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AERONAUTICAL TELECOMMUNICATION NETWORK PANEL

WORKING GROUP 3 (APPLICATIONS AND UPPER LAYERS)

Sub Group 3, (Architecture)

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Validation of the draft Upper Layer SARPs for the CNS/ATM-1 Package

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SUMMARY
This paper proposes the approach to be taken for validating the draft ATN Upper Layer SARPs for the CNS/ATM-1 Package.
WG3 is invited to endorse the recommendations in this paper.

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1. BACKGROUND

The fourth meeting of ATNP/WG3 in Banff, 16-20 October 1995, concluded that all 3 subgroups of WG3 should use the SARPs validation framework as proposed in WG2/6 Flimsy No 12 "ATN Draft SARPs Validation Approach" as the basis for the validation of the draft SARPs for the CNS/ATM-1 Package. Each subgroup was tasked with reviewing this framework and reporting back to WG3 at its fifth meeting on how they would propose to apply this framework to the SARPs sub-volume for which they are responsible. This paper is the response of sub-group 3 (Upper Layer Architecture) in respect of Sub-volume IV "Draft SARPs and Guidance Material for ATN Upper Layers for the CNS/ATM-1 Package."

A draft SARPs may be considered as validated when it has been demonstrated to specify the stated functions (no more, no less) as a series of requirements, and each requirement has itself been validated. A requirement (expressed in SARPs as a “shall” clause, or a series of related “shall” clauses) is considered to be validated when it has been examined and tested to determine that it is a true and accurate specification, unambiguous and not in conflict with any other requirement.

The objectives of SARPs validation are to ensure that the draft SARPs are:

- Complete and self-consistent;
- Unambiguous;
- Mutually consistent (within the CNS/ATM-1 package),

and that they achieve the declared user requirement.

2. VALIDATION OBJECTIVES

The objectives of the UL SARPs validation are to ensure that:

- the draft UL SARPs are complete, consistent and unambiguous.
- implementations conforming to the draft UL SARPs are capable of interworking at both the syntactic and semantic levels
- the draft UL SARPs satisfy all user requirements.

What are the user requirements?

The Validation Objectives (VOs) for the UL SARPs can be structured into a hierarchy of high-level requirements as follows:

VO	Short name	Description
1	OSI compliance	Validate that the protocols specified in the UL SARPs comply with the OSI basic reference model to the stated extent
1.1	ALS	Validate the specified application layer structure
1.1.1	ISO	Validate compliance with referenced ISO and ITU-T standards
1.1.2	ULA	Validate the Upper Layer Architecture
1.1.2.1	AE	Validate the Application Entity specification
1.2	Efficiency	Validate that the goals of minimising octets and minimising round-trips have been addressed
1.3	Interworking	Validate the degree of interworking with “conventional OSI” stacks

VO	Short name	Description
1.4	Migration	Validate that requirements for forward compatibility are satisfied (PDU extensibility)
2	Dialogue Service	Validate the provisions which support the service assumed by the application ASEs
2.1	DS-User requirements	Validate the requirements placed upon the user of the Dialogue Service
2.2	CF State Table	Validate that the specified state table supports the defined service, generates valid sequences of events, and is free from errors such as deadlocks, loops, undefined states, etc.
2.3	CF parameter mapping	Validate the provisions for the mapping of parameters between Dialogue Service and ACSE / Presentation services
2.4	ACSE ed. 2	Validate the conformance to ISO-standard ACSE (edition 2), and the re-mapping of the lower service boundary by the CF
2.5	ACSE mapping	Validate the re-mapping of the lower service boundary of ACSE by the CF
2.6	ACSE adaptations	Validate the ATN-specific adaptations to ACSE (extensibility, PER encoding)
2.7	PER	Validate the specification of the use of ASN.1 Packed Encoding Rules
2.8	PDV	Validate that Presentation Data Values are unambiguously identified ("top level choice" in ASN.1 definitions of P-DATA).
2.9	P/S mappings	Validate the mapping of parameters and primitives to the service supported by the Presentation and Session layer "fast byte" protocols
2.10	P/S state tables	Validate the specification of Presentation and Session layer "fast byte" state tables
2.11	Application integration	Validate that the UL SARPs are consistent with application SARPs and that together they define a valid application entity.
3	UL Naming and Addressing	Validate the specified upper layer naming and addressing provisions
3.1	Naming tree	Validate the specified provisions for naming hierarchy and resulting Object Identifier encodings
3.2	PSAPs	Validate the provisions describing the construction and use of Presentation Service Access Point addresses
4	Transport Service	Validate the specific use of the Transport Service.
4.1	QOS (RER)	Validate the provision and use of the Residual Error Rate parameter
4.2	Traffic Type	Validate the provision and use of the Traffic Type parameter (Security Label construction).

