

# EUROCONTROL Specification for SWIM Information Definition

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**EUROCONTROL Specification  
for  
SWIM Information Definition**

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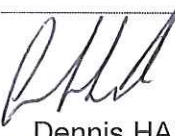


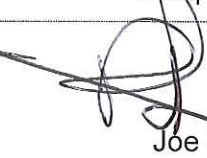


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Abstract			
<p>This specification contains requirements for information definitions, meaning the formal descriptions of exchanged information, in the context of Initial System Wide Information Management (iSWIM). This contributes to semantic interoperability of information.</p>			
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## DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

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## EXECUTIVE SUMMARY

This specification contains requirements for information definitions in the context of Initial System Wide Information Management (iSWIM) in Europe.

Information definitions, the formal descriptions of exchanged information, are produced or reused by operational stakeholders. They act as the means whereby the exchanged information is clearly defined, understood and harmonised between stakeholders. Examples of information definitions are the description of information exchanged by services, standardised information exchange models, data catalogues used to list details on the exchanged information, and information exchanges captured as part of a business process model.

The requirements come in two broad categories: general requirements for information definitions and requirements on how to document semantic correspondence to the ATM Information Reference Model (AIRM).

The general requirements include, for example, the need for an edition and a reference date.

The semantic correspondence requirements facilitate semantic interoperability, which is the ability of computer systems to exchange data with unambiguous, shared meaning. The requirements ensure that information definitions conform to the semantics of the AIRM, the common reference language for iSWIM.



# 1. Introduction

## 1.1 Purpose

This specification contains requirements for information definitions in the context of Initial System Wide Information Management (iSWIM) in Europe.

Information definitions, the formal descriptions of exchanged information, are produced or reused by operational stakeholders. They act as the means whereby the exchanged information is clearly defined, understood and harmonised between stakeholders. Examples of information definitions are the description of information exchanged by services, standardised information exchange models, data catalogues used to list details on the exchanged information, and information exchanges captured as part of a business process model.

The requirements come in two broad categories: general requirements for information definitions and requirements on how to document semantic correspondence to the ATM Information Reference Model (AIRM) [RD 2].

The general requirements include, for example, the need for an edition and a reference date.

The semantic correspondence requirements facilitate semantic interoperability, which is the ability of computer systems to exchange data with unambiguous, shared meaning. The requirements ensure that information definitions conform to the semantics of the AIRM, the common reference language for iSWIM.

## 1.2 Scope

This specification places general and semantic interoperability requirements on information definitions.

This specification does not include requirements on the content or structure of the AIRM as these are maintained in a separate AIRM Rulebook [RD 3].

Furthermore, it is not in the scope of this specification to impose a specific format or notation (such as Unified Modeling Language (UML) or Extensible Markup Language (XML) Schema) on information definitions.

## 1.3 Applicability

iSWIM supports “*information exchanges that are built on standards and delivered through an internet protocol (IP)-based network by SWIM enabled systems*”[RD 1]. It lists four areas for information exchanges:

1. aeronautical information exchange;
2. meteorological information exchange;
3. cooperative network information exchange; and
4. flight information exchange.

The Pilot Common Project Regulation (PCP) [RD 1] requires that service implementations in support of the listed information exchanges “*be compliant with the applicable version of [the ATM] Information Reference Model (AIRM), the AIRM Foundation Material and the Information Service Reference Model (ISRM) Foundation Material*” (see sections 5.1.3, 5.1.4, 5.1.5 and 5.1.6 of the Annex to the Pilot Common Project).

Satisfying the requirements of this specification can be considered a means of compliance for the enabling ATM functionality iSWIM as defined by the PCP [RD 1] in relation to the AIRM and its “*Foundation Material*”.

This specification can also be adopted outside of the specific PCP context by those seeking to

achieve the benefits of SWIM.

## 1.4 Target Audience

The target audience for this specification includes, but is not limited to:

- operational stakeholders implementing services supporting the exchange of information over SWIM This audience includes:
  - business experts procuring systems and services;
  - technical experts designing and implementing systems and services; and
  - operational experts expressing operational needs in terms of information exchange requirements;
- oversight authorities.

## 1.5 Conventions

The following conventions are used in this EUROCONTROL specification:

- **'shall'** - indicates a requirement that must be implemented to provide conformity with this specification;
- **'should'** - indicates a requirement that is recommended to achieve the best possible implementation of this specification; and
- **'may'** - indicates an option.

