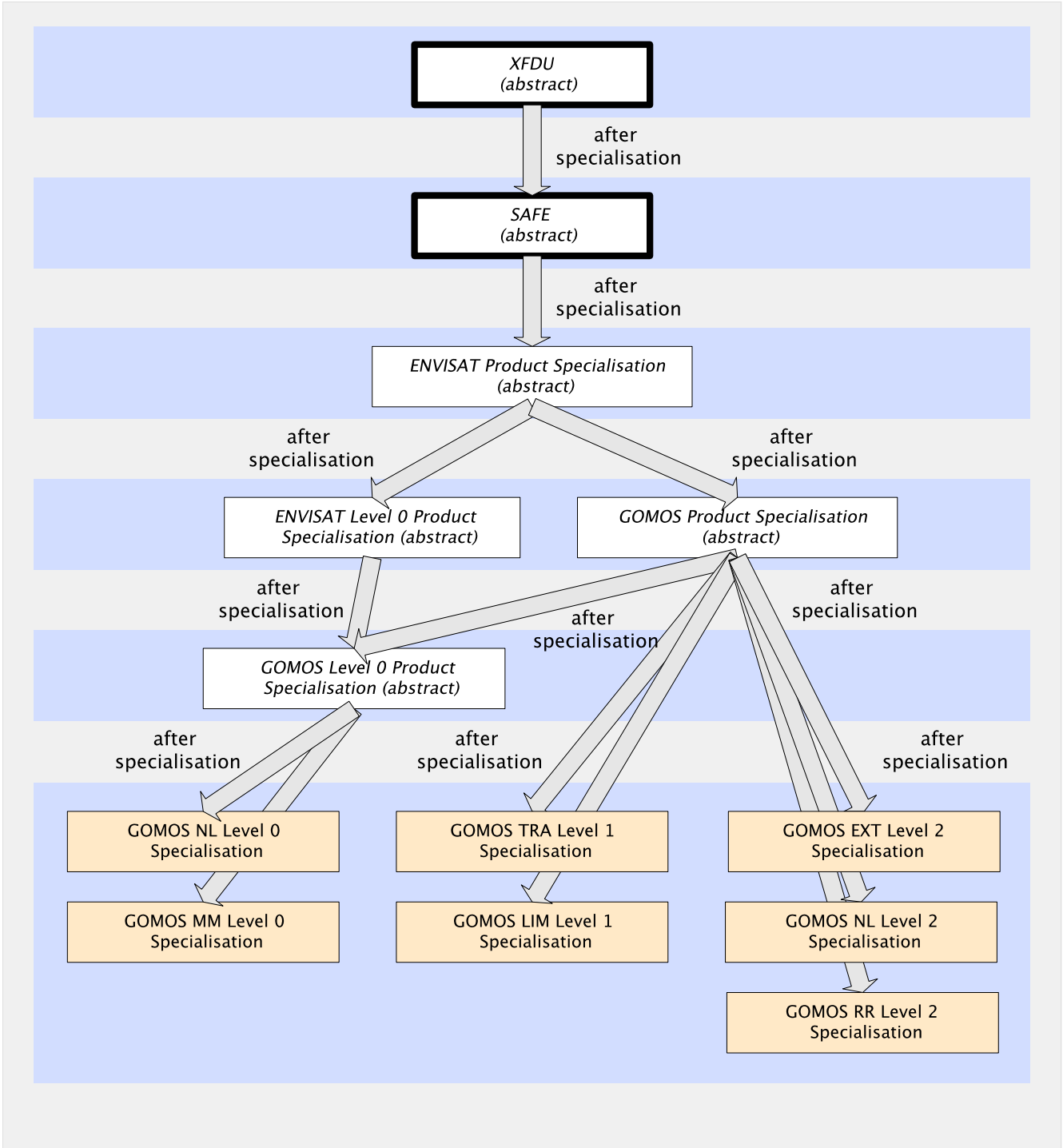
Example 3.2. Restriction of safe:platformFamilyNameType for ENVISAT Products

Redefinition and restriction of Manifest Types:

- shall be done at the higher possible level (possibly by a SAFE Abstract Specialisation);
- can be inherited from a SAFE Abstract Specialisation by one or more SAFE Specialisation(s) (SAFE Abstract Specialisation, SAFE Auxiliary Specialisation or SAFE Product Specialisation).

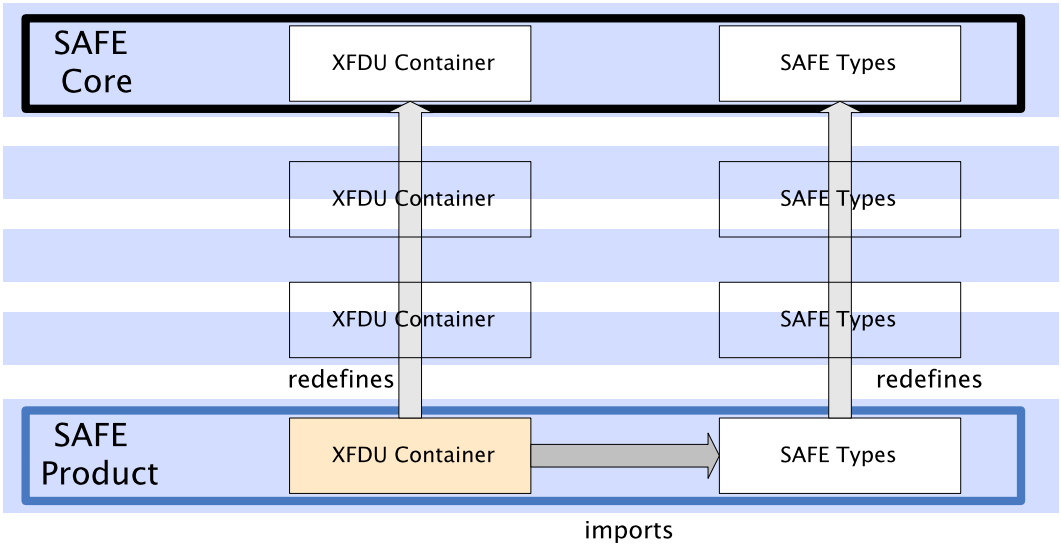
A SAFE Specialisation can inherit types from one or more SAFE Abstract Specialisations.

The following example describes the SAFE Specialisation for ENVISAT GOMOS tree:



Example 3.3. SAFE Specialisations for ENVISAT GOMOS Products

3.2. XML Schema Mechanisms



Redefinition and Import of Manifest Types

```
<xs:schema xmlns:xs       ="http://www.w3.org/2001/XMLSchema"
           xmlns:safe     ="http://www.esa.int/safe/1.3"
           xmlns:xfdu     ="urn:ccsds:schema:xfdu:1"
           targetNamespace="urn:ccsds:schema:xfdu:1"

           elementFormDefault ="qualified"
           attributeFormDefault="unqualified">

   <xs:import namespace="http://www.esa.int/safe/1.3"
              schemaLocation="safe.xsd"/>

   <xs:redefine schemaLocation="xfdu.xsd">

   <xs:complexType name="xmlDataType">
      <xs:complexContent>
         <xs:restriction base="xfdu:xmlDataType">
            <xs:choice>
               <xs:element ref="safe:processing"
                           minOccurs="1" maxOccurs="unbounded"/>
               <xs:element ref="safe:platform"/>
               <xs:element ref="safe:acquisitionPeriod"/>
               <xs:element ref="safe:orbitReference"/>
               <xs:element ref="safe:gridReference"/>
               <xs:element ref="safe:qualityInformation"/>
            </xs:choice>
         </xs:restriction>
      </xs:complexContent>
   </xs:complexType>

   </xs:redefine>

</xs:schema>
```

Example 3.4. Redefinition and Import of Manifest Types

3.2.1. Use of xs:redefine

SAFE is defined by:

- an xfdu.xsd XML Schema, provided in the Appendix A of the [SAFE-CORE] .
- a safe.xsd XML Schema, provided in the Appendix B of the [SAFE-CORE] .
- an active-sensor-types.xsd XML Schema, provided in the Appendix C of the [SAFE-CORE] .
- an index.xsd XML Schema, provided in the Appendix E of the [SAFE-CORE] .

As said in Chapter 1, any SAFE Specialisation *must* "be" an instance of SAFE.

To restrict SAFE (and its XML Schemas), it is recommended to use the `xs:redefine` mechanism.

This mechanism is intended to provide a declarative and modular approach to schema modification.

The definitions within the `xs:redefine` element itself are restricted to be redefinitions of types from the redefined XML schema document, in terms of themselves. Type definitions must use themselves as their base type definition.

XML Schema recommendations allow type redefinition either by restriction or extension (`xs:restriction` or `xs:extension`). According to SAFE specialisation rules, it is *very strongly* recommended:

Redefinition of Manifest Types shall be done by restriction (`xs:restriction`). Use of `xs:extension` can *not* guarantee a SAFE Specialisation to "be" an instance of SAFE.

`xs:any` Wild Cards have been added to SAFE Types. These Wild Cards allow addition of New Specific Types.

3.2.2. Use of xs:import

SAFE uses several namespaces. In particular, the "container" XFDU Types and the "contained" SAFE Types have two different namespaces.

The SAFE Manifest of a SAFE Product is an "XFDU container"; its namespace is `urn:ccsds:schema:xfdu:1`. According to the XML Schema recommendations, the only method to allow SAFE Types (which are qualified) inside XFDU Types is to use `xs:import`.

The only method to allow New Specific Types (defined and provided by a SAFE Specialisation) as part of XFDU Types and/or SAFE Types is to use `xs:import` too.

3.2.3. Use of xs:include

Use of `xs:include` for specialising SAFE Types and XFDU Types is neither recommended, nor forbidden. From our experience (specialisation of 49 SAFE Products), `xs:include` mechanism is simply not interesting.

`xs:include` mechanism *can* be useful for New Specific Types (management of XML schemas), for types qualified with the same namespace.