3. VALIDATION METHODS

The following validation methods have been identified:

IA Inspection and Analysis. The SARPs requirement can be judged to be valid or invalid based on a paper analysis. This includes verification that the requirement is consistent with other requirements, and that it is unambiguous.

S Simulation. The SARPs requirement can be validated by a simulation of some aspect(s) of the target environment.

FM Formal modelling. The SARPs requirement can be validated by use of a formal model. For example the GEODE tool from Verilog will ensure that the modelled entity is free from deadlocks, loops, invalid state transitions, ambiguous behaviour, etc.

PI Prototype implementation. The SARPs requirement can be validated by specifying and implementing a concrete realisation.

IW Interworking. The SARPs requirement can be validated by demonstrating interoperability between two or more independent implementations. Interoperability testing between independent implementations will help to ensure that there are no ambiguities or omissions in the draft SARPs.

TE Target environment testing. The requirement can only be validated by testing in the real target environment.

EJ Engineering judgement. The requirement can be validated based on experience with similar requirements.

It is proposed that the validation objectives listed above should be addressed by the means indicated in the following table.

VO	Short name	Validation Means	Comments
1	OSI compliance	IA	Formal conformance testing is not required.
1.1	ALS	IA	
1.1.1	ISO	IA	
1.1.2	ULA	IA	
1.1.2.1	AE	IA	
1.2	Efficiency	IA, PI	
1.3	Interworking	IW	
1.4	Migration	IA	
2	Dialogue Service		
2.1	DS-User requirements	IA	It should be validated during application integration that the requirements are met.
2.2	CF State Table	FM	
2.3	CF parameter mapping	IA, PI	
2.4	ACSE ed. 2	N/A	Pre-validated (see following section)

VO	Short name	Validation Means	Comments
2.5	ACSE mapping	PI	
2.6	ACSE adaptations	PI, IW	
2.7	PER	PI, IW	
2.8	PDV	IA, IW	
2.9	P/S mappings	IA, PI	
2.10	P/S state tables	FM	Only connect phase requires validation
2.11	Application integration	PI	See note on embedded testing
3	UL Naming and Addressing		
3.1	Naming tree	IA	
3.2	PSAPs	PI, IW	
4	Transport Service		
4.1	QOS (RER)	IA, PI	
4.2	Traffic Type	IA, PI	

3.1 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).

4. DEPENDENCIES ON EXTERNAL STANDARDS

The UL SARPs incorporate by reference a number of ISO and ITU-T standards. A potential advantage of using ISO/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 no, amendments and defect reports included)?

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.

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 proposed 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.

4.3 Presentation layer

The UL SARPs require the “fast byte” efficiency enhancements to the presentation protocol. These have recently been ratified by ITU-T and have reached the status of proposed draft amendment (PDAM) 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 only to validate the connect phase with successful negotiation of null encoding, i.e. both presentation protocol machines supporting the “fast byte” connect PDU. This should be done by simulation, implementation and interoperability trials.

4.4 Session layer

The UL SARPs require the “fast byte” efficiency enhancements to the session protocol. These have recently been ratified by ITU-T and have reached the status of proposed draft amendment (PDAM) within the more extensive efficiency enhancements being progressed within ISO. No known implementations exist.

There are known defects in the ITU-T “fast byte” addenda, and outstanding defect reports on the ISO efficiency PDAM.

It is therefore necessary to validate the session layer standards with efficiency enhancements incorporated. It is proposed only to validate the connect phase with successful negotiation of null encoding, i.e. both session protocol machines supporting the “fast byte” connect PDU. This should be done by simulation, implementation and interoperability trials.

5. RECOMMENDATIONS

It is recommended that the validation approach proposed in this paper should be adopted by ATNP/WG3 and followed by the States who are performing validation.

It is recommended that automated tools for requirements tracing should be employed during validation of the draft SARPs. Examples of such tools include RDD-100 and RTM.

ANNEX A KNOWN VALIDATION PROJECTS

A.1 FAA Upper Layer Implementation

The US is sponsoring a current Upper Layer validation effort. Computer Sciences Corporation (CSC), based at the FAA Technical Center (FAATC), has been tasked to develop the Upper Layers, based on the version 1.3 ("Boston") Subvolume IV SARPs. The work is under the guidance of the SG3 chair.

As part of the development effort on the Data Link Processor (DLP), CSC will implement the Context Management Application (CMA), per Subvolume II, Part 1 SARPs. CMA will be supported by the Upper Layer implementation. The implementation will be resident on the CSC DLP router, affording a complete ATN implementation.

The US implementation will be completed in time for interoperability testing with the other ATN Upper Layer implementations in third quarter 1996.