Annex B to this specification provides the conformity checklist indicating, per requirement, the level of implementation to be achieved – see tables 4 and 5.

Each requirement is detailed in a table with the following structure.

<b>Title</b>	Title of the requirement, used as a short name for the requirement for mnemonic and readability purposes.
<b>Identifier</b>	Unique identifier of the requirement.
<b>Requirement</b>	Statement expressing the requirement.
<b>Rationale</b>	Justification of the existence of the requirement.
<b>Verification</b>	Quality characteristics to be assessed when inspecting an information definition with regards to the requirement. This field can have as value any combination of the following: <ul style="list-style-type: none"> <li>• Completeness<sup>1</sup></li> <li>• Consistency<sup>2</sup></li> <li>• Correctness<sup>3</sup></li> </ul>
<b>Examples/Notes</b>	Examples in support of the requirement or additional notes to clarify the requirement. The examples and the notes are informative.

**Table 1 – Requirement structure**

<sup>1</sup> E.g., that an edition number is present.

<sup>2</sup> E.g., that an edition number is present.

<sup>3</sup> E.g., that an expression of semantic correspondence is correct.

## 1.6 Abbreviations

Abbreviation	Term
<b>AIRM</b>	ATM Information Reference Model
<b>AIS</b>	Aeronautical Information Services
<b>AIXM</b>	Aeronautical Information Exchange Model
<b>AMXM</b>	Aerodrome Mapping Exchange Model
<b>ATM</b>	Air Traffic Management
<b>ERAF</b>	EUROCONTROL Advisory Framework
<b>EU</b>	European Union
<b>FIXM</b>	Flight Information Exchange Model
<b>ICAO</b>	International Civil Aviation Organization
<b>IETF RFC</b>	The Internet Engineering Task Force Request for Comments
<b>IP</b>	Internet Protocol
<b>IR</b>	Implementing Regulation
<b>ISO</b>	International Organization for Standardization
<b>ISRM</b>	Information Service Reference Model
<b>iSWIM</b>	Initial System Wide Information Management
<b>IWXXM</b>	ICAO Meteorological Information Exchange Model
<b>NAF</b>	NATO Architecture Framework
<b>PCP</b>	Pilot Common Project
<b>SESAR</b>	Single European Sky ATM Research
<b>SKOS</b>	Simple Knowledge Organization System
<b>SWIM</b>	System Wide Information Management
<b>UML</b>	Unified Modeling Language
<b>URN</b>	Uniform Resource Name

<b>WXXM</b>	Weather Information Exchange Model
<b>XML</b>	Extensible Markup Language

***Table 2 – List of abbreviations***

## 1.7 Definitions

Term	Definition	Source
<b>AIRM concept</b>	An information concept or data concept that is represented and managed in the AIRM.	-
<b>AIRM conformant information definition</b>	An information definition that conforms to the semantics of the AIRM.	-
<b>completeness</b>	The degree to which the content contains the expected information.	Adapted from ISO/IEC 25012:2008 [RD 6]
<b>concept</b>	A representation of a notion, a unit of thought.	Adapted from SKOS [RD 9]
<b>consistency</b>	The degree to which the content is free from contradiction and is coherent within itself and with referenced resources.	Adapted from ISO/IEC 25012:2008 [RD 6]
<b>correctness</b>	The degree to which the content correctly represents the true value.	Adapted from ISO/IEC 25012:2008 – Accuracy [RD 6]
<b>data</b>	A representation of fact, concept, or instruction represented in a formalized form suitable for communication, interpretation or processing either by human and/or by automated systems.	-
<b>data concept</b>	A specification of a concept using descriptive text and a given data type.	Adapted from SKOS [RD 9]
<b>data type</b>	A specification of a value domain with operations allowed on values in this domain.  <i>Example: Integer, Real, Boolean, String, Date and SG Point (conversion of data into a series of codes).</i>  <i>Note: Data types include primitive predefined types and user-definable types.</i>	ISO/TS 19103:2005 [RD 5]
<b>information</b>	Any communication or representation of knowledge such as facts, data, or opinions in any medium or form, including textual, numerical, graphic, cartographic, narrative, biometric or audio.	-
<b>information concept</b>	A specification of a concept using descriptive text only.	Adapted from SKOS [RD 9]
<b>information definition</b>	A formal representation of information concepts or data concepts.	-
<b>information exchange model</b>	A document in a formal language identifying the information that is agreed to be shared between two or more organisations or groups.  <i>Note: The document may be in, for example, UML or XML.</i>	-