3.2.4. Global or Local Types?

XML Schema recommendations allow to declare types and elements. Declared types are global types, i.e. modifiables. Declared elements can be local typed, i.e. not modifiables. The following examples illustrate the two methods:

```
<xs:element name="familyName"
            type="safe:platformFamilyNameType"

<xs:simpleType name="platformFamilyNameType">
   <xs:restriction base="xs:string"/>
</xs:simpleType>
```

Example 3.5. Declaration of a global type

```
<xsd:element name="familyName" type="xs:string"/>
```

Example 3.6. Declaration of an element of local type

For Manifest Types, it is *strongly* recommended to declare global types and use these to declare elements (as declared within the Example 3.5).

This method allows redefinition by restriction of types and, consequently, of elements of those latter.

3.2.5. XML Schema Validation Limit

XML Schema role is mainly to control and validate the *structure* of an XML file and *not* its content. Even if XML Schema can also be used to control and validate *some* fields content (by use of `xs:enumeration` or `xs:pattern`), for very open XML Schemas like safe.xsd and xfdu.xsd this validation is incomplete.

For a fully complete and guaranteed validation, use of specific tools is needed (Schematron, XQuery, etc.).

3.3. XFDU Types

3.3.1. Restriction

SAFE provides XFDU Types. Even if a SAFE Product is able to contain many information (for example an unbounded number of Data Objects, an unbounded number of Metadata Objects, etc.), every product contains a fixed quantity of Data and Metadata.

```
An xfdu:dataObjectSectionType allows from one to unbounded number of
dataObjects:

dataObject (from 1 to n);

For an ENVISAT GOMOS NL level 0 product, there is a single Data Object
holding recorded measurements:

dataObject (1);

ENVISAT GOMOS NL level 0 Specialisation shall restrict the
xfdu:dataObjectSectionType in order to avoid any case of validating
an ENVISAT GOMOS NL level 0 product holding more than a single Data Object:

<xs:complexType name="dataObjectSectionType">
   <xs:complexContent>
      <xs:restriction base="xfdu:dataObjectSectionType">
         <xs:sequence>
            <xs:element name="dataObject" type="xfdu:dataObjectType"
                        form="unqualified"
                        minOccurs="1" maxOccurs="1"/>
         </xs:sequence>
      </xs:restriction>
   </xs:complexContent>
</xs:complexType>

The ENVISAT GOMOS NL level 0 product single Data Object holds recorded
measurements:

Data Object = Measurements

ENVISAT GOMOS NL level 0 Specialisation shall restrict the
xfdu:dataObjectSectionType in order to:
- avoid any case of validating an ENVISAT GOMOS NL level 0 product
holding other Data Object than measurements;
- avoid any case of validating an ENVISAT GOMOS NL level 0 product
holding a Data Object without a Representation Information:

<xs:complexType name="dataObjectType">
   <xs:complexContent>
      <xs:restriction base="xfdu:dataObjectType">
         <xs:sequence>
            <xs:element name="byteStream" type="xfdu:byteStreamType"
                        form="unqualified"/>
         </xs:sequence>
         <xs:attribute name="ID" use="required">
            <xs:simpleType>
               <xs:restriction base="xs:ID">
                  <xs:enumeration value="measurementData"/>
               </xs:restriction>
            </xs:simpleType>
         </xs:attribute>
         <xs:attribute name="repID" type="xs:IDREFS" use="required"/>
      </xs:restriction>
   </xs:complexContent>
```

```
    </xs:complexType>
```

Example 3.7. Why Restrict XFDU Types?

The following recommendation can be provided:

If possible, value and occurrences shall always be restricted.

3.3.2. Use of Content Units

The Information Package Map (`xfdu:informationPackageMapType`) outlines a hierarchical structure for the original object being encoded, by a series of nested contentUnit elements [XFDU].

SAFE provides an `informationPackageMap` that can contain only one `contentUnit`: this single `contentUnit` is *a view* of the SAFE Product.

SAFE provides a `contentUnit` that can contain none or one `dataObjectPointer`, and none, one or more `contentUnit`(s):

- each `contentUnit` (except the "Root" `contentUnit` i.e. the unique sub-element of `informationPackageMap`) shall be *a view* of a SAFE Object. This *does not* mean that "each SAFE Object has a dedicated `contentUnit`".
- for each Data Component, there shall be a `contentUnit`;
- for each Metadata Component (except XML Schema Component), there shall be a `contentUnit`;
- for each `contentUnit`, *view* of a SAFE Object composed of a Data Component or a Metadata Component (except XML Schema Component):
  - the `contentUnit` shall have a `dataObjectPointer` sub-element pointing on a `dataObject` referencing the Data Component or the Metadata Component;
  - as each Data Component and Metadata Component (except XML Schema Component) *must* have a Representation Information, the `contentUnit` shall hold a `repID` attribute pointing on one or more `metadataObject`(s) referencing an XML Schema Component;

SAFE provides an `ID` attribute to `contentUnit`. Its use is recommended, even if not mandatory. `contentUnit` element has also a `unitType` attribute: its use is not recommanded, since it is not a perfect identifier (even if not prohibited).

As an example of use of Content Units, a SAFE Manifest for ERS AMI SAR Level 0 Product is provided in Appendix A.

3.3.3. Relationship between metadataObject and dataObject

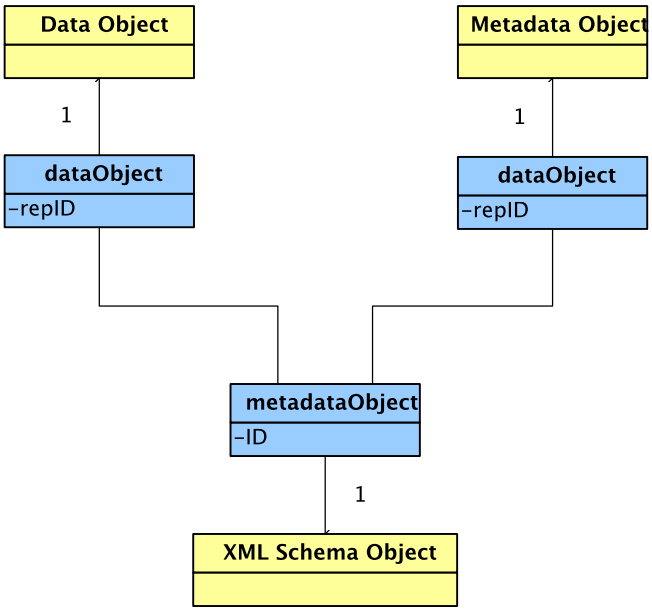
As introduced in the Section 2.1, classification of information as Data or Metadata is delicate. Classifying two information, one as Data, the other as Metadata, it's applying a *view* on both information.

XFDU (and so SAFE) provides two kinds of "objects-types": `dataObjectType` and `metadataObjectType`. As defined in the [SAFE-CORE] :

- `metadataObject` is always part of a Metadata Object (never part of a Data Object);
- `dataObject` is always part of a Data Object *or can be part of a Metadata Object*.

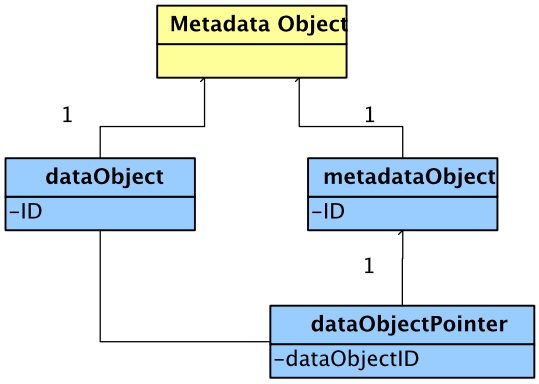
A dataObject and a metadataObject shall be linked together in the following cases:

- for the `metadataObject`, part of an XML Schema Object, `ID` attribute shall be pointed by the `repID` attribute hold by the `dataObject` part of the associated Data Object or Metadata Object;



metadataObject and dataObject Linking

- for the `dataObject`, part of a Metadata Object, `ID` attribute shall be pointed by the `dataObjectID` attribute of `dataObjectPointer` sub-element of the `metadataObject`.



metadataObject and dataObject Linking

3.4. SAFE Types

3.4.1. Restriction

SAFE provides SAFE Types. Even if a SAFE Type is able to contain many information, for some products some of the information are not available.

```
For safe:orbitReferenceType, the following sub-elements are provided:

Orbit Number (from 0 to 2);
Relative Orbit Number (from 0 to 2);
Cycle Number (from 0 to 1);
Phase Identifier (from 0 to 1);
Start Track (from 0 to 1);
Stop Track (from 0 to 1);
Any Information (Wild Card) (from 0 to unbounded).

If a product contains information about:
- Orbit Number (1)
- Relative Orbit Number (1)
- Cycle Number (1)
- Phase Identifier (1)
and does not contain any other orbit information, the
safe:orbitReferenceType shall be restricted in order to avoid any
case of misinformation:

<xs:complexType name="orbitReferenceType">
   <xs:complexContent>
      <xs:restriction base="safe:orbitReferenceType">
         <xs:sequence>
            <xs:element name="orbitNumber"
                        type="safe:orbitNumberType"
                        minOccurs="1" maxOccurs="1"/>
            <xs:element name="relativeOrbitNumber"
                        type="safe:relativeOrbitNumberType"
                        minOccurs="1" maxOccurs="1"/>
            <xs:element name="cycleNumber"
                        type="safe:cycleNumberType"
                        minOccurs="1" maxOccurs="1"/>
            <xs:element name="phaseIdentifier"
                        type="safe:phaseIdentifierType"
                        minOccurs="1" maxOccurs="1"/>
         </xs:sequence>
      </xs:restriction>
   </xs:complexContent>
</xs:complexType>
```

Example 3.8. Why Restrict SAFE Types?

The following recommendation can be provided:

If possible, value and occurrences shall always be restricted.

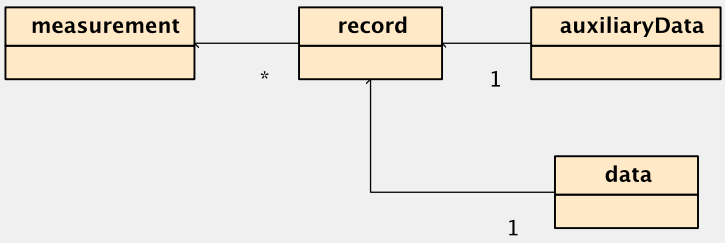
3.4.2. Use of safe:qualityInformationType

The [SAFE-CORE] provides the definition of `safe:qualityInformationType`.

