INTERNATIONAL STANDARD

ISO/IEC 9041-1

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Information technology — Open Systems Interconnection — Virtual Terminal Basic Class Protocol —

Part 1:
Specification

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Protocole de classe de base de terminal virtuel —

Partie 1: Spécification

Contents

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO and IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75% of the national bodies casting a vote.

International Standard ISO 9041-1 was prepared by Joint Technical Committee ISO/IEC JTC1, *Information technology*, Subcommitee SC21, *Open systems interconnection, data management and open distributed processing*.

This second edition cancels and replaces the first edition (ISO/IEC 9041-1:1990), which has been technically revised. It also incorporates Amendment 2:1992, Technical Corrigendum 1:1992 and Technical Corrigendum 2:1993.

ISO/IEC 9041 consists of the following parts, under the general title *Information technology – Open Systems Interconnection – Virtual Terminal Basic Class Protocol*:

– *Part 1: Specification*

– *Part 2: Implementation Conformance Statement (PICS) Proforma*

Annexes A and B form an integral part of this part of ISO/IEC 9041.

Introduction

ISO/IEC 9041 is one of a set of International Standards produced to facilitate the interconnection of computer systems. It is related to other International Standards in the set as defined in the Reference Model for Open Systems Interconnection (ISO/IEC 7498-1). The Reference Model subdivides the area of standardization for interconnection into a series of layers of specification, each of manageable size.

This part of ISO/IEC 9041 defines the manner in which two protocol machines (called Virtual Terminal Protocol Machines or VTPMs) in the Application Layer of the Reference Model for Open Systems Interconnection communicate in order to provide the Virtual Terminal Basic Class Service defined in ISO/IEC 9040 making use of the Presentation Layer and of the association control service of ACSE within the Application Layer.

Part 2 of ISO/IEC 9041 includes the Protocol Implementation Conformance Statement (PICS) proforma for the Virtual Terminal Basic Class Protocol as defined in this part of ISO/IEC 9041.

Information technology – Open Systems Interconnection – Virtual Terminal Basic Class Protocol – Part 1: Specification

1 Scope

This part of ISO/IEC 9041 specifies:

a) a set of procedures for the connection-oriented transfer of data, control and reference information between protocol machines which implement the functions of a provider of the Basic Class Virtual Terminal Service;

b) the two modes in which those procedures operate;

c) the structure of protocol elements used for the transfer of data and control information and the mapping of these protocol elements onto ACSE and lower layer services;

d) the means of negotiating the functional units to be used by the protocol machines and the parameters of the service;

e) the structure and mapping of protocol elements used for the transfer of data and control information.

The procedures are defined in terms of:

f) the interactions between Virtual Terminal Protocol Machines through the exchange of Virtual Terminal protocol elements;

g) the interactions between a Virtual Terminal Protocol Machine and the Virtual Terminal service user in the same system through the exchange of Virtual Terminal service primitives;

h) the interactions between a Virtual Terminal Protocol Machine and the ACSE and Presentation Service providers through the exchange of service primitives.

This part of ISO/IEC 9041 also specifies conformance requirements (see clause 13) for systems implementing these procedures. It does not contain tests which can be used to demonstrate this conformance.

These procedures are applicable to instances of communication between systems that support the Basic Class Virtual Terminal Service in the Application Layer of the Reference Model for Open Systems Interconnection and which wish to interconnect in an open systems environment.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9041. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 9040 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 2022:1994, *Information technology – Character code structure and extension techniques (fourth edition).*

ISO/IEC 6429:1992, *Information technology – Control functions for coded character sets (third edition).*

ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model.*

ISO/IEC 7498-3:1997, *Information technology – Open Systems Interconnection – Basic Reference Model: Naming and addressing.*

ISO/IEC 8326:1996, *Information technology – Open System Interconnection – Session service definition (second edition).*

ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the Association Control Service Element (second edition).*

ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition.*

ISO/IEC 8824-1:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

ISO/IEC 8825-1:1994, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

ISO/IEC 9040:1997, *Information technology – Open Systems Interconnection – Virtual Terminal Basic Class Service.*

ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services.*

The International Register of Coded Character Sets to be used with Escape Sequences. [1]

3 Definitions

3.1 Global OSI definitions

This part of ISO/IEC 9041 is based on the concepts developed in ISO/IEC 7498, and makes use of the following terms defined in it:

1) application entity;
2) application layer;
3) protocol data unit;
4) user element.

