EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

Electronic AIP Specification

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EUROPEAN AIR TRAFFIC MANAGEMENT

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Abstract

This document contains the formal Electronic AIP Specification (eAIP) developed by EUROCONTROL. The Specification and its associated guidance material have been developed between the years 2000-2004 as a project of the AIS AHEAD Programme. It provides a standard way to:

- publish the content of an AIP (including AMDT, SUP and AIC) in a structured electronic format;
- visualise the content of an AIP on a computer screen, using Web technology.

The specification is based on the Extensible Markup Language (XML) technology, central component being the eAIP Document Type Definition (DTD).

The eAIP Specification is fully compliant with the ICAO SARPS.

Keywords

Electronic AIP	XML	integrity
AIP	DTD	security
eAIP	stylesheet	
AIS	paperless	

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ELECTRONIC SOURCE

Path:	U:\AHEAD\PROJECTS\P4- e-AIP\eAIP ROLL OUT\Sources\formal	
Host System	Software	Size
Windows_NT	Microsoft Word 10.0	742 Kb

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DOCUMENT APPROVAL

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The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	INFOCENTRE REFERENCE	REASON FOR CHANGE	PAGES AFFECTED
1.0.3	16 FEB 2004		First release	All

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EXECUTIVE SUMMARY

The development of the Electronic AIP Specification (eAIP) is a major EUROCONTROL initiative in the drive towards paperless AIS and the potential this has in achieving the required integrity of data and enhanced data selection and distribution.

The eAIP Specification and its associated guidance material have been developed between the years 2000-2004 as a project of the AIS AHEAD Programme. It provides a standard way to:

- publish the content of an AIP (including AMDT, SUP and AIC) in a structured electronic format;
- visualise the content of an AIP on a computer screen, using Web technology.

The eAIP Specification is fully compliant with the ICAO requirements for AIP content and structure, as laid down in ICAO Annex 15. In addition, the eAIP Specification enforces a strict application of the ICAO requirements concerning the AIP structure.

The use of the Extensible Markup Language (XML) for the eAIP Specification guarantees that the eAIP is a true electronic document. The information content is completely separated from presentation, which, in turn, may be tailored to every target media.

The central component of the eAIP Specification is the eAIP Document Type Definition (DTD). This is complemented by additional rules, stylesheets, security considerations, etc. A series of eAIP Manuals are also provided, each targeting a specific stakeholder category: users, editors and developers.

The eAIP Specification has undergone comprehensive testing and validation, which have been completed mainly through pilot implementations initiated in Belgium, Slovenia, The Netherlands, Armenia, Moldavia, Germany, Slovak Republic, Italy and Latvia. The contribution of these States to the development of the eAIP Specification is hereby acknowledged.

Chapter 1. Introduction

1.1. The need for the Electronic AIP Specification

In the years preceding the launch of the AIS AHEAD Programme, there was an increasing trend in the European area for implementing and using electronic document technologies for Aeronautical Information Services (AIS) publications.

The undertaking by States of such developments in isolation was an unnecessary multiplication of effort which was likely to lead to incompatibility problems. Each such development was proposing a different way of browsing/navigating the AIP content on screen. The users did not apreciate the idea of having to learn a dozen of different styles, navigation patterns and layouts.

There was a clear need for a standard. Thus, the decision of EUROCONTROL to develop an Electronic Aeronautical Information Publication (eAIP) Specification aiming to harmonise the publication and consultation of the Aeronautical Information Publication (AIP) in electronic format.

1.2. History of the Specification

Between 2000-2001, EUROCONTROL contracted with the company Mekon Ltd., UK the development of an Extensible Markup Language (XML) Document Type Definition (DTD) for the Aeronautical Information Publication (AIP). XML is a subset of the Standard Generalized Markup Language (SGML, ISO 8879). Since 1998, when it was published by the World Wide Web Consortium (W3C), XML has rapidly become the de-facto industry standard for electronic data interchange.

The first draft version of the AIP DTD was finalised in April 2001 and was inspired by the DocBook DTD. Also contracted was the development of stylesheets to be used for converting the XML files into HTML format (for browsing) and PDF format (for printing).

From August 2001 till March 2004, EUROCONTROL contracted with Moltek Ltd. and their partner Synclude Ltd. to continue the work on the DTDs and the style sheets with the help of a number of Pilot Countries. The pilot implementations initiated in Belgium, Slovenia, The Netherlands, Germany (military AIP), Armenia and Moldova have significantly contributed to the improvement, testing and validation of the eAIP Specification.

1.3. Benefits of the Electronic AIP

The eAIP has advantages both for producers and for users. The on-screen presentation part of the eAIP Specification was validated with a group of real users, in the form of a Usability Study. Some of the most important advantages for users of an eAIP are listed below:

- ease of browsing, facilitated by the HTML technology (hot links, tool tips, etc.);
- the possibility to visualise changes (both in text and graphics);
- no maintenance effort (no time spent on page replacement at every amendment);
- can be made available for the whole company (no need to go to the library);
- no postal delays (if distributed through the Internet);

Some of the advantages for the producers (AIS offices), as identified during the pilot implementation phase, are also listed below:

- better AIP product, with increased consistency, integrity , usability;
- HTML and PDF produced from the same source
- facilitates the production of derived products (VFR Guide, etc.);
- 70-80% of users do no longer subscribe to paper amendments;
- technological leap forward;
- reduced risk and cost when compared to an isolated development
- easier to create integrated regional AIP

1.4. Relation with ICAO

Although run by EUROCONTROL primarily for the benefit of the ECAC area, the project took into account that AIS is a global business and attention was paid to ensure that it is globally applicable.

The eAIP Specification is fully compatible with the ICAO SARPS. The current paper based AIP, including Amendments, can be produced from the eAIP files.

The eAIP Specification is fully compliant with the ICAO requirements for AIP content and structure, as laid down in ICAO Annex 15. In addition, through the use of the XML DTD technology, the requirements for AIP structure are enforced by the eAIP Specification in a way which is not possible for a paper document.

1.5. The Aeronautical Information Management context

The eAIP is an enabler for Aeronautical Information Management (AIM): information content is separated from presentation aspects and the user can select and further process data directly from the eAIP in electronic format, according to his needs. All electronic media, be they on-line or off-line - Internet, intranet, CD-ROM, DVD - can be supported.

The EUROCONTROL eAIP is not a software tool. It is a concept and a technical specification. It is a foundation on which aeronautical information users and industry can define and build the tools they need in order to exploit the "electronic AIP" concept at its full potential.

Chapter 2. eAIP Specification Overview

2.1. General

The EUROCONTROL eAIP is a specification for the publication and exchange of the Aeronautical Information Publication in electronic format.

- Specification: the eAIP defines an electronic format and the general usage process
- Publication: the eAIP is designed to be published, be it on screen or on paper and used by people;
- Exchange: to a certain extent, the eAIP can be used for computer-to-computer data exchange. However, the eAIP Specification does not offer the same capabilities for structured aeronautical data exchange as the Aeronautical Information Exchange Model (AIXM).

  The essential difference between the two is that AIXM models the aeronautical information, while the eAIP models the AIP document. AIXM is primarily intended for computer-to-computer aeronautical data exchange. The eAIP is primarily intended to provide the AIP content for publication in various formats and on various media, according to user needs.

2.2. Technology

The EUROCONTROL eAIP is based on XML (eXtensible Mark-up Language). An electronic AIP is in fact an XML document, conforming to the eAIP DTD.

The eAIP in XML is transformed into other formats using XSLT:

- for on-screen display, the eAIP is transformed into HTML (Hyper-Text Mark-up Language);

- when paper is the target, the eAIP is transformed into XSL-FO. Software tools must be used to print XSL-FO. Currently, the most convenient method is to first convert XSL-FO to PDF or PostScript and then print those files.

Charts and graphics can be in various formats, and a very interesting one for aeronautical charts is Scalable Vector Graphics (SVG). All these technologies are official recommendations (standards) published by the W3C (World Wide Web Consortium).

2.2.1. What is XML

XML stands for eXtensible Mark-up Language. XML is a subset of the Standard Generalized Markup Language (SGML, ISO 8879). Since 1998, when it was published as a recommendation by the World Wide Web Consortium (W3C), XML has rapidly become the de-facto industry standard for electronic data interchange.

XML is a meta-language (a language to define other languages). It allows us to define an "AIP language" for computers. Using the EUROCONTROL eAIP language, people and computers can talk to each other using the same vocabulary and grammar.

XML has been chosen because it fulfils the eAIP's main objective: it is commonly used for structuring documents and it is suitable for both human to computer and computer to computer interactions. Also, it is a recognised standard since 1998, widely adopted by the software developers in many industries.

2.2.2. What is a DTD

DTD stands for Document Type Definition. It is a formal representation of XML documents' structure. To keep up with our previous analogy with languages, the eAIP DTD is a formal definition of the eAIP language vocabulary and grammar.

2.2.3. What is XSLT

XSLT stands for eXtensible Stylesheet Language Transformations. It is an XML-based language that allows to transform an XML document into another XML document (or into text document as well). In the eAIP context, XSLT is used to convert eAIP files from XML into HTML format or XSL-FO format.

2.2.4. What is XSL-FO

XSL-FO stands for eXtensible Stylesheet Language Formatting Objects. It is an XML-based language that allows to express a document with its formatting, for example to print it on paper. In the eAIP context, XSL-FO is used to format an eAIP in order to print it on paper. With adequate software, it will be possible in future to directly print an XSL-FO document. In the mean time, it is possible to use software that convert XSL-FO to PDF or PostScript and then print those files.

2.2.5. What is SVG

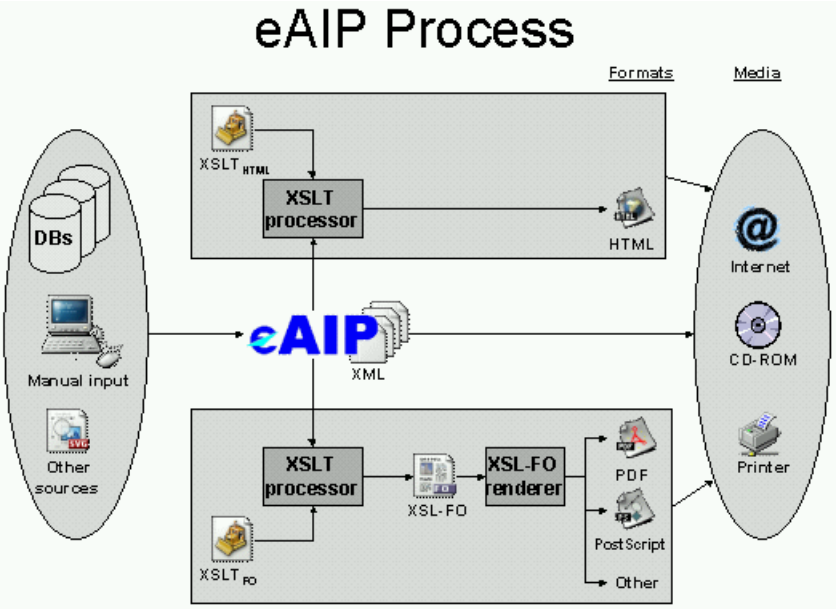
SVG stands for Scalable Vector Graphics. It is an XML-based language to express 2-dimensional drawings using simple graphical objects such as lines, circles, rectangles and text, and object properties such as color, size and position. Being written in XML, SVG charts can quite easily be linked to other XML information.

