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STANDARD

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**Information technology — Open Systems
Interconnection — Application Layer
structure**

*Technologies de l'information — Interconnexion de systèmes ouverts
(OSI) — Structure de la couche Application*



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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 or 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 JTC 1. 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/IEC 9545 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in collaboration with ITU-T. The identical text is published as ITU-T X.207.

This second edition cancels and replaces the first edition (ISO/IEC 9545:1989), which has been technically revised.

Annexes A, B and C of this International Standard are for information only.

Introduction

This Recommendation | International Standard is a refinement of the description of the OSI Application Layer contained in ITU-T Rec. X.200 | ISO/IEC 7498-1.

The purpose of this Recommendation | International Standard is to facilitate a coherent and modular approach to Application Layer standardization. It defines a set of architectural principles and concepts that provide a basis for structuring and relating the specifications contained in Application Layer Recommendations and Standards. It defines the internal structure of the Application Layer, providing a framework for the development of Application Layer Recommendations and Standards. It also describes the general principles underlying the operation of application-protocols.

The following subjects are covered by this Recommendation | International Standard:

- a) the relationship between distributed information processing and OSI communication services;
- b) the structure of application-entities;
- c) the OSI-service and protocol structure in the Application Layer; and
- d) ASO-context and application-context.

This Recommendation | International Standard only considers those aspects of distributed information processing for an application which are relevant for the derivation of generic requirements for the structuring of Application Layer communications.

The architectural framework specified in this Recommendation | International Standard embodies concepts that may not be fully supported by existing Application Layer Recommendations and Standards. However, these concepts have been specified so as to provide a basis for the development of future Application Layer Recommendations and Standards which, it is anticipated, will require their use.

This Recommendation | International Standard may be subject to future expansion, particularly with regard to multi-peer communication, security, application-context management, recovery, and Open Distributed Processing.

A companion Technical Report, which is currently under development, will provide guidance on applying this Application Layer Structure during the creation of Application Layer service and protocol Recommendations and Standards.

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – APPLICATION LAYER STRUCTURE

1 Scope

This Recommendation | International Standard refines the description of the Application Layer contained in the Basic Reference Model for OSI (ITU-T Rec. X.200 | ISO/IEC 7498-1). It provides a framework for coordinating the development of existing and future Application Layer Recommendations and Standards. It is provided for reference by Application Layer Recommendations and Standards.

In particular this Recommendation | International Standard:

- a) defines the nature of Recommendations and Standards in the Application Layer and the relationships among them;
- b) defines the architectural framework in which individual OSI Application Layer protocols are developed.
- c) defines concepts which provide a flexible approach to structuring in the Application Layer;
- d) defines the categories of identifiable objects which are necessary for the specification and operation of protocols;
- e) relates distributed information processing activities to the Recommendations and Standards in the Application Layer;
- f) structures, and relates, specifications in Application Layer Recommendations and Standards;
- g) identifies the various kinds of specification necessary in Application Layer Recommendations and Standards.

This Recommendation | International Standard is provided for reference by Application Layer Recommendations and Standards. Its purpose is to facilitate a coherent and modular approach to the structuring of specifications for Application Layer behaviour. It neither specifies services nor protocols for OSI; nor is it an implementation specification for systems, nor a basis for appraising the conformance of implementations.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994)¹⁾ | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model*.
- ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1993, *Information technology – Open Systems Interconnection – Conventions for the Definition of OSI services*.
- CCITT Recommendation X.660 (1992) | ISO/IEC 9834-1:1993, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: General Procedures*.

¹⁾ Presently at the stage of draft.

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.217 (1992), *Service definition for the Association Control Service Element*.
ISO 8649:1989, *Information technology – Open Systems Interconnection – Service Definition for the Association Control Service Element*.
- CCITT Recommendation X.216 (1988), *Presentation service definition for Open Systems Interconnection for CCITT applications*.
ISO 8822:1988, *Information processing systems – Open Systems Interconnection – Connection oriented presentation service definition*.
- CCITT Recommendation X.650 (1992), *Open Systems Interconnection (OSI) Reference Model for naming and addressing*.
ISO 7498-3:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model: Naming and Addressing*.

