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WORKING GROUP 3 (APPLICATIONS AND UPPER LAYERS)

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Appendix I
Upper Layer SARPs Validation Report

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SUMMARY

This document presents the results of the validation programmes that have been undertaken by various States and Organisations, which apply to the ATN Upper Layer Communications Service (ULCS) SARPs. It summarises the ULCS-related results, and analyses them against a set of high level validation objectives, drawing conclusions on the level of validation achieved to date.

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1. INTRODUCTION

1.1. Scope

Since the start of the development of the ULCS SARPs, a number of validation programmes have been established due to the efforts of a number of Organisations and States. The purpose of this document is to report on the results of those programmes that have reported their ULCS-related results so far, and to draw conclusions on the level of validation of the ULCS SARPs which has been achieved.

1.2. Background

The ULCS SARPs were placed under configuration control at the 5th meeting of WG3 (Brisbane, February 1996), and since that time a detailed change record has been included in the configuration sheet which is part of the SARPs document. The change history is as follows:

Table 0-1 - ULCS Change History

Version	Date	Comment
1.0	October 1995	Banff Proposed Draft SARPs.
1.1	October 1995	Final Banff draft
1.2	December 1995	Updated at Bracknell editing meeting
1.3	December 1995	Output of Boston SG3 meeting Technically stable draft.
2.0	March 1996	Output of Brisbane WG3 meeting. Configuration control applied.
3.0p	April 1996	Input to ATNP/WG3 Brussels meeting.
3.0	April 1996	Output from ATNP/WG3 Brussels meeting.
4.0p	June 1996	SG3 meeting, Reston
4.0	July 1996	Output of ATNP/WG3 Munich meeting. Baseline version submitted to ICAO.

Table 1: Change History

1.3. Embedded Testing

The UL SARPs cannot be completely validated in isolation; they must be considered in combination with ATN Application SARPs. There is no requirement that the Dialogue Service should be explicitly realised in an implementation; it serves as the abstract interface between the common UL SARPs and each individual ATN Application SARPs. It must therefore be validated that the UL SARPs and ATN Application SARPs when taken together specify a complete, implementable function.

When implementing prototypes, the ATN Application and the supporting Upper Layer entities should be indivisible; they are effectively embedded within a complete ATN-AE. It will in

general be possible to perform application interoperability tests using any supporting Transport service (including loopback).

1.4. Dependencies on External Standards

The UL SARPs incorporate by reference a number of ISO standards. A potential advantage of using ISO or ITU-T standards is that they are pre-validated, i.e. studied and approved by national standards bodies, implemented and interoperability demonstrated between independent implementations. To benefit from such pre-validation, the validation status of each referenced standard needs to be verified. For each referenced external standard, the following points must be answered:

What is the status of the standard (committee draft, draft or fully ratified)?

Do implementations exist?

Has interoperability been demonstrated?

Are there any outstanding defect reports?

Are the references in the SARPs sufficiently precise (version number, amendments and defect reports included)?

1.4.1. ASN.1/PER

The Packed Encoding Rules (ISO 8825-2) are assumed to be stable. It is proposed not to validate this standard any further in this effort. It is noted that the PER implementations have not converged in the firtst interoperability tests.

1.4.2. ACSE (second edition)

Although the second edition text has only recently been published, final draft text has been circulating for a considerable time. Numerous implementations of the first edition exist and have been demonstrated to interwork. The second edition is an incremental development of the first edition, incorporating published amendments. It is proposed that no further validation of the ACSE state table and service definition be performed.

However, as ACSE is embedded in the ATN Application Entity, it is recommended that the behaviour of the ACSE protocol machine should be modelled as part of the validation of the CF specification.

Further, the UL SARPs impose the condition that the ACSE PDU definitions should be augmented with the ASN.1 extensibility notation (this is currently a draft amendment to the ISO standard) and encoded using PER. There are no known implementations of these features. Therefore it is necessary to validate that the ACSE protocol definitions result in well-formed, unambiguous encoded bit patterns for interchange.

1.4.3. Presentation layer

The UL SARPs require the “fast byte” efficiency enhancements to the presentation protocol. These have reached the status of draft amendment (DAM) within the more extensive efficiency enhancements being progressed within ISO. No known implementations exist.