It is possible to zoom into a small portion of an SVG image and still see a very precise definition of the image. In fact, SVG image resolution is only limited by printers' resolution. SVG images can be interactive; for example, it is possible to highlight a single route on route map or click on an object on a map and get additional information about this object.

2.3. EUROCONTROL eAIP - Publication Process

2.3.1. Default process

This diagram shows the default eAIP production process from XML production to HTML and paper AIP publication. Technologies used on this process are mentioned as well.



The advantage of this process is that the both the browsing format and the printing format are generated from the same XML files, which can be made available to the user.

2.3.1.1. Alternate process

It is also possible that both the XML files and the printing format (PDF) are produced from another source. Structured text editors, such as Adobe FrameMaker, are able to produce export files both in PDF and in XML format. The advantage of such an alternate process is that the generation of the PDF files is straight-forward, as done by the editing tool.

On the other side, the XML export process is usually embedded into the software tool and the editors do not have much control over it. Therefore, the editors must ensure at every issue that there are no discrepancies between the XML/HMTL content on one side and the PDF content on the other side. The users do not have access to the original file sources which were use to produce the XML and PDF format.

2.4. Open source

2.4.1. eAIP Specification Software

The eAIP Specification software, including the DTD (document type definition), the source code and documentation is provided under a specific Open Source license. Please read the file LICENSE.txt in the eAIP package, or the license section in this document, for more details. You can find more information on Open source Software licensing at the Open Source Initiative [http://www.opensource.org] organisation.

OSI certified

This software is OSI Certified Open Source Software. OSI Certified is a certification mark of the Open Source Initiative.

2.4.2. Bundled Software

The full eAIP package is bundled with the following Open Source Software:

- SAXON XSLT Processor by Michael Kay
- Schematron 1.5 tools by David Carlisle and Rick Jelliffe (modified for the eAIP)
- Xerces XML Parser by the Apache Software Foundation
- XHTML Modularization by the World Wide Web Consortium
- OpenSSL by The OpenSSL Project
- GPG by the Free Software Foundation

They are re-distributed with permission, following their respective license. Please read the file LICENSE.txt in the eAIP package, or the license section in this document, for more details.

Chapter 3. eAIP Specification

3.1. Status of the Specification

The eAIP DTD 1.0.3 is the current stable release. This means that it can be used to produce an eAIP or to develop software based on it without the risk of loosing pace with the eAIP DTD development.

Obviously, a stable release does not mean that the DTD will never be changed. Subsequent eAIP development will result in new versions being published:

- major updates, which greatly transforms the structure of an eAIP document, will receive major version numbers: 2.0, 3.0, etc.
- changes in the content model that keep the general structure but invalidate previous eAIP will receive minor version numbers: 1.1, 1.2, etc.
- small changes, which do not invalidate a previous minor version, will have sub-minor version numbers such as 1.0.4, 1.0.5, etc.

At the time of the writing, there were no plans for such changes. Any future changes will be implemented only after consultation with the eAIP Specification stakeholders.

3.2. Compliance

3.2.1. Definition

Compliance with the EUROCONTROL eAIP Specification 1.0.3 may be claimed for eAIP instances that:

- are valid against the eAIP DTD 1.0.3 and
- follow the additional rules;

A software product may be declared compliant with the EUROCONTROL eAIP 1.0.3 Specification if it can handle/produce/edit/etc. compliant eAIP documents.

3.2.2. How to check compliance

3.2.2.1. Formal validation

To formally validate an eAIP means to validate it against the official DTD published on EUROCONTROL's Web site, at the address defined in the Location section and then to check the eAIP for additional rules compliance.

3.2.2.2. Using MakeAIP

MakeAIP is a batch script provided within the eAIP package. It allows to check compliance to both the eAIP DTD and the additional rules. Please refer to the MakeAIP Documentation for more details. If MakeAIP is properly configured, typing `MakeAIP validator` will check compliance to the DTD and report any error; then it will automatically run `MakeAIP schematron`, which is described below. The Validator will not explicitly report compliance.

Note that MakeAIP validates an eAIP against the DTD declared in the eAIP itself, which is generally a local copy of the DTD.

3.2.2.3. Interactive validation

Most XML editing software are able to validate an eAIP against its DTD, but not against the additional rules. Therefore, the eAIP package includes an interactive tool, based on Schematron, which is able to list additional rules validation errors. To use it, follow these 2 steps:

1. Run `MakeAIP schematron`
2. Open or reload the file ../../tools/Validator/schematron-frame.html

This tool shows the list of errors in the upper part of the browser window and the whole XML source of your eAIP in the bottom part. When you click on an error, the bottom part is scrolled to the place where the error occurs. Each error is presented with a link to the eAIP Specification, precisely to the rule related to the error.

To see how such a report looks like, please see the eAIP Specimen's additional rules validation report [../../tools/Validator/schematron-frame.html]. When downloading the eAIP package, it is necessary to generate that report for the first time: open a command-prompt window, change directory to where the eAIP package is installed and type `MakeAIP schematron`. The eAIP Specimen contains a lot of errors with respect to the additional rules; most of them are there to check the validation process.

3.2.3. File formats

As the baseline, the eAIP should be published in three formats: XML, HTML (for browsing) and PDF (for printing). The compliance can be formally checked only for the XML format.

Through the use of the Extensible Markup Language (XML), the eAIP data content is completely separated from presentation, which, in turn, may be tailored to every target media. While the capability to fine-tune the eAIP presentation for every media (paper, CD-ROM, Web, etc.) is an advantage for the users, it is also a challenge for the producers. They must ensure the consistency between the different formats. Most likely, the reference format is XML. However, depending on the legislation in force in the issuing State and/or the user's State, it might be that another format (for example PDF or the paper document) is declared as the reference format. This is important in case of discrepancies between the different formats. The producer shall clearly state which of the different formats (XML, HTML, PDF, etc.) should be considered as prevailing in case of discrepancies.

3.3. eAIP Specification

The eAIP Specification is composed of a DTD and "additional rules".

The stylesheets used for converting XML into HTML, which complement the specification, are not imposed. However, the eAIP user community expects uniformity in the layout and navigation structure of all eAIP implementations. This can be achieved through a consistent application of the EUROCONTROL eAIP stylesheets.

3.3.1. eAIP DTD

3.3.1.1. Location

The official location of the eAIP DTD is http://www.eurocontrol.int/ais/eaip/dtd/[version number]/eAIP.dtd. For example, the DTD version 1.0.3 is located at http://www.eurocon-

trol.int/ais/eaip/dtd/1.0.3/eAIP.dtd. This URL is only useful to software tools which need to access the official DTD: it is not convenient for downloading the DTD, as it is composed of some 35 files. The DTD is part of the eAIP package, which is available for download on the eAIP Web site [http://www.eurocontrol.int/ais/eaip]. The DTD is not easy to read, even for XML developers, because it makes use of XHTML Modularisation. The DTD documentation is much more accessible.

3.3.1.2. Overview

The eAIP DTD defines a number of 245 XML elements. They are listed below, grouped by category.

3.3.1.2.1. Root Elements

The root elements are e:eAIP for an AIP document, e:eSUP for a Supplement document and e:eAIC for a Circular. All other elements are descendants of these three roots in the element hierarchy.

3.3.1.2.2. AIS-specific structural elements

3.3.1.2.2.1. AIP documents

Table 3.1. eAIP structure overview

eAIP	GEN	GEN-0	GEN-0.1, GEN-0.2, GEN-0.3, GEN-0.4, GEN-0.5, GEN-0.6
		GEN-1	GEN-1.1, GEN-1.2, GEN-1.3, GEN-1.4, GEN-1.5, GEN-1.6, GEN-1.7
		GEN-2	GEN-2.1, GEN-2.2, GEN-2.3, GEN-2.4, GEN-2.5, GEN-2.6, GEN-2.7
		GEN-3	GEN-3.1, GEN-3.2, GEN-3.3, GEN-3.4, GEN-3.5,GEN-3.6
		GEN-4	GEN-4.1, GEN-4.2
	ENR	ENR-0	ENR-0.1, ENR-0.2, ENR-0.3, ENR-0.4, ENR-0.5, ENR-0.6
		ENR-1	ENR-1.1, ENR-1.2, ENR-1.3, ENR-1.4, ENR-1.5, ENR-1.6, ENR-1.7, ENR-1.8, ENR-1.9, ENR-1.10, ENR-1.11, ENR-1.12, ENR-1.13, ENR-1.14
		ENR-2	ENR-2.1, ENR-2.2
		ENR-3	ENR-3.1, ENR-3.2, ENR-3.3, ENR-3.4, ENR-3.5, ENR-3.6
		ENR-4	ENR-4.1, ENR-4.2, ENR-4.3, ENR-4.4
		ENR-5	ENR-5.1, ENR-5.2, ENR-5.3, ENR-5.4, ENR-5.5, ENR-5.6
		ENR-6	—
	AD	AD-0	AD-0.1, AD-0.2, AD-0.3, AD-0.4, AD-0.5, AD-0.6
		AD-1	AD-1.1, AD-1.2, AD-1.3, AD-1.4
		AD-2, Aerodrome	AD-2.1, AD-2.2, AD-2.3, AD-2.4, AD-2.5, AD-2.6, AD-2.7, AD-2.8, AD-2.9, AD-2.10, AD-2.11, AD-2.12, AD-2.13, AD-2.14, AD-2.15, AD-2.16, AD-2.17, AD-2.18, AD-2.19, AD-2.20, AD-2.21, AD-2.22, AD-2.23, AD-2.24
		AD-3, Heliport	AD-3.1, AD-3.2, AD-3.3, AD-3.4, AD-3.5, AD-3.6, AD-3.7, AD-3.8, AD-3.9, AD-3.10, AD-3.11, AD-3.12, AD-3.13, AD-3.14, AD-3.15, AD-3.16, AD-3.17, AD-3.18, AD-3.19, AD-3.20, AD-3.21, AD-3.22, AD-3.23

3.3.1.2.2.2. AIP Supplements

eSUP, Address, Address-part, References, SUP-section.

3.3.1.2.2.3. Circulars

eAIC, Address, Address-part, References.