Definitions of the following terms are given in ISO/IEC 10731:

5) primitive;
6) confirm (primitive);
7) indication (primitive);
8) request (primitive);
9) response (primitive);
10) service provider;
11) service user.

3.2 Association Control Service Element definitions

This part of ISO/IEC 9041 makes use of the following terms defined in ISO/IEC 8649:

1) application association;
2) application context.

3.3 Presentation Layer Service Element definition

This part of ISO/IEC 9041 makes use of the term abstract syntax which is defined in ISO/IEC 8822.

3.4 Virtual Terminal Service definitions

This part of ISO/IEC 9041 uses the following definitions contained in ISO/IEC 9040:

1) A-mode, Asynchronous Mode;
2) access-rule;
3) Application VT-user;
4) Block;
5) character-box graphic element;
6) Context Control Object (CCO);
7) current-VTE;
8) draft-VTE;
9) Field;

10) Field Definition Control Object (FDCO);
11) Field Definition Record (FDR);
12) Field Element;
13) Field Entry Condition (FEC);
14) Field Entry Event (FEE);
15) Field Entry Instruction (FEI);
16) Field Entry Instruction Control Object (FEICO);
17) Field Entry Instruction Record (FEIR);
18) Field Entry Pilot Control Object (FEPCO);
19) Field Entry Pilot Record (FEPR);
20) Field Entry Reaction (FER);
21) full-VTE;
22) Initial Facility Set;
23) net-effecting;
24) Reference Information Object (RIO);
25) repertoire;
26) ripple.
27) S-mode, Synchronous Mode;
28) Terminal VT-user;
29) Transmission Policy Control Object (TPCO);
30) VT-association;
31) VT-context-value;
32) VT-environment (VTE);
33) VT-user;
34) VTE-parameter;

3.5 Virtual Terminal Protocol definitions

For the purposes of this part of ISO/IEC 9041 the following definitions apply.

3.5.1 protocol element: An abstract unit of information, defined in clause 6, communicated between peer VTPMs, that maps

a) directly to an ACSE or presentation service primitive; and/or

b) to a PDU type that is conveyed by a user information parameter of ACSE or a user data parameter of the presentation service.

3.5.2 initiating VTPM: The VTPM that initiates an individual procedure.

3.5.3 target VTPM: The VTPM to which the protocol element initiating a procedure is directed.

3.5.4 sending VTPM: The initiating VTPM for a data transfer procedure.

3.5.5 receiving VTPM: The target VTPM for a data transfer procedure.

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[1] Available from the European Computer Manufacturers Association (ECMA), 114 Rue du Rhône, CH 1204 Genève, Switzerland.

3.5.6 dynamic conformance requirements: All those requirements (and options) which determine what observable behaviour is permitted in instances of communication.

3.5.7 static conformance requirements: Constraints which facilitate interworking by defining the requirements for kernel sets of capabilities of an implementation.

3.5.8 protocol implementation conformance statement (PICS): A statement made by the supplier of an implementation which states the capabilities and options which have been implemented, and any features which have been omitted.

3.5.9 VT-token: A single entity which maps onto all of the available session tokens provided by the Presentation Layer. If there are no session tokens available then both sides are considered to hold this token.

4 Abbreviations

4.1 Virtual Terminal Service abbreviations

A-mode	Asynchronous Mode
ACS	Access Control Store
CCA	Conceptual Communication Area
CCO	Context Control Object
CDS	Conceptual Data Store
CO	Control Object
CSS	Control, Signal and Status Store
DO	Display Object
DSD	Data Structure Definition
FDCO	Field Definition Control Object
FDR	Field Definition Record
FEC	Field Entry Condition
FEE	Filed Entry Event
FEI	Field Entry Instruction
FEICO	Field Entry Instruction Control Object
FEIR	Field Entry Instruction Record
FEPCO	Field Entry Pilot Control Object
FEPR	Field Entry Pilot Record
FER	Field Entry Reaction
MIN	Multiple Interaction Negotiation
RIO	Reference Information Object
S-mode	Synchronous Mode
TPCO	Transmission Policy Control Object
VT	Virtual Terminal
VTE	Virtual Terminal Environment
VTS	Virtual Terminal Service

4.2 Miscellaneous

ACSE	Association Control Service Element

ASN.1	Abstract Syntax Notation One
PAB	Provider Abort
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
TWA	Two-Way Alternate
TWS	Two-Way Simultaneous
VTP	Virtual Terminal Protocol
VTPM	Virtual Terminal Protocol Machine