`safe:qualityInformationType` has been designed in order to list all missing and corrupted units detected in a product. Role of a Quality Information Metadata Object is also to list all the parts of a product checked without detected error.

SAFE provides many elements and attributes for the listing of missing and corrupted units (`safe:location/safe:path`, `safe:location/safe:time`, elements, `following`, `after`, `preceding` and `before` attributes...). Even if it is possible to freely use `safe:missingElementsType` and `safe:corruptedElementsType`, some recommendations can be provided with plenty of examples.

An example of a product is provided in order to illustrate following recommendations. The product (with a `measurement` root node) is a concatenation of `records`. Each `record` has two mandatory sub-elements: `auxiliaryData` and `data` (each one is a single unsignedByte element).



Example 3.9. Logical view of a Component

```
<xs:element name="measurement">
   <xs:complexType>
      <xs:sequence>
         <xs:element name="record" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
               <xs:sequence>
                  <xs:element name="auxiliaryData" type="xs:unsignedByte"/>
                  <xs:element name="data"          type="xs:unsignedByte"/>
               </xs:sequence>
            </xs:complexType>
         </xs:element>
      </xs:sequence>
   </xs:complexType>
</xs:element>
```

Example 3.10. XML Schema, Representation Information of a Component

3.4.2.1. Corrupted and Missing Units

One thing important to understand is that:

- the corrupted units are present in the product but their value are wrong;
- the missing units are *not* present in the product while they should.

This leads to the possibility for corrupted units to locate them using only an XPath, while it's impossible to locate the missing units using only an XPath since the missing units do not exist in the product. For missing units use of safe:path attributes and/or safe:count element is mandatory.

For example, if a physical product contains 10 records and it has been detected that there are 5 missing records, it means that the product should contain 15 records. safe:path attributes and/or safe:count will allow to locate the 5 “non-present” records.

3.4.2.2. Use of safe:missingElementsType

3.4.2.2.1. Cases of Unknown Location

3.4.2.2.1.1. Missing Units - Unknown Location

If missing units have been detected, but their location are completly unknown, a `safe:missingElements` element shall be created using XPath of `safe:location/safe:path` element and `safe:count` element.

```
<safe:missingElements>
   <safe:location>
      <safe:path>
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.11. 3 Detected Missing Records - Unknown Location

3.4.2.2.1.2. Missing Units - Unknown Location (but beginning of the product is known and correct)

If missing units have been detected, but their location are partially unknown (the beginning of the product is known and correct), a `safe:missingElements` element shall be created using XPath and `after` attribute of `safe:location/safe:path` element, and `safe:count` element.

```
<safe:missingElements>
   <safe:location>
      <safe:path after="100">
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.12. 3 Detected Missing Records - Unknown Location (but we know that the records #1 to #100 are present)

3.4.2.2.1.3. Missing Units - Unknown Location (but end of the product is known and correct)

If missing units have been detected, but their location are partially unknown (the end of the product is known and correct), a `safe:missingElements` element shall be created using XPath and `before` attribute of `safe:location/safe:path` element, and `safe:count` element.

```
<safe:missingElements>
   <safe:location>
      <safe:path before="100">
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.13. 3 Detected Missing Records - Unknown Location (but we know that after the record #100, all records are present)

3.4.2.2.1.4. Missing Units in a Segment

If missing units have been detected in a segment of units, a `safe:missingElements` element shall be created using XPath, `after` and `before` attributes of `safe:location/safe:path` element, and `safe:count` element.

```
<safe:missingElements>
```

```
      <safe:location>
         <safe:path after="200" before="300">
            measurement/record
         </safe:path>
      </safe:location>
      <safe:count value="3"/>
   </safe:missingElements>
```

Example 3.14. 3 Detected Missing Records (located between records #200 to #300)

3.4.2.2.2. Cases of Known Location

3.4.2.2.2.1. Missing Unit(s) (neither first nor last elements of a sequence)

If missing units have been detected and located (neither first nor last elements of a sequence), a `safe:missingElements` element shall be created using XPath, `following` *or/and* `preceding` attributes of `safe:location/safe:path` element, and `safe:count` element.

```
   <safe:missingElements>
      <safe:location>
         <safe:path following="3">
            measurement/record
         </safe:path>
      </safe:location>
      <safe:count value="3"/>
   </safe:missingElements>
```

Example 3.15. 3 Detected Missing Records (records #4, #5, #6): first case

```
   <safe:missingElements>
      <safe:location>
         <safe:path preceding="4">
            measurement/record
         </safe:path>
      </safe:location>
      <safe:count value="3"/>
   </safe:missingElements>
```

Example 3.16. 3 Detected Missing Records (records #4, #5, #6): second case

```
<safe:missingElements>
   <safe:location>
      <safe:path following="3" preceding="4">
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.17. 3 Detected Missing Records (records #4, #5, #6): third case

3.4.2.2.2.2. Missing Unit(s) (first elements of a sequence)

If missing units (first elements of a sequence) have been detected, a `safe:missingElements` element shall be created using XPath, `preceding` attribute of `safe:location/safe:path` element, and `safe:count` element.

```
<safe:missingElements>
   <safe:location>
      <safe:path preceding="1">
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.18. 3 Detected Missing Records (records #1, #2, #3)

3.4.2.2.2.3. Missing Unit(s) (last elements of a sequence)

If missing units (last elements of a sequence) have been detected, a `safe:missingElements` element shall be created using XPath, `following` attribute of `safe:location/safe:path` element, and `safe:count` element.

```
<safe:missingElements>
   <safe:location>
      <safe:path following="99">
         measurement/record
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:missingElements>
```

Example 3.19. 3 Detected Missing Records (records #100, #101, #102 should be present - the product last record is the #99)

3.4.2.2.2.4. Time Located Missing Unit(s)

If missing units have been detected and time located, a `safe:missingElements` element shall be created using `safe:location/safe:time/safe:start` and `safe:location/safe:time/safe:stop` elements (and `safe:location/safe:path` element since the product can gather more than one Data Object).

```
<safe:missingElements>
   <safe:location>
      <safe:time>
         <safe:start>2004-12-16T23:55:53.000000Z</safe:start>
         <safe:stop>2004-12-16T23:55:57.55555Z</safe:stop>
      </safe:time>
      <safe:path>
         measurement/record
      </safe:path>
   </safe:location>
</safe:missingElements>
```

Example 3.20. Detected Missing Records (between 2004-12-16T23:55:53.000000Z and 2004-12-16T23:55:57.55555Z)

3.4.2.3. Use of safe:corruptedElementsType

3.4.2.3.1. Cases of Unknown Location

3.4.2.3.1.1. Corrupted Units - Unknown Location

If corrupted units have been detected, but their location are completly unknown, a

`safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and `safe:count` element.

```
<safe:corruptedElements>
   <safe:location>
      <safe:path>
         measurement/record/data
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:corruptedElements>
```

Example 3.21. 3 Detected Corrupted data elements - Unknown Location

3.4.2.3.1.2. Corrupted Units - Unknown Location (but beginning of the product is known and correct)

If corrupted units have been detected, but their location are partially unknown (the beginning of the product is known and correct), a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and `safe:count` element.

```
<safe:corruptedElements>
   <safe:location>
      <safe:path>
         <![CDATA[measurement/record[fn:position() > 100]/data]]>
      </safe:path>
   </safe:location>
   <safe:count value="3"/>
</safe:corruptedElements>
```

Example 3.22. 3 Detected Corrupted data elements - Unknown Location (but we know that the records #1 to #100 are correct)

3.4.2.3.1.3. Corrupted Units - Unknown Location (but end of the product is known and correct)

If corrupted units have been detected, but their location are partially unknown (the end of the product is known and correct), a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and `safe:count` element.

```
<safe:corruptedElements>
   <safe:location>
      <safe:path>
```

```
            <![CDATA[measurement/record[fn:position() < 101]/data]]>
         </safe:path>
      </safe:location>
      <safe:count value="3"/>
   </safe:corruptedElements>
```

Example 3.23. 3 Detected Corrupted data elements - Unknown Location (but we know that the records #101 to the end of the product are correct)

3.4.2.3.1.4. Corrupted Units in a Segment

If corrupted units have been detected in a segment of units, a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and `safe:count` element.

```
   <safe:corruptedElements>
      <safe:location>
         <safe:path>
             <![CDATA[measurement/record[fn:position() > 200
                and fn:position() < 300]/data]]>
         </safe:path>
      </safe:location>
      <safe:count value="3"/>
   </safe:corruptedElements>
```

Example 3.24. 3 Detected Corrupted data elements (located between records #200 to #300)

3.4.2.3.2. Cases of Known Location

3.4.2.3.2.1. Corrupted Unit(s) (neither first nor last elements of a sequence)

If corrupted units have been detected and located (neither first nor last elements of a sequence), a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and *non-mandatory* `safe:count` element.

```
   <safe:corruptedElements>
      <safe:location>
         <safe:path>
             <![CDATA[measurement/record[fn:position() > 3
                and fn:position() < 7]/data]]>
         </safe:path>
      </safe:location>
      <safe:count value="3"/> non mandatory
   </safe:corruptedElements>
```

Example 3.25. 3 Detected Corrupted data elements (data of records #4, #5, #6)

3.4.2.3.2.2. Corrupted Unit(s) (first elements of a sequence)

If corrupted units (first elements of a sequence) have been detected, a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and *non-mandatory* `safe:count` element.

```
<safe:corruptedElements>
   <safe:location>
      <safe:path>
          <![CDATA[measurement/record[fn:position() < 4]/data]]>
      </safe:path>
   </safe:location>
   <safe:count value="3"/> non mandatory
</safe:corruptedElements>
```

Example 3.26. 3 Detected Corrupted data elements (data of records #1, #2, #3)

3.4.2.3.2.3. Corrupted Unit(s) (last elements of a sequence)

If corrupted units (last elements of a sequence) have been detected, a `safe:corruptedElements` element shall be created using XPath of `safe:location/safe:path` element and *non-mandatory* `safe:count` element.