3.3.1.2.3. AIS-specific elements

3.3.1.2.3.1. Amendments and supplements

Affects, Amendment, Deleted, eAIP-reference, Inserted, See-supplement (deprecated), Supplement.

3.3.1.2.3.2. GEN-specific tables

Abbreviations: Abbreviation, Abbreviation-description, Abbreviation-details, Abbreviation-ident.

Locations: Location, Location-definition, Location-ident, Location-name, Location-table.

3.3.1.2.3.3. ENR-specific tables

Routes: Route, Route-designator, Route-remark, Route-RNP.

Segment: Route-segment, Route-segment-airspace-class, Route-segment-ATC, Route-segment-COP, Route-segment-length, Route-segment-lower, Route-segment-lower-override, Route-segment-minimum, Route-segment-remark, Route-segment-remark-reference, Route-segment-RNP, Route-segment-upper, Route-segment-width, Route-segment-mag-track, Route-segment-reverse-mag-track, Route-segment-reverse-true-track, Route-segment-true-track, Route-segment-usage, Route-segment-usage-reference, Route-segment-usage-direction, Route-segment-usage-level-type.

Significant point: Significant-point-ATC, Significant-point-description, Significant-point-reference, Significant-point-remark, Significant-point-remark-reference, Navaid-indication, Navaid-indication-distance, Navaid-indication-radial.

Navaids: Navaid, Navaid-declination, Navaid-elevation, Navaid-frequency, Navaid-hours, Navaid-ident, Navaid-magnetic-variation, Navaid-name, Navaid-remarks, Navaid-table, Navaid-type.

Designated points: Designated-point, Designated-point-ident, Designated-point-table, SID-STAR.

3.3.1.2.4. Generic & editorial elements

Addresses: Address, Address-part. Graphics: Figure, Graphic-file. Misc. block: Generated, NIL, Sub-section, Title. Misc. inline: Date-time, Latitude, Longitude.

3.3.1.2.5. XHTML elements

The following elements are taken from the W3C [http://www.w3.org/] XHTML Modularisation Recommendation specification. They are functionally equivalent to their corresponding elements in the HTML 4.01 Recommendation, with the exception that most deprecated HTML attributes are not used in the eAIP DTD.

Block elements: div, p.

In-line elements: a, br, cite, em, span, strong.

List elements: li, ol, ul.

Table elements: caption, col, colgroup, table, tbody, td, tfoot, th, thead, tr.

3.3.2. Additional Rules

3.3.2.1. About additional rules

3.3.2.1.1. Introduction

The current list of additional rules is based on the experience gathered through the eAIP Pilot Implementations. In future, this list is expected to be extended. All the rules listed below are implemented in the eAIP Validator, which can be found in the tools directory of the eAIP package.

There are two sets of rules:

- Mandatory Rules are part of the eAIP Specification and must be followed;
- Optional Rules are not part of the eAIP Specification; they are only recommendations.

3.3.2.1.2. Why additional rules?

The eAIP "language" is composed of a vocabulary (elements, attributes, lists of values), which is entirely defined in the DTD, and a grammar, which is split between the DTD and the additional rules. This grammar split is due to limitations of the DTD technology, which does not allow to express all the necessary constraints. As many constraints as technically possible have been put in DTD. In future, it might be decided to replace the DTD with an XML Schema. Even than, some additional rules might be needed, due to the inherent limitations of any schema language.

3.3.2.1.3. Implementation

The eAIP Specification defines the additional rules in plain English. An implementation of these rules, in Schematron language, is provided in the eAIP package, in the file ..\..\tools\Validator\eAIP-schematron.xml, which is located in the tools/Validator directory in the eAIP package. Schematron is another XML grammar language, like DTD and XML Schema. It is undergoing ISO standardization to become "ISO/IEC 19757 - DSDL Document Schema Definition Language - Part 3: Rule-based validation - Schematron". A Schematron grammar is written in XML and is able to express certain rules that DTDs and XML Schemas can't. For more information about Schematron, please refer to the Schematron home page [http://www.ascc.net/xml/resource/schematron/].

3.3.2.2. Mandatory Rules

3.3.2.2.1. Data Structure Rules

Route track
: Route segments within the same route may not have mixed true track and magnetic track.

Route sequence
: A Route sequence of Significant-point-reference and Route-segment elements must begin and end with a Significant-point-reference

Route-segment
: The first non-deleted element following a non-deleted Route-segment must be a Significant-point-reference. The same assertion may be made about non-inserted ones, but we should expect the eAIP to be valid before the amendment anyway.

Significant-point-reference
: The first (if any) non-deleted element following a non-deleted Significant-point-reference must be a Route-segment. The same assertion may be made about non-inserted ones, but we should expect the eAIP to be valid before the amendment anyway.

Graphic-files
: If there are 2 Graphic-file elements inside a Figure element, their Updated attribute must be Inserted for one and Deleted for the other one.

Amendments attributes
: Elements, whose Updated attribute has a value different than "No", must have an id and an Updated-ref attributes

Nested amendments
: Amendments may not be nested. This means that any element whose Updated attribute is different than "No" may not have a descendant whose Updated attribute is different than "No".

NIL
: If a NIL element has following sibling(s), it must have its Updated attribute set to Inserted or Deleted and they must have it set to the opposite.

3.3.2.2.2. Data Consistency Rules

ToC and id
: An element whose Toc attribute is set to "Yes" must have an id attribute.

MIME types
: The Type attribute of Graphic-file elements must contain a "known" MIME type. The list of known MIME types is given in XML format in the file mime-types.xml (in directory tools/Validator in the eAIP package). All eAIP software implementation must be able to handle these MIME types.

Graphics and paper AIP
: If the xlink:show attribute on e:Graphic-file is set to "replace" or "new", then attribute Page-name must not be empty.

Internal links
: Internal links (x:a elements with a href attribute value beginning with "#") must point to an existing element. That is, the value after the "#" character must be the id of an element in the same eAIP document.

Internal References
: Internal references must refer to an existing element, depending on the referrer:

  - An Abbreviation must refer to an Abbreviation-description;
  - A Location must refer to a Location-definition
  - A Significant-point-reference must refer to a Navaid or a Designated-point
  - A Significant-point-remark-reference must refer to a Significant-point-remark
  - A Route-segment-usage-reference must refer to a Route-segment-usage
  - A Route-segment-remark-reference must refer to a Route-segment-remark
  - An Aerodrome must refer to a Location-definition
  - A Heliport must refer to a Location-definition
  - The Updated-ref attribute must refer to an Amendment

Significant-point-ATC
: Legal values are: "Request", "Compulsory" and "No-report" and they must be expressed inside a single text node. These values can be inside child elements (typically e:Deleted and e:Inserted), but no other text is allowed. Text inside e:Deleted elements is not considered for this rule (as it must have been valid before the amendment).

Route-segment-usage-direction
: Legal values are: "Forwards" and "Backwards". These values can be inside child elements (typically e:Deleted and e:Inserted), but no other text is allowed. Text inside e:Deleted elements is not considered for this rule (as it must have been valid before the amendment).

Route-segment-usage-level-type
: Legal values are: "Odd" and "Even". These values can be inside child elements (typically e:Deleted and e:Inserted), but no other text is allowed. Text inside e:Deleted elements is not considered for this rule (as it must have been valid before the amendment).

Location-name
: Location-name must not be empty.

Location-ident
: Location-ident must exist and not be empty if its parent Location-definition's Type attribute is set to "ICAO".

3.3.2.2.3. Data types Rules

Column width
: The width attribute of x:col element must be a positive integer.

Dates
: Effective-date and Publication-date attributes' value must be an ISO-8601 date without time zone information.

3.3.2.3. Optional Rules

Route segment usage and track
: If a route segment has at least one child Route-segment-usage-reference of value "Forwards" (respectively, "Backwards"), then the route segment should have a Route-segment-true-track (resp. Route-segment-reverse-true-track) or a Route-segment-mag-track (resp. Route-segment-reverse-mag-track) element.

Numbering and id
: It is a good idea to set the id attribute on an element whose Number attribute is not empty (Number creates a reference for humans but not for computers)

Deprecated elements/attributes
: The following element and attribute are deprecated and will be removed from the eAIP DTD in the future. Please refer to the eAIP DTD documentation for more details.

  - e:See-supplement
  - e:Location's Type attribute

Effective date
: Elements eAIC and eSUP may omit their Effective-date attribute, but it is not recommended.

Links
: The a element's href attribute is not mandatory, but it should be provided in order for this element to be meaningful. Note that, contrary to HTML, you should not define an anchor using the name attribute, but instead use an id attribute on the element you want to refer to.

3.3.3. Style Sheets

The eAIP Specification includes XSLT and CSS style sheets, to format an eAIP in a standard way. These style sheets are not mandatory. EUROCONTROL recommends the use of these

style sheets in order to promote a consistent visual eAIP format for users. There is a set of style sheets for HTML format and another set for PDF.

The style sheets are part of the eAIP package.

3.4. License

source code, is available at http://saxon.sourceforge.net/.

Saxon is subject to Conditions of Use, available at
http://saxon.sourceforge.net/saxon6.5.3/conditions.html and copied to
the file tools/saxon/LICENSE_Saxon.html.

Xerces:

The eAIP package includes software developed by the Apache Software
Foundation (http://www.apache.org/), namely Xerces, an XML parser.

Its license is available in the file tools/xerces/License.

Schematron:

The eAIP package includes the Schematron 1.5 tools, which are copyrighted
by David Calisle, Oliver Becker, Rick Jelliffe and Academia Sinica
Computing Center, Taiwan. These tools were slightly modified by Benoit
Maisonny for the eAIP. The original versions are available at
http://www.ascc.net/xml/resource/schematron/.

The licence is located at the top of each file in the directory
tools/schematron.

OpenSSL:

This product (the eAIP package) includes software developed by the OpenSSL
Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)
Copyright (c) 1998-2003 The OpenSSL Project. All rights reserved.
The whole OpenSSL distribution, including documentation and source code,
is available at this Web site. Only the binaries are included in the eAIP
package.

Its license is available in the file tools/OpenSSL/License.

GnuPG:

The eAIP package includes the GnuPG software, which is Copyright 1998,
1999, 2000, 2001, 2002, 2003 Free Software Foundation, Inc. The whole
GnuPG distribution, including documentation and source code, is available
at http://www.gnupg.org/, and also on the eAIP Web site. Only the binaries
are included in the eAIP package.

Its license is available in the file tools/GnuPG/Copying.

Chapter 4. User Requirements and Usability Guidelines

4.1. Introduction

Paper and screen are two different presentation media. For example, the concept of fixed length pages does not apply to the screen. It is much more natural to group the information in chapters, per subject. Also, when expressed in pixels, a good computer screen has half the size of an A4 paper. For the text to remain readable, the length of a text in a table cell has to be reduced at least by one third.