4.3 VT Protocol elements

APQ	VT-P-ABORT
ASQ	VT-ASSOCIATE-REQ
ASR	VT-ASSOCIATE-RESP
AUQ	VT-U-ABORT
BKQ	VT-BREAK-REQ
BKR	VT-BREAK-RESP
DAQ	VT-ACK-RECEIPT
DLQ	VT-DELIVER
ENQ	VT-END-NEG-REQ
ENR	VT-END-NEG-RESP
EXQ	VT-P-EXCEPTION-REQ
EXR	VT-P-EXCEPTION-RESP
GTQ	VT-GIVE-TOKEN
HDQ	VT-HIGH-PRI-DATA
NAQ	VT-NEG-ACCEPT
NDQ	VT-DATA
NIQ	VT-NEG-INVITE
NJQ	VT-NEG-REJECT
NOQ	VT-NEG-OFFER
RLQ	VT-RELEASE-REQ
RLR	VT-RELEASE-RESP
RTQ	VT-REQUEST-TOKEN
SNQ	VT-START-NEG-REQ
SNR	VT-START-NEG-RESP
SPQ	VT-SWITCH-PROFILE-REQ
SPR	VT-SWITCH-PROFILE-RESP
UDQ	VT-URGENT-DATA

5 Overview

5.1 Virtual Terminal Service summary

The protocol specified in this part of ISO/IEC 9041 provides the Basic Class Virtual Terminal Service defined in ISO/IEC 9040. The VT-service primitives are listed in table 1.

Table 1 - Virtual Terminal Service Primitives

Service Primitive		Service Parameters
VT-ASSOCIATE	request indication	Called Application Entity Title Calling Application Entity Title VT-class VT-functional-units VT-mode VT-WAVAR-owner VT-profile-name VT-profile-arg-offer-list
	response confirm	Responding Application Entity Title VT-functional-units VT-WAVAR-owner VT-profile-arg-value-list VT-result VT-user-failure-reason (confirm only)
VT-P-ABORT	indication	VT-reason
VT-RELEASE	request indication	
	response confirm	VT-result VT-user-failure-reason VT-provider-failure-reason (confirm only)
VT-U-ABORT	request indication	VT-user-failure-reason
VT-DATA (excluding the two following cases)	request indication	VT-echo-now VT-start-entry VT-object-update VT-object-descriptor VT-object-data
VT-DATA (high priority Control Objects only)	request indication	VT-object-update VT-object-descriptor VT-object-data
VT-DATA (urgent priority Control Objects only)	request indication	VT-object-update VT-object-descriptor VT-object-data
VT-DELIVER	request indication	VT-ack-request
VT-ACK-RECEIPT	request indication	
VT-GIVE-TOKEN	request indication	
VT-REQUEST-TOKEN	request indication	

4

Table 1 (concluded)

Service Primitive		Service Parameters
VT-SWITCH-PROFILE	request indication	VT-profile-name VT-profile-arg-offer-list VT-object-retention-list
	response confirm	VT-profile-arg-value-list VT-result VT-user-failure-reason VT-provider-failure-reason (confirm only) VT-object-retention-list
VT-START-NEG	request indication	VT-profile-name VT-profile-arg-offer-list
	response confirm	VT-profile-arg-value-list VT-result VT-user-failure-reason VT-provider-failure-reason (confirm only)
VT-END-NEG	request indication	VT-vte-choice VT-vte-failure-allowed VT-object-retention-list
	response confirm	VT-vte-choice VT-result VT-user-failure-reason VT-provider-failure-reason (confirm only) VT-object-retention-list
VT-NEG-INVITE	request indication	VT-param-ident-list
VT-NEG-OFFER	request indication	VT-param-offer-list
VT-NEG-ACCEPT	request indication	VT-param-value-list
VT-NEG-REJECT	request indication	VT-param-ident-list
VT-BREAK	request indication	VT-token VT-information
	response confirm	VT-token VT-information
VT-P-EXCEPTION	indication	VT-exception-source VT-exception-type VT-information

5.2 Model

The Basic Class Virtual Terminal Protocol operates between two Virtual Terminal Protocol Machines (VTPMs) in the Application layer of the OSI model. Protocol elements are exchanged between these, using the services of Association Control and of the Presentation layer as defined in ISO/IEC 8649 and ISO/IEC 8822.