Term	Definition	Source
<b>information exchange requirement</b>	A specification of the information that is to be exchanged.	NAF v3 [RD 15]
<b>mapping</b>	A set of traces that establishes a semantic correspondence between a concept in an information definition and AIRM concepts.	-
<b>metadata</b>	Data about data. <i>Note: The latest version of the ISO 19115 expands the definition to be "Information about a resource".</i>	ISO 19115:2003/Cor 1:2006 [RD 4]
<b>namespace</b>	A set of elements in which each element has a name unique within that set. The same name may be associated with elements in different sets.	Adapted from Oxford English Dictionary
<b>operational stakeholders</b>	Civil and military: airspace users, air navigation service providers and airport operators. <i>Note: The operational stakeholders are identified in the Annex to the Implementing Regulation.</i>	EU Implementing Regulation No 409/2013 [RD 8]
<b>semantic correspondence</b>	The relation between a concept in an information definition and the AIRM. <i>Note: A semantic correspondence takes the form of a mapping to AIRM concepts based on their meanings, an out-of-scope declaration, a declaration that no semantic correspondence has been established or a reference to a change request.</i>	-
<b>semantic interoperability</b>	The ability of computer systems and organisations to exchange data with unambiguous, shared meaning	-
<b>trace</b>	A directed link from a concept in an information definition to an AIRM concept.	-

**Table 3 – List of terms with definition**

## 1.8 Reference Material

- [RD 1] Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan
- [RD 2] ATM Information Reference Model
- [RD 3] ATM Information Reference Model Rulebook

- [RD 4] International Organization for Standardization – ISO 19115:2003/Cor 1:2006 - Geographic information — Metadata
- [RD 5] International Organization for Standardization – ISO/TS 19103:2005 - Geographic information — Conceptual schema language
- [RD 6] International Organization for Standardization – ISO/IEC 25012:2008 - Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Data quality model
- [RD 7] ICAO Doc 10039 - Manual on System Wide Information Management (SWIM) Concept
- [RD 8] Commission Implementing Regulation (EU) No 409/2013 of 3 May 2013 on the definition of common projects, the establishment of governance and the identification of incentives supporting the implementation of the European Air Traffic Management Master Plan
- [RD 9] Simple Knowledge Organization System (SKOS), <http://www.w3.org/TR/2009/REC-skos-reference-20090818/#concepts>
- [RD 10] Aeronautical Information Exchange Model (AIXM), [www.aixm.aero](http://www.aixm.aero)
- [RD 11] Flight Information Exchange Model (FIXM), [www.fixm.aero](http://www.fixm.aero)
- [RD 12] Aerodrome Mapping Exchange Model (AMXM), [www.amxm.aero](http://www.amxm.aero)
- [RD 13] Weather Information Exchange Model (WXXM) [www.wxxm.aero](http://www.wxxm.aero)
- [RD 14] ICAO Meteorological Information Exchange Model (IWXXM) <https://schemas.wmo.int/iwxxm/>
- [RD 15] NATO Architecture Framework (NAF) version 3
- [RD 16] IETF RFC 3986 Uniform Resource Identifier (URI): Generic Syntax <https://www.ietf.org/rfc/rfc3986.txt>

## 1.9 Document Structure

Chapter 1 introduces this document, including its purpose, scope and audience. Chapter 2 gives the conformance statements. Chapter 3 lists the requirements addressing information definitions. Chapter 3 contains a section (3.1) listing general requirements on information definitions and a section (3.2) listing semantic correspondence requirements. Annex A provides the key principles followed by the AIRM to ensure that it is suitable for use in these requirements. Annex B summarises the requirements to be checked when assessing conformity to this specification. Annex C lists contributing subject matter experts.

## 1.10 Maintenance of the Specification

This EUROCONTROL Specification has been developed under the EUROCONTROL Advisory Framework (ERAF) and is maintained by EUROCONTROL in accordance with this framework.

## 2. Conformance

The conformity checklist table is available in Annex B. It is provided in support of assessing conformance with this specification.