It is therefore necessary to validate the presentation layer standards with efficiency enhancements incorporated. It is proposed to validate only the Connect phase, as there is no Presentation functionality in the Data or Disconnect phases when the “fast byte” protocol option is selected. It is further proposed to validate only the successful negotiation of null encoding, i.e. the case where both presentation protocol machines support the “fast byte”

connect PPDU. This should be done by simulation, implementation and interoperability trials.

There are known defects in the ISO efficiency DAM. The resolution of these problems by the international standards bodies is included in the draft SARPs by reference.

1.4.4. Session layer

The UL SARPs require the “fast byte” efficiency enhancements to the session protocol. These have reached the status of draft amendment (DAM) within the more extensive efficiency enhancements being progressed within ISO. No known implementations exist.

It is therefore necessary to validate the session layer standards with efficiency enhancements incorporated. It is proposed to validate only the Connect phase, as there is no session functionality in the Data or Disconnect phases when the “fast byte” protocol option is selected. It is further proposed to validate only the successful negotiation of null encoding, i.e. the case where both session protocol machines support the “fast byte” connect SPDU. This should be done by simulation, implementation and interoperability trials.

There are known defects in the ISO efficiency DAM. The resolution of these problems by the international standards bodies is included in the draft SARPs by reference.

2. HIGH LEVEL VALIDATION OBJECTIVES

Table 2 shows the high level validation objectives for ULCS.

VO	Description
SVO 1	To determine which System Level Requirements are satisfied by the functional descriptions in combination with the user requirements and recommended practices of the SARPs.
SVO 2	To determine if the CNS/ATM-1 Package applications specifications are mutually consistent.
FVO 1	To determine if the functional descriptions in the SARPs are compatible with the technical requirements.
FVO 2	To determine if the user requirements and recommended practices are compatible with the technical requirements.
FVO 3	To determine if the SARPs are complete.
FVO 4	To determine if the SARPs are unambiguous.
FVO 5	To determine if the SARPs are consistent.
FVO 6	To determine if there are requirements in the SARPs which would have no effect if removed. *Note: This VO should be interpreted to mean that there are no requirements in the SARPs that are not necessary for CNS/ATM-1 package functionality, or to achieve migration to future CNS/ATM. It is not meant to eliminate possible duplicated statements of requirement that are known to exist.*
FVO 7	To determine if provision has been made to ensure that the SARPs are implementation independent.
TVO 1	To determine if the protocol description supports the end to end services.
TVO 2	To determine if the protocol description has any unacceptable behaviour
TVO 3	To determine if the abstract service interface parameters are mapped appropriately to PDU fields and/or communication service interface parameters, and vice versa.
TVO 4	To determine if protocol errors in the peer application entity are correctly handled.
TVO 6	To determine if the APDUs are correctly specified.
TVO 7	To determine if provision for QOS management has been addressed.
TVO 8	To determine if provision for future migration has been addressed.
TVO 9	To determine if efficiency requirements have been addressed, e.g. minimising size of data transfer, appropriate maintenance of dialogue.
TVO 10	To determine that the functionality described in the SARPs is implementable.
TVO 11	To determine that independent implementations built in accordance with the SARPs will be able to interoperate.

Table 2: Validation Objectives

2.1. Grouping of Requirements

For the ULCS SARPs validation projects undertaken, the following functional groups of requirements have been identified:

- D-START service and supporting protocols
- D-DATA service and supporting protocols
- D-END service and supporting protocols
- D-ABORT service and supporting protocols
- D-P-ABORT service and supporting protocols

In addition, other useful groupings are:

- Application layer structure and naming requirements
- Session Layer Requirements and use of Transport service (Chapter 4)
- Presentation Layer Requirements (Chapter 5)
- ACSE Requirements (Chapter 6)
- Protocol (Chapter 3)
- Other (any requirement not considered in any other grouping)

Each of these groupings ("high-level requirements") is made up of an identified set of low-level requirements ("shall" clauses) and recommendations ("should" clauses).

3. VALIDATION MEANS

The following generic means of validation have been identified, and are used in Table 3

a) Two or more independently developing interoperating implementations validated by two or more states/organisations.

b) Two or more independently developing 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. APPLICATION FUNCTIONALITY VALIDATION ACHIEVED BY STATES AND ORGANISATIONS

Note: At the time of writing version 0.B of this document, detailed information has been included from ATNP/WG3/SG3 and Eurocontrol concerning their validation activities. Although it is known that other validation activities are on-going in other states and

organisations, no information has been received about the current results of those activities. It is anticipated that later versions of this document will contain results from other organisations.