A.2 Eurocontrol Simulation

Eurocontrol is conducting a modelling activity using the GEODE tool from Verilog. Currently, the ADS application and the Upper Layer SARPs are being modelled. The activity involves specifying the state tables using a formal language and using the tool to ensure that the state tables have been correctly specified in the SARPs.

A.3 Eurocontrol Trials End System

Eurocontrol is in the process of sponsoring the Trials End System (TES) project, which involves the prototype implementation of ADS, CM and CPDLC applications, together with supporting upper layers. A major goal is to identify any problems in the draft SARPs during the analysis, design and implementation of the prototypes. The applications will then be available for interoperability testing with other, independent implementations.

A.4 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 of this Demonstrator is being upgraded to conform to the CNS/ATM-1 Package draft SARPs. The Provisional Acceptance of this upgraded Demonstrator is planned for the beginning of May 1996. 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 Harmonized 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. This activity is planned to be completed at the beginning of March 1996. After the upgraded EURATN has become available (i.e. begin May 1996), the PATN consequently 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 harmonize 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 spans the area of several national administrations.

ANNEX B. LOW-LEVEL REQUIREMENTS

The draft UL SARPs have been constructed such that related requirements at the lowest level are already grouped together in a single "shall" clause. Examples are:

- "shall" clauses which contain lists of actions to be performed by the CF in response to a given stimulus when in a given state
- "shall" clauses which refer to Profile Requirements List (PRL) tables, where requirements are specified by coded table entries.

The following table lists all sentences containing the string "shall" in version 1.3 of the draft Upper Layer SARPs. These sentences constitute entries in the validation database (VDB) for the draft UL SARPs. (There are 187 occurrences of the string "shall" and no occurrences of the string "should").

For each of these VDB entries, a cross-reference is given to one or more of the Validation Objectives (VOs) described in this paper.

SARPs V1.3 reference	"Shall" clause.	VO
2.1.1	The ATN-App ASE shall be specified to use the Dialogue Service defined in this section.	2.1
2.1.2	Implementations of the ATN-App ASE, together with the UL elements which together provide the Dialogue Service, shall exhibit the behaviour defined in this section.	2
2.2.1	For the CNS/ATM-1 Package, the realisation of the dialogue service shall support a communication relationship between two peers...	2
2.2.1	... for a duration which shall exist until the peers agree to terminate the relationship or the relationship is aborted.	2
2.2.3.1	An implementation of an application SARPs specification which makes use of the DS shall be designed with error handling procedures for local error conditions.	2.1
2.3.1.2	The DS-User shall only issue and be prepared to receive primitives according to the permitted sequences of DS primitives shown in Table 2.3, where intersections marked "Y" show possible primitives which may occur after the primitive in the column heading.	2.2
2.3.2.3	The name shall take an abstract value corresponding to either a 24-bit ICAO aircraft-id or a four-character ICAO facility designator.	3.1
2.3.2.4	If present, it shall take an abstract value corresponding to either a 24-bit ICAO aircraft-id or a four-character ICAO facility designator.	3.1
2.3.2.7.1	The following abstract values shall be supported for the Routing Class parameter: [list of abstract values]	2.3
2.3.2.7.1	If the Routing Class parameter is not provided by the DS-User, the default value "No Traffic Type Policy Preference" shall be assumed.	2.3
2.3.2.7.2	The following abstract values shall be supported for the Priority parameter, in order of decreasing priority: [list of abstract values]	2.3
2.3.2.7.2	If a Priority value is not provided by the DS-User, the default value "network/systems administration" shall be assumed.	2.3
2.3.2.7.3	The following abstract values shall be supported for the RER parameter: [list of abstract values]	2.3, 4.1