3 Definitions

3.1 For the purposes of this Recommendation | International Standard, the following terms as defined in ITU-T Rec. X.200 | ISO/IEC 7498-1 apply:

- a) abstract syntax;
- b) application-entity;
- c) application-process;
- d) application-process-invocation;
- e) application-process-type;
- f) (N)-address;
- g) (N)-association;
- h) (N)-entity;
- i) (N)-entity-invocation;
- j) (N)-entity-type;
- k) (N)-function;
- l) (N)-layer;
- m) (N)-protocol;
- n) (N)-protocol-control-information;
- o) (N)-protocol-data-unit;
- p) (N)-service-access-point;
- q) presentation context;
- r) real open system; and
- s) transfer syntax.

3.2 For the purposes of this Recommendation | International Standard, the following terms as defined in CCITT Rec. X.650 | ISO 7498-3 apply:

- a) AEI-identifier;
- b) AE-qualifier;
- c) AE-title;
- d) AE-type-title;
- e) AP-invocation-identifier;
- f) application-association-identifier;
- g) AP-title;
- h) (N)-directory-function; and
- i) (N)-protocol-addressing-information.

3.3 For the purposes of this Recommendation | International Standard, the following terms as defined in ITU-T Rec. X.210 | ISO/IEC 10731 apply:

- a) deliver (primitive);
- b) OSI-service;
- c) OSI-service primitive;
- d) OSI-service-user; and
- e) submit (primitive).

3.4 For the purposes of this Recommendation | International Standard, the following definitions apply.

NOTE – The word “object” is used here in the general English sense.

3.4.1 **AE-invocation:** A specific utilization of part or all of the capabilities of a given application-entity in support of the communications requirements of an application-process-invocation.

NOTE – This is a specific use of the ASO-invocation concept.

3.4.2 **AE-type:** A description of a class of application-entities in terms of a set of capabilities defined for the Application Layer.

NOTE – This is a specific use of the ASO-type concept.

3.4.3 **application-association, association:** A cooperative relationship between two ASO-involutions which governs their bilateral use of the Presentation Service for communication of information and coordination of their joint operation.

NOTE – This is a specific use of the ASO-association concept.

3.4.4 **application-association-identifier:** A name that unambiguously identifies an application-association within the scope of the participating ASO-involutions.

3.4.5 **application-context:** A set of rules shared in common by two ASO-involutions in order to support an application-association.

NOTE – This is a specific use of the ASO-context concept.

3.4.6 **application-context-definition:** A specification of an application-context.

3.4.7 **application-context- name:** A name that unambiguously identifies an application-context-definition.

3.4.8 **application-service-element:** A set of application-functions that provides a capability for the interworking of application-entity-involutions for a specific purpose; application-service-elements are a component of application-service-objects.

NOTE – This definition refines the original definition of application-service-elements in ITU-T Rec. X.200 | ISO/IEC 7498-1.

3.4.9 **application-service-object:** An active element within (or equivalent to the whole of) the application-entity embodying a set of capabilities defined for the Application Layer that corresponds to a specific ASO-type (without any extra capabilities being used).

NOTE – This is a specific use of the (N)-entity concept defined in ITU-T Rec. X.200 | ISO/IEC 7498-1.

3.4.10 **ASE-invocation:** A specific utilization of part or all of the capabilities of a given application-service-element.

3.4.11 **ASE-type:** A description of a class of application-service-elements in terms of a set of capabilities defined for the Application Layer.

3.4.12 **ASO-association:** A cooperative relationship among two or more ASO-involutions for the purpose of communication of information and the coordination of their joint operation.

NOTE – This is a specific use of the (N)-association concept.

3.4.13 **ASO-association-identifier:** A name that unambiguously identifies an ASO-association within the scope of the participating ASO-involutions.

3.4.14 **ASO-context:** A set of rules shared in common among ASO-involutions in order to support an ASO-association.

3.4.15 **ASO-context-definition:** A specification of an ASO-context.

3.4.16 ASO-invocation: A specific utilization of part or all of the capabilities of a given ASO (without extra capabilities being used).