The following table summaries the validation activities that have completed to date. The letters in the table correspond to the validation means given in section 3.

Group	ATNP WG3 SG3	FAA Implement	EurATN / PATN	Eurocontrol TES Project
D-START service and protocols	g	b,g	c.g	e,f,g
D-DATA service and protocols	g	b,g	c,g	e,f,g
D-END service and protocols	g	b,g	c,g	e,f,g
D-ABORT service and protocols	g	b,g	c,g	e,f,g
D-P-ABORT service and protocols	g	b,g	c,g	e,f,g
ALS and naming requirements	g	b.g	c,g	e,f,g
Session Layer	g	b,g	c,g	e,f,g
Presentation Layer	g	b,g	c,g	e,f,g
ACSE	g	b,g	c,g	e,f,g
Protocol	g	b,g	c,g	e,f,g
Other	g	b,g	c,g	e,f,g

Table 3: Validation Activities Summary

The validation programme has employed a number of validation methods including inspection and desk checking, the specification of an API based on the abstract service interface, simulation and modelling of the CF protocol machine, as well as the initial work that has been undertaken in a prototype implementation.

5. VALIDATION ACTIVITIES UNDERTAKEN BY STATES AND ORGANISATIONS

5.1. FAA Upper Layer Implementations

The US is sponsoring two current Upper Layer validation efforts. Computer Sciences Corporation (CSC), based at the FAA Technical Center (FAATC), has been tasked to develop the Upper Layers, based on the version 3.0 ("Bruxelles") Sub-Volume 4 SARPs. The work is under the guidance of the ATNP/WG3/SG3 chair.

As part of the development effort on the Data Link Processor (DLP), CSC will implement the Context Management Application (CMA), per Sub-Volume 2, Part 1 SARPs. CMA will be supported by the Upper Layer implementation.

The US CSC implementation has completed limited interoperability testing with the other US Upper Layer implementation.

The US is also sponsoring an Upper Layer validation effort based on an implementation from Open Network Solutions, Inc. (ONS). ONS has been tasked to develop the Upper Layers based on the latest Version 4.0 Sub-Volume 4 SARPs. This Upper Layer work is in conjunction with the validation of the Pass Through Service (Type A Gateway), per Sub-Volume 3.

The Upper Layer implementation is compelete and is available for interoperability testing at the present time.

The application implementations will be based on the ONS Upper Layer implementation and will be completed by the first quarter of 1997. Interoperability testing with other ATN implementations will be scheduled for compeletion before the end of first quarter 1997. Discussions with Eurocontrol on interoperability testing are under way.

The CMA implementation is scheduled to be completed by the end of November 1996 and will be available for interoperability testing at that time.

5.2. Eurocontrol TES Project

Eurocontrol developed a set of tools to support the analysis of "requirements" ("shalls" and "shoulds") in the SARPs. These were used to extract the requirements of the ULCS SARPs for analysis. A number of technical and editorial improvements were made to the SARPs text as a direct result of these activities.

Eurocontrol developed an Application Programming Interface (API) specification for the Dailogue Service defined in the ULCS SARPs. This API was defined in the "C" programming language in a format compatible with that adopted by the X/Open organisation for the Transport Service Interface. The interface definitions were then test compiled. As part of this specification work, a number of defects in the SARPs were detected and notified to the SARPs editor for corrections to be applied.

Eurocontrol is developing the Trials End System (TES) prototype applications to assist in the validation of SARPs for the CNS/ATM-1 Package. The TES prototypes are being developed by a European industry consortium, who will independently analyse the SARPs, produce functional and design specifications based on the SARPs and implement the software realisations. The TES prototype will then be used to test the functionality, interoperability and performance resulting from the SARPs.

When the TES prototypes are completed, Eurocontrol plan to use them for interoperability testing, to achieve further levels of validation. These interworking tests will be carried out

between difference instances of the TES software, and also with other States and organisations who have SARPs conformant implementations available for interworking tests.

