APPENDIX H: AIDC SARPs VALIDATION REPORT

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APPENDIX H: AIDC SARPs VALIDATION REPORT

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1. INTRODUCTION

1.1 Scope

The purpose of this document is to report on the results of the validation of the draft Air Traffic Services (ATS) Interfacility Data Communication (AIDC).

In addition, this document draws conclusions on the level reached so far by the validation of the draft AIDC SARPs.

1.2 Background

The AIDC SARPs were placed under configuration control at the 6th meeting of WG3 (Brussels, 15-26 April 1996), and since that time a detailed change record has been maintained.

The baseline version of the AIDC SARPs was agreed at the 7th meeting of WG3 (Munich, 24-29 June 1996) and submitted to ICAO.

The following table describes the change history of the AIDC SARPs.

Date	Version	Comments
October 1995	0.1	First Draft
November 1995	0.2	Second Draft, major rework of service definitions
February 1996	0.3	Third Draft, major rework of SARPs due to ADSP and ULA changes (CDSE removed)
February 1996	0.4	Input to 5th WG3 meeting (South Brisbane, 4-15 February 1996)
February 1996	0.41	Output of Brisbane WG3 meeting
April 1996	Proposed 1.0	Input to 6th WG3 meeting (Brussels, 15-26 April 1996), Chapters 3, 4 & 5 revised, chapters 6 & 8 added
April 1996	1.0z	Output of Brussels WG3 meeting, WG3 Baseline version, start of configuration control
June 1996	Proposed 2.0	Input to 7th WG3 meeting (Munich, 24-29 June 1996), all chapters revised
June 1996	2.0	Output of Munich WG3 meeting. Baseline version submitted to ICAO
September 1996	Amended pages	Revisions to chapters 1, 3, 5, 6 & 7 to take into account defect reports, user requirements not correctly captured and results of modelling and of the compilation of the ASN.1 specification

2. HIGH LEVEL VALIDATION OBJECTIVES

Validation Objectives (VOs) are statements which express the analysis, tests and evaluations required in order to declare the SARPs validated. WG3 has defined common VOs for ATN applications. The following is the list of these common VOs. Each VO is applicable to the AIDC application.

VO	Description
SVO1	To determine which System Level Requirements (which are based in particular on operational requirements within the *ICAO Draft Manual of ATS Data Link Applications*) are satisfied by the functional descriptions in combination with the user requirements and recommended practices of the SARPs.
SVO2	To determine if the CNS/ATM-1 Package applications specifications are mutually consistent.
FVO1	To determine if the functional descriptions in the SARPs are compatible with the technical requirements.
FVO2	To determine if the user requirements and recommended practices are compatible with the technical requirements.
FVO3	To determine if the SARPs are complete.
FVO4	To determine if the SARPs are unambiguous.
FVO5	To determine if the SARPs are consistent.
FVO6	To determine if there are requirements in the SARPs which would have no effect if removed [1].
FVO7	To determine if provision has been made to ensure that the SARPs are implementation independent.
TVO1	To determine if the protocol description supports the end-to-end services.
TVO2	To determine if the protocol has unacceptable behaviour.
TVO3	To determine if the abstract service interface parameters are mapped appropriately to PDU fields and/or communication service interface parameters, and vice versa.
TVO4	To determine if protocol errors in the peer application are correctly handled.
TVO5	To determine if the SARPs are consistent with the upper layer architecture to the extent that this is a requirement, e.g. use of the Dialogue Service, application of the control function.
TVO6	To determine if the APDUs are correctly specified.
TVO7	To determine if provision for QOS management has been addressed.
TVO8	To determine if provision for future migration has been addressed.
TVO9	To determine if efficiency requirements have been addressed, e.g. minimising size of data transfer, appropriate maintenance of dialogue.
TVO10	To determine that the functionality described in the SARPs is implementable.