The VT service is modelled as a single Conceptual Communication Area which is accessible to two communicating service users and which contains all the necessary information to allow these VT-users to derive a consistent view of the Virtual Devices which constitute the Virtual Terminal. The CCA is partitioned into four sub-areas:

a) a conceptual data store (CDS) containing one or more display objects;

b) a control, signaling and status store (CSS) containing a number of control objects;

c) an access control store (ACS);

d) a data structure definition (DSD) which parametrically defines the structure of the CDS and CSS.

The CCA is conceptually accessed by VT-users via service primitives in which information is transferred to or from the VT-users. Each VTPM is modelled as having its own CCA, see figure 1. These two CCAs constitute the VT context referred to in the Basic Class VTS definition. Each VTPM may also maintain a reset context which preserves the contents of all DOs and COs as they existed at the time the current VTE was established. This is used to provide the VT-context-value after completion of the break procedure, see 8.8.

5.3 Service assumed from the Presentation Layer

The protocol specified in this part of ISO/IEC 9041 assumes the use of the Presentation Service defined in ISO/IEC 8822. Information is transferred to and from the Presentation service provider in the primitives listed in table 2.

5.4 Service assumed from ACSE

The protocol specified in this part of ISO/IEC 9041 assumes the use of the Association Control service defined in ISO/IEC 8649. Information is transferred to and from ACSE in the service primitives listed in table 3.
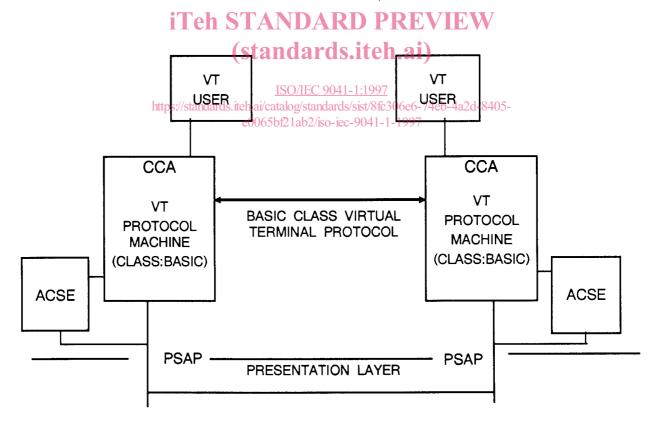

Figure 1 - Model

Table 2 - Presentation Service primitives

Presentation service	primitives
P-DATA	request indication
P-EXPEDITED-DATA	request indication
P-RESYNCHRONIZE	request indication response confirm
P-SYNCHRONIZE-MAJOR	request indication response confirm
P-TOKEN-GIVE	request indication
P-TOKEN-PLEASE	request indication
P-TYPED-DATA	request indication

Table 3 - ACSE service primitives

ACSE service	primitive
A-ASSOCIATE	request indication response confirm
A-RELEASE	request indication response confirm
A-ABORT	request indication
A-P-ABORT	indication

5.5 Functions of the VT Protocol

5.5.1 Association Establishment

The purpose of VT-association establishment is to establish a VT-association between two VT-users such that:

a) the use of this VT-protocol is confirmed;

b) the required dialogue discipline is agreed;

c) a suitable transfer syntax is used;

d) either an initial VTE is agreed or it is agreed that the VT-environment will be negotiated later before any data is transferred.

5.5.2 Association Termination

The purpose of VT-association Termination is to cause the VT-association to cease to exist.

5.5.3 Negotiation

Negotiation provides a mechanism by which the VT-users and VTPMs can agree upon the VT-environment to be used. Two forms of negotiation are supported, a single interaction profile switch and a multiple interaction dialogue.

5.5.4 Data Transfer

The purpose of Data Transfer is the sending, from one VTPM to the other, of structured data representing operations upon an object or objects in the CCA defined in the virtual terminal model.

5.5.5 Delivery Control

The purpose of Delivery Control is:

a) to allow the VT-user sending data to indicate points at which operations on VT objects conceptually take effect;

b) to allow the receipt of such a delivery point indication to be acknowledged;

c) to allow data which update objects with the same access rules to be grouped together and simultaneously be made available to the VT-user.

5.5.6 Dialogue Management

Dialogue Management provides the VT-users with access to the lower layer functions. This dialogue management enforces TWA discipline on the sending of some data and on the exercise of some control functions.

5.5.7 Error Handling

Error Handling permits detection of non-compliance with the protocol, reception of error indications from other service providers and the taking of appropriate action. The errors cause the association to be terminated with an appropriate error indication (identifying the source of error).