The ADS protocol is described in the SARPs in textual form. The functionality has been transcribed into a formal definition language, which was then read and processed by the modelling tool GEODE. Each of the valid sequences of events were simulated individually and in mixed scenarios. Exhaustive simulation can ensure that all possible scenarios are tested

5.3. EurATN and PATN

In Europe, the EURATN and the PATN are planned to be used for the validation of the CNS/ATM-1 Package.

The EURATN Demonstrator has been developed by the EURATN Consortium, consisting of 13 European industry, research and university partners, under sponsorship of the Commission of the European Communities (CEC) and Eurocontrol. At present, the ATN Internet part of this Demonstrator is being upgraded to conform to the CNS/ATM-1 Package draft SARPs. The resulting EURATN Demonstrator is planned to be used for validation in the context of various European national and international projects.

The PATN is being developed in the context of PHARE (Programme for Harmonised Air Traffic Management Research in Eurocontrol), in which five European research institutes collaborate with Eurocontrol to investigate future European Air Traffic Management concepts which include the use of the ATN. The PATN will be based on the systems developed within the EURATN project, however it will ultimately be implemented at the various research centres as well as in the three research aircraft of these centres. In addition, the EURATN Upper Layers will be replaced by an Upper Layer stack which conforms to the CNS/ATM-1 Package draft SARPs

The PATN subsequently will become a deployed European network which conforms to the CNS/ATM-1 Package draft SARPs up to and including the Dialogue Service interface. Given that the PATN will contain both an Internet and upper layers which conform to the CNS/ATM-1 Package draft SARPs, in addition to its use within PHARE, it is expected to be used in European trials and validation projects.

Eurocontrol is planning to integrate existing and developing experimental ATN systems (i.e. P-ATN, the Trials ATN Router and the Trials End System) into The ATN Trials Infrastructure. This project will harmonise and integrate wherever possible all European initial and experimental ATN facilities. This will be done by organising the upgrades of experimental facilities to CNS/ATM-1 Package compatibility, to provide common interfaces, to organise the availability of the infrastructure for trials and to assist the national administrations in the configuration of the Trials infrastructure in trials which span the area of several national administrations.

6. SUMMARY OF VALIDATION METHODS AND TOOLS

Inspection and analysis of the ULCS SARPs has been performed by both ATNP/WG3/SG3 and Eurocontrol, as well as by FAA and Eurocontrol contractors. This has involved close reading of the text with the specific aim of checking to make certain that there are no defects in the SARPs. Once the validation objectives listed in section 2 were created, inspection has used these objectives as a measure of the validity of the draft SARPs.

In its work in developing the ULCS draft SARPs, ATNP/WG3/SG3 has read the document many times, both as a group and individually. This, in itself, is a validation activity.

7. VALIDATION RESULTS

7.1. Inspection

Eurocontrol has provided the editor for this Sub-Volume, so has performed a considerable amount of inspection and analysis as part of the normal editorial activities.

7.1.1. Application

Inspection began on the SARPs at version 1.0. Inspection is also used to determine non-regression when changes are incorporated as a result of defect reports arising from other validation projects.

7.1.2. Validation Results

The "Inspection" project addresses the VOs indicated in the following table. A "final inspection" was carried out on version 4.0 of the SARPs in August and September 1996. All of the groupings identified above were inspected, with the following conclusions:

ULCS Inspection Results

VO	Result (Provisional)
SVO 1	As far as can practicably be determined, all the system level requirements relevant to ULCS are satisfied by version 4.0 of the draft SARPs.
SVO 2	All of the technical requirements arising from other draft SARPs have been checked for inclusion in these draft SARPs.
FVO 1	The technical requirements have been examined to ensure that they provide the intended functionality. (The functional descriptions are mostly in non-normative notes).
FVO 2	After extensive revision of the Dialogue Service specification at WG3-7, there are no normative requirements placed on the user of the ULCS SARPs. All non-normative user requirements have been examined and have been determined to be compatible with the technical requirements.
FVO 4	A number of ambiguities were detected in earlier inspections and have been rectified. No further ambiguities were detected in the final inspection.
FVO 5	A number of inconsistencies were detected in earlier inspections and have been rectified. No further inconsistencies were detected in the final inspection.
FVO 7	The SARPs are independent of any particular implementation constraints as far as can be determined.
TVO 3	Dialogue Service abstract parameters are mapped appropriately to PDU fields and/or ACSE or Presentation Service primitives. Received Presentation Service primitives are mapped appropriately to ACSE and/or Dialogue Service abstract parameters
TVO 5	Not applicable to ULCS SARPs.