Presenting the information on screen has different constraints from presenting the same information on paper. XML and HTML are Web technologies, developed specifically with the aim to make information available on computer screens. The on-screen (HTML) presentation part of the eAIP Specification is based on the conclusions of a User Requirements and Usability Guidelines [usability_study.pdf], performed under contract for EUROCONTROL by Helios Technology, UK. The study included a validation workshop with a group of real users.

4.2. User requirements

The requirements identified through this study have been characterised as 'inherited' requirements or 'functional' requirements:

- inherited requirements are those deriving from the ICAO SARPS specified in Annex 15, such as:
    - the eAIP structure and layout must adhere to the requirements for presentation as set out by ICAO;
    - the update cycle of the eAIP must adhere to the AIRAC cycle requirements;
    - all Amendments (alterations, additions and deletions) made to the eAIP in the last AIRAC cycle must be indicated.
- functional requirements are those deriving from the transition from paper-based to electronic media, such as:
    - the Table of Contents is the main navigation tool into the eAIP document; it must be simple, fast and effective to use;
    - where Amendments modify text, there must be some provision for comparing the previous and modified versions;
    - 'live access' versions of the eAIP (e.g. Web sites) should incorporate the core AIP (GEN, ENR, AD) and all accompanying documents (AMDTs, SUPs, AICs, NOTAMs);
    - 'disseminated' versions (for example, CDs) will exclude NOTAMs, but must incorporate links to NOTAMs on a live website;
    - it must be possible to verify the date on which each section became effective, and the source of the information if relevant;
    - cross-references within the body of the text (e.g. 'See section …') will be implemented as links
    - charts in the eAIP must be scalable, zoom-able and display configurable content.

The full results of the study are available in the User Requirements and Usability Guidelines [usability_study.pdf] document. Not all requirements identified by the study are supported

by the current eAIP browsing stylesheets. In particular, requirements that refer to advanced search facilities are not supported yet (for example: "the eAIP must have a facility for searching for all instances of a given word in the body of the AIP, and accompanying documents. The search results will have links into the appropriate sections of the body of the document").

However, such requirements do not affect the eAIP DTD structure, but rather the functionality offered by the stylesheets. It is expected that such requirements could be fulfilled by integrating the eAIP into an XML/HTML document management system.

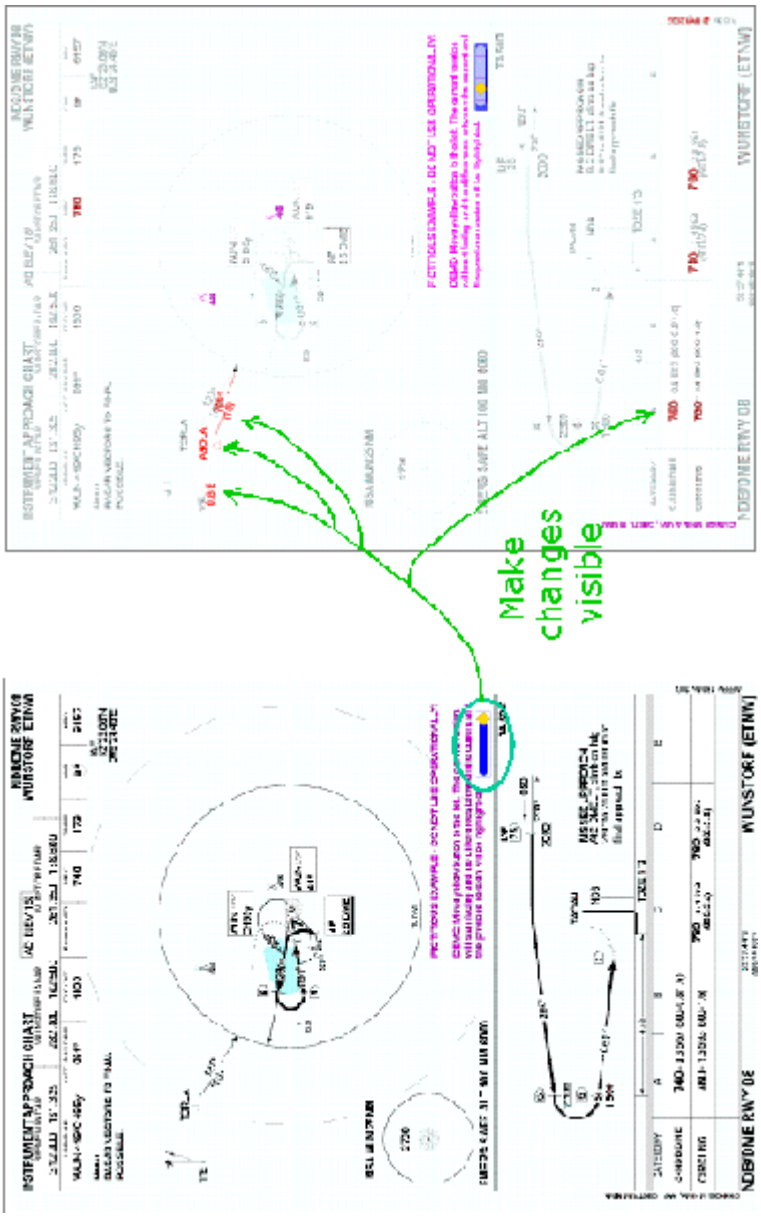
Chapter 5. Graphics Support

5.1. Supported Graphics Formats

5.1.1. SVG

The recommendation of the EUROCONTROL eAIP Project is for all eAIP graphics to be made available in Scalable Vector Graphics (SVG) format. The SVG format offers perfect quality for display and printing, possibilities to zoom and pan, to search for text, etc. File sizes are typically smaller than for an equivalent graphic in raster format. In addition, it is possible to add "script functions" into the SVG file, which opens the way for an endless number of enhancements. For example, it is possible to show the differences between the current and the previous version of a chart.

Figure 5.1. SVG chart sample



5.1.2. Web Graphics and PDF

More generally, the eAIP Specification supports the usual graphical file formats which are supported by Web browsers: GIF, JPEG, PNG.

5.1.3. PDF

PDF (Acrobat) is directly supported as a "graphic" format as well, provided that PDF files contain only one page. PDF is used by many AIS offices to publish their charts electronically. It has the advantage of supporting a vectorial graphic definition, yet being more widely supported than SVG. However, on medium term, the SVG format is likely to become the de-facto format for vectorial graphics in Web browsers.

5.1.4. Other Formats

In theory, any graphical format could be supported by the eAIP. The only limitation is the support from the various softwares that can be used to read or convert an eAIP.

For on-screen consultation, a Web browser is typically used to display the eAIP in HTML format. Some browsers support other graphical formats than those listed above, but not all browsers do.

For paper AIP production, other softwares are used to convert an eAIP in XML in order to print it. AIP producers must naturally pay attention to what graphical formats are supported by their production chain.

Generally speaking, it is safer to use graphical formats which are "open standards". That is, formats which are defined by an independent organisation, which make the format specification freely available. This is the case for SVG, GIF, JPEG, PNG and PDF. As an example, this is not the case for VML (similar to SVG). Moreover, there must not be any patent claim related to these formats. This is specifically not the case for compressed GIF files, which should then be avoided (PNG format is a better alternative).

5.2. Embedded versus not embedded graphics

The eAIP Specification supports three different ways of referencing a graphic file in an AIP: fully embedded, embedded in paper only or external. In this context, an embedded graphic is a graphic file whose image is directly visible on the page, between two paragraphs, for instance. A graphic file which is not embedded is not visible until the user performs some action, such as clicking on a link in HTML.

Fully embedded graphic
: Such a graphic file is directly visible both in HTML format and on paper. It is part of the text flow. Typical examples are small diagrams included in the GEN part.

Paper embedded graphic
: The image is not embedded in HTML and other on-screen presentation formats; a link to the image is presented instead. The image is embedded in XSL-FO format and derivatives (PDF, PostScript, etc.) so that the image still appears on paper, but it is embedded in a separate page, after the last page of the current section (or the current aerodrome or heliport). Typical examples are ENR and AD 2.

External graphic
: Rarely used, it is presented as a Web link to the graphic in HTML (the user must follow the link in order to access the image). On paper, the link is visible (i.e. the graphic address

on the Web is printed), but of course not click-able. In PDF format, the link may be click-able, just like in HTML. Typical examples are addresses of the Web pages of an organisation/authority.

Chapter 6. eAIP Amendments

6.1. Introduction

The ICAO Annex 15 requirements for AIP amendments are fully suported by the eAIP Specification. When the eAIP is presented on-screen, in HTML format, every individual change can be clearly highlighted. Further more, it is possible to compare the current (modified) content with the previous content. When an eAIP is printed, in PDF format, change bars are inserted on all affected lines within the document.

Paper AIPs are kept up-to-date by removing/inserting pages at every amendment date (AIRAC and non-AIRAC). These pages are issued in the form of an AIP Amendment (AMDT) document. The concept of 'replacement pages' does not apply to an Electronic AIP, which is reissued in full at every amendment date. However, in order to facilitate the maintenance of a paper AIP, it is also possible to identify the pages that have been affected by the changes between two consecutive issues of the AIP in PDF format.

6.2. Document Type Definition aspects

In order to support amendments, a dedicated set of XML elements and attributes have been included into the eAIP Document Type Definition (DTD). For example, new text is marked using an `Inserted` element, while deleted text is marked using a `Deleted` element. There is no special element for modified text. Instead, modified text is marked as a sequence of `Inserted` and `Deleted` elements.

There are also DTD elements, which do not have in-line text content, such as a references, graphics, etc.. An `Updated` attribute, which may take the values `Inserted` or `Deleted` is used in this case. The old element will get the value `Deleted` in its `Updated` attribute and a new element of the same type will be inserted, with the new content.

Details about how the content of each individual DTD element may be amended have been included into the DTD Documentation.

6.3. Procedures

6.3.1. Old changes

Each eAIP issue contains markup (`Inserted` and `Deleted` XML elements and attributes) only for the changes made in that issue. Eventually, if that eAIP issue corresponds to an AIRAC amendment, the changes of the previous non-AIRAC amendment can be kept (and vice-versa).

There are a few reasons behind the decision to remove the old changes in XML. If old inserted and deleted elements were kept, then:

- the XML eAIP files might soon become very complex and even invalid, due to clashes between current and previous `Inserted` and `Deleted` elements; at one moment, some of the old amendment markup would need anyhow to be deleted for the content to become again understandable;
- in HTML, the functionality to 'Show/Hide Amendments' would become very complex, as it should distinguish between current and previous amendments.

Before a new issue is created, a process called "fixing the amendment" has to be executed. This definitively applies the changes of an amendment into an eAIP by removing all elements marked as "deleted" (including their content) and by converting all elements marked as "inserted" so that they are seen as not amended.