```
<safe:corruptedElements>
   <safe:location>
      <safe:path>
          <![CDATA[measurement/record[fn:position() > 99]/data]]>
      </safe:path>
   </safe:location>
   <safe:count value="3"/> non mandatory
</safe:corruptedElements>
```

Example 3.27. 3 Detected Corrupted data elements (data of records #100, #101, #102 - the product last record is the #102)

3.4.2.3.2.4. Time Located Corrupted Unit(s)

If corrupted units have been detected and time located, a `safe:corruptedElements` element shall be created using `safe:location/safe:time/safe:start` and `safe:location/safe:time/safe:stop` elements (and `safe:location/safe:path` element since the product can gather more than one Data Object).

```
<safe:corruptedElements>
   <safe:location>
      <safe:time>
         <safe:start>2004-12-16T23:55:53.000000Z</safe:start>
         <safe:stop>2004-12-16T23:55:57.55555Z</safe:stop>
      </safe:time>
      <safe:path>
         measurement/record
      </safe:path>
   </safe:location>
</safe:corruptedElements>
```

Example 3.28. Detected Corrupted Records (between 2004-12-16T23:55:53.000000Z and 2004-12-16T23:55:57.55555Z)

3.4.3. Use of Wild Cards

Some SAFE Types (`safe:acquisitionPeriodType`, `safe:instrumentType`...) allow, thanks to an `xs:any` Wild Card, elements which *are not* SAFE Types.

Any element “using” a Wild Card to be part of a SAFE Type:

- *shall* be qualified with a namespace different from `http://www.esa.int/safe/1.3`;
- *shall* have its type (a New Specific Type) fully defined by a SAFE Specialisation.

Wild Cards have been introduced in SAFE to prevent from using `xs:extension` mechanism. For the same goal, a SAFE Abstract Specialisation can define New Specific Types which allow Wild Cards (for further SAFE Specialisation(s)).

Wild Cards can be used according to the *critical* definition provided in Chapter 1.

Exemple of Use of the Platform Wilcard (ENVISAT ASAR APC Level 0 Specialisation) follows:

```
[...]
<metadataObject ID="platform"
                classification="DESCRIPTION" category="DMD">
   <metadataWrap textInfo="Platform Description"
                 vocabularyName="SAFE" mimeType="text/xml">
      <xmlData>
         <safe:platform>
            <safe:nssdcIdentifier>2002-009A</safe:nssdcIdentifier>
```

```
            <safe:familyName>ENVISAT</safe:familyName>
            <safe:number>1</safe:number>
            <safe:instrument>
               <safe:familyName abbreviation="ASAR"
               >Advanced Synthetic Aperture Radar</safe:familyName>
               <asar:txRxPolar>HV/HV</asar:txRxPolar>
               <asar:swath>IS3</asar:swath>
            </safe:instrument>
            <safe:timeReference>
               <safe:utc>2004-11-19T21:25:46.600940Z</safe:utc>
               <safe:clock>535089664</safe:clock>
               <safe:clockStep>3906249803</safe:clockStep>
            </safe:timeReference>
         </safe:platform>
      </xmlData>
   </metadataWrap>
</metadataObject>

[...]
```

Example 3.29. Manifest File for ENVISAT ASAR APC Level 0 Product

```
[...]

<xs:schema xmlns:xs  ="http://www.w3.org/2001/XMLSchema"
           xmlns:asar="http://www.esa.int/safe/1.3/envisat/asar"
           targetNamespace="http://www.esa.int/safe/1.3/envisat/asar"
           elementFormDefault="qualified">

   <xs:element name="txRxPolar" type="asar:txRxPolarType"/>
   <xs:element name="swath" type="asar:swathType"/>

   <xs:simpleType name="txRxPolarType">
      <xs:restriction base="xs:string"/>
   </xs:simpleType>

   <xs:simpleType name="swathType">
      <xs:restriction base="xs:string"/>
   </xs:simpleType>

</xs:schema>

[...]
```

Example 3.30. XML Schema Defining New Specific Types for ENVISAT ASAR Level 0 Products

```
[...]

<xs:complexType name="instrumentType">
   <xs:complexContent>
      <xs:restriction base="safe:instrumentType">
         <xs:sequence>
            <xs:element name="familyName"
                        type="safe:instrumentFamilyNameType"/>
            <xs:element name="number"
                        type="safe:instrumentNumberType"
                        minOccurs="0"/>
            <xs:element name="sideLookingAngle"
                        type="safe:sideLookingAngleType"
                        minOccurs="0"/>
            <xs:element name="fieldOfView"
                        type="safe:fieldOfViewType"
                        minOccurs="0"/>
            <xs:element ref="asar:txRxPolar"/>
            <xs:element ref="asar:swath"/>
         </xs:sequence>
      </xs:restriction>
   </xs:complexContent>
</xs:complexType>

[...]
```

Example 3.31. XML Schema Redefining instrumentType for ENVISAT ASAR Level 0 Products

3.5. Specialisation Types

SAFE provides SAFE Types for basic data of an EO product. For some products, some data cannot match the definition of any SAFE Type.

If needed, a SAFE Specialisation (possibly a SAFE Abstract Specialisation) shall provide New Specific Types. These types shall be fully defined by the SAFE Specialisation, qualified with a new namespace. Elements from New Specific Types shall become part of XFDU Types and/or SAFE Types.

If possible, value and occurrences shall be restricted.

Chapter 4. Representation Information of Data and Metadata Components

4.1. The Package and the XML Schema Components

SAFE *do not* impose any place within the SAFE Product for the XML Schema Components. These XML Schema Components can be placed in any subfolder within the SAFE Product.

Example of multi-folders within the SAFE Product:

```
My-SAFE-Product/manifest.safe
               /measurement-one.dat
               /measurement-two.dat
               /schemas/shared/types.xsd
               /schemas/measurement-one.xsd
               /schemas/measurement-two.xsd
```

Example 4.32. Example of Multi-Folders

Even if it is up to the creator of the specialisation to provide the location of the XML Schema Components, the following recommendation can be provided:

All XML Schema Components shall be put in a single folder named *rep-info*.

Example of single "rep-info" folder within the SAFE Product:

```
My-SAFE-Product/manifest.safe
               /measurement-one.dat
               /measurement-two.dat
               /rep-info/types.xsd
               /rep-info/measurement-one.xsd
               /rep-info/measurement-two.xsd
```

Example 4.33. Example of single "rep-info" folder

4.2. XML Schema Mechanisms

4.2.1. Use of xs:redefine

No recommendation is provided about use of `xs:redefine`.

4.2.2. Use of xs:import

No recommendation is provided about use of `xs:import`.

4.2.3. Use of xs:include

Use of `xs:include` for "calling" Additional abstract XML Schemas is recommended. This mechanism is simpler than other mechanisms provided by XML. All elements and types used by an XML Schema Object, if qualified, shall share the same namespace.

4.2.4. Global or Local Types?

As defined in the Section 3.2.4, XML Schema recommendations allow to declare types and elements. Declared types are global types, i.e. modifiables. Declared elements can be local typed, i.e. not modifiables.

For elements and types provided by an XML Schema Component, the following recommendations can be provided:

- if the type can be used inside another XML Schema Component, then it can be provided by an Additional abstract XML Schema as a global type;
- if the type is used only inside a single XML Schema Component, then it can be provided as a local type.

4.3. Accuracy Depth

SAFE is a *Standard Archive Format*. Long-term preservation of any data is pretty useless if after years noone knows what represent these data. So, the following recommendation can be provided:

Representation Information of any data hold by a SAFE Product shall be as accurate as possible.

These information can also be available in the SAFE Specialisation Control Book or in an existing specification referenced by the SAFE Specialisation Control Book.

Chapter 5. Product Identification

A SAFE Product is composed of multiple files (a SAFE Manifest and a collection of Components). As well the SAFE Manifest as the Components names shall not have a reference to the product.

For example a Manifest file shall almost always be named “manifest.safe” or “MANIFEST.SAFE”.

The name of the product shall be the name of the *directory* which gathers all the files of the SAFE Product (with the exception the SAFE Product is only composed of a SAFE Manifest).

Inside the SAFE Manifest of a product, there is a mandatory `version` attribute, which role is to identify the SAFE Product Specialisation or the SAFE Auxiliary Specialisation (and its major/minor version) defining content of the product.

Value of the `version` attribute shall *always* be defined by the SAFE Product Specialisation or the SAFE Auxiliary Specialisation.

The `version` attribute value *must* be a perfect identifier.

Examples of `version` value follow:

```
For an ENVISAT ASAR APC Level 0 Product:
   version="esa/safe/1.3/envisat/asar/apc/level-0"

For a Landsat MSS Level 0 Product:
   version="esa/safe/1.3/landsat/mss/level-0"

For a MODIS (TERRA or AQUA platform) Level 0 Product:
   version="esa/safe/1.3/modis/level-0"
```

Example 5.34. `version` Value

Chapter 6. Namespaces and Prefixes

6.1. Manifest File Representation Information

A SAFE Manifest contains elements and types qualified with several namespaces. Principal namespaces are:

- the SAFE namespace `http://www.esa.int/safe/1.3`;
- the SAFE - Active Sensor namespace `http://www.esa.int/safe/1.3/active-sensor`;
- the XFDU namespace `urn:ccsds:schema:xfdu:1`;
- the GML namespace `http://www.opengis.net/gml`;

If using a prefix inside the SAFE Manifest for anyone of these namespaces, it is recommended to create a prefix as explicit as possible:

- for `http://www.esa.int/safe/1.3`: “safe”;
- for `http://www.esa.int/safe/1.3/active-sensor`: “safe-as”;
- for `urn:ccsds:schema:xfdu:1`: “xfdu”;
- for `http://www.opengis.net/gml`: “gml”;

A New Specific Type, if provided by a SAFE Specialisation *must* be qualified with a new namespace. The following recommendation can be provided:

A namespace defined by a SAFE Specialisation *must* be a perfect identifier.

If using a prefix inside the SAFE Manifest for any new namespace, it is recommended to create a prefix as explicit as possible.

Examples of new namespace and associated prefix follow:

```
"http://www.esa.int/safe/1.3/envisat/gomos" (used prefix "gomos")
"http://www.esa.int/safe/1.3/seastar"       (used prefix "seastar")
"http://www.esa.int/safe/1.3/modis"         (used prefix "modis")
```

Example 6.35. Namespace and Prefix Defined for a New Specific Type

6.2. Component Representation Information

An XML Schema Component gathers elements and types qualified with several namespaces. Two namespaces are mandatory:

- the XML Schema namespace `http://www.w3.org/2001/XMLSchema` (current version);
- the SDF namespace `http://www.gael.fr/2005/04/drb/sdf` (current version).

If using a prefix inside the XML Schema Component for anyone of these namespaces, it is recommended to create a prefix as explicit as possible:

- for `http://www.w3.org/2001/XMLSchema`: “xs”;
- for `http://www.gael.fr/2005/04/drb/sdf`: “sdf”.

Elements and types defined by an XML Schema Component shall be qualified with a namespace. The following recommendations can be provided:

- a namespace defined for an element or a type *must* be a perfect identifier.
- regarding the XML Schemas tree (with included or imported XML Schemas), choice of a namespace shall be done *very carefully*.

If using a prefix inside an XML Schema Component for any new namespace, it is recommended to create a prefix as explicit as possible.

Examples of new namespace and associated prefix follow:

```
"http://www.esa.int/safe/1.3/envisat" (used prefix "envisat")
"http://www.esa.int/safe/1.3/seastar"  (used prefix "seastar")
"http://www.esa.int/safe/1.3/modis"    (used prefix "modis")
```

Example 6.36. Namespace and Prefix Defined for Elements and Types

Chapter 7. Naming Recommendations

7.1. File Naming Recommendations

7.1.1. SAFE Package

According to the [SAFE-CORE], SAFE Products are usually composed of a SAFE Manifest and one or more Component(s). The SAFE Product shall be packaged either in a directory or in another type of packaging (zip, tar, etc.). For the name of the directory or package file, the following recommendation can be provided:

The directory or package file shall be named:

“MMNN_PPPPPPPPPP_ttttttttttttttt_TTTTTTTTTTTTTTT_FFF_OOOOOO_XXXX.EEEE”

where:

- “MM”: platform name: 2 uppercase letters;
- “NN”: mission number: 2 digits;
- “PPPPPPPPPP”: product type: 10 uppercase letters, digits or underscores “_”;
- “ttttttttttttttt”: product start time, where:
  - “ttttttttttttttt” = “YYYY” (year: 4 digits) + “MM” (month: 2 digits) + “DD” (day: 2 digits) + “T” (constant) + “HH” (hours: 2 digits) + “MM” (minutes: 2 digits) + “SS” (seconds: 2 digits).
- “TTTTTTTTTTTTTTT”: product stop time, where:
  - “TTTTTTTTTTTTTTT” = “YYYY” (year: 4 digits) + “MM” (month: 2 digits) + “DD” (day: 2 digits) + “T” (constant) + “HH” (hours: 2 digits) + “MM” (minutes: 2 digits) + “SS” (seconds: 2 digits).
- “FFF”: originating facility which has generated the product: 3 characters;
- “OOOOOO”: platform absolute orbit: up to 6 characters (no leading zeroes);
- “XXXX”: CRC-16 computed on the SAFE Manifest: 4 hexadecimal characters;
- “.EEEE”: the SAFE extension: “SAFE”.

Examples of SAFE Product composed only of a SAFE Manifest follow:

```
"EN01_ASA_WS__0P_20050130T080000_20050130T081000_ESR_15263_1FA5.SAFE"
"ER01_AT1_ATS_0P_19920531T234020_19920601T012340_GAT_4584_1FA5.SAFE"
```

Example 7.37. SAFE Manifest Names (products composed only of a SAFE Manifest)

7.1.2. Manifest File

According to the [SAFE-CORE], for SAFE Products which are composed of a SAFE Manifest and one or more Component(s), the SAFE Manifest File *must* be named “manifest.safe” or “MANIFEST.SAFE”.

For SAFE Products which are *only* composed of a SAFE Manifest, the following recommendation can be provided:

The SAFE Manifest shall be named:

“MMNN_PPPPPPPPPP_tttttttttttttt_TTTTTTTTTTTTTTT_FFF_OOOOOO_XXXX.EEEE”

where:

- “MM”: platform name: 2 uppercase letters;
- “NN”: mission number: 2 digits;
- “PPPPPPPPPP”: product type: 10 uppercase letters, digits or underscores “_”;
- “tttttttttttttt”: product start time, where:
  - “tttttttttttttt” = “YYYY” (year: 4 digits) + “MM” (month: 2 digits) + “DD” (day: 2 digits) + “T” (constant) + “HH” (hours: 2 digits) + “MM” (minutes: 2 digits) + “SS” (seconds: 2 digits).
- “TTTTTTTTTTTTTTT”: product stop time, where:
  - “TTTTTTTTTTTTTTT” = “YYYY” (year: 4 digits) + “MM” (month: 2 digits) + “DD” (day: 2 digits) + “T” (constant) + “HH” (hours: 2 digits) + “MM” (minutes: 2 digits) + “SS” (seconds: 2 digits).
- “FFF”: originating facility which has generated the product: 3 characters;
- “OOOOOO”: platform absolute orbit: up to 6 characters (no leading zeroes);
- “XXXX”: CRC-16 computed on the SAFE Manifest: 4 hexadecimal characters;
- “.EEEE”: the SAFE extension: either “safe” or “SAFE”.

Examples of SAFE Product composed only of a SAFE Manifest follow:

```
"EN01_ASA_WS__0P_20050130T080000_20050130T081000_ESR_15263_1FA5.safe"
"ER01_AT1_ATS_0P_19920531T234020_19920601T012340_GAT_4584_1FA5.safe"
```

Example 7.38. SAFE Manifest Names (products composed only of a SAFE Manifest)

7.1.3. Data Components

The [SAFE-CORE] defines that:

Binary Data Components shall always be named:

```
filename = “[a-z,0-9,-].dat”
```

ASCII Data Components shall always be named:

```
filename = “[a-z,0-9,-].txt”
```

XML Data Components shall always be named:

```
filename = “[a-z,0-9,-].xml”
```

Even if the part of the name *before* the extension “.dat”, “.txt” or “.xml” is free, the following recommendation can be provided.

The name of a Data Component shall be as explicit as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

```
A Data Component holding measurement data could be named:
      “measurement.dat”
```

Example 7.39. Name of a Data Component

```
A Data Component holding the ocean wave spectrum of a small, high-resolution,
complex image could be named:
      “ocean-wave-spectra.dat”
```

Example 7.40. Name of a Data Component

```
A Data Component holding information describing the pressure, temperature
and height correction profiles could be named:

      “pressure-temperature-height.dat”
```

Example 7.41. Name of a Data Component

7.1.4. Metadata Components

The [SAFE-CORE] defines that:

Binary Metadata Components shall always be named:

```
filename = “[a-z,0-9,-].dat”
```

ASCII Metadata Components shall always be named:

```
filename = “[a-z,0-9,-].txt”
```

XML Metadata Components shall always be named:

```
filename = “[a-z,0-9,-].xml”
```

Even if the part of the name *before* the extension “.dat”, “.txt” or “.xml” is free, the following recommendation can be provided.

The name of a Metadata Component shall be as explicit as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

```
A Metadata Component holding an index for a measurement Data Component could
be named:

      “measurement-index.dat”
```

Example 7.42. Name of a Metadata Component

```
A Metadata Component holding the reference star spectrum measurement
corresponding to a measurement Data Component could be named:

      “reference-star-spectrum.dat”
```

Example 7.43. Name of a Metadata Component

```
A Metadata Component holding solar angles (nadir view) could be named:

      “nadir-view-solar-angles.dat”
```

Example 7.44. Name of a Metadata Component

7.1.5. XML Schema Components

7.1.5.1. Manifest File Representation Information

7.1.5.1.1. XFDU Types and SAFE Types

A SAFE Manifest gathers elements and types defined by:

- the xfdu.xsd XML Schema provided in the Appendix A of the [SAFE-CORE] (for XFDU Types).
- the safe.xsd XML Schema provided in the Appendix B of the [SAFE-CORE] (for SAFE Types).

As defined in the Chapter 3, there can be one or more SAFE Abstract Specialisation(s) involved in a SAFE Product Specialisation or in a SAFE Auxiliary Specialisation (i. e. a SAFE Specialisation provides one or more redefinition(s) of XFDU Types and one or more redefinition(s) of SAFE Types).

The following recommendations can be provided.

- Every XML Schema which redefines XFDU Types shall be named “xfdu.xsd”;
- Every XML Schema which redefines SAFE Types shall be named “safe.xsd”.

Multiple xfdu.xsd and multiple safe.xsd shall be distinct because placed in appropriate directories.

If a single directory gathers more than one xfdu.xsd XML Schema or more than one safe.xsd XML Schema, the following recommendations can be provided.

- The XML Schema which redefines XFDU Types shall be named “xfdu-[a-z,-].xsd”;
- The XML Schema which redefines SAFE Types shall be named “safe-[a-z,-].xsd”.

The name of the XML Schema shall be defined freely but as explicitly as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

7.1.5.1.2. New Specific Types

Several SAFE Types allow Wild Cards, by use of `xs:any`. For some SAFE Specialisations, new New Specific Types defined by the SAFE Specialisation shall be required inside SAFE Types.

SAFE allows also New Specific Types as Wrapped Metadata Objects. The following example can be part of a SAFE Manifest of a product defined by a SAFE Specialisation.

```
[...]