VO	Result (Provisional)
TVO 6	The APDU definitions have been inspected and appear correct. An ASN.1 compiler is required to verify the syntax of application layer PDUs. The ISO specifications of Session and Presentation "short" PDUs have not been fully validated.
TVO 7	QOS management is provided on a pass-through basis. Mapping to Transport and CLNP QOS parameters is satisfactorily defined.
TVO 8	ASN.1 extensibility markers have been included as an aid to future migration. Presentation Context identifier values are open-ended. The naming hierarchy is extensible. This appears to be sufficient to meet the requirement for future migration.
TVO 9	PER is invoked, and PER-visible constraints have been specified for optimal encoding efficiency. Some further optimisations are possible.

7.2. Requirements Analysis

7.2.1. Application

The low-level requirements ("shall" statements) have been continuously monitored since ATNP/WG3-4 (Banff) in October 1995.

For version 4.0 of the ULCS SARPs, there are:

- 170 low-level requirements ("shall" clauses)
- 0 low-level recommendations ("should" clauses).

The RDB was used in the first step of validation; a paper analysis for consistency and completeness.

The UL SARPs V4.0 was analysed for low-level requirements ("shall" statements) and recommendations ("should" statements), which were identified and extracted into a Word table. A number of structural deficiencies had been corrected as a result of similar exercise on previous versions of the document, and no new defects were detected.

7.2.2. Validation Results

A number of structural and editorial improvements were made to the SARPs texts as a direct result of these activities. For example, SARPs clauses containing more than one requirement were identified and split into separate clauses, redundant "shall" statements were identified and eliminated, and context-free shall clauses (e.g. "The CF shall...") were given context (e.g. "When event X happens, the CF shall...").

In some cases a "hanging requirement" was identified, indicating that at some level in the hierarchy there is an unstated or implied requirement that needs to be stated. These observations were fed through to the SARPs editor.

A number of technical and editorial deficiencies were found, and a Defect Report was sent to the SARPs editor. A table of requirements and recommendations was produced for use in other validation activities.

The Requirements Analysis project addresses the VOs indicated in the following table.

ULCS Requirements Analysis Results

VO	Result (Provisional)
SVO 2	Comparison of the tabulated requirements of ULCS with the A-G applications reveals that a consistent approach has mostly been adopted.
FVO 6	The tabulated requirements indicate that all stated requirements are necessary.

7.3. Simulation and Modelling

7.3.1. Application

The "GEODE" protocol simulation and modelling tool was used with version 3.0 of the ULCS SARPs during February 1996 - July 1996. The model provided for:

- the Control Function specification (excluding the "pass-through" between the upper AE service boundary and the upper application ASE boundary)
- the ACSE protocol
- D-START, D-END, D-DATA, D-ABORT and D-P-ABORT services

This validation project addressed the Dialogue Service groupings of "shalls".

That part of the control function between the AE user and the application ASE upper interface was not modelled. Since this is defined as a simple pass through (a one-to-one mapping of primitives with no change in parameters), there is no added value in producing a model of this part of the protocol.

The session and presentation protocols were NOT modelled.

7.3.2. Validation Results

The Dialogue service / protocol requirements groupings were successfully modelled, based on version 3.0 of the SARPs together with proposed changes to rectify the defects that were identified. The CF state machine was exhaustively exercised within certain limits, and a large number of scenarios were simulated.

During the modelling and simulation, a number of defect reports were raised and reported to the editor of the ULCS draft SARPs. The conclusions listed in the table below can be drawn under the assumption that these defect reports are addressed.

This work was performed on version 3.0 of the ULCS draft SARPs. Changes have been made to the draft SARPs since then, partly because of the defect raised due to this work, and partly for other reasons. Strictly speaking, the conclusions can only be said to apply to version 3.0, but there is a high probability that they can be applied to the later versions of the draft SARPs, since the defects detected have been corrected in these later versions.

VO	Result
FVO 3	All statements in the section on protocols were modelled, and care was taken not to make any assumptions where there were no "shall" statements. Having built the model, it achieved the functions that were intended - there were no parts of the protocol that were "missing". It can be concluded, therefore, that the "shall" statements describing the protocol are complete.