## 3. Requirements

### 3.1 General Requirements for Information Definitions

<b>Title</b>	Need for information definitions
<b>Identifier</b>	SWIM-INFO-001
<b>Requirement</b>	Exchanged information <b>shall</b> be documented in an information definition.
<b>Rationale</b>	The requirement for information definitions is essential in order to facilitate semantic interoperability. Without information definitions, there are no resources to allow the meaning of the information to be clearly defined, understood and harmonised between stakeholders.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Example:</i> Standardised information exchange models such as the Aeronautical Information Exchange Model (AIXM) [RD 10], the Flight Information Exchange Model (FIXM) [RD 11], the Weather Information Exchange Model (WXXM) [RD 13] and the ICAO Meteorological Information Exchange Model (IWXXM) [RD 14].</p> <p><i>Example:</i> Descriptions of information exchanged by services.</p> <p><i>Example:</i> Data catalogues used to list details on the exchanged information.</p> <p><i>Example:</i> Information exchanges captured as part of a business process model.</p>

<b>Title</b>	Information definition language
<b>Identifier</b>	SWIM-INFO-002
<b>Requirement</b>	An information definition <b>shall</b> be written in English using the spelling listed as the primary British spelling when conflicting spellings exist.
<b>Rationale</b>	By using a single reference language, the risk of translation ambiguities when comparing information definitions and the concepts they contain is removed.
<b>Verification</b>	Correctness
<b>Examples/Notes</b>	<i>Note:</i> This requirement does not apply to implementation details that are reflected in the content of the information definition e.g. identifiers for concepts.

<b>Title</b>	Information definition identification
<b>Identifier</b>	SWIM-INFO-003
<b>Requirement</b>	<p>An information definition <b>shall</b> have:</p> <ul style="list-style-type: none"> <li>• a title by which it is known;</li> <li>• an edition; and</li> </ul>

	<ul style="list-style-type: none"> <li>a reference date for use in citing the information definition.</li> </ul>
<b>Rationale</b>	This requirement supports the identification and citation of an information definition.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Example: "Aerodrome Mapping Exchange Model (AMXM), 2.0.0, 2015-08-24" [RD 12].</i></p> <p><i>Example: Identification information contained in a service description.</i></p>

<b>Title</b>	Information definition responsible party
<b>Identifier</b>	SWIM-INFO-004
<b>Requirement</b>	<p>An information definition <b>shall</b> be accompanied by statements on the party or parties responsible for the information definition including:</p> <ul style="list-style-type: none"> <li>the name of the responsible organisation or person;</li> <li>the contact information of the responsible party; and</li> <li>the role played by the responsible party.</li> </ul>
<b>Rationale</b>	This requirement supports the identification of the contact for an information definition.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Example: Example roles are "author" and "point of contact".</i></p> <p><i>Example: Service provider information contained in a service description.</i></p>

<b>Title</b>	Information definition scope
<b>Identifier</b>	SWIM-INFO-005
<b>Requirement</b>	An information definition <b>shall</b> be accompanied by a textual description of the scope of the information it covers.
<b>Rationale</b>	This requirement supports decisions on whether an information definition is suitable for use in a particular situation.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Example: The description provided by the Aeronautical Information Exchange Model is: "The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS)."</i></p> <p><i>Example: The service abstract contained in a service description.</i></p>

<b>Title</b>	Information definition namespace
<b>Identifier</b>	SWIM-INFO-006
<b>Requirement</b>	An information definition <b>shall</b> declare a dedicated namespace for its

	concepts.
<b>Rationale</b>	A dedicated namespace is needed to disambiguate the content of one information definition from the content of another and from the content of the AIRM.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Example:</i> The namespace used in the Aeronautical Information Exchange Model is: “<i>aixm:http://www.aixm.aero/schema/5.1</i>”.</p> <p><i>Note:</i> In the absence of a declared namespace, the namespace can be derived from the service that is described in a service description.</p>

<b>Title</b>	Information definition concepts
<b>Identifier</b>	SWIM-INFO-007
<b>Requirement</b>	<p>An information definition <b>shall</b> specify concepts by providing, at a minimum:</p> <ul style="list-style-type: none"> <li>• the name of the concept;</li> <li>• the definition of the concept; and</li> <li>• for data concepts only, the data type of the concept.</li> </ul>
<b>Rationale</b>	This requirement gives the minimum details needed about a concept (information concepts and data concepts) in order to apply the other requirements such as the ability to establish a semantic correspondence between concepts based on the definitions of the concepts.
<b>Verification</b>	Completeness, Consistency, Correctness
<b>Examples/Notes</b>	<p><i>Note:</i> This requirement concerns information concepts and data concepts.</p> <p><i>Note:</i> This requirement is deliberately generic to allow multiple notations and modelling techniques. For example, concepts may be represented as classes in UML, elements in XML Schemas or as rows in a spreadsheet.</p> <p><i>Note:</i> As the requirement sets out the minimum needed, there is nothing to stop an information definition from including more details such as the relationships between concepts and constraints on the concepts. Furthermore, concepts may be contained in other concepts.</p>

<b>Title</b>	Unique identifiers for concepts
<b>Identifier</b>	SWIM-INFO-008
<b>Requirement</b>	An information definition <b>shall</b> provide explicit unique identifiers, in accordance with IETF RFC 3986 [RD 16], for each of its concepts or ensure that each concept is uniquely identifiable within the information definition.