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[1]   This VO should be interpreted to mean that there are no requirements in the SARPs that are not necessary for CNS/ATM-1 Package. It is not meant to eliminate possible duplicated statements of requirements that are known to exist.

VO	Description
TVO11	To determine that independent implementations built in accordance with the SARPs will be able to interoperate.

3. VALIDATION MEANS

The following generic means of validation have been identified for all ATN applications:

a) Two or more independently developed interoperating implementations, validated by two or more States/Organisations.

b) Two or more independently developed interoperating implementations, validated by one State/Organisation.

c) One implementation, validated by more than one State/Organisation.

d) One implementation, validated by one State/Organisation.

e) Partial implementation, validated by one or more State/Organisation.

f) Simulation, analysis using tools e.g. ASN.1 compiler, modelling tools.

g) Analysis and inspection.

4. VALIDATION ACHIEVED

The following table summarises the validation activities for the AIDC SARPs that have been achieved to date. The letters in the table correspond to the validation means of the previous section.

AIDC services	Participating States/Organisations				
	ATNP/WG3/ SG1	**Eurocontrol**	**European States**	**Various industry suppliers of ATM Systems**	**Summary**
Flight Notification	g	e	e	e	e,g
Flight Co-ordination	g	e	e	e	e,g
Transfer of Control	g	f	f	e	e,f,g
Transfer of Communication	g	f	f	e	e,f,g
Transfer of Surveillance Data	g	f	f	e	e,f,g
General Information Interchange	g	e	e	e	e,g

5. SUMMARY OF ACTIVITIES SUPPORTING VALIDATION

The objective of this section is to briefly describe the activities undertaken by States/Organisations which have contributed to the AIDC SARPs validation.

5.1 ATNP/WG3/SG1

Members of ATNP/WG3/SG1 have thoroughly analysed and inspected the AIDC SARPs with the view to determine if:

> a) the operational requirements within the ICAO Draft Manual of ATS Data Link Applications are satisfied by the functional descriptions in the SARPs;
>
> b) the AIDC application specification is consistent with the other applications;
>
> c) the functional descriptions and the user requirements in the SARPs are compatible with the technical requirements;
>
> d) the AIDC SARPs are complete, unambiguous and consistent;
>
> e) the AIDC SARPs contain no requirements which would have no effect if removed.

This task has been completed by ATNP/WG3/SG1.

5.2 Eurocontrol

5.2.1 Real-time simulation activities

The automatic exchange of coordination data between ATC computer systems (i.e. Flight Data Processing Systems) using electronic data transfer has been in operation in Europe since a number of years. The exchange of data conforms to the Eurocontrol Standard for On-Line Data Interchange (OLDI) which covers the Notification Phase and the Coordination Phase of a given flight.

Extensions to this base-standard have been developed to include a dialogue procedure during the Coordination Phase and the Transfer of Control Phase of a flight. These extensions have been extensively and successfully tested within a real-time simulated operational environment consisting of a representative part of four European ATC centres (a total of 10 sectors) using representative traffic sample data.

The OLDI application complemented by the dialogue procedure during the Coordination Phase and the Transfer of Control Phase of a flight was therefore considered as being a possible regional implementation of the AIDC application, taking into account that:

> a) a one-to-one relationship almost exists between the OLDI messages and the AIDC services defined in the ICAO Draft Manual of ATS Data Link Applications;
>
> b) message sequencing is the same for the OLDI and AIDC applications.

All the AIDC services, with the exception of the Transfer of Control service, have been successfully tested in such a simulated environment.

5.2.2 Modelling of AIDC SARPs

The validation of the draft AIDC SARPs undertaken by Eurocontrol concentrated on their functional validation. The defined ULA was assumed to have been validated as part of the Air/Ground applications SARPs since these applications place more stringent performance requirements than the AIDC application.

Taking into account the similarities between the AIDC application and the long existing operational OLDI application, the approach chosen to validate the AIDC SARPs was based on the verification of the interoperability between an OLDI user and an AIDC user.