2.3.4.1	The DS shall perform an orderly release...	2.2
2.3.4.1	... i.e. any service previously invoked shall be completed before the dialogue is terminated.	2.2
2.3.4.2	The DS-User shall not then issue any other service primitive (except D-ABORT if required), until the D-END confirmation is received.	2.1, 2.2
2.3.4.3	After issuing a D-END request primitive, the DS-User shall be prepared to continue receiving D-DATA indications from the peer user, until a D-END confirmation primitive is received.	2.1, 2.2
2.3.4.4	It shall at some time issue a D-END response primitive, with a result code of “accepted” or “rejected”.	2.1, 2.2
2.3.4.4	After issuing a D-END response primitive with result “accepted”, a DS-User shall not issue any other service primitive, as the dialogue no longer exists.	2.1, 2.2
2.3.4.7	When a DS-User application is designed such that either peer may terminate the dialogue, then the application shall not require a response to any User-Data which is sent on a D-END request primitive.	2.1
2.3.5.1	This is the default value which shall be assumed if the parameter is absent.	2.3
3.1.1	The ATN-App AE shall behave as if implemented according to the model shown in figure 3.1, with the protocols defined in ACSE and the ATN-App ASE specifications.	1.1
3.2.1.1	Each ATN application entity shall be assigned an unambiguous application entity title (AE Title).	3.1
3.2.1.1	For ATN, an AE Title shall be an Object Identifier type as defined in ISO/IEC 8824-1 (this is defined as AE-title-form2 in ISO/IEC 8650-1).	3.1
3.2.1.2	The AE Title shall be composed of an Application Process title (AP-title) and an AE-qualifier.	3.1
3.2.1.3	The AP-title shall be an Object Identifier (this is defined as AP-title-form2 in ISO/IEC 8650-1).	3.1
3.2.1.4	The Object Identifier comprising the AP-title shall represent an ATN end system.	3.1
3.2.1.5	The AE-qualifier shall be an INTEGER (this is defined as AE-qualifier-form2 in ISO/IEC 8650-1).	3.1
3.2.1.5	The AE-qualifier value shall represent the ATN application type (e.g. "ADS" or "CMA").	3.1
3.2.2.1	For the CNS/ATM-1 package, the Application Context name shall be used to indicate the version and policy aspects relative to the AE with which it is associated.	3
3.2.2.2	Each Application Context shall be assigned an Application Context name.	3
3.2.3.1	All User Data which is passed across the presentation service boundary shall be encoded using the unaligned variant of the Packed Encoding Rules (PER) for ASN.1 (ISO/IEC 8825-2).	2.7

3.2.3.2	In order to be able to distinguish APDUs which are defined in different abstract syntax modules, the presentation User Data encoding shall assume the Full Encoding option of ISO/IEC 8823-1, augmented with the PER-visible constraints defined in ISO/IEC 8823-1:1994/PDAM 2 as follows...[ASN.1 definitions]	2.8
3.2.3.3	The transfer-syntax name field [in the ASN.1 definition] shall not be present in the encoded presentation User Data.	2.8
3.2.3.4	The "arbitrary" choice for presentation-data-values [in the ASN.1 definition] shall be used in the encoded presentation User Data.	2.8
3.2.3.5	The values of Presentation-context-identifier which are pre-defined in Table 3.1 shall be used in the encoding of presentation User Data; the presentation-context-identifiers are not dynamically assigned by the presentation service.	2.8
3.2.3.6	Upon receiving User Data from the presentation service, the CF shall... [list of actions]	2.8
3.2.3.7	When an ASE issues a request or response primitive at its lower service boundary which would otherwise map onto a presentation service primitive, the CF shall...[list of actions]	2.8
3.3.1.1	The ATN-App AE shall behave as if it has a Control Function which can exist only in one of the following states... [list of states]	2.2
3.3.1.2.1	The ATN-App AE CF shall behave as if it has a control function which functions in accordance with the following state table, which shows diagrammatically the state transitions and actions performed by the CF in response to incoming events.	2.2
3.3.1.2.1	Each cell in the state table shows:...the new state that the CF shall enter after the action has been performed	2.2
3.3.1.2.1	...the action, if any, which the CF shall perform.	2.2
3.3.1.2.2	Any input event not listed in Table 3.3 shall be treated as an error.	2.2
3.3.1.2.2	The error handling shall result in the association being aborted, if one exists, and a notification being given to the Application user.	2.2
3.3.1.2.3	In the event of a conflict between the actions implied by the state table and the text in the following sections, the text shall take precedence.	2.2
3.3.2.2.2.1	When the [Application User] Request or Response primitive is issued, the CF shall... [list of actions]	2.2, 2.3
3.3.3.1.2.1.1	When the [ATN-App ASE] Indication or Confirmation primitive is issued, the CF shall... [list of actions]	2.2, 2.3
3.3.3.2.1.1	This primitive [D-START Request] may be validly invoked by the ATN-App ASE when the CF is in the NULL state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.3.2.2.1	[When a D-START Request primitive is validly invoked] The CF shall exhibit the following behaviour... [list of actions]	2.2, 2.3, 3.2
3.3.3.2.2.1.f	If the Security Requirements parameter is not present, the A-ASSOCIATE parameter "ACSE Requirements" shall not be used.	2.2, 2.3
3.3.3.2.2.1.f	Otherwise, the ACSE Requirements parameter shall be set to the symbolic value "authentication"...	2.2, 2.3