NOTE – The procedure for Error Handling is included with that for unconditional termination of an association.

5.5.8 Interrupt

Two interrupt functions are provided. The first is a non- destructive mechanism which allows priority information to be exchanged between the VT-users outside the normal data flow without disrupting that data flow. The second is a destructive mechanism which allows a VT-user unconditionally to bring the current dialogue to a halt. Information is exchanged between the VT-users to enable them to resynchronize their operations.

5.5.9 Exceptions Handling

Exceptions Handling permits the VT service provider to advise the VT-users of certain non-fatal exception conditions arising during the operation of a VT-association without terminating the VT-association.

5.6 Protocol functional units

This part of ISO/IEC 9041 defines the following functions which are available in the Basic Class Virtual Terminal Protocol independently of which functional units have been selected:

    a)   Association Establishment;

    b)   Association Termination;

    c)   Data Transfer;

    d)   Delivery Control (optional, see Note 1);

    e)   Dialogue Management (S-mode only);

    f)   Error Handling.

NOTE 1 – Use of delivery-control is controlled at the level of VTE-profile by a VTE-parameter.

This part of ISO/IEC 9041 also defines seven functional units of the Basic Class Virtual Terminal Protocol which correspond to the similarly named service functional units which are defined in ISO/IEC 9040. The following functions are available only if the corresponding functional unit has been selected:

    g)   Switch Profile Negotiation;

    h)   Multiple Interaction Negotiation;

    i)   Negotiated Release;

    j)   Break;

    k)   Urgent Data;

    l)   Reference Information Objects;

    m)   Exceptions.

The Multiple Interaction Negotiation functional unit may only be selected if the Switch Profile functional unit is also selected. The Exceptions functional unit may only be selected if the Break functional unit is also selected.

NOTE 2 – Service functional units defined in ISO/IEC 9040 but not included above do not affect the protocol procedures but may affect the allowed content of some protocol elements as defined in later clauses.

5.7 Modes of operation

The protocol operates in two modes: Asynchronous and Synchronous. In the Synchronous mode (S-mode) the presentation connection supporting the VT communication is treated as a TWA connection, and the VTPMs send normal update data to each other alternately. In the Asynchronous mode (A-mode) the presentation connection is treated as a TWS connection, and the VTPMs are not restricted in the exchange of data.

5.8 Access control

The initiation and reception of some protocol elements by a VT-user is conditional upon the location of the token and upon the access-rules associated with the objects affected by the elements.

6 Protocol elements

Table 4 lists the elements of the Virtual Terminal Basic Class protocol with the associated VT service and a cross reference to the clause where the protocol element is further described. The description includes, for each element, its purpose and a list of its parameters.

Table 4 - VT protocol elements

Protocol element	VT service	Cross reference
ASQ	VT-ASSOCIATE	6.2
ASR	VT-ASSOCIATE	6.3
APQ	VT-P-ABORT	6.1
AUQ	VT-U-ABORT	6.4
RLQ	VT-RELEASE	6.18
RLR	VT-RELEASE	6.19
HDQ	VT-DATA (high priority)	6.12
NDQ	VT-DATA (normal)	6.14
UDQ	VT-DATA (urgent priority)	6.25
DAQ	VT-ACK-RECEIPT	6.7
DLQ	VT-DELIVER	6.8
GTQ	VT-GIVE-TOKEN	6.11
RTQ	VT-REQUEST-TOKEN	6.20
BKQ	VT-BREAK	6.5
BKR	VT-BREAK	6.6
EXQ	VT-P-EXCEPTION	6.26
EXR	VT-P-EXCEPTION	6.27
SPQ	VT-SWITCH-PROFILE	6.23
SPR	VT-SWITCH-PROFILE	6.24
ENQ	VT-END-NEG	6.9
ENR	VT-END-NEG	6.10
NAQ	VT-NEG-ACCEPT	6.13
NIQ	VT-NEG-INVITE	6.15
NJQ	VT-NEG-REJECT	6.16
NOQ	VT-NEG-OFFER	6.17
SNQ	VT-START-NEG	6.21
SNR	VT-START-NEG	6.22

Procedures specifying the use of the elements are specified in clauses 7 through 10 and their mapping to the presentation service or ACSE and their ASN.1 structure are specified in clauses 11 and 12.