<b>Rationale</b>	The unique identifiers can be used in statements of semantic correspondence to ensure that mappings are unambiguous.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<i>Note:</i> Explicit unique identifiers can be provided, for example, as metadata fields attached to the concept in the information definition.

<b>Title</b>	Preservation of meaning
<b>Identifier</b>	SWIM-INFO-009
<b>Requirement</b>	If an information definition contains a concept with the same name as an AIRM concept or a synonym from the AIRM concept's list of synonyms, it <b>shall</b> preserve the meaning of the AIRM concept.
<b>Rationale</b>	<p>This requirement ensures that the definitions that are agreed in the AIRM are used consistently by information definitions.</p> <p>This removes the risk of semantic misalignment, possible reinterpretations and drift of meaning between different information definitions.</p>
<b>Verification</b>	Consistency
<b>Examples/Notes</b>	<p><i>Note:</i> The preservation of meaning requirement does allow some differences in the definitions of the concepts. For example, a definition in an information definition may have to be “rewritten” to take account of different terms used in the information definition as compared to the AIRM. To illustrate this:</p> <p>The AIRM’s “Runway” concept has a property called “associatedAerodrome” that is defined as “The aerodrome the runway is associated with”. An information definition uses the term “AirportHeliport” rather than “Aerodrome”. As “AirportHeliport” is a synonym of “Aerodrome”, the meaning shall be preserved. However, the information definition could rewrite the definition as “The AirportHeliport the runway is associated with.”</p> <p><i>Note:</i> An information definition may add data capture rules and constraints to the definition of a concept without breaking the meaning.</p> <p><i>Note:</i> Preservation of meaning is not to be taken to intend preservation of structure. Therefore, the structure of concepts in an information definition may be different from the structures found in the AIRM.</p> <p><i>Note:</i> If a concept does not use the same name (or a synonym) as an AIRM concept, SWIM-INFO-010 applies.</p>

<b>Title</b>	Principles for definitions for concepts
<b>Identifier</b>	SWIM-INFO-010
<b>Requirement</b>	<p>An information definition <b>should</b> apply the following principles for the definitions of its concepts when not using the definition from the AIRM:</p> <ul style="list-style-type: none"> <li>• the definition should be concise, clear, and whenever possible no longer than one sentence;</li> <li>• the definition should state what the concept is, rather than what it is not;</li> <li>• the definition should not use words whose definitions refer back to the concept in question, or begin with the term itself; and</li> <li>• the definition should not be a paraphrase of the term, but rather a description the concept.</li> </ul>
<b>Rationale</b>	Interoperability is dependent on detailed definitions that are well understood, and understood in the same way by all participants. At a very minimum, the definitions should be of good quality. This requirement promotes good quality definitions.
<b>Verification</b>	Correctness
<b>Examples/Notes</b>	<i>Example: "Aerodrome" is defined by ICAO as "A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft."</i>

<b>Title</b>	Semantics of metadata
<b>Identifier</b>	SWIM-INFO-011
<b>Requirement</b>	An information definition that defines metadata fields <b>should</b> base its metadata on the metadata semantics of the AIRM.
<b>Rationale</b>	Interoperability does not only concern the exchanged information. It also concerns the information about the exchanged information.
<b>Verification</b>	Consistency
<b>Examples/Notes</b>	<p><i>Example: Metadata that may be exchanged includes the lineage of the information and access rights to the information.</i></p> <p><i>Note: The AIRM imports the ISO 19115 [RD 4] metadata standard.</i></p> <p><i>Note: At the current time, there is a gradual convergence on the use of ISO 19115 for the semantics of metadata. This is particularly true for the Aeronautical Information domain. However, this convergence is not complete.</i></p>