3.3.3.2.2.1.f	... and the Security Requirements value shall be mapped to the A-ASSOCIATE Authentication-value parameter.	2.2, 2.3
3.3.3.2.2.1.j	The D-START Quality of Service parameters shall be conveyed to the ATN Internet by local means, where they may be used, for example, to influence routing decisions; they do not map onto the A-ASSOCIATE Quality of Service.	2.2, 2.3, 4
3.3.3.3.1.1	This primitive [D-START Response] may be validly invoked by the ATN-App ASE when the responder CF is in the ASSOCIATION PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.3.3.2.1	[When a D-START Response primitive is validly invoked] The CF shall exhibit the following behaviour... [list of actions]	2.2, 3.2
3.3.3.3.2.1.c	If the Security Requirements parameter is not present, the A-ASSOCIATE parameter "ACSE Requirements" shall not be used.	2.3
3.3.3.3.2.1.c	Otherwise, the ACSE Requirements parameter shall be set to the symbolic value "authentication" ...	2.3
3.3.3.3.2.1.c	... and the Security Requirements value shall be mapped to the A-ASSOCIATE Authentication-value parameter.	2.3
3.3.3.3.2.1.e	If the D-START Response Result parameter has the abstract value "accepted" the CF shall invoke the positive A-ASSOCIATE Response primitive, and remain in the ASSOCIATION PENDING state.	2.2
3.3.3.3.2.1.f	If the D-START Response Result parameter has the abstract value "rejected" the CF shall invoke the negative A-ASSOCIATE Response primitive, and remain in the ASSOCIATION PENDING state.	2.2
3.3.3.3.2.1.g	The D-START Quality of Service parameters shall be conveyed to the ATN Internet by local means, where they may be used, for example, to influence routing decisions; they do not map onto the A-ASSOCIATE Quality of Service.	2.2, 2.3, 4
3.3.3.4.1.1	This primitive [D-END Request] may be validly invoked by the ATN-App ASE when the CF is in the DATA TRANSFER state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.3.4.1.1	For example, if the CF is in the RELEASE PENDING state, then the D-END Request shall be rejected locally, with an appropriate result code.	2.2
3.3.3.4.2.1	[When a D-END Request primitive is validly invoked] The CF shall exhibit the following behaviour... [list of actions]	2.2
3.3.3.5.1.1	This primitive [D-END Response] may be validly invoked by the ATN-App ASE when the responder CF is in the RELEASE PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.3.5.2.1	If the D-END Result parameter has the value "accepted", the CF shall exhibit the following behaviour... [list of actions]	2.2
3.3.3.5.2.2	If the D-END Response Result parameter has the abstract value "rejected" the CF shall exhibit the following behaviour... [list of actions]	2.2
3.3.3.6.1.1	This primitive [D-DATA Request] may be validly invoked by the ATN-App ASE when the CF is in the DATA TRANSFER state; if it is in any other state then appropriate error recovery action shall be taken.	2.2

3.3.3.6.2.1	[When a D-DATA Request primitive is validly invoked] The CF shall exhibit the following behaviour... [list of actions]	2.2
3.3.3.7.2.1	[When a D-ABORT Request primitive is validly invoked] The CF shall exhibit the following behaviour... [list of actions]	2.2
3.3.4.1.1.1	This primitive [A-ASSOCIATE Indication] may be validly invoked by the ACSE Protocol Machine (ACPM) when the CF is in the ASSOCIATION PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.4.1.2.1	[When an A-ASSOCIATE Indication primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.4.2.1.1	This primitive [A-ASSOCIATE Confirmation] may be validly invoked by the ACPM when the CF is in the ASSOCIATION PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.4.2.2.1	If the A-ASSOCIATE Confirmation Result parameter has the abstract value "accepted" the CF shall... [list of actions]	2.2
3.3.4.2.2.2	If the A-ASSOCIATE Confirmation Result parameter has the abstract value "rejected (permanent)" or "rejected (transient)" the CF shall... [list of actions]	2.2
3.3.4.3.1.1	This primitive [A-RELEASE Indication] may be validly invoked by the ACPM when the CF is in the RELEASE PENDING or the RELEASE COLLISION state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.4.3.2.1	[When an A-RELEASE Indication primitive is validly invoked] If the CF is in the RELEASE PENDING state, it shall... [list of actions]	2.2
3.3.4.3.2.2	[When an A-RELEASE Indication primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Initiator CF, it shall... [list of actions]	2.2
3.3.4.3.2.2	The D-END Confirmation shall not be issued to the DS-User until the orderly release procedure is complete, and an A-RELEASE Confirmation is received.	2.2
3.3.4.3.2.3	[When an A-RELEASE Indication primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Responder CF, it shall... [list of actions]	2.2
3.3.4.3.2.3	The D-END Confirmation shall not be issued to the DS-User until the orderly release procedure is complete, and an A-RELEASE Confirmation is received.	2.2
3.3.4.4.1.1	This primitive [A-RELEASE Confirmation] may be invoked by the ACPM when the CF is in the RELEASE PENDING or RELEASE COLLISION state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.4.4.2.1	[When an A-RELEASE Confirmation primitive is validly invoked] If the CF is in the RELEASE PENDING state, and the A-RELEASE Confirmation Result parameter has the abstract value "affirmative" the CF shall... [list of actions]	2.2