It should be noted that this approach does not have a direct impact on the paper format. It is still possible to keep the old changes, by printing the PDF and inserting into the paper version only the updated pages. Naturally, the old pages are not affected.

6.3.2. AIRAC cycle aspects

The eAIP Specification allows for publishing changes in advance by 2 or more AIRAC cycles. However, the fact that a full eAIP is issued, requires special consideration. When an amended eAIP is issued with an effective date earlier than that of a previously issued eAIP which is not yet in force, the previous issue needs to be updated.

The full eAIP Amendment process is described in the eAIP Editors Manual. This includes the procedure for advanced changes publication, by two or more AIRAC cycles.

Users will benefit from receiving a full eAIP, in which all changes are clearly marked. They are no longer required to do the page replacement, which, estimated at the scale of the whole aviation community, every AIRAC cycle, is a costly effort. However, the benefit of not having to do yourself the updates comes at a price in terms of complexity/flexibility for the eAIP editor.

6.3.3. Automation

Amendment production can be partially automated. For example, provided a content management and versioning software is available, the amendment creation, validation and publication procedure can be completely embedded in the tool.

Similarly, if automation is available within the XML editor software, then the actual creation and manipulation of changes can be made a lot simpler. It is highly recommended that especially the XML to PDF production process is automated, as the manual process is quite fastidious.

Another approach is a fully automated text amendment editing. In this approach, editors simply amend their eAIP without worrying at all about amendment mark-up. They just replace text where needed, add and remove paragraphs where necessary. When the edition process is finished, a software program compares the new (modified) eAIP with the previous issue and inserts amendment mark-up as appropriate. After that, the editors can check the result on screen and on paper.

Chapter 7. Multi-lingual eAIP

7.1. Introduction

The eAIP Specification supports multilingual AIP and the expectations of the user for each presentation media have been also considered. In a browser, the user expect to see the eAIP in one language, while being able to switch to another language at any moment. On paper, users expect that multilingual AIP present the two languages in the classical style, either recto-verso or on two columns.

7.1.1. XML version

For technical reasons, one eAIP document in XML contains all the AIP content for a single language. That language is indicated by the attribute xml:lang on the e:eAIP element. When the AIP needs to be published in more than one language, the publishing organisation will have to create a separate set of eAIP XML files for each language.

There are some good reasons behind this decision:

- the complexity of the DTD is considerably reduced, as a single language attribute is necessary;
- separating the languages allows to keep eAIP files at a reasonable size.

7.1.2. HTML version

Using the XSLT style sheets provided by EUROCONTROL, only one language is produced per HTML page. This is very much in line with the way almost all Web sites are organised. The user is offered the possibility to select his preferred language early on a Web site, and stick with it most of the time. The eAIP menu, which sits in the upper right corner of every eAIP page in HTML, will contain a link to the other language version.

7.1.3. XSL-FO and PDF versions

At the time of the writing, using the stylesheets provided by EUROCONTROL it was not yet possible to combine 2 language versions in XSL-FO. Work is in progress in this area. It should be noted that using an alternate production process, where both the PDF and the XML files are produced from within a structured editor, this is not an issue. The PDF files may be created directly with two or more languages being embedded in the same document (recto-verso or multiple columns).

7.2. Internationalisation and Localisation

The XSLT style sheets that produce HTML and XSL-FO are (almost) language- and locale-independent ("internationalised"). When they need to generate static text, such as for en-route tables headings, they use a separate file, which contains translations (localisations) of (almost) all static content. For the EUROCONTROL's eAIP Specimen, this file is named "EC-locales-en-GB.xml".

The locales file is part of an eAIP: the eAIP is not usable without its locales file. It should always be located in the same directory as the XML eAIP file, and be named "-locales.xml", prefixed with the ICAO country code.

7.2.1. Localisation

In the eAIP, a language is identified by a language tag, composed of an ISO language code (ISO 639) and a mandatory ISO country code (ISO 3166), separated by a dash ('-'). By convention, language codes are always in lower case while country codes are always in upper case. This is not imposed by ISO standards but it is good practice to respect case in XML context.

7.2.2. How localisations are selected?

An eAIP document declares its language by way of the xml:lang attribute on the e:eAIP element. XSLT style sheets use this attribute value to find a translation in the translations file.

For each bit of static text to be output, the style sheet (namely, g-gettext.xslt) looks for an exact match of the language tag. If no exact match is available, it produces an error message.

7.2.3. What is NOT language-independent?

The current style sheets contain some static output of numbers and some punctuation characters. Also, no provision is made for language that are not written left to right, top to bottom. For these language, additional work will be needed to adapt the style sheets.

7.3. Reference

RFC 1766 [http://www.ietf.org/rfc/rfc1766.txt]
This document explains the use of ISO language and country codes in the context of Internet communication.

Chapter 8. Safety and security considerations

8.1. Introduction

For the purpose of this document, the following definitions apply:

Safety
: Freedom from unacceptable risk. [EUROCONTROL, SRC DOC 4, Glossary of Terms and Definitions & List of Acronyms, Edition 2, 27.02.2002]

Security
: A combination of measures and human and material resources intended to safeguard civil aviation against acts of unlawful interference. [ICAO, DOC 9569, Definitions]

The Integrated Aeronautical Information Package (IAIP) contains safety-related aeronautical information, which is essential for the daily operations of airlines, pilots, air traffic controllers and other actors in the aeronautical sector.

The eAIP Specification relates to those aspects that are specific to the electronic format. In this context, most stakeholders are concerned with the security and data integrity issue, especially regarding the distribution of aeronautical data over public networks.

Safety and security are not completely separated issues. For example, an attack on computer a server can take the server out of service for several hours or days. This is a security aspect, which triggers a safety issue: the eAIP site hosted by that server might become unavailable for some time.

In this example, software and procedures would be put in place to protect the server against this kind of attack or to ensure the continuity of the service by using different servers or routes. On the safety side, risk mitigation of eAIP unavailability could require to always store and make available on the client side computer/network a local copy of the eAIP. Due to the AIRAC cycle, a local copy will not be outdated in a few hours or days.

8.1.1. Scope

The eAIP Specification defines an electronic format for the AIP data, which is different from the paper format currently in use. The information content and structure is however exactly the same. The quality system (ICAO Annex 15 requirement) and the static data procedures currently implemented in AIS are equally applicable to the eAIP production process. This shall ensure that data issued in the form of an electronic AIP are of the same quality as data issued in the form of a paper AIP.

The way AIP/eAIP data are used for operational needs is subject to specific ATS, ATM, avionics, etc. regulations and is considered outside the scope of the eAIP Specification. This will however fall within the scope of the proposed EUROCONTROL project on end-to-end data integrity.

Therefore, the scope of the safety and security considerations included in the eAIP Specification is limited to demonstrating that the data integrity provided by the electronic format is the same or better than for the paper format.

8.1.2. Data integrity

How can data integrity be ensured on the (electronic) path between the eAIP editor and the eAIP user? The answer to this question does not lie in data format, but in data transmission. If the transmission path is safe, then data are safe as well. However, we know that the Internet, as a public network, is currently not a secure path. In order to have a secure path through an insecure environment, we need to enclose data inside a protection layer. This layer can be provided by technologies such as electronic signature and authentication. These technologies even bring an additional benefit: non-repudiation. Once electronically signed, the originator cannot deny having signed and issued the data.

8.1.3. Documentation

This chapter and the following one discuss general safety / security aspects and risks associated with publishing an eAIP. Additional documentation is available in the User's, Editor's and Developer's manuals. Most eAIP safety and security related documentation is targeted to a specific audience, as detailed below:

Table 8.1.

Intended Audience	eAIP Security Document
All stakeholders	This document
eAIP Users	How to check the signature of an eAIP
eAIP Distributors	How to sign an eAIP with x509 How to sign an eAIP with PGP
eAIP Developers	Technical and procedural choices
Security Managers and eAIP Distributors	How to setup up a x509 signing environment How to setup up a PGP signing environment

Note

"eAIP Distributors" designates the persons in charge of the distribution of eAIP material, within the eAIP publishing organisation. In some organisations, this might be the Editors, performing both roles. In other organisations, eAIP distribution might be outsourced. In this case, "eAIP Distributors" means the persons responsible for sending all material to the distribution company.

Disclaimer: Please note that the information contained in these documents should not be considered as ultimate computer security expert advice; they only give a general introduction to the concepts. Security-conscious organisations should seek expert computer security advice before implementing the technologies described hereunder.

Please read also the safety-related questions in the Frequently Asked Questions (FAQ) and the eAIP Security Risks and Mitigating Strategies.

8.2. What kind of security?

There are three different aspects to information security: Confidentiality, Integrity and Availability.

Table 8.2. Security Aspects

Security aspect	When it applies
Confidentiality	when a piece of information must not be read by any unauthorised party
Integrity	when a piece of information must not be tampered with
Availability	when a piece of information must be accessible without interruption or delays (H24, typically)

Different technologies exist that usually address one or two of these aspects. Needless to say, it is more difficult (read: costly) to address all of them at the same time. Information system managers need to evaluate these three aspects based on their relative importance in their specific context.

Confidentiality: In the AIS domain in general, information is rarely confidential. An exception may be in some AIS-related military information. For the rest, it is usually in the interest of the publishing authority that access to AIS data is as open as possible.

Integrity: This is a growing concern.

Availability: In the context of static AIS data, availability is not the primary concern. It should not be a serious problem if an AIP is not available for a few minutes or even for a few hours for an on-line document. Simple solutions, such as local storage are available. However, this is obviously not the case with NOTAM, which must be immediately available to those concerned.

An interesting IT security technique for the AIS domain is electronic signature. An electronic signature not only ensures data integrity, but also guarantees the sender's identity. This means that a recipient can be sure that he received AIS information from the legitimate sender (authentication) and it also means that the sender cannot deny having sent the information (non-repudiation). When applied to a specific document, an electronic signature ensures that document's integrity as well.

8.3. eAIP integrity

The use of an electronic signature scheme is the favourite candidate for ensuring the eAIP integrity. This will provide users with three levels of protection:

1. AIS data integrity: protection against modification on the path from originator to user;
2. AIS data authentication: certification of the data originator;
3. AIS data non-repudiation: originator cannot deny having signed the data.

Note

Non-repudiation normally concerns a transaction and applies to both parties, namely originator and recipient. In this document, the recipient side is not addressed, but it can be addressed in a very similar way if necessary (for example, through the use of a trusted third party).

8.3.1. Electronic signature process

The concept of the electronic signature is very similar to the hand signature:

1. The originator electronically signs a document using a private "key".
2. The originator sends the document to the user with a copy of his public key or certificate.
3. The user opens the document and checks the electronic signature against his copy of the originator's public key or certificate.