NOTE – This is a specific use of the (N)-entity-invocation concept defined in ITU-T Rec. X.200 | ISO/IEC 7498-1.

3.4.17 ASOI-identifier: A name that unambiguously identifies an ASOI within the scope of the pair (parent invocation, ASO).

3.4.18 ASOI-tag: A name that unambiguously identifies an ASOI within the scope of the pair (API, ASO).

3.4.19 ASO-name: A name that unambiguously identifies an ASO within the scope of an AP.

3.4.20 ASO-qualifier: A name that unambiguously identifies an ASO within the scope of its parent.

NOTE – When the ASO is the AE, the parent of the ASO is the AP. In all other cases, the parent is the parent ASO.

3.4.21 ASO-title: A name that unambiguously identifies an ASO in the OSI environment.

3.4.22 ASO-type: A description of a class of ASOs in terms of a set of capabilities defined for the Application Layer.

NOTE – This is a specific use of the (N)-entity-type concepts defined in ITU-T Rec. X.200 | ISO/IEC 7498-1.

3.4.23 ASO-type-title: A name that unambiguously identifies an ASO-type in the OSI environment.

3.4.24 association control service element: An ASE that provides the exclusive means for establishing and terminating all application-associations.

NOTE – The functionality of this ASE is defined in CCITT Rec. X.217 | ISO/IEC 8649.

3.4.25 child ASO: An ASO is a child ASO of the ASO that immediately contains it.

3.4.26 control function: The component of an ASO that controls the interactions among the ASEs and/or ASOs within the containing ASO.

3.4.27 parent ASO: An ASO is a parent ASO to its immediately contained ASOs and ASEs.

4 Abbreviations

ACSE	Association Control Service Element
AE	application-entity
AEI	AE-invocation
AP	application-process
APCI	application-protocol-control-information
API	AP-invocation
APDU	application-protocol-data-unit
ASE	application-service-element
ASEI	ASE-invocation
ASO	application-service-object
ASOI	ASO-invocation
CF	control function
ISP	International Standardized Profile
OSI	Open Systems Interconnection

5 Application Layer concepts

5.1 Introduction

5.1.1 Recommendations and International Standards for OSI are intended to support the communication requirements of applications (i.e. information processing tasks) requiring coordinated processing activities in two or more real open systems. In particular, standards for the OSI Application Layer define procedures for the support of distributed information processing.

5.1.2 This Application Layer Structure provides a basis for the modelling and specification, within Application Layer Recommendations and Standards, of the structure of application-entities (AEs) and the communications behaviour of AE-involutions (AEIs). This Application Layer Structure contains:

- a) a model that enables the description of the internal structure of an AE and its AEIs;
- b) a specification of generic features of interactions among Application Layer components;
- c) a description of the categories of specification that are necessary in Application Layer Recommendations and Standards together with a description of their inter-relationships.

NOTE – Application Layer specifications developed before this edition of this Application Layer Structure may use different terms for equivalent concepts. The extent to which such specifications can be used within this structure has to be considered on a case-by-case basis.

5.1.3 The Application Layer differs from the other layers of OSI in several important respects. As the highest layer of OSI, it does not provide connections within the Application Layer. Also, it provides a wide range of communications services to support various kinds of distributed information processing requirements. Therefore, this Application Layer Structure provides a recursive modular approach to the modelling and specification of these communications services that will enable particular distributed information processing requirements to be satisfied.

5.1.4 The Application Layer is supported by layers 1 to 6 in OSI as visible at the Presentation service.

5.1.5 This Application Layer Structure makes no assumptions about whether communicating application-processes (APs) are in the same or different open systems.

5.2 Application-processes

5.2.1 In ITU-T Rec. X.200 | ISO/IEC 7498-1, the cooperative operation of real open systems is modelled in terms of the interactions among APs in these systems. An AP is an abstract representation of a set of resources including processing resources within a real open system which perform information processing for a particular application. The capabilities of the APs that are involved in interaction among AP-involutions are determined by the requirements of the information processing that the APs support: no constraints are imposed by this Application Layer Structure either on the form of these interactions or on the possible relationships that may exist among them.