3.3.4.4.2.2	[When an A-RELEASE Confirmation primitive is validly invoked] If the CF is in the RELEASE PENDING state, and the A-RELEASE Confirmation Result parameter has the abstract value "negative" the CF shall... [list of actions]	2.2
3.3.4.4.2.3	[When an A-RELEASE Confirmation primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Initiator CF, it shall... [list of actions]	2.2
3.3.4.4.2.4	[When an A-RELEASE Confirmation primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Responder CF, it shall... [list of actions]	2.2
3.3.4.5.2.1	[When an A-ABORT Indication primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.4.6.2.1	[When an A-P-ABORT Indication primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.5.1.1.1	This primitive [P-CONNECT Request] may be validly invoked by the ACPM when the CF is in the ASSOCIATION PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.5.1.2.1	[When a P-CONNECT Request primitive is validly invoked] The CF shall transparently invoke the equivalent presentation service primitive.	2.2
3.3.5.2.1.1	This primitive [P-CONNECT Response] may be validly invoked by the ACPM when the CF is in the ASSOCIATE PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.5.2.2.1	[When a P-CONNECT Response primitive is validly invoked] The CF shall transparently invoke the equivalent presentation service primitive.	2.2
3.3.5.3.2.1	[When a P-U-ABORT Request primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.5.4.1.1	This primitive [P-RELEASE Request] may be validly invoked by the ACPM when the CF is in the RELEASE PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.5.4.2.1	[When a P-RELEASE Request primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.5.5.1.1	This primitive [P-RELEASE Response] may be validly invoked by the ACPM when the CF is in the RELEASE PENDING or RELEASE COLLISION state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.5.5.2.1	[When a P-RELEASE Response primitive is validly invoked] If the CF is in the RELEASE PENDING state, and the P-RELEASE Response Result parameter has the abstract value "affirmative" the CF shall... [list of actions]	2.2
3.3.5.5.2.2	[When a P-RELEASE Response primitive is validly invoked] If the CF is in the RELEASE PENDING state, and the P-RELEASE Response Result parameter has the abstract value "negative" the CF shall... [list of actions]	2.2
3.3.5.5.2.3	[When a P-RELEASE Response primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Initiator CF, it shall... [list of actions]	2.2

3.3.5.5.2.4	[When a P-RELEASE Response primitive is validly invoked] If the CF is in the RELEASE COLLISION state, and it is the Responder CF, it shall... [list of actions]	2.2
3.3.6	When the supporting communications service exhibits the behaviour modelled by the passing of indication or confirmation primitives to the application layer, the ATN upper layers shall exhibit the behaviour specified in the following subsections.	2.2
3.3.6.1.1.1	This primitive [P-CONNECT Indication] may be validly invoked by the supporting service when the CF is in the NULL state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.6.1.2.1	[When a P-CONNECT Indication primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.6.2.1.1	This primitive [P-CONNECT Confirmation] may be validly invoked by the supporting service when the CF is in the ASSOCIATE PENDING state; if it is in any other state then appropriate error recovery action shall be taken.	2.2
3.3.6.2.2.1	[When a P-CONNECT Confirmation primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.6.3.2.1	[When a P-U-ABORT Indication primitive is validly invoked] The CF shall transparently invoke the equivalent presentation service primitive at the lower ACSE service boundary, and remain in the same state.	2.2
3.3.6.4.2.1	[When a P-P-ABORT Indication primitive is validly invoked] The CF shall transparently invoke the corresponding presentation service primitive at the lower ACSE service boundary, and remain in the same state.	2.2
3.3.6.5.2.1	[When a P-DATA Indication primitive is validly invoked] The CF shall... [list of actions]	2.2
3.3.6.5.2.1.2.v	... Otherwise, if the received APDU is not RLRQ, RLRE or ABRT, an error has occurred; the CF shall issue a P-U-ABORT request to the supporting service and behave as if a P-U-ABORT indication had been received.	2.2
3.3.6.5.2.1.4	... Otherwise, if the destination ASE is neither ACSE nor the ATN-App ASE, then an error has occurred; the CF shall issue a P-U-ABORT request to the supporting service and behave as if a P-U-ABORT indication had been received.	2.2
4.1	The Session protocol versions specified as “M” in Table 4.1 shall be supported [PRL table].	2.10
4.1	o.1: the implementation of one, and only one, version of the protocol shall be described [note from ISO PICS].	2.10
4.2	The Session functional units selected shall be as specified in Table 4.2 [PRL table].	2.10
4.2	o.2: At least one of the functional units Duplex and Half Duplex shall be implemented [note from ISO PICS].	2.10
4.3	The Session protocol mechanisms specified as “M” in Table 4.3 shall be supported [PRL table].	2.10