   <metadataObject ID="occultationInformation"
                   classification="DESCRIPTION" category="DMD">
      <metadataWrap textInfo="Occultation Information"
                    vocabularyName="SAFE" mimeType="text/xml">
         <xmlData>
            <gomos:occultation>
               <gomos:duration>7050</gomos:duration>
               <gomos:number>14</gomos:number>
               <gomos:samplingDuration>500</gomos:samplingDuration>
               <gomos:measurementNumber>141</gomos:measurementNumber>
            </gomos:occultation>
         </xmlData>
      </metadataWrap>
   </metadataObject>

[...]
```

Example 7.45. New Specific Type as a Wrapped Medatada Object

These new types shall be defined in one or more XML Schema(s).

The following recommendations can be provided.

The XML Schema shall be named “[a-z,-]-types.xsd”.

The name of the XML Schema shall be defined freely but as explicitly as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

7.1.5.2. Component Representation Information

The [SAFE-CORE] defines that each Component *must* have a Representation Information.

Each Component (Data Component or Metadata Component; ".dat", ".txt" or ".xml") shall be accompanied with an XML Schema Component describing its content.

The [SAFE-CORE] defines that:

- XML schemas which describe binary, XML or ASCII Data Components or Metadata Components shall always be named:

```
filename = "[a-z,0-9,-].xsd"
```

- Additional abstract XML Schemas shall always be named:

```
filename = "[a-z,-]-object-types.xsd"
```

Even if the part of the name *before* the extension ".xsd" (for Additional abstract XML Schemas, *before* "-object-types.xsd") is free, the following recommendations can be provided.

- The name of an XML Schema Component, unique or part of the Representation Information of a Data Component or a Metadata Component shall be as explicit as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).
- The name of an XML Schema Component which describes a Data Component or a Metadata Component shall match the name of the Data Component or the Metadata Component (except extensions).

```
An XML Schema Component which describes a Metadata Component named:
      "nadir-view-solar-angles.dat"
shall be named:
      "nadir-view-solar-angles.xsd"
```

Example 7.46. Name of an XML Schema Component

- The name of an XML Schema Component which is an Additional abstract XML Schema shall be defined freely but as explicitly as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

```
An Additional Abstract XML Schema referenced by all Level 0 Products of a
platform named:

      “ETERNITY”

could be named:

      “eternity-level-0-object-types.xsd”
```

Example 7.47. Name of an Additional Abstract XML Schema

7.2. Entities Naming

A SAFE Specialisation shall use types (SAFE Types and XFDU Types) provided by SAFE.

But a SAFE Specialisation defines new types, specific to the Specialisation. It *can* define New Specific Types for the SAFE Manifest, and *shall* define types and elements for the Representation Information of Components.

Whether it is for the SAFE Manifest or for the Representation Information of Components, types and elements defined shall be named following these recommendations:

Entities name shall use only [a-z,A-Z,0-9,-] characters.

Entities name shall be lowerCamelCase (mixed case with a lowercase first letter, internal words start with capital letters).

Name of an entity shall be as explicit as possible (avoid acronyms and abbreviations, unless the abbreviation is much more widely used than the long form, such as URL or XML).

Examples of recommended element and type name follow:

```
measurementRecord

instrumentStatus

instrumentStatusType

packetFieldHeaderType
```

Example 7.48. Recommended Entities Field Naming

Examples of not recommended element and type name follow:

```
measurement-record
measurement_record
measRec
MEAS-REC
```

Example 7.49. Not Recommended Entities Field Naming

7.3. Manifest File Field Values

Many XFDU Types hold one or more attributes. These attributes can be classified in two categories:

- attributes holding an information (`mimeType`, `unitType`...);
- attributes permitting the internal linking (`ID`, `repID`...).

For attributes of first category, either the [SAFE-CORE] provides enumerations or allow any value regarding the XML Type (`xs:string`, `xs:double`...).

For attributes of second category, either the [SAFE-CORE] provides mandatory patterns (for `metadataObject/@ID` only), or allow any value regarding the XML Type (`xs:NCName`).

The [SAFE-CORE] defines relationships between Content Units, dataObjects and metadataObjects. If these relationships are defined for basic cases (an index, a Data Component...), value of attributes permitting the internal linking is not mentioned.

7.3.1. Root Content Unit

While recommended at Section 3.3.2, the `ID` attribute of the root `contentUnit` should be used.

Value of this `ID` attribute is free but the following recommendation can be provided.

Value of the `ID` attribute of the root `contentUnit` shall always be “packageUnit”.

```
<informationPackageMap>
   <xfdu:contentUnit ID="packageUnit"
                     textInfo="ERS AMI SAR Level 0"
                     pdiID="processing"
                     dmdID="acquisitionPeriod platform">
      [...]
   </xfdu:contentUnit>
```

```
    </informationPackageMap>
```

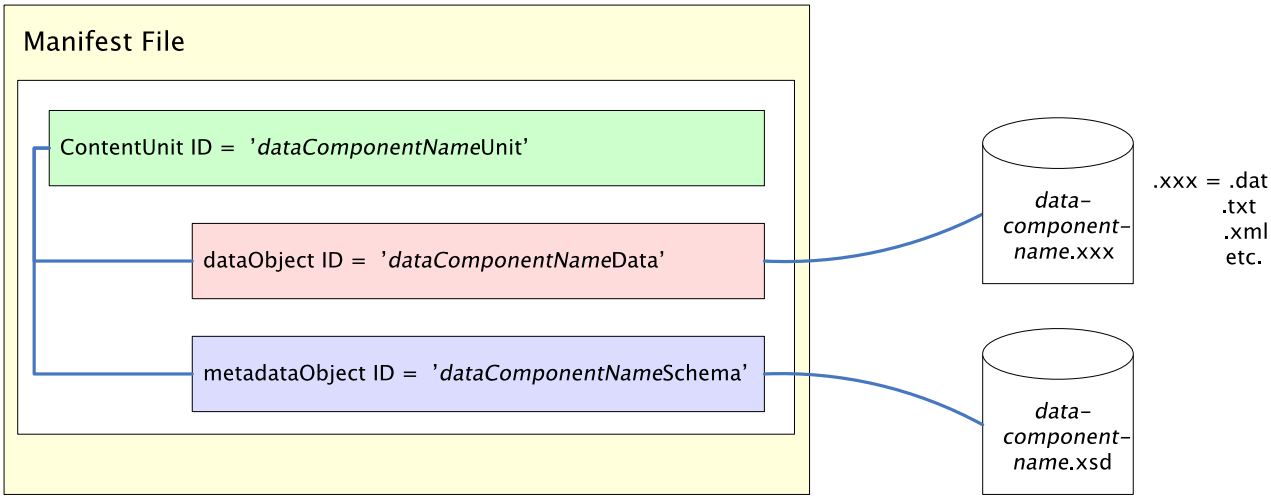
Example 7.50. Manifest File Field Values: The ID attribute of the Root Content Unit

7.3.2. Case of Data Object and its Representation Information (and their common Content Unit)

The [SAFE-CORE] defines:

- a Data Object is constituted of a `dataObject` element and a Data Component;
- an XML Schema Object is constituted of a `metadataObject` element and an XML Schema Component.

ID value of the `dataObject` element, ID value of the `metadataObject` element, ID value of the `contentUnit` pointing to these objects, filename of the Data Component and filename of the XML Schema Component shall be as close as possible (except for suffixes “Data”, “Schema” or “Unit”, extensions “.dat” / “.xml” / “.txt” or “.xsd”, and regarding the recommendations provided in Section 7.1.3, Section 7.1.5.2 and Section 7.2). The following figure and example illustrate this recommendation:



Manifest File Field Values: Data Object and its Representation Information

```
[...]
```

```
   <xfdu:contentUnit ID="aerosolsUnit"
                     repID="aerosolsSchema
                            envisatSchema">
      <dataObjectPointer dataObjectID="aerosolsData"/>
   </xfdu:contentUnit>

[...]

   <metadataObject ID="aerosolsSchema"
                   classification="SYNTAX" category="REP">
      <metadataReference locatorType="URL" href="aerosols.xsd"
                         vocabularyName="SDF" mimeType="text/xml"/>
   </metadataObject>

[...]

   <dataObject ID="aerosolsData"
               repID="aerosolsSchema
                      envisatSchema">
      <byteStream mimeType="application/octet-stream">
         <fileLocation locatorType="URL" href="aerosols.dat"/>
         <checksum checksumName="MD5">e94f8303ad92d056c3b2d0d5d250111b</checksum>
      </byteStream>
   </dataObject>

[...]
```

Example 7.51. Manifest File Field Values: Data Object and its Representation Information, and their common Content Unit

7.3.3. Case of Referenced Metadata Object

7.3.3.1. Case of XML Schema Object

7.3.3.1.1. Case of XML Schema Describing a Component

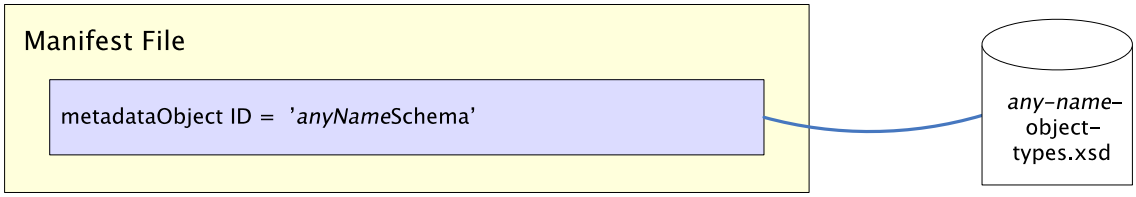
This case is treated in Section 7.3.2.

7.3.3.1.2. Case of Additional Abstract XML Schema

The [SAFE-CORE] defines:

- an Additional abstract XML Schema (a particular case of XML Schema Object) is constituted of a `metadataObject` element and a XML Schema Component.

ID value of the `metadataObject` element and filename of the XML Schema Component shall be free, but as close as possible (regarding the recommendations provided in Section 7.1.5.2 and Section 7.2). The following figure and example illustrate this recommendation:



Manifest File Field Values: Case of Additional Abstract XML Schema