The validation activities carried out by Eurocontrol included:

> a) the modelling of the state machine of an AIDC ATSU and of an OLDI ATSU in terms of message sequencing and timers. For this purpose, use was made of the Object GEODE v2.2.3 SDL editor which provides model simulation features. In this environment, events are qualified as in/out signals which can be received by the user of the state machine or the OSI underlying service provider.

> b) the modelling of the mapping between OLDI message and AIDC service primitives.

This modelling has proven that a high level of interoperability exists between OLDI and AIDC implementations.

5.3 France

Taking into account the similarities between the AIDC application and the long existing operational OLDI application, it has been assumed that the contents of the AIDC APDUs do not have to be validated. However, the formal definition of the AIDC service primitives were validated in order to verify that the ASN.1 specification is valid and to determine if unambiguous provision has been made for the ASN.1 encoding.

The AIDC ASN.1 specification has therefore been compiled by France in order to verify the AIDC definition. This compilation has resulted in some defects which have been corrected.

5.4 European States

The OLDI standard (referred to in section 5.2.1 above) has been implemented and is used in an operational environment by a number of European States comprising inter alia Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, Spain, and the United Kingdom.

This includes OLDI functionalities identical to the following AIDC services: Flight Notification, Flight Coordination, Transfer of Communication and General Information Interchange.

5.5 Industry ATM Suppliers

Industry suppliers of ATM systems implement the Eurocontrol OLDI baseline Standard for European customer States as off-the-shelf functionality. This includes, at least, the implementation of the AIDC Flight Notification service, the Flight Coordination service, the Transfer of Communication service, and the General Information Interchange service.

The AIDC Transfer of Surveillance service, although not yet used in an operational environment, is also available.

6. DEFECT REPORT SUMMARY

The baseline version of the AIDC Application SARPs submitted to ICAO included, where applicable, all defects/comments made prior to the Munich WG3 meeting.

Inspection and analysis process conducted by several parties, formal modelling of the protocol and compilation of the ASN.1 specification have generated comments and defect reports which have been analysed. These comments and defects are related to:

- the alignment of the terminology used in the SARPs with that used in the Draft ICAO Manual for ATS Data Link Application;s

- the refinement of the behaviour of the AIDC Control Function;

- the refinement of the AIDC-ASE protocol definition; and

- a better capture of some user requirements, such as the possibility for a C-ATSU to invoke the Information Transfer Service prior to the Notification regime.

These comments and defects have been submitted to and approved by the Toulouse WG3/SG1 meeting (23-26 September 1996) and taken into account to propose amendment pages to the baseline version submitted to ICAO.

7.   ANALYSIS AND CONCLUSIONS

7.1   Achievement of Validation Objective SVO1

VO	VO Description	Conclusion
SVO1	To determine which System Level Requirements (which are based in particular on operational requirements within the *ICAO Draft Manual of ATS Data Link Applications*) are satisfied by the functional descriptions in combination with the user requirements and recommended practices of the SARPs.	Achieved

7.1.1   User Requirements fulfilled by the AIDC Application SARPs

The following user requirements within the Draft ICAO Manual for ATS Data link Applications are fulfilled by the AIDC Application SARPs.

Flight Notification

This function allows the Controlling ATS Unit (C-ATSU) to notify the Downstream ATS Unit (D-ATSU) of a flight's cleared profile some time before the flight enters the D-ATSU's area of interest. This function may be initiated a multiple number of times for the same flight, depending on the number and type of changes made to the flight's cleared profile.

Flight Co-ordination

This function allows the C-ATSU to co-ordinate the conditions of transfer for a flight with a D-ATSU.

Transfer of Control

This function allows the C-ATSU to transfer control authority for a flight to the R-ATSU and allows the R-ATSU to accept the control authority for the flight.