The main difference lies in the way to check for an electronic signature's validity. An electronic signature is created using strong encryption technology and is virtually impossible to forge (with current computer technology). With appropriate software, a user can read the electronic signature, which contains information about its owner and issuer.

This issuer can be a centrally-managed organisation (called Certificate Authority, or CA), which is trusted by the user community to certify public keys of legitimate owners. For example, a CA would verify thoroughly a user's identity before certifying public keys containing that user's name.

A private key is protected by a password, known only by its owner. If the password were to be disclosed, the owner would revoke his certificate and obtain a new one. The CA can be queried for certificates that have been revoked by their owners.

For more a more detailed explanation, you can refer for example to Learning About Cryptography [http://www.ciphersbyritter.com/LEARNING.HTM] by Terry Ritter.

8.4. Existing implementation in the AIS community

Electronic signatures (also called security certificates) are common in the Internet community. They are notably used to authentify Web servers, for example for Web banking services (when you connect to your bank's Web site, you want to be sure that it is indeed your bank and not a fake Web site that has hijacked your connection). Consequently, several companies offer CA services: Thawte, VeriSign, GlobalSign to name a few. They sell public certificates and also CA delegation, when an organisation wants to issue certificates directly to its members or employees.

It is also possible for an organisation (or individual) to proclaim itself as the Certificate Authority and begin to issue certificates. The only natural condition is that a community of users exists who trusts it (him/her) as a CA. Open Source (free) software as well as commercial software are available to manage a CA and issue certificates.

These techniques are being used, for example, in the European AIS Database (EAD) project. EAD's system-to-system interface is based on the exchange of XML messages, which are signed by the originator for authentication.

Chapter 9. eAIP Security Risks and Mitigation Strategies

9.1. Introduction

9.1.1. Scope

Security risks discussed in this chapter concern the transmission of the eAIP, from an AIS office, to the AIP end-user. The following areas are not covered:

- the creation and edition of an eAIP (covered by the AIS quality assurance process),
- the use of the eAIP (relevant to the end-user internal safety/security policy and covered by specific regulations).

It is assumed that the data contained in an eAIP is non-confidential and that it does not need to be modified during transport. A user must be able to notice if it has been modified between publication and usage.

9.1.2. Overview

Publishing an electronic AIP introduces a variety of risks: the publication, transmission and use of the eAIP could take place over several untrusted networks, such as the Internet. To reduce the risk of data tampering and data loss, the use of electronic signatures is recommended.

9.1.3. Disclaimer

Most software mentioned in relation with the eAIP Specification is Open Source and Free Software. This software environment is not intended for production use, but rather to facilitate the adoption of and experimentation with public key technology. It is up to the interested organisation to select software, open or closed source, to fulfil the goals of eAIP security.

These documents do not contain guidelines for internal security policy, or any other information necessary for the set-up and operation of a production-quality Certificate Authority (CA) or PGP-based security infrastructure.

The security implications of operating any cryptographic technology, legal ramifications and other issues are outside the scope of this document. Interested parties should consider seeking professional help from security experts if they don't have adequate knowledge internally.

9.2. Risk Classification

For each identified risk below, a risk classification table is included. It describes the risk, its likelihood, and its impact on the parties involved. The table is structured as follows:

Table 9.1.

Type	Impact	Difficulty
Impersonation	High	Easy

Type: What kind of risk is it?

- Impersonation: the end-user believes the attacker is a legitimate person
- Data Integrity: the content of the eAIP is modified or destroyed
- Availability: the eAIP is not available to the end-users

Impact of risk: What is the impact level to the sending and/or receiving party?

- High: severe impact on safety
- Medium: some minor impacts
- Low: no impacts on safety

Difficulty: How easy is it to achieve or how likely is it to happen?

- Easy: unskilled hacker / short time / very likely
- Difficult: confirmed hacker / medium time frame / likely
- Very difficult: well equipped and confirmed hacker / long time frame / unlikely

9.3. Risks

9.3.1. Introduction

The following risks have been identified:

- Download Server Tampering
- Download Server Denial of Service
- Download Server Hijacking
- Email impersonation
- Media interception
- Data corruption

Please note that this list is not exhaustive.

9.3.2. Download Server Tampering

9.3.2.1. Risk classification table

Table 9.2.

Type	Impact	Difficulty
Data Integrity, Availability	High	Easy to Difficult

9.3.2.2. Context

This vulnerability applies to eAIP distribution via a file download service, for example a Web server or an FTP server. It can concerns both secured (by Secure Socket Layer - SSL) and not secured download servers, accessible on the Internet or any other network.

9.3.2.3. Description

An AIS office can publish eAIP packages on-line on a server for end-users to download. This server is an obvious target. A successful attacker who, using a flaw in the server software, gains control over the computer on which it is running, may impact:

- Availability: He is able to take the server out of order or to delete eAIP packages;

- Data Integrity: He can replace an eAIP by another document of his craft, while an end-user things that he is using an official eAIP.

9.3.2.4. Mitigating controls

Possible controls to mitigate the risks stated above:

1. Proper security practice: Keep the server secure, with the latest security patches applied. Secure the operating system the service is running on.
2. Electronic signature: End users can check authenticity of the electronically signed packages they download.

9.3.3. Download Server Denial of Service

9.3.3.1. Risk classification table

Table 9.3.

Type	Impact	Difficulty
Availability	Low to Medium	Easy

9.3.3.2. Context

This vulnerability applies to eAIP distribution via a file download service, for example a Web server or an FTP server. It can concerns both secured (by SSL) and not secured download servers, accessible on the Internet or any other network.

9.3.3.3. Description

Hardware and software are more likely to fail against this type of attack. A successful attacker who, using a flaw in the server software, manages to remotely take the server out of order, may impact availability: eAIP packages will not be available until the attack ends or the service is restored.

9.3.3.4. Mitigating controls

Possible controls to mitigate the risks stated above:

1. Proper security practice: Keep the server secure, with the latest security patches applied. Secure the operating system the service is running on.
2. Offer redundant service;
3. For end users: do not rely solely on remote services, especially through public networks.

9.3.4. Download Server Hijacking

9.3.4.1. Risk classification table

Table 9.4.

Type	Impact	Difficulty
Impersonation	High	Difficult

9.3.4.2. Context

This vulnerability applies to eAIP distribution via Web downloads, secured by SSL or not, through the Internet or not.

9.3.4.3. Description

This "man in the middle" attack consists in intercepting Web requests sent by end users to the Web server, and responding to them. The attacker is effectively bypassing the Web server, and providing his own forged Web server instead. This can be done by DNS hijacking or by network path control (i.e. one of the computers traversed by the request is controlled by the attacker).

It can happen even on servers secured by SSL if the end user does not carefully verify the server's certificate or if his computer has been tampered without his knowledge so that it silently accepts forged certificates.

9.3.4.4. Mitigating controls

Possible controls to mitigate the risks stated above:

1. Proper security practice: Securing all computers and devices which are crossed by the Web requests from the end-user's side to the server's side. This includes firewall, routers and proxy servers.
2. Use of SSL: Using an SSL enabled Web server confirms to the end-user that he is connected to the expected Web server, and not the attacker's. However, the end user must manually check the authenticity of the SSL certificate. If not, he may be connecting to the attacker's Web server without noticing.
3. Electronic signature: End users can check authenticity of the electronically signed packages they download.

9.3.5. Email impersonation

9.3.5.1. Risk classification table

Table 9.5.

Type	Impact	Difficulty
Impersonation, Data Integrity	High	Easy

9.3.5.2. Context

This vulnerability applies to eAIP distribution by email through the Internet or another network.

9.3.5.3. Description

SMTP, the protocol used for email transmission on the Internet, does not provide authentication of the sending party. Anybody can forge the sender's name and email address. Therefore, the sender's name and address cannot be trusted. To impersonate an AIS office, all the attacker needs to know is the (usually, publicly available) email address and name. He can then simply change his name and email address in his email client software and send out mails which appear to come from the official AIS office, and which contains modified, outdated or erroneous data..

9.3.5.4. Mitigating controls

Electronic signature: The sending party signs the email or attached documents. The end-user can then confirm the authenticity and origin of the message, as the attacker can not forge the electronic signature.

9.3.6. Media interception

9.3.6.1. Risk classification table

Table 9.6.

Type	Impact	Difficulty
Impersonation, Data Integrity	High	Very difficult

9.3.6.2. Context

This vulnerability applies to eAIP distribution via CD-ROM, DVD, hard disk or any other digital transmission which requires physical transport.

9.3.6.3. Description

A determined attacker may arrange the interception of one or several packages containing eAIP digital media. He may replace these media by others containing a modified or outdated eAIP.

9.3.6.4. Mitigating controls

Electronic signature: An end user can check the authenticity and origin of the package he receives by validating the electronic signature associated to it.

9.3.7. Data corruption

9.3.7.1. Risk classification table

Table 9.7.

Type	Impact	Difficulty
Data Integrity	High	Easy

9.3.7.2. Context

This vulnerability applies to all digital channels of distribution of the eAIP.

9.3.7.3. Description

The integrity of the eAIP package is not guaranteed: transport and media failures (a hard disk failure, CD-ROM corruption or interrupted download) can leave the user with an incomplete or corrupt eAIP.

This corruption can be accidental or intentional (i.e. sabotage).

9.3.7.4. Mitigating controls

Electronic signature: An end user can check the validity of a file using the electronic signature. Indeed, the signature contains integrity information regarding the signed file. Data corruption is similar to data tampering in the sense that the file is modified. As such, it will not match its signature.

9.4. Proposed Mitigation

9.4.1. Proposed solution

The risk analysis above shows us that the use of electronic signatures can reduce the risks associated with the publication and transmission of the electronic AIP.

The use of electronic signature in conjunction with the eAIP has the following effects:

- The end-user can certify the authenticity of the information: certify that the eAIP originates from the right authority;
- The end-user can guarantee the integrity of the data: certify that the received eAIP is complete, not corrupt and unmodified since its publication by the AIS office.

In short, this solution requires first to set-up the necessary environment:

1. The AIS office sets up a signing environment, for example, x509 or PGP.
2. The AIS office provides each end-user with the signing certificate or public key using a different channel than the one used for transmitting the eAIP. The end-user checks with the AIS office for authenticity.
3. The end-user acquires the proper software to verify the signature.

For each publication of an eAIP:

1. The AIS office signs the published eAIP package, for example using x509 or PGP. If several packages are provided, each is signed individually.
2. The eAIP packages are distributed together with their signatures.
3. The end-user receives the eAIP and checks the signature [secValidateSignature.xml#sec_validate_signature].

9.4.2. Limitations

Introducing cryptography in a document work-flow solves some security problems, as seen above. However, it also introduces other issues, such as:

9.4.2.1. Overconfidence

Once using cryptography, it is easy for producer and end-users to believe that ultimate security has been achieved. This is not the case. Cryptography is only a tool, which can be used to increase security. It is nothing without proper security practises (e.g. strong password policy, efficient physical security, etc.). The secure state of mind is often described as "healthy paranoia".