```
[...]
   <metadataObject ID="envisatLevel0MeasurementSchema"
                   classification="SYNTAX" category="REP">
      <metadataReference locatorType="URL"
                         href="envisat-level-0-object-types.xsd"
                         vocabularyName="SDF" mimeType="text/xml"/>
   </metadataObject>
[...]
```

Example 7.52. Manifest File Field Values: Case of Additional Abstract XML Schema

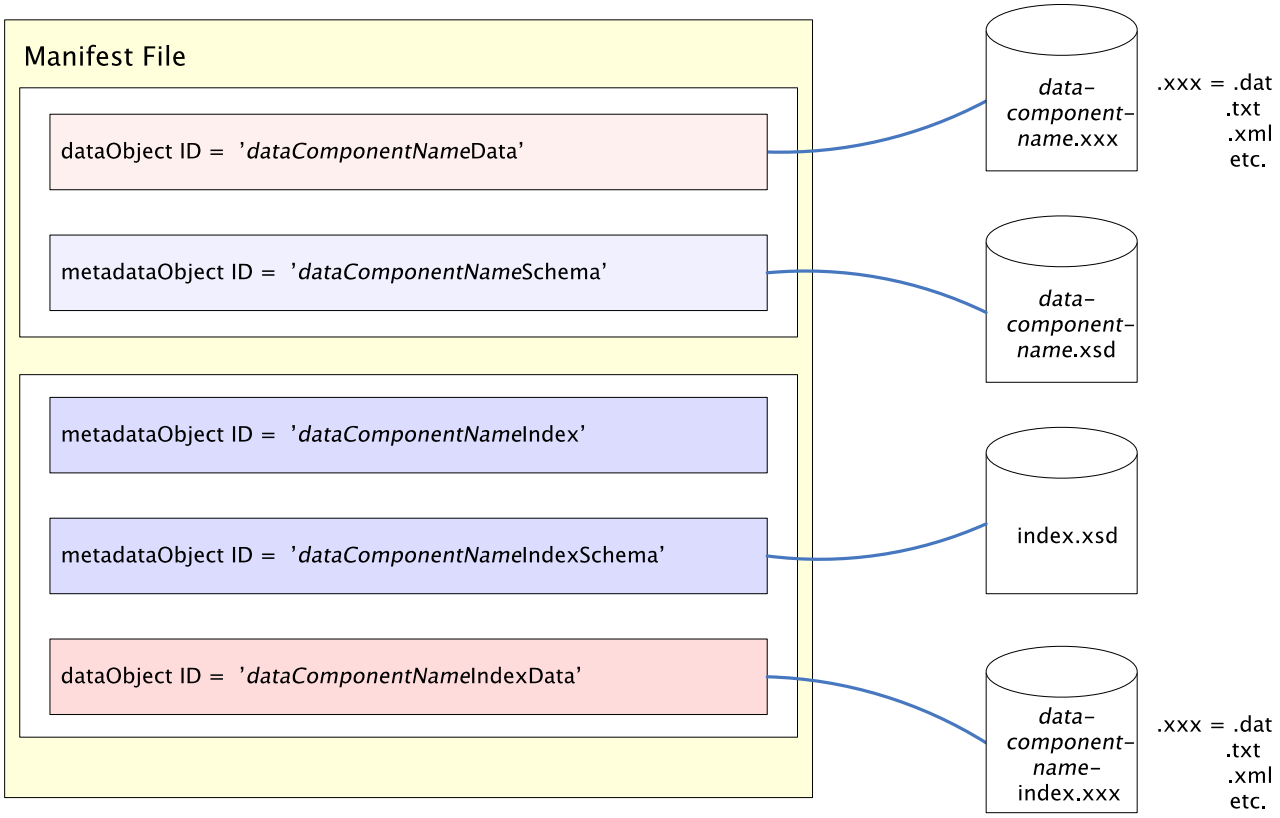
7.3.3.2. Case of Metadata Object

7.3.3.2.1. Case of Data Index Object and its Representation Information

The [SAFE-CORE] defines:

- a Metadata Object holding an index is constituted of a `metadataObject` element, a `dataObject` element and a Metadata Component;
- an XML Schema Object is constituted of a `metadataObject` element and a XML Schema Component;
- for a Data Object or a Metadata Object, there shall be only one index file; for an index file, there shall be only one Data Object or Metadata Object.

ID value of the two `dataObject` elements (both for data file and its index), ID value of the three `metadataObject` elements (both for data file and its index), filename of the Data Component and filename of the Metadata Components shall be as close as possible (except for suffixes “Data”, “Schema”, “Index”, “IndexData” or “IndexSchema”, extensions “.dat” / “.xml” / “.txt” or “.xsd”, and regarding the recommendations provided in Section 7.1.3, Section 7.1.4, Section 7.1.5.2 and Section 7.2). Note that for any index, the Representation Information is the index.xsd XML Schema provided in the Appendix E of the [SAFE-CORE] . The following figure and example illustrate this recommendation:



Manifest File Field Values: Case of Data Index Object and its Representation Information

```
[...]

   <dataObject ID="measurementData"
               repID="measurementSchema">
      <byteStream mimeType="application/octet-stream">
         <fileLocation locatorType="URL" href="measurement.dat"
                  textInfo="Measurement Data Set File"/>
            <checksum checksumName="MD5">
               e94f8303ad92d056c3b2d0d5d250111b</checksum>
      </byteStream>
   </dataObject>

[...]

   <metadataObject ID="measurementSchema"
                   classification="SYNTAX" category="REP">
      <metadataReference locatorType="URL" href="measurement.xsd"
                         vocabularyName="SDF" mimeType="text/xml"/>
   </metadataObject>

[...]

   <metadataObject ID="measurementIndex"
                   classification="DESCRIPTION" category="DMD">
```

```
      <dataObjectPointer
                    dataObjectID="measurementIndexData"/>
   </metadataObject>

[...]

   <metadataObject ID="measurementIndexSchema"
                    classification="SYNTAX" category="REP">
      <metadataReference locatorType="URL"
                           href="index.xsd"
                           vocabularyName="SDF" mimeType="text/xml"/>
   </metadataObject>

[...]

   <dataObject ID="measurementIndexData"
               repID="measurementIndexSchema">
      <byteStream mimeType="application/octet-stream">
         <fileLocation locatorType="URL" href="measurement-index.dat"
                 textInfo="Measurement Data Set Index File"/>
            <checksum checksumName="MD5">
               e94f8303ad92d056c3b2d0d5d250111b</checksum>
      </byteStream>
   </dataObject>

[...]
```

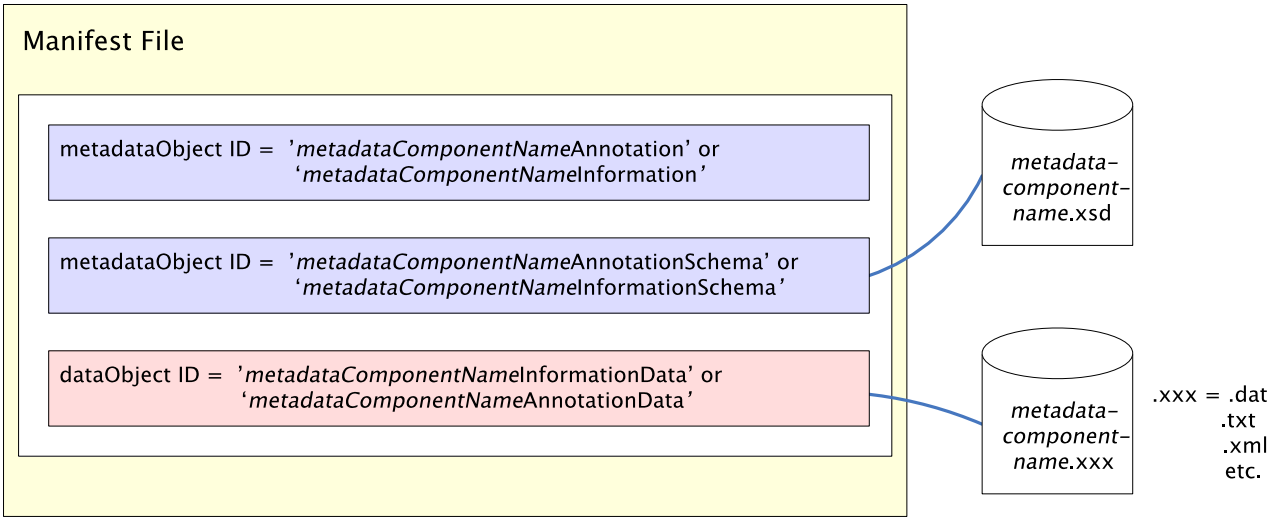
Example 7.53. Manifest File Field Values: Case of Data Index Object and its Representation Information

7.3.3.2.2. Case of Metadata Object (not an index)

The [SAFE-CORE] defines:

- a Metadata Object is constituted of a `metadataObject` element, a `dataObject` element and a Metadata Component;
- an XML Schema Object is constituted of a `metadataObject` element and a XML Schema Component.

ID value of the `dataObject` element, ID value of the two `metadataObject` elements, filename of the Metadata Component and filename of the XML Schema Component shall be as close as possible (except for suffixes “Annotation” or “Information”, “AnnotationData” or “InformationData”, “AnnotationSchema” or “InformationSchema”, extensions “.dat” / “.xml” / “.txt” or “.xsd”, and regarding the recommendations provided in Section 7.1.4, Section 7.1.5.2 and Section 7.2). The following figure and example illustrate this recommendation:



Manifest File Field Values: Case of Metadata Object (not an index)

```
[...]

   <metadataObject ID="landSeaMaskInformation"
                   classification="DESCRIPTION" category="DMD">
      <dataObjectPointer
                   dataObjectID="landSeaMaskInformationData"/>
   </metadataObject>

[...]

   <metadataObject ID="landSeaMaskInformationSchema"
                   classification="SYNTAX" category="REP">
      <metadataReference locatorType="URL"
                         href="land-sea-mask.xsd"
                         vocabularyName="SDF" mimeType="text/xml"/>
   </metadataObject>

[...]