VO	Result
FVO 5	The ULCS model was built, taking care that all statements were modelled. No part of the model had to be removed in order to be replaced by other statements. Thus it can be concluded that the statements on protocol are consistent.
TVO 1	All end-to-end services were exercised within the model. End-to-end services were exercised under all possible conditions. It can therefore be concluded that the protocol description meets the end-to-end services in all cases.
TVO 2	The protocol was modelled completely. During exhaustive testing, no unacceptable behaviour was detected. It can be concluded that there is no unacceptable behaviour in the protocol.
TVO 4	All aspects of the protocol were implemented in the model, including error handling. Error handling was not tested against a model which produced incorrect protocol, and therefore it is not claimed that this objective has been fully met. It can be concluded that it is highly likely that sequence errors in the peer ACSE and control function are correctly handled.
TVO 10	Not Applicable. Note: Use of the GEODE tool in principle allows the automatic generation of C code which implements the system that has been modelled. Since the protocol has been modelled it is possible to automatically generate C code. It can therefore be implied that the protocol can be implemented, in terms of event sequencing. PDU structures are not validated by this exercise.

7.4. API Implementation

7.4.1. Application

The ATN Upper Layer architecture for the CNS/ATM-1 Package includes the specification of a Dialogue Service as the boundary between application service element (ASE) specifications and the control function (CF) specification. An API corresponding to this abstract boundary was specified for the TES prototype system, to allow application SARPs to be implemented and validated in a common manner.

The API specification for the Dialogue Service was produced in April 1996 (V0.G).

7.4.2. Validation Results

The interface definitions were successfully test-compiled. No defects in the ULCS SARPs were detected.

A study of the API specifications will alert potential ATN application implementors to many of the implementation issues that will arise.

VO	Result (Provisional)
SVO 2	Study of the use of the Dialogue Service in each of the application SARPs ensured that they were specified in a consistent manner.

VO	Result (Provisional)
FVO 2	The "User Requirements" correspond to the requirements at the Dialogue Service boundary, therefore specification of the API ensured that such requirements can be conveyed.
FVO 4	Specification of the API ensured that the Dialogue Service is specified unambiguously.
FVO 5	Specification of the API ensured that the various Dialogue Service primitives and their parameters are specified consistently in the SARPs.
FVO 7	Specification of the C language API verified that nothing in the ASI specification required a particular implementation platform.
TVO 7	The provision for QOS management was reflected in the Version, Security and QOS parameters. The mapping onto the Transport Service was also specified in the APIs document, verifying that such a mapping is possible.

7.5. Prototype Implementation

7.5.1. Application

Prototype Implementation began in June 1996, based on version 4.0 of the SARPs. The prototype implementation includes:

- Exposed Dialogue Service API
- Specified CF mappings and context identification
- ACSE (edition 2) protocol, PER-encoded
- Presentation "short connect" and "Null encoding" protocols
- Session "short connect" and "Null encoding" protocols.

It does NOT include the full Session, Presentation and ACSE protocols, which would support interworking with full OSI stacks, so strictly is non-conformant to ISO standards.

The work is being undertaken by an industry consortium led by Thomson in France. Implementation is expected to be completed by February 1997.

7.5.2. Validation Results

A number of defect reports were created through this validation project. Full results are expected by December 1996.

The prototype implementation project addresses the VOs indicated in the following table.

VO	Result (Provisional)
SVO 2	
FVO 3	
FVO 4	
FVO 5	
FVO 7	

VO	Result (Provisional)
TVO 1	
TVO 2	
TVO 3	
TVO 4	
TVO 5	
TVO 6	
TVO 10	

7.6. Interoperability Testing

7.6.1. Application

Interoperability testing, using prototype implementations, is scheduled to start early in 1997. This will include testing between independently produced implementations.

7.6.2. Validation Results

Full results are expected by March 1997.

The Interoperability Testing project addresses the VOs indicated in the following table.

VO	Result (Provisional)
FVO 3	
FVO 4	
TVO 1	
TVO 2	
TVO 4	
TVO 6	
TVO 7	
TVO 11	

8. ANALYSIS AND CONCLUSIONS

As far as can be determined from the provisional validation results obtained to date, the ULCS SARPs can be considered to have passed the first stages of validation.

Corrigenda have been produced by the SARPs editor to resolve reported defects and change requests.

Greater confidence will be obtained as the remaining validation activities proceed.