9.4.2.2. Key theft

Public/private key cryptography (both PGP and x509) relies on the secrecy of the private key. The theft of the private key (and the knowledge of its associated password) is dramatic: the

attacker now has the ability to impersonate the publisher in the eyes of the end-users. The issue is to create a security environment where it becomes possible to detect such an event, and have appropriate procedure to revoke and change the incriminated keys and associated certificates.

9.4.2.3. Look-alike certificates

It is easy to create forged certificates and PGP keys which bear the same contact and organisation information as the legitimate one. If an attacker manages to convince an end-user to trust such a look-alike certificate, he can avoid other more difficult attack scenarios. Therefore, it is vital to organise a verification procedure: when the end-user receives any certificate, he must check its validity with the originating party using an alternative communication channel (i.e., not the channel used to distribute the certificate). Note that if the attacker manages to convince the end-user to send him an email or phone him on his "direct line", he has effectively bypassed the verification procedure. So the end-user must use trusted contact information for this verification procedure.

9.4.3. Conclusion

The use of electronic signatures ensures that the data integrity of the eAIP product can be ensured with relatively little efforts, at the same level as for the paper document. In addition, authenticity and non-repudiation may be ensured, which is not the case with the paper document. Therefore, it is recommended that electronic signatures are used in all eAIP package distribution to end-users.

Chapter 10. Frequently Asked Questions

10.1. General

Q: What is the eAIP?
A: The EUROCONTROL eAIP is a specification for the publication and exchange of the Aeronautical Information Publication in electronic format.

- Specification: the eAIP defines an electronic format and the general process to use it;
- Publication: the eAIP is designed to be published, be it on screen or on paper and used by people;
- Exchange: to a certain extent, the eAIP can be used for computer-to-computer data exchange. However, the eAIP Specification does not offer the same capabilities for structured aeronautical data exchange as the Aeronautical Information Exchange Model (AIXM).

Q: What are the eAIP advantages?
A: When compared to the current paper AIP, the implementation of an eAIP has advantages for both the Organisation producing the eAIP and for its Users.

Advantages for users of an eAIP:

- possibility to visualise changes (both in text and graphics)
- no maintenance effort (no time spent on page replacement at every amendment)
- no postal delays (if distributed through the Internet)
- available at hand for the whole company (no need to go to the library)

Advantages for producers of an eAIP:

- better AIP (consistency, integrity , usability)
- 70-80% of users do no longer ask for paper amendments (this has resulted from a recent survey)
- possibility to easily create derived products (VFR guide, airport guide, etc.)
- technological leap forward (XML is likely to become the "AIS language" in future)
- reduced risk and cost as compared to isolated development of a proprietary electronic AIP format

Q: Is the eAIP free?
A: Yes, the eAIP Specification is free and anybody may use it. Also provided are some free supporting tools, just to let you "play around" with the eAIP Specification and see what can be done with a truly electronic AIP.
Q: My AIP is in PDF: is it an electronic AIP?
A: Short answer: it is an electronic AIP but it is not compliant to the EUROCONTROL eAIP Specification and it does not fulfil all user expectations with regard to an electronic AIP. If interested, please read the Electronic Aeronautical Information Publications: User Requirements and Usability Guidelines [usability_study.pdf] document.

Longer answer: Yes, one could say that an AIP in PDF format is an electronic AIP, since PDF is indeed an electronic document format. However, PDF (Portable Document Format) is only designed for paper document presentation on screen and does not have the flexibility and all the capabilities of the EUROCONTROL eAIP Specification, which is based on XML. In fact, we could also consider that the AIPs written in HTML,

PostScript, in a database or even a scanned image of the paper AIP pages are electronic AIPs as well. These document formats are all meant for one single purpose (HTML for on-screen display by human beings, PostScript for printer, and so on). This is not the case of the eAIP.

See also the following questions: What is the eAIP? What is XML?

Q: Is eAIP a new software?

A: No. The EUROCONTROL eAIP is a specification, not any kind of software. To state it differently, the eAIP is a data format. EUROCONTROL does provide some tools together with the eAIP in order for adventurous and enthusiast users (and especially: computer-literate people) to be able to check out the eAIP and see how it can be used. But these tools are not part of the eAIP specification (only the general concepts are). EUROCONTROL expects the industry to provide more user-friendly software that are compliant with the eAIP specification.

Q: How does the eAIP fit with the ICAO Annex 15? Is it SARPS-compliant?

A: The eAIP is 100% compliant with the ICAO Annex 15. It closely follows the SARPS standard, including ICAO Document 8126 (AIP Template), with some differences in the formatting (such as the route tables) and some optional additions in content to take advantage of the electronic format (such as with the use of hyperlinks or interactivity as far as the on-screen version is concerned).

Q: What will happen to the paper AIP?

A: Paper will still be used for many years... but we now have an additional option. The EUROCONTROL eAIP does not ignore paper: eAIP editors and users are still able to produce a paper version of the AIP. With a big difference: the same electronic source, the eAIP, will be used to produce both paper and screen-based (e.g. HTML) formats. And that same electronic source (in XML) will be directly used by users who need to present the AIP data differently (on board, for instance).

Q: What about Amendments, Supplements, Circulars (AICs) and NOTAMs?

A: The EUROCONTROL eAIP project proposes a complete solution, encompassing all the above mentioned elements of the IAIP (Integrated Aeronautical Information Package). So we could have named it "eIAIP", but eAIP is already difficult enough to pronounce, isn't it?

Q: How are charts/graphics dealt with in the eAIP?

A: Charts can be provided with an eAIP in various format. One particularly interesting format is SVG, as it is an XML representation of vectorial graphics.

See also the following questions: What is SVG?

Q: Is the eAIP supported by the industry?

A: Yes. We are in contact with a few companies, which are already working on adapting their existing products to comply with the EUROCONTROL eAIP specification, or on developing new products specifically for the eAIP.

10.2. eAIP project status

Q: Is the eAIP ready for everyone to use?

A: The eAIP DTD 1.0.3 is the current stable release. This means that it can be used to produce an eAIP or to develop software based on it without the risk of loosing pace with the eAIP DTD development.

Obviously, a stable release does not mean that the DTD will never be changed. Subsequent eAIP development will result in new versions being published. At the time of the writing, there were no plans for such changes. Any future changes will be implemented only after consultation with the eAIP Specification stakeholders.

See also the following questions: Which countries have already prepared their eAIP?

Q: Which countries have already prepared their eAIP?

A: At the date of the writing, 4 States have implemented an eAIP:

- Belgium - distributed by Belgocontrol on CD-ROM
- Slovenia - available on the Web [http://www.caa-rs.si/acrobat/aip/eaip/history.html]
- Moldavia - available on the Web [http://www.moldatsa.md/ais/LU-eAIP/html/LU-GEN-0.1-en-MD.html]
- Armenia - available on the Web [http://www.moldatsa.md/ais/UD-eAIP/html/UD-GEN-0.1-en-GB.html]

Also, a complete example of an eAIP, based on the ICAO AIP Template, is available on the EUROCONTROL Web site [http://www.eurocontrol.int/ais/eaip/index.htm#eaip].

See also the following questions: How do I create an eAIP? How can I use an eAIP?

10.3. Relations with other projects

Q: Why do we need an eAIP when we will have the EAD?

A: 90% of the textual information in the AIP is not available in a structured form in the EAD. EAD also recognises the need for the AIP, because it offers for consultation PDF versions of AIP. With the eAIP, we try to offer it in a format which is more adapted to screen presentations than PDF. Many eAIP user requirements, as defined during the usability study, are not supported by PDF.

Therefore, the AIP Tool of the EAD will be enhanced with support the eAIP Specification.

The eAIP may be regarded as a special type of report, incorporating static data and other textual information, comprehensive for one State (or more), in a format that users are accustomed to, which may be carried away.

The eAIP is an end product. The EAD is a complete system, the AIP and the eAIP being one of the subsystems.

Q: Will the eAIP be incorporated in the EAD?

A: EUROCONTROL has investigated the most effective way to support the eAIP Specification through the EAD. This will be done within 12-18 months after the start of the EAD Tentative Operations.

Q: How does the eAIP fit with the AIXM?

A: AIXM and the eAIP have many things in common, such as the fact that they are both based on XML. The essential difference is that AIXM models the aeronautical information, while the eAIP models the AIP document. AIXM is primarily intended for computer-to-computer aeronautical data exchange. The eAIP is primarily intended for providing the AIP content for publication in various formats and on various media, according to user needs.

AIXM focuses on describing in detail the characteristics of aeronautical features such as airports, runways, navaids, routes, etc. and the relationships which exist between these. AIXM does not contain the (unstructured) textual content of the AIP. The recommended way of producing an eAIP is to incorporate such data into the eAIP XML files from an AIXM compatible database.

10.4. Operations

Q: How do I create an eAIP?

A: Edition: please read "How to create a new eAIP", from the eAIP Developer's Manual.

Publication: please read "Publication Process", from the eAIP Editor's Manual, and "Publication Process (revisited)", from the eAIP Developer's Manual.

Q: How can I use an eAIP?

A: This is quite simple: if you have an eAIP on CD-ROM, just insert it in your CD drive and your default Web browser should open itself on the first page of the eAIP. If you want to access an eAIP online, just point your Web browser to an eAIP Web site.

Please read as well the eAIP User's Manual.

Q: How do I distribute the eAIP?

A: On the Internet: The main way is to publish your eAIP on your Web site. You will typically have a dedicated section for AIS publications. Depending on your policy, access to this section might be either cost-free or subject to a specific fee. On this AIS publications section, you will give access to the 3 formats of your eAIP: XML, HTML and PDF. We expect this method to be the main way to publish eAIP because online eAIP could be linked to dynamic AIS data such as NOTAMs, which is obviously not possible on a CD-ROM.

On CD-ROM: You can burn a CD-ROM with all 3 formats of the eAIP, together with Supplements, Circulars and other relevant documents. You might even be able to add permanent NOTAM. A link can also be provided to your site for NOTAMs and other dynamic information, but these will not be accessible if the user does not have Internet connection. Amendment issues of this CD-ROM will then be sent by post just like paper AIP. The only difference is that a complete eAIP is sent on CD-ROM, instead of only the few pages that have been amended.

Q: How much does eAIP production/distribution cost?

A: EUROCONTROL is working on a business case to compare costs of paper vs. electronic AIP production and distribution. The business case will notably use input from the eAIP Pilot Countries.

We consider that day-to-day costs will be lower than paper AIP production and distribution, at least because of a simplified Amendments management. However, the initial move towards a fully electronic Static Data Process will require some investments in hardware, possibly in software, certainly in personnel training and time. Another strong return on investment is expected in regards to data integrity and quality of service.