Transfer of Communication

This function allows one of the following to take place:

- the C-ATSU to offer the control authority and communications authority for a flight to the R-ATSU and the R-ATSU to accept the control and communications authority for the flight; or

- the R-ATSU to take the control authority and communications authority for a flight.

Transfer of Surveillance Data

This function allows an ATSU1 to transfer surveillance data to an ATSU2.

General Information Interchange

This function allows an ATSU1 to exchange general flight related data, including free text messages, with an ATSU2.

7.1.2 System Level Requirements fulfilled by the AIDC Application SARPs

The following System Level Requirements are fulfilled by the AIDC Application SARPs.

OSI Standard	The Draft SARPs for AIDC are based on ISO OSI Standards, using the ATN Upper Layer Architecture which itself meets this requirement;
Authorised Paths	The Draft SARPs for AIDC enables the exchange of tactical control information between two ATSUs when an authorised path exists between these ATSUs;
ATSC Traffic Classes	As allowed by the ATN, the AIDC application does not express any preference in terms of ATS Traffic Class since this application makes only use of ground subnetworks which are not subject to major bandwidth limitations;
Communications Priorities	The communication priority assigned to AIDC is: "Normal Priority, Flight Safety Messages";
Peer Information Exchange	The Draft SARPs for AIDC enable the exchange of tactical control information between peer AIDC applications when an authorised path exists between these applications;
Lack of Path Notification	The AIDC application is notified when no authorised path exists between peer applications by means of a Service Provider Abort indication;
Unambiguous Addressing	AIDC is an ATN application which relies on the ATN naming and addressing plan;
Originator Identification	The AIDC application maintains a strict correspondence between originator and recipient within a given flight related dialogue;
Addressing and Name Assignments	AIDC is an ATN application which relies on the ATN naming and addressing plan;
Fixed and Mobile Systems	AIDC is strictly an ATN ground application between fixed systems;
Exchange of Address	The AIDC application relies on the ATN Upper Layer Communication Services which enables the exchange of application address information;
AIDC Association	The AIDC application is capable of establishing, maintaining, releasing and aborting peer-to-peer application associations;
UTC Reference	All dates and times referenced in the AIDC application are expressed as UTC.

7.2 Achievement of Validation Objective SVO2

VO	VO Description	Conclusion
SVO2	To determine if the CNS/ATM-1 Package applications specifications are mutually consistent.	Achieved. Application specifications in the SARPs are consistent with other applications, since there is no direct relationship with other CNS/ATM-1 Package applications, and thus no risk of inconsistency.

7.3 Achievement of Validation Objective FVO1

VO	VO Description	Conclusion
FVO1	To determine if the functional descriptions in the SARPs are compatible with the technical requirements.	Achieved. After inspection and analysis of the SARPs by several parties, no incompatibility has been reported, nor has any defect report been generated in this area.

7.4 Achievement of Validation Objective FVO2

VO	VO Description	Conclusion
FVO2	To determine if the user requirements and recommended practices are compatible with the technical requirements.	Achieved. After inspection and analysis of the SARPs by several parties, the comments/defects reported in relation with this VO have been analysed and taken into account where appropriate.

7.5 Achievement of Validation Objective FVO3

VO	VO Description	Conclusion
FVO3	To determine if the SARPs are complete.	Achieved. After inspection and analysis of the SARPs by several parties, the comments/defects reported in relation with this VO have been analysed and taken into account where appropriate.

7.6 Achievement of Validation Objective FVO4

VO	VO Description	Conclusion
FVO4	To determine if the SARPs are unambiguous.	Achieved. After inspection and analysis of the SARPs by several parties, the comments/defects reported in relation with this VO have been analysed and taken into account where appropriate.

7.7 Achievement of Validation Objective FVO5

VO	VO Description	Conclusion
FVO5	To determine if the SARPs are consistent.	Achieved. After inspection and analysis of the SARPs by several parties, the comments/defects reported in relation with this VO have been analysed and taken into account where appropriate.