<b>Title</b>	Use of data types
<b>Identifier</b>	SWIM-INFO-012
<b>Requirement</b>	An information definition <b>shall</b> use basic data types for its data concepts that are compatible with the system of basic data types

	used in the AIRM.
<b>Rationale</b>	Compatibility between data types facilitates interoperability. Agreement on a reference set of basic data types facilitates the understanding of the data types used in an information definition. This, in turn, facilitates the correct translation of data types between various implementations.
<b>Verification</b>	Consistency
<b>Examples/Notes</b>	<p><i>Note:</i> The AIRM imports ISO 19103 [RD 5] for its basic data types. These include: Boolean, CharacterString and Real.</p> <p><i>Note:</i> The XML Schema Definition Language supports, inter alia, Boolean, string and real.</p>

## 3.2 Semantic Correspondence Requirements for Information Definitions

<b>Title</b>	Establish semantic correspondence
<b>Identifier</b>	SWIM-INFO-013
<b>Requirement</b>	An information definition <b>shall</b> document a semantic correspondence for each of its concepts.
<b>Rationale</b>	Documentation of semantic correspondence is the evidence that an information definition is an AIRM conformant information definition.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Note:</i> This requirement covers information concepts and data concepts.</p> <p><i>Note:</i> This requirement allows an information definition to:</p> <ul style="list-style-type: none"> <li>• be accompanied by a standalone resource containing the statements of semantic correspondence; or</li> <li>• have statements of semantic correspondence embedded in it; or</li> <li>• be accompanied by a reference to an already existing set of semantic correspondences.</li> </ul> <p><i>Note:</i> The forms that a semantic correspondence can take are given in SWIM-INFO-014.</p> <p><i>Note:</i> It is important to ensure that the syntax used for mappings is self-explaining or appropriately explained. To this end, extra information can accompany the information definition in order to ensure that the mappings can be understood without having to read external documentation or make assumptions on how the mappings are technically and procedurally implemented.</p> <p><i>Example:</i> A statement that the “container’s traces” are considered as part of the concept mappings (as discussed in SWIM-INFO-018).</p>

<b>Title</b>	Forms of semantic correspondence
<b>Identifier</b>	SWIM-INFO-014
<b>Requirement</b>	<p>A semantic correspondence <b>shall</b> be:</p> <ul style="list-style-type: none"> <li>• a mapping from a concept in the information definition to a concept or concepts in the AIRM; or</li> <li>• a declaration that the concept in the information definition is out-of-scope of the AIRM; or</li> <li>• a reference to a change request for the AIRM that intends to change the AIRM to cover the concept from the information definition; or</li> <li>• a declaration that no semantic correspondence has been established for the concept.</li> </ul>
<b>Rationale</b>	<p>This requirement ensures that the expression of semantic correspondence becomes verifiable.</p> <p>It allows gaps with the AIRM to be identified so that they can be managed. A reference to the change request is designed to allow an information definition to cause an evolution of the AIRM.</p>
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Note:</i> There are several methods for documenting a semantic correspondence. For example, this requirement can be satisfied in a tabular format using the unique identifier of the concept in the information definition and the unique identifier of the related AIRM concept.</p> <p>Semantic correspondences could also be represented using:</p> <ul style="list-style-type: none"> <li>• UML trace relationships; or</li> <li>• metadata fields attached to the concept in the information definition that contains the unique identifier of the AIRM concept.</li> </ul> <p><i>Example:</i> The following is an example of a semantic correspondence written in tabbed-outline format.</p> <pre>+ concept: ...name: <u>Airspace</u> ...semantic correspondence: .....mapping: .....trace: <u>urn:x- ses:sesarju:airm:v410:ConsolidatedLogicalDataModel:SubjectFields: AirspaceInfrastructure:Airspace:Airspace</u></pre> <p><i>Note:</i> This requirement ensures that the documentation of semantic correspondence is complete. It is important to ensure that there are no gaps in the documentation as gaps are difficult to interpret.</p>

<b>Title</b>	Out-of-scope and no semantic correspondence established declarations
<b>Identifier</b>	SWIM-INFO-015
<b>Requirement</b>	A semantic correspondence declaring that a concept in an information definition is out-of-scope of the AIRM or that no semantic correspondence has been established <b>shall</b> provide a rationale.
<b>Rationale</b>	An out-of-scope declaration is not verifiable without information about the rationale.
<b>Verification</b>	Completeness
<b>Examples/Notes</b>	<p><i>Note:</i> The following were used in SESAR related work as rationales for an out-of-scope declaration:</p> <ul style="list-style-type: none"> <li>• container (e.g. XML complexTypes);</li> <li>• messaging (e.g. Aeronautical Fixed Telecommunication Network address);</li> <li>• network (e.g. datalink protocol version, IP address);</li> <li>• system (e.g. technical identifiers, availability flags);</li> <li>• non-atm (e.g. human resource related information);</li> <li>• local (e.g. data only making sense for on specific service instance); and</li> <li>• other (not covered by the other categories).</li> </ul> <p><i>Note:</i> The declaration that no semantic correspondence has been established allows the authors of an information definition to perform the mapping exercise in an iterative manner. However, it is important that a rationale is made available to make clear why no semantic correspondence has been established.</p>