10.5. Technology

Q: What are the hardware requirements?

A: **For users (browsing an eAIP online or on a CD-ROM)**

- Intel Pentium processor or similar
- 32MB of memory (64MB or more is recommended for large charts)
- Internet connectivity (56k modem is enough for text only; 256k recommended for large charts) or CD-ROM drive or local network
- 256 color video display with 800x600 resolution; recommended: 65k colors with 1024x768 resolution 17" display

For editors and publishers

- Intel Pentium processor or similar
- 128MB of memory (256MB recommended)
- 256 color video display with 800x600 resolution; recommended: 65k colors with 1024x768 resolution 17" display
- At least one "publishing workstation" should have a more powerful configuration: minimum Pentium III, 512MB memory, Internet connectivity 256k, CD-ROM writer; recommended: Pentium 4, 1GB memory;
- Note: this does not apply to charts editors, who need a more powerful configuration

Windows XP users should add 64MB to the memory requirements above.

Q: What are the software requirements?

A: Because the EUROCONTROL eAIP relies on open standards such as XML, your software options are quite large: from Open Source (free) Software to COTS XML software to AIS-specific ones in the near future. The actual software you should use depend on your computer literacy and the presence of IT expertise in your organisation. Editors and publishers will certainly need IT support to create their eAIP, at least in the beginning.

Editing tasks

You will need an XML editor software. There are plenty of them, including free ones, which you can download from the Internet. COTS XML editors examples are XML Spy, XMetal, Epic, Morphon, etc. Finally, EUROCONTROL expects the industry to provide AIS-domain specific software supporting the eAIP specification.

Publishing tasks

The objectives of these tasks is to let your users access the eAIP in the format they are most interested in: HTML for on-screen browsing, PDF for printing or XML itself for further processing. Again, plenty of tools are available. For transformation of XML into HTML or PDF, all you need is an XSLT processor and an XSL-FO renderer. Most such software are developed in Java, so you will probably need a Java Runtime Environment as well.

XSLT processor: An XSLT processor is a software that transforms XML files into other formats, using XSLT instructions. For more information about XSLT, see the references section. Two common XSLT processors are Xalan, an Open Source Software written in Java by the Apache Software Foundation and MSXML from Microsoft. Note that MSXML only runs on Windows platforms, while Xalan runs on any Java 2 platform (Windows, Unix, Mac and others). There are many other processors available.

XSL-FO renderer: An XSL-FO renderer is a software that transforms XSL-FO files into other formats, such as PDF (Portable Document Format, made popular by Adobe Acrobat) and PostScript. For more information about XSL-FO, see the references section. Two common XSL-FO renderers are FOP, an Open Source Software written in Java by the Apache Software Foundation and XEP from RenderX. Both run on any Java 2 platform (Windows, Unix, Mac and others). FOP is free but not complete. XEP is complete but not free. A free evaluation version of XEP is available at their Web site. There are some other renderers available.

Usage tasks

On-screen display: a Web browser is the typical software to use for on-screen display of an eAIP. Some of these browsers are able to display the XML format directly, but this is not the recommended method, due to the size of an AIP document. It is recommended to use the HTML version (which will be provided by AIS offices on their Web site or on CD-ROM).

On paper: users would typically print an eAIP from the PDF files, as provided by the AIS offices. To do that, they would need a PDF document reader, such as Adobe Acrobat Reader.

Computer processing: when further processing of AIP data is needed, such as to extract specific parts of the AIP or to format it differently for on-board devices, developers would use the eAIP in XML format directly. In this case, tools such as an XSLT processor and probably a Java Runtime Environment (JRE) or Java Development Kit (JDK) will be needed.

See also the following questions: How do I create an eAIP? How can I use an eAIP? Is the eAIP supported by the industry?

Q: What technologies is the eAIP using?

A: The EUROCONTROL eAIP is based on XML (eXtensible Mark-up Language). An electronic AIP is in fact an XML document, conforming to eAIP DTD. The eAIP in XML is transformed into other formats using XSLT. For on-screen display, the eAIP is transformed into HTML (Hyper-Text Mark-up Language). When paper is the target, the eAIP is transformed into XSL-FO. Charts and graphics can be in various formats, and a very interesting one for aeronautical charts is SVG. All these technologies are official recommendations (standards) by the W3C (World Wide Web Consortium). Finally, software tools must be used to print XSL-FO; currently, the most convenient method is to first convert XSL-FO to PDF or PostScript and then print those files.

See also the answers to the questions What is XML? What is a DTD and what has it to do with eAIP? What is XSLT? What is XSL-FO? What is SVG?

Q: What is XML?

A: XML stands for eXtensible Mark-up Language. XML is a subset of the Standard Generalized Markup Language (SGML, ISO 8879). Since 1998, when it was published as a recommendation by the World Wide Web Consortium (W3C), XML has rapidly become the de-facto industry standard for electronic data interchange.

XML is a meta-language (a language to define other languages). It allows us to define an "AIP language" for computers. Using the EUROCONTROL eAIP language, people and computers can talk to each other using the same vocabulary and grammar.

You can find a lot more information about XML on the Web, but the XML FAQ might be a good place to start.

Q: What is a DTD and what has it to do with eAIP?

A: DTD stands for Document Type Definition. It is a formal representation of XML documents' structure. To keep up with our previous analogy with languages, the eAIP DTD is a formal definition of our eAIP language's vocabulary and grammar. For more details about the eAIP DTD, please read the eAIP DTD Documentation.

Q: Why XML?

A: XML has been chosen because it fulfils the main eAIP objectives: it is commonly used for structuring documents and it is suitable for both human to computer and computer

to computer interactions. Also, it is a recognised standard since 1998, widely adopted by the software developers in many industries.

Q: What is XSLT?

A: XSLT stands for eXtensible Stylesheet Language Transformations. It is an XML-based language that allows to transform an XML document into another XML document (or into text document as well). In the eAIP context, we use XSLT to convert an eAIP in XML into an HTML format or an XSL-FO format. For more information about XSLT, see the references section.

Q: What is XSL-FO?

A: XSL-FO stands for eXtensible Stylesheet Language Formatting Objects. It is an XML-based language that allows to express a document with its formatting, for example to print it on paper. In the eAIP context, we use XSL-FO to format an eAIP in order to print it on paper. With adequate software will be available, one will be able to directly print an XSL-FO document. In the mean time, we use software that convert XSL-FO to PDF or PostScript and then print those files. For more information about XSL-FO, see the references section.

Q: What is SVG?

A: SVG stands for Scalable Vector Graphics. It is an XML-based language to express 2-dimensional drawings using simple graphical objects such as lines, circles, rectangles and text, and object properties such as color, size and position. One can zoom in to a small portion of an SVG image and still see a very precise definition of the image. In fact, SVG image resolution is only limited by printers' resolution. SVG images can be interactive; for example, one can highlight a single route on route map or click on an object on a map and get additional information about this object. For more information about SVG, see the references section.

Being written in XML, SVG charts can quite easily be linked to other XML information. We will very soon see SVG graphics on-line that are linked to NOTAMs and to textual sections of an eAIP.

10.6. Safety

Q: How safe is the eAIP?

A: The eAIP Specification defines an electronic format for the AIP data, which is different from the paper format currently in use. The information content and structure is exactly the same. The quality control system and the static data procedures currently implemented in AIS (ICAO Annex 15 requirement) are equally applicable to the eAIP production process. This ensures that data issued in the form of an electronic AIP is of the same quality as data issued in the form of a paper AIP.

The way AIP/eAIP data is used for operational needs is subject to specific ATS, ATM, avionics, etc. regulations. This will be within the scope of the end-to-end data integrity EUROCONTROL project.

The safety / security considerations included in the eAIP Specification demonstrate that the use of electronic signature technologies can provide better data integrity for the electronic format than for the paper format.

Q: Is it safe to access aeronautical information via the Internet?

A: No. Or at least not "naturally": we need to protect data by using security technologies such as electronic signature and authentication.

On a Web site serving an eAIP, for instance, this would mean that the Web server can be accessed securely (through the HTTPS/SSL protocol), much like we are used to

access secured e-commerce Web sites. The Web server would feature a security certificate, ensuring that it is indeed the official Web site for serving that eAIP. For more detailed discussion, please read the safety and security considerations.

Q: Is it safe to access aeronautical information on CD-ROM?

A: This is very similar to paper: Most people tend to say yes, because data written on a CD-ROM cannot be modified (though it can be destructed). However, when you receive a CD-ROM by post, how can you be sure that it has not been replaced on the way? Similarly to data transmitted over the Internet, data on CD-ROM must be authenticated.

Q: How can we ensure data integrity while allowing users/intermediaries to modify data format?

A: Strictly speaking, we cannot offer that guarantee. However, the use of XML technology is a great step in the right direction. Because elements of data in the eAIP are individually identified and marked up, XML developers can write scripts to process data without actually tampering with data itself.

For example, all routes in sections ENR-3.1 to 3.4 are marked up as route tables. One can fetch all route tables from an eAIP and display them differently (say, with other colours). The actual route definitions are preserved: only formatting is different. Now what we cannot guarantee is that one will not display the route remarks written in white on a white background...

Appendix A. References and useful links

XML: [http://www.w3.org/XML/]
Specification and other links
XSL-FO and XSLT: [http://www.w3.org/Style/XSL/]
Specification and other links
Saxon: [http://saxon.sourceforge.net/]
A free and open source XSLT processor
Xalan: [http://xml.apache.org/xalan-j/index.html]
A free and open source XSLT processor
MSXML: [http://msdn.microsoft.com/library/default.asp?url=/nhp/default.asp?contentid=28000438]
XML resources from Microsoft
XT: [http://www.blnz.com/xt/index.html]
Another XSLT processor
SVG: [http://www.w3.org/Graphics/SVG/]
Scalable Vector Graphics, an XML-based vectorial graphics format
FOP: [http://xml.apache.org/fop/index.html]
A free and open source XSL-FO renderer
XEP: [http://xep.xattic.com/]
A commercial XSL-FO renderer

Appendix B. Glossary

AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
AIXM	Aeronautical Information Exchange Model
AMDT	Amendment
CA	Certification Authority
CSS	Cascading Style Sheet
DTD	Document Type Definition
eAIP	Electronic AIP
ECAC	European Civil Aviation Conference
HTML	Hyper-Text Mark-up Language
ITU	International Telecommunication Union
PKI	Public Key Infrastructure
PGP	Pretty Good Privacy
SGML	Standard Generalized Markup Language (ISO 8879)
SVG	Scalable Vector Graphics
XML	Extensible Markup Language
XSLT	Extensible Stylesheet Language Transformations
XSL-FO	Extensible Stylesheet Language - Formatting Language