4.3	If the null encoding protocol option is offered by the initiating SPM, the responding SPM shall select only the kernel, full-duplex and no-orderly release functional units for use on this connection.	2.10
4.3	SPDUs associated with the Short-connect protocol option (i.e. SCN, SAC and SRF) shall be transferred as User-data on the Transport layer T-CONNECT primitives, where possible.	2.10
4.4.1	The roles for Session Connection specified as “M” in Table 4.4 shall be supported [PRL table].	2.10
4.4.1	o.3: a conforming implementation shall support at least one of these roles as required by the implementation [note from ISO PICS].	2.10
4.4.2	The roles for Session Orderly Release specified as “M” in Table 4.5 shall be supported [PRL table].	2.10
4.4.2	o.4: a conforming implementation shall support at least one of these roles [note from ISO PICS].	2.10
4.4.2	Note 1: Not applicable, as the No Orderly Release functional unit shall be selected.	2.10
4.4.3	The roles for Session Normal Data Transfer specified as “M” in Table 4.6 shall be supported [PRL table].	2.10
4.4.3	o.5: a conforming implementation shall support at least one of these roles [note from ISO PICS].	2.10
4.5	The SPDUs specified as “M” in Table 4.7 shall be supported [PRL table].	2.10
4.5	Note 2: Not applicable, as the no-orderly-release functional unit shall be selected.	2.10
4.5	Note 3: Not applicable, as the null-encoding protocol option shall be selected.	2.10
4.5	Note 4: Not applicable, as the short-connect protocol option shall be selected.	2.10
4.6	The Session protocol data units associated with Token exchange shall be supported as specified in Table 4.8. [PRL table].	2.10
4.6	Note 2: Not applicable, as the null-encoding protocol option shall be selected.	2.10
5.1	The Presentation protocol mechanisms specified as “M” in Table 5.1 shall be supported [PRL table].	2.10
5.1	o.1: either Normal mode or X.410(1984) mode or both shall be supported [note from ISO PICS].	2.10
5.1	If only X.410(1984) mode is supported, then the remainder of the profile requirements shall be ignored [note from ISO PICS].	2.10
5.2	The use of the null encoding protocol option shall be as specified in Table 5.2 [PRL table].	2.10
5.2	c1: At least one of these conditions shall be true, thus enabling the PPM to select the null-encoding protocol option for use on the established connection.	2.10

5.2	The Presentation Protocol Machine shall select the null-encoding protocol option if any of the requirements a, b, c in the table above is true.	2.9, 2.10
5.2	When initiating a connection, there shall be no parameters of the S-CONNECT request service primitive issued by the Presentation layer other than, optionally, user data.	2.9, 2.10
5.3	The user of the presentation service shall not issue any presentation primitives other than P-CONNECT request, P-CONNECT response, P-DATA request and P-U-ABORT request.	2.9, 2.10
5.3	When it is required to release the presentation connection, the presentation service user shall issue a P-U-ABORT request...	2.10
5.3	... any user data shall be ignored by the presentation service provider.	2.9
5.4	The Presentation functional units selected shall be as specified in Table 5.3 [PRL table].	2.10
5.4	The Presentation pass-through functional units selected shall be as specified in Table 5.4 [PRL table].	2.10
5.4	o.2: Pass through for at least one of the Session functional units Duplex and Half Duplex shall be supported [note from ISO PICS].	2.10
5.5.1.1	The supported roles for establishing Presentation connections shall be as specified in Table 5.5 [PRL table].	2.10
5.5.1.1	o.3: a conforming implementation shall support at least one of these roles [note from ISO PICS].	2.10
5.5.1.2	The supported roles for the orderly release of Presentation connections shall be as specified in Table 5.6 [PRL table].	2.10
5.5.1.3	The supported roles for Normal Data shall be as specified in Table 5.7 [PRL table].	2.10
5.5.2	The Presentation Protocol Data Units supported shall be as specified in Table 5.8 [PRL table].	2.10
5.5.2	Note 2: PPDUs not applicable, as the null-encoding protocol option shall be selected.	2.10
5.5.3	The SHORT-CP, SHORT-CPA and SHORT-CPR PPDUs shall have the encoding-choice bit-field set to “unaligned PER”.	2.9
6.2	The specification of the ACSE protocol supported shall be as defined in Table 6.1 [PRL table].	2.4
6.3	The version of the ACSE protocol supported shall be as specified in Table 6.2 [PRL table].	2.4
6.3	o.1: support of the implementation of only one version of the protocol shall be described [note from ISO PICS].	2.4
6.4.1	The supported roles for Association Establishment shall be as specified in Table 6.3 [PRL table].	2.4
6.4.1	o.2: a conforming implementation shall support at least one of the roles [note from ISO PICS].	2.4
6.4.1	c1: either one or both of these [Association Establishment] roles shall be supported.	2.4