7.8 Achievement of Validation Objective FVO6

VO	VO Description	Conclusion
FVO6	To determine if there are requirements in the SARPs which would have no effect if removed.	Achieved. After inspection and analysis of the SARPs by several parties, no defect has been reported.

7.9 Achievement of Validation Objective FVO7

VO	VO Description	Conclusion
FVO7	To determine if provision has been made to ensure that the SARPs are implementation independent.	Partly achieved. Upon completion of the SARPs inspection and analyses process by several parties, no defect has been reported in this area. Complete achievement of this VO is subject to prototype implementations to be developed and tested.

7.10 Achievement of Validation Objective TVO1

VO	VO Description	Conclusion
TVO1	To determine if the protocol description supports the end-to-end services.	Partly achieved. Complete achievement of this VO is subject to prototype implementations to be developed and tested.

7.11 Achievement of Validation Objective TVO2

VO	VO Description	Conclusion
TVO2	To determine if the protocol has unacceptable behaviour.	Achieved. After inspection and analysis of the SARPs by several parties, no defect has been reported.

7.12 Achievement of Validation Objective TVO3

VO	VO Description	Conclusion
TVO3	To determine if the abstract service interface parameters are mapped appropriately to PDU fields and/or communication service interface parameters, and vice versa.	Achieved. After inspection and analysis of the SARPs by several parties, no defect has been reported.

7.13 Achievement of Validation Objective TVO4

VO	VO Description	Conclusion
TV04	To determine if protocol errors in the peer application are correctly handled.	Partly achieved. Complete achievement of this VO is subject to prototype implementations to be developed and tested.

7.14 Achievement of Validation Objective TVO5

VO	VO Description	Conclusion
TVO5	To determine if the SARPs are consistent with the upper layer architecture to the extent that this is a requirement, e.g. use of the Dialogue Service, application of the control function.	Achieved. The AIDC SARPs model the AIDC application using the OSI Extended Application Layer Structure. The specification of the AIDC Control Function is consistent with the use of the Dialogue Service.

7.15 Achievement of Validation Objective TVO6

VO	VO Description	Conclusion
TVO6	To determine if the APDUs are correctly specified.	Achieved. After compilation of the ASN.1 specification contained in the SARPs and inspection/analysis by several parties, the comments/defects reported in relation with this VO have been analysed and taken into account where appropriate.

7.16 Achievement of Validation Objective TVO7

VO	VO Description	Conclusion
TVO7	To determine if provision for QOS management has been addressed.	Partly achieved. QOS management has been addressed. Complete achievement of this VO is subject to prototype implementations to be developed and tested.

7.17 Achievement of Validation Objective TVO8

VO	VO Description	Conclusion
TVO8	To determine if provision for future migration has been addressed.	Achieved. This results from the use of the ATN Upper Layer Communication Services. Additionally, extensibility markers have been inserted in the AIDC message definitions. After inspection and analysis of the SARPs by several parties, no defect has been reported.

7.18 Achievement of Validation Objective TVO9

VO	VO Description	Conclusion
TVO9	To determine if efficiency requirements have been addressed, e.g. minimising size of data transfer, appropriate maintenance of dialogue.	Achieved. This results from the use of the ATN Upper Layer Communication Services. After inspection and analysis of the SARPs by several parties, no defect has been reported.

7.19 Achievement of Validation Objective TVO10

VO	VO Description	Conclusion
TVO10	To determine that the functionality described in the SARPs is implementable.	Partly achieved using simulation/modelling techniques. Complete achievement of this VO is subject to prototype implementations to be developed and tested.

7.20   Achievement of Validation Objective TVO11

VO	VO Description	Conclusion
TVO11	To determine that independent implementations built in accordance with the SARPs will be able to interoperate.	Partly achieved. Complete achievement of this VO is subject to prototype implementations to be developed and tested.