8.1. SVO 1

As far as can practicably be determined by inspection, all the system level requirements relevant to ADS are satisfied by version 4.0 of the draft SARPs.

8.2. SVO 2

Technical requirements arising from other draft SARPs have been checked for inclusion in these draft SARPs.

Examination of the draft Application SARPs shows that (with the exception of AIDC and X.400), the dialogue service defined for use by the application SARPs has been adopted and its use specified correctly.

8.3. FVO 1

The technical requirements have been examined to ensure that they provide the intended functionality.

8.4. FVO 2

The “User Requirements” correspond to the requirements at the DS boundary, therefore specification of the API ensured that such requirements can be conveyed.

8.5. FVO 3

All statements in the CF section on protocols were modelled, and care was taken not to make any assumptions where there were no “shall” statements. Having built the model, it achieved the functions that were intended - there were no parts of the protocol that were “missing”. It can be concluded, therefore, that the “shall” statements describing the CF State Table are complete.

8.6. FVO 4

A number of ambiguities were detected in earlier inspections and have been rectified. No further ambiguities were detected in the final inspection.

Specification of the API ensured that the DSI parts of the SARPs are specified unambiguously.

8.7. FVO 5

A number of inconsistencies were detected in earlier inspections and have been rectified. No further inconsistencies were detected in the final inspection.

Specification of the API ensured that the various DSI primitives and their parameters are specified consistently in the SARPs.

The ULCS model was built, taking care that all statements were modelled. No part of the model had to be removed in order to be replaced by other statements. Thus it can be concluded that the statements on protocol are consistent.

8.8. FVO 6

The tabulated requirements indicate that all stated requirements are necessary. The implementation projects have reported redundant requirements which have been removed by corrigenda.

8.9. FVO 7

The SARPs are independent of any particular implementation constraints as far as can be determined. The abstract nature of the service “interfaces” is not always clear.

Specification of the C language API verified that nothing in the DSI specification required a particular implementation platform.

8.10. TVO 1

All end-to-end services and the ACSE protocol were exercised within the modelling exercise. It was not possible to run exhaustive testing, due to resource limitations, therefore end-to-end services were not exercised under all possible conditions. It can therefore be concluded that the protocol description meets the end-to-end services in all normal cases.

8.11. TVO 2

The CF state table was modelled completely. No unacceptable behaviour was detected, although it was not possible to run exhaustive testing, due to resource limitations. It can be concluded that there is a high probability that there is no unacceptable behaviour in the CF as specified.

8.12. TVO 3

Inspection of the text shows that the Dialogue service interface parameters are mapped appropriately to PDU fields and/or ACSE or Presentation Service primitives.

8.13. TVO 4

All aspects of the CF State machine were implemented in the modelling exercise, including error handling. Error handling was not tested against a model which produced incorrect protocol, and therefore cannot claim that this objective has been fully met. It can be concluded that it is probable that sequence errors in the peer application are correctly handled.

8.14. TVO 6

The APDU definitions have been inspected and appear correct. An ASN.1 compiler is required to verify the syntax.

8.15. TVO 7

Priority, RER and Routing Class (Traffic Type and ATSC class) handling has been examined. Routing class (which maps to CLNP security label) is specified by the AE-User, and can take any of the permitted ATSC values - it is not dynamically managed.

The provision for QOS management was reflected in the “pass-through” Class of Communication parameter.

8.16. TVO 8

ASN.1 extensibility markers have been included as an aid to future migration. The naming hierarchy and Presentation Context identification have been designed to ensure forward migration is possible. Future migration has been a key concern at all stages of ISO standards development. This appears to be sufficient to meet the requirement for future migration.

8.17. TVO 9

PER is invoked, and PER-visible constraints have been specified for optimal encoding efficiency. Some further optimisations are possible.

8.18. TVO 10

Engineering judgement suggests that the functionality is implementable.

8.19. TVO 11

Engineering judgement suggests that independent implementations will interoperate.

ANNEX A DEFECT REPORT SUMMARY

A summary of the defect reports raised during the validation programme is available as a separate paper.

<Ed Note -- The DRs will be baselined at edition 4.0z.>

ANNEX B SUMMARY OF LOW-LEVEL REQUIREMENTS

A summary of the low-level Requirements (“shall” statements) and Recommendations (“should” statements) is available as a separate paper.