6.4.2	The supported roles for the Normal Release procedure shall be as specified in Table 6.4 [PRL table].	2.4
6.4.2	c1: either one or both of these [Normal Release] roles shall be supported.	2.4
6.4.3	The supported roles for the Abnormal Release procedure shall be as specified in Table 6.5 [PRL table].	2.4
6.5	The ACSE protocol mechanisms specified as "M" in Table 6.6 shall be supported [PRL table].	2.4
6.5	o.4: either Normal mode or X.410-1984 mode or both shall be supported [note from ISO PICS].	2.4
6.5	If only X.410-1984 mode is supported, then the remainder of the conformance requirements shall be ignored [note from ISO PICS].	2.4
6.5.1.1	For the purposes of this document, the abstract syntax module defined in clause 9 of the ACSE protocol specification shall be augmented with the ASN.1 extensibility notation, as specified in ISO/IEC 8650-1:1995, ed.2/PDAM 2.	2.6
6.5.1.2	The system shall support that encoding which results from applying the ASN.1 packed encoding rules (basic, unaligned variant), as specified in ITU-T Recommendation X.691 | ISO/IEC 8825-2, to the abstract syntax module specified above.	2.7
6.5.1.2	Packed encoding (basic, unaligned) shall be used for encoding all ACSE PCI for interchange.	2.7
6.6	The ACSE functional units selected shall be as specified in Table 6.7 [PRL table].	2.4
6.7	The ACSE Protocol data units specified as "M" in Table 6.8 shall be supported [PRL table].	2.4
6.7.1.1	The parameters in the AARQ APDU shall be supported as specified in Table 6.9 [PRL table].	2.4
6.7.1.1	Note 1: Shall be supported only if the connection initiator role (A-CON_initiator) and the Authentication functional unit (A-FU(AU)) are supported [note from ISO PICS].	2.4
6.7.1.1	Note 2: Shall be supported only if the connection responder role (A-CON_responder) and the Authentication functional unit (A-FU(AU)) are supported [note from ISO PICS].	2.4
6.7.1.2	The parameters in the AARE APDU shall be supported as specified in Table 6.10 [PRL table].	2.4
6.7.1.2	Note 1: Shall be supported only if the connection initiator role (A-CON_initiator) and the Authentication functional unit (A-FU(AU)) are supported [note from ISO PICS].	2.4
6.7.1.2	Note 2: Shall be supported only if the connection responder role (A-CON_responder) and the Authentication functional unit (A-FU(AU)) are supported [note from ISO PICS].	2.4
6.7.1.3	The parameters in the RLRQ APDU shall be supported as specified in Table 6.11 [PRL table].	2.4

6.7.1.4	The parameters in the RLRE APDU shall be supported as specified in Table 6.12 [PRL table].	2.4
6.7.1.5	The parameters in the ABRT APDU shall be supported as specified in Table 6.13 [PRL table].	2.4
6.7.2.1	The Application Entity Title parameter shall be supported in the forms specified in Table 6.14 [PRL table].	2.4
6.7.2.1	o.5: a conforming implementation shall support at least one of the forms [note from ISO PICS].	2.4
6.7.2.2	The Authentication value parameter shall be supported in the forms specified in Table 6.15 [PRL table].	2.4
6.7.2.2	Note 1: If the authentication functional unit is supported, at least one of these forms shall be implemented.	2.4
6.7.2.2	o.6: a conforming implementation shall support at least one of the forms [note from ISO PICS].	2.4
7.1.4	Within the ICAO name space, the allocation of object identifiers for the CNS/ATM-1 Package shall follow the structure and values indicated in this section.	3.1
7.2.2	Application Context names in the CNS/ATM-1 Package shall have the following structure... [OID template]	3.1
7.3.4	Thus, Application Process titles for the CNS/ATM-1 Package shall have values as follows... [OID templates]	3.1
7.4.2	Thus, AE-titles for the CNS/ATM-1 Package shall have values as follows... [OID templates]	3.1
7.5.1	The INTEGER encoding shall be obtained as follows... [choice of encoding]	3.1
7.5.3	For ground stations, the <end-system-id> shall be the PER-encoding of the ICAO facility designator, where the characters in the facility designator are members of the restricted character set (A..Z).	3.1