<b>Title</b>	Mapping of information concepts to the matching AIRM concept
<b>Identifier</b>	SWIM-INFO-016
<b>Requirement</b>	The mapping of an information concept <b>shall</b> contain a trace from the information concept in the information definition to the AIRM concept that has an equivalent or wider meaning.
<b>Rationale</b>	This is a basic trace to establish the semantic correspondence between concepts. Without such a trace the mapping is pointless.
<b>Verification</b>	Correctness



<b>Examples/Notes</b>	<p><i>Example:</i> An example of trace to an AIRM concept with an equivalent meaning is provided by AIXM. It contains an information concept called “AirportHeliport” that is defined as “A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft/helicopters.” This traces to the AIRM concept “Aerodrome” that has exactly the same definition.</p> <p><i>Note:</i> In cases where the trace is to an AIRM concept that has a wider meaning, SWIM-INFO-018 also applies. An example of a trace to an AIRM concept with a wider meaning can be found in SWIM-INFO-018.</p> <p><i>Note:</i> SWIM-INFO-019 requires the use of the AIRM’s unique identifiers in traces.</p>
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<b>Title</b>	Mapping of data concepts to the matching AIRM concepts
<b>Identifier</b>	SWIM-INFO-017
<b>Requirement</b>	The mapping of a data concept <b>shall</b> contain a trace from the data concept in the information definition to the AIRM concept that has an equivalent or wider meaning <b>and</b> a trace to the data type in the AIRM that has an equivalent or wider meaning.
<b>Rationale</b>	<p>This includes a basic trace to establish the semantic correspondence between concepts. Without such a trace the mapping is pointless.</p> <p>The requirement adds a second trace for data concepts, as the constraint on value space expressed by the data type is also important to the semantics.</p>
<b>Verification</b>	Correctness
<b>Examples/Notes</b>	<p><i>Example:</i> An example is an information definition contains a data concept called “Target Startup Approval Time” that is a time.</p> <p>Two traces are needed for this mapping:</p> <ul style="list-style-type: none"> <li>• one trace to the AIRM concept called “StartUp”; and</li> <li>• one trace to the AIRM data type called “DateTime”.</li> </ul> <p><i>Note:</i> In cases where the trace is to an AIRM concept that has a wider meaning, SWIM-INFO-018 also applies. An example of a trace to an AIRM concept with a wider meaning can be found in SWIM-INFO-018.</p> <p><i>Note:</i> It may be possible to combine these traces into one single statement depending on the tracing techniques adopted.</p> <p><i>Note:</i> This requirement implies that implementations using technology that provides no typing (for example, JSON) will need to specify the applicable value range constraints at design time relative</p>

	<p>to the AIRM data type to demonstrate semantic correspondence.</p> <p><i>Note:</i> SWIM-INFO-019 requires the use of the AIRM's unique identifiers in traces.</p>
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<b>Title</b>	Additional traces to clarify the mapping of narrower concepts
<b>Identifier</b>	SWIM-INFO-018
<b>Requirement</b>	The mapping of a concept to an AIRM concept that has a wider meaning <b>shall</b> contain additional traces to AIRM concepts to fully describe the narrowing of the concept being mapped.
<b>Rationale</b>	This requirement accounts for the diversity in data modelling strategy.
<b>Verification</b>	Correctness
<b>Examples/Notes</b>	<p><i>Note:</i> This requirement requires additional traces to those required by SWIM-INFO-016 (for information concepts) and SWIM-INFO-017 (for data concepts).</p> <p><i>Note:</i> In practice, additional traces need to be provided for all qualifiers in the definition of a concept in an information definition that are absent in the definition of an AIRM concept. This ensures that the mapping is precise.</p> <p><i>Example:</i> An example is an information definition that contains a data concept called "Target Startup Approval Time" that is a time.</p> <p>Three traces are needed for this mapping to be unambiguous. The first two traces are those required by SWIM-INFO-017 and the third is an additional trace to ensure the mapping is unambiguous:</p> <ul style="list-style-type: none"> <li>• one trace to the AIRM concept called "StartUp";</li> <li>• one trace to the AIRM data type called "DateTime"; and</li> <li>• one additional trace to the "CodePlanningStatusType" value "TARGET" in order capture the "Target" qualifier in the concept. This is required as "StartUp" has a wider meaning than "Target Startup".</li> </ul> <p><i>Note:</i> It is laborious to repeat traces established for concepts that contain the concept being traced. Therefore, the concept being traced can treat its container's traces as part of its own mapping.</p> <p><i>Example:</i> To continue the example: An information definition contains a data concept called "Startup Approval Time" and a contained concept (e.g. modelled by specialisation in UML) called "Target Startup Approval Time". In this case, the first two traces will be established for "Startup Approval Time" and can be treated as part of the mapping of the "Target Startup Approval Time" concept.</p> <p><i>Note:</i> SWIM-INFO-019 requires the use of the AIRM's unique identifiers in traces.</p>