In some implementations it may not be possible to provide the parameters of the APQ and AUQ protocol elements. This is due to possible length limitations in the supporting services. Consequently, the decision whether to send these parameters is a local one based upon a knowledge of the capability of the supporting services. For the same reason the parameters of other protocol elements, while they may be sent, may be restricted as to their complexity. These latter are:

a) ASQ;
b) ASR;
c) SNQ;
d) SNR;
e) SPQ;
f) SPR;
g) UDQ.

NOTE – In the following sub-clauses the prefix VT- is used where there is a service parameter in ISO/IEC 9040 with the same name.

6.1 APQ (VT-P-ABORT)

6.1.1 Purpose

To force unconditional termination of the VT-association (initiated by the VTPM).

6.1.2 Parameter

VT-reason: Optional, if present takes one of the values "local error" or "protocol error".

6.2 ASQ (VT-ASSOCIATE-REQ)

6.2.1 Purpose

To request establishment of a VT-association.

6.2.2 Parameters

a) called-application-entity-title: Specifies the application entity with which a VT-association is to be established;

b) calling-application-entity-title: Identifies the application entity initiating the VT-association;

c) VT-class: Specifies the VT service class to be provided; takes the value "Basic" to invoke the service specified in ISO/IEC9040;

NOTE – The use of other values of this parameter for the invocation of other International Standards is outside the scope of ISO/IEC 9041.

d) VT-mode: Specifies whether A-mode or S-mode will be in effect when the association is established and whether mode switching is to be permitted;

e) VT-WAVAR-owner: Defines which side of the dialogue will initially own the WAVAR token if this exists; takes one of the values "initiator-side", "acceptor-side", or "acceptor-chooses"; omitted if WAVAR does not exist;

f) VT-profile-name: If present, the name of the profile (see ISO/IEC 9040); if absent, the default profile defined in ISO/IEC 9040 for A-mode or for S-mode, as selected by the VT-mode parameter, is used;

g) VT-profile-arg-offer-list: if present, a list of items in which each profile argument under negotiation is either a value, list of values or range of values; omitted if the profile identified by VT-profile-name has no profile arguments;

h) VT-functional-units: If present, specifies the proposed functional units of the current VT service class; takes one or more values from the following list:
1) Profile Switch,
2) Multiple Interaction Negotiation,
3) Negotiated Release,
4) Urgent Data,
5) Destructive Break,
6) Enhanced Access-rules,
7) Structured Control Objects (Structured COs),
8) Blocks,
9) Fields,
10) Reference Information Objects (RIOs),
11) Ripple,
12) Exceptions,
13) Context Retention;

i) protocol-version: For the initiating VTPM this is a variable length bit string where each bit set to one indicates that the corresponding version of the protocol is supported. Bit 0 represents the first version, bit 1 represents the second, etc. Multiple bits may be set indicating support of multiple versions. No trailing bits higher than the highest version of this standard that the VTPM supports shall be sent, i.e., the last bit of the string must be set to one. The receiving VTPM shall ignore trailing bits higher than the one indicating the latest version of this part of ISO/IEC 9041 that it supports;

j) implementation-identifier: Optional, allows implementors to identify their implementation and its version for maintenance purposes.

6.3 ASR (VT-ASSOCIATE-RESP)

6.3.1 Purpose

To complete or refuse establishment of a VT-association.

6.3.2 Parameters

a) responding-application-entity-title: Identifies the application entity which is responding to a VT-association request;

b) VT-WAVAR-owner: As in 6.2 except that the value "acceptor chooses" is not allowed. Only present if the ASQ parameter was "acceptor chooses";

c) VT-profile-arg-value-list: If present, a list of parameters with unique values of each parameter selected from the list or range of values in the profile argument offer list; not present if the value of VT-result is "failure", see also 6.2.2 g);

d) VT-result: Takes one of the values "success", "success-with-warning" or "failure";

e) failure-reason: Conveys either a text string supplied by the responding VT-user or one of the values "VTE-incomplete", VTE-parameter-not-supported", "VTE-parameter-combination-not-supported", or "VTE-profile-not-supported";

f) protocol-version: In the case of successful establishment this is similar to the corresponding item in 6.2.2 except that only a single bit may be set to one. This bit selects the version of the protocol which will be used during the association. If the VT-result value is "failure" this bit string indicates the protocol version(s) of this part of ISO/IEC 9041 that can be supported by the rejecting VTPM;

g) VT-functional units: As in 6.2.2 h);

h) implementation-identifier: As in 6.2.2 j).