   <dataObject ID="landSeaMaskInformationData"
               repID="landSeaMaskInformationSchema">
      <byteStream mimeType="application/octet-stream">
         <fileLocation locatorType="URL" href="land-sea-mask.dat"
                 textInfo="Measurement Data Set Index File"/>
            <checksum checksumName="MD5">
               e94f8303ad92d056c3b2d0d5d250111b</checksum>
      </byteStream>
   </dataObject>

[...]
```

Example 7.54. Manifest File Field Values: Case of Metadata Object (not an index)

Appendix A. ERS AMI SAR Level 0 Specialisation: Example of SAFE Manifest document (informative)

```
<?xml version="1.0" encoding="UTF-8"?>

<!--
   SAFE - Standard Archive Format for Europe
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-->


<!-- ERS AMI SAR Level 0 archive.
     This document is a sample manifest file of a SAFE archive. -->

<xfdu:XFDU xmlns:xfdu="urn:ccsds:schema:xfdu:1"
           xmlns:safe="http://www.esa.int/safe/1.3"
           xmlns:gml ="http://www.opengis.net/gml"
           version   ="esa/safe/1.3/ers/ami/sar/level-0">

   <!-- ====================================================================
        INFORMATION PACKAGE MAP SECTION
        ==================================================================== -->
   <informationPackageMap>

      <xfdu:contentUnit ID="packageUnit"
                        textInfo="ERS AMI SAR Level 0"
                        pdiID="processing"
                        dmdID="acquisitionPeriod platform">

         <!-- The single ERS AMI SAR Level 0 measurement data set -->
         <xfdu:contentUnit ID="measurementUnit"
                           textInfo="Measurement Data Unit"
                           dmdID="measurementQualityInformation
                                  measurementOrbitReference
                                  measurementFrameSet
                                  measurementIndex"
                           repID="measurementSchema">

            <dataObjectPointer dataObjectID="measurementData"/>

         </xfdu:contentUnit>

         <!-- An index to the measurement data set for access efficiency -->
         <xfdu:contentUnit ID="measurementIndexUnit"
```

```
                        textInfo="Measurement Data Index"
                        repID="measurementIndexSchema">

            <dataObjectPointer dataObjectID="measurementIndexData"/>

         </xfdu:contentUnit>

      </xfdu:contentUnit>

   </informationPackageMap>

   <!-- Metadata Section -->
   <metadataSection>

      <!-- Processing -->
      <metadataObject ID="processing"
                      classification="PROVENANCE" category="PDI">
         <metadataWrap mimeType="text/xml" vocabularyName="SAFE"
                       textInfo="Processing">
            <xmlData>
               <safe:processing name="Conversion from MDPS to SAFE format"
                                start="2006-01-12T15:27:50.975000Z">
                  <safe:facility country="France" name="ACS"
                                 organisation="ACS"
                                 site="Roma">
                     <safe:software name="ACS ERS SAR Transformer"
                                    version="1.1"/>
                  </safe:facility>
                  <safe:resource name=
                  "AMI_SAR__0P_20021231T042805_20021231T061130_PS_40239.E2"
                                 role="Input data">
                     <safe:processing name="Downlink">
                        <safe:facility country="Sweden" name="Kiruna"
                                       organisation="ESA" site="Kiruna"/>
                     </safe:processing>
                  </safe:resource>
               </safe:processing>
            </xmlData>
         </metadataWrap>
      </metadataObject>

      <!-- Acquisition Period -->
      <metadataObject ID="acquisitionPeriod"
                      classification="DESCRIPTION" category="DMD">
         <metadataWrap textInfo="Acquisition Period"
                       vocabularyName="SAFE" mimeType="text/xml">
            <xmlData>
               <safe:acquisitionPeriod>
                  <safe:startTime>2004-05-18T00:30:55.134207Z</safe:startTime>
                  <safe:stopTime>2004-05-18T00:30:57.134207Z</safe:stopTime>
               </safe:acquisitionPeriod>
            </xmlData>
         </metadataWrap>
      </metadataObject>

      <!-- Platform description -->
      <metadataObject ID="platform"
                      classification="DESCRIPTION" category="DMD">
         <metadataWrap textInfo="Platform Description"
                       vocabularyName="SAFE" mimeType="text/xml">
            <xmlData>
               <safe:platform>
                  <!-- Platform identification -->
```

```
                <safe:nssdcIdentifier>1995-021A</safe:nssdcIdentifier>
                <safe:familyName>ERS</safe:familyName>
                <safe:number>2</safe:number>
                <!-- Instrument identification -->
                <safe:instrument>
                   <safe:familyName abbreviation="AMI"
                   >Active Microwave Instrument</safe:familyName>
                   <safe:mode identifier="IM">Image Mode</safe:mode>
                </safe:instrument>
                <safe:timeReference>
                   <safe:utc>2004-03-12T09:38:12.354666</safe:utc>
                   <safe:clock>2521531000</safe:clock>
                   <safe:clockStep>23524000</safe:clockStep>
                </safe:timeReference>
                <safe:timeReference>
                   <safe:utc>2005-03-12T09:38:12.354666</safe:utc>
                   <safe:clock>2521531000</safe:clock>
                   <safe:clockStep>23524000</safe:clockStep>
                </safe:timeReference>
             </safe:platform>
          </xmlData>
       </metadataWrap>
    </metadataObject>

    <!-- Quality information of the measurements -->
    <metadataObject ID="measurementQualityInformation"
                    classification="DESCRIPTION" category="DMD">
       <metadataWrap textInfo="Quality Information"
                     vocabularyName="SAFE" mimeType="text/xml">
          <xmlData>
             <safe:qualityInformation>
                <!-- RangeLine 23 is missing -->
                <safe:missingElements>
                   <safe:location>
                      <safe:path following="22">
                         measurements/rangeLine
                      </safe:path>
                   </safe:location>
                   <safe:count value="1"/>
                </safe:missingElements>
                <!-- 5 RangeLines are missing
                     We only know that there are before the 54th record -->
                <safe:missingElements>
                   <safe:location>
                      <safe:path before="54">
                         measurements/rangeLine
                      </safe:path>
                   </safe:location>
                   <safe:count value="5"/>
                </safe:missingElements>
                <!-- 4 CORRUPTED (UNKNOWNCAUSE) RangeLines -
                position #7, #8, #9, #10 -->
                <safe:corruptedElements>
                   <safe:location>
                      <safe:path>
                         measurements/rangeLine[
                            position() > 6 and position() &lt; 11]
                      </safe:path>
                   </safe:location>
                </safe:corruptedElements>
             </safe:qualityInformation>
          </xmlData>
       </metadataWrap>
```

```
      </metadataObject>

      <!-- Orbital reference of the measurements -->
      <metadataObject ID="measurementOrbitReference"
                      classification="DESCRIPTION" category="DMD">
         <metadataWrap textInfo="Orbit Reference"
                       vocabularyName="SAFE" mimeType="text/xml">
            <xmlData>
               <safe:orbitReference>
                  <safe:orbitNumber type="start"
                                    groundTrackDirection="ascending"
                                    >79</safe:orbitNumber>
                  <safe:relativeOrbitNumber
                     type="start">7</safe:relativeOrbitNumber>
                  <safe:cycleNumber>27</safe:cycleNumber>
                  <safe:phaseIdentifier>2</safe:phaseIdentifier>
               </safe:orbitReference>
            </xmlData>
         </metadataWrap>
      </metadataObject>

      <!-- Frame set of the measurements -->
      <metadataObject ID="measurementFrameSet"
                      classification="DESCRIPTION" category="DMD">
         <metadataWrap textInfo="Frame Set" vocabularyName="SAFE"
                       mimeType="text/xml">
            <xmlData>
               <safe:frameSet>
                  <safe:footPrint
                     srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
                     <gml:coordinates>-44.286612,-14.937040 -75.312935,-11.387472
                     -75.312935,-11.387472</gml:coordinates>
                  </safe:footPrint>
               </safe:frameSet>
            </xmlData>
         </metadataWrap>
      </metadataObject>

      <!-- Measurement Data Set Index Representation Information -->
      <metadataObject ID="measurementIndex"
                      classification="DESCRIPTION" category="DMD">
         <dataObjectPointer dataObjectID="measurementIndexData"/>
      </metadataObject>

      <!-- Measurement Schema -->
      <metadataObject ID="measurementSchema"
                      classification="SYNTAX" category="REP">
         <metadataReference locatorType="URL" href="rep-info/measurement.xsd"
                            vocabularyName="SDF" mimeType="text/xml"/>
      </metadataObject>

      <!-- Measurement Data Set Index Representation Information -->
      <metadataObject ID="measurementIndexSchema"
                      classification="SYNTAX" category="REP">
         <metadataReference locatorType="URL" href="rep-info/index.xsd"
                            vocabularyName="SDF" mimeType="text/xml"/>
      </metadataObject>

   </metadataSection>

   <!-- ====================================================================
        DATA OBJECT SECTION
        ==================================================================== -->
```

```
   <dataObjectSection>

      <!-- Measurement -->
      <dataObject ID="measurementData"
                  repID="measurementSchema">
         <byteStream mimeType="application/octet-stream">
            <fileLocation locatorType="URL" href="measurement.dat"
                          textInfo="Measurement Data Set File"/>
            <checksum
               checksumName="MD5">3bf095eedf4b8c9c87252dda8aeec1c0</checksum>
         </byteStream>
      </dataObject>

      <!-- Index -->
      <dataObject ID="measurementIndexData"
                  repID="measurementIndexSchema">
         <byteStream mimeType="application/octet-stream">
            <fileLocation locatorType="URL" href="measurement-index.dat"
                          textInfo="Measurement Data Set Index File"/>
            <checksum
               checksumName="MD5">d5fg4d4g3fds45s3s3d4fs36d3f45</checksum>
         </byteStream>
      </dataObject>

   </dataObjectSection>

</xfdu:XFDU>
```

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Version 1.3, 3 November 2008

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Document Improvement Proposal		
Document I.D. PGSI-GSEG-EOPG-FS-05-0002	**Document Title.** Standard Archive Format for Europe Control Book - Volume 2 - Recommendation for specialisations	**Document Status.** Issue 1 Revision 11 - 2010-06-22
Recommended Improvement. (identify clauses, subclauses and include modified text and/or graphic, attach pages as necessary)		
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