<b>Title</b>	Use of the AIRM's unique identifiers in traces
<b>Identifier</b>	SWIM-INFO-019
<b>Requirement</b>	A trace <b>shall</b> use the unique identifier provided by the AIRM concept at its end-point.
<b>Rationale</b>	This requirement determines the path of the end-point regardless of the format in which the AIRM is represented.
<b>Verification</b>	Correctness
<b>Examples/Notes</b>	<i>Note:</i> The unique identified is provided by the "URN" field attached to each concept in the AIRM.

## ANNEX A – Principles for AIRM

This specification relies on the AIRM as the common reference language to be used to facilitate semantic interoperability. The content of the AIRM and the building of the AIRM are not in the scope of this specification. However, it is important to note that the AIRM applies the following principles that create confidence that it serves the needs of semantic interoperability:

- the AIRM covers the ATM information and the necessary ATM-related information that is exchanged via interoperable SWIM information services;
- the AIRM is consistent with the ICAO SWIM Concept (ICAO Doc 10039 [RD 7]);
- the AIRM uses an agreed set of international standards for basic types, such as free-text types, spatial types and temporal types to ensure that these common concepts are defined once;
- the AIRM is independent of specific technologies, implementations, or other concrete details;
- the AIRM contains a standard to define the semantics of the metadata fields for datasets/data;
- the AIRM has version control and deprecation mechanisms in place to ensure that the content of the AIRM is managed in a transparent way; and
- the AIRM evolution is managed by a change control board to which stakeholders can submit change requests.

## ANNEX B – Conformity Checklist

This annex summarises the requirements to be checked when assessing conformity to this specification.

Table 5 lists each requirement in the specification using its identifier and title. It then states the level of implementation to be achieved (see Table 4). In some cases the implementation is conditional which means that the requirement is to be implemented when the condition applies.

Level of Implementation	Operative verb used in requirement
M = Mandatory	<b>shall</b>
R = Recommended	<b>should</b>
O = Optional	<b>may</b>

**Table 4 – Level of implementation**

Identifier	Title	Level of Implementation
<b>General Requirements</b>		
SWIM-INFO-001	Need for information definitions	M
SWIM-INFO-002	Information definition language	M
SWIM-INFO-003	Information definition identification	M
SWIM-INFO-004	Information definition responsible party	M
SWIM-INFO-005	Information definition scope	M
SWIM-INFO-006	Information definition namespace	M
SWIM-INFO-007	Information definition concepts	M
SWIM-INFO-008	Unique identifiers for concepts	M
SWIM-INFO-009	Preservation of meaning	M Conditional
SWIM-INFO-010	Principles for definitions for concepts	R
SWIM-INFO-011	Semantics of metadata	R
SWIM-INFO-012	Use of data types	M
<b>Requirements for semantic correspondence</b>		
SWIM-INFO-013	Establish semantic correspondence	M
SWIM-INFO-014	Forms of semantic correspondence	M
SWIM-INFO-015	Out-of-scope and no semantic correspondence established declarations	M
SWIM-INFO-016	Mapping of information concepts to the matching AIRM concept	M
SWIM-INFO-017	Mapping of data concepts to the matching AIRM concepts	M
SWIM-INFO-018	Additional traces to clarify the mapping of narrower concepts	M
SWIM-INFO-019	Use of the AIRM's unique identifiers in traces	M

**Table 5 – Conformity checklist**

## ANNEX C – List of Contributors

This specification was prepared by EUROCONTROL with the assistance of the following subject matter experts:

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**Table 6 – List of subject matter experts**



EUROCONTROL

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