5.2.2 Depending upon the nature of an application, an AP may only need to communicate with other APs intermittently; moreover, the set of APs involved in distributed processing for an application may change with time. At a particular time, an AP may be represented by zero, one, or more AP-involutions.

5.2.3 Cooperative operation among AP-involutions requires that they share sufficient information to interact and carry out processing activities in a compatible manner. The information determining the nature of the interactions among AP-involutions is of three kinds:

- a) Information describing the set of objects (using this term in its most general sense) which are the subject of distributed information processing activities.
- b) Information describing the procedures to be used to effect communication among the AP-involutions for the control and co-ordination of distributed information processing.
- c) Information representing the net effect (i.e. state) of past interactions among the AP-involutions.

The purpose of OSI Application Layer Recommendations and International Standards is to provide definitions of procedures for interworking which are related to these three kinds of information.

5.3 Application-entities

5.3.1 The aspects of an AP that need to be taken into account for the purpose of OSI are represented by one or more AEs. An AE represents a set of OSI communication capabilities of a particular AP.

5.3.2 An AE represents one, and only one, AP in the OSI environment. Different APs may be represented by AEs of the same AE-type. An AP may be represented by a set of AEs: these AEs may be, but need not be, of different AE-types.

5.3.3 An AE-type specifies the communications capabilities of AEs of a particular type: i.e. it specifies the range of OSI service and protocol behaviours that may be displayed by AEs of that type.

5.3.4 An AEI is a specific use of the capabilities of an AE in order to communicate with peer AEs and so provide an OSI-service.

5.3.5 An AEI is an integral part of an AP-invocation. It supports those activities of an AP-invocation which require communication within the OSI environment. There may be zero, one or more AEIs within an AP-invocation at a particular point in time: these AEIs may be, but need not be, of different AE-types.

5.3.6 Communication in the Application Layer takes place among two or more AEIs. These cooperating AEIs may be of different AE-types. However, where different AE-types are involved, some correspondence and compatibility is necessary among the behaviours described by the AE-types.

5.3.7 The lifetime of an AEI is controlled by the AP-invocation which it represents in the OSI environment. An AP-invocation may have a longer lifetime than any or all of its AEIs.

5.4 Application-service-objects

5.4.1 An application-service-object (ASO) is a composite component that is distinguished for the purpose of structuring the Application Layer.

5.4.2 An ASO is a configuration of various groups of application communication functions, each of which has been separately distinguished for purposes of OSI service and protocol specification. The components of such a configuration are ASEs, other ASOs, and a CF which determines the properties of the configuration. An ASO is a composition of:

- a) one or more ASEs and a CF; or
- b) one or more ASOs and a CF; or
- c) one or more ASEs and one or more ASOs and a CF.

The component ASOs can, in turn, be decomposed in the same way. Component ASEs and ASOs may be of the same or different type.

5.4.3 An ASO-invocation (ASOI) represents a specific use of the capabilities of an ASO. The behaviour of an ASOI is characterised by:

- a) the OSI-service which it provides to its OSI-service-user(s), in conjunction with its peer(s);
- b) the APCI contained in the APDUs it exchanges with its peer(s); and
- c) the OSI-service(s) which it uses.

An ASOI exhibits a communications behaviour within a range specified by its ASO-type. An ASOI includes state information related to its communication behaviour.

5.4.4 An AE is itself an ASO. It is an ASO which, in a particular configuration, is not contained by any other ASO. An AE-type is the ASO-type for the ASO which is equivalent to the AE. An AEI is an ASOI of the ASO which is equivalent to the AE.

5.4.5 Within an ASOI there are other ASOIs and/or ASEIs which correspond to the ASOs and/or ASEs from which the relevant ASO is composed. At a particular point in time there may be zero, one or more ASOIs corresponding to a particular ASO: the actual number is affected by factors including constraints imposed by the CF and by the requirements of particular instances of communication.

5.4.6 The CF of an ASOI determines how its component ASEIs and ASOIs operate in combination so as to enable the ASOI to provide a particular OSI-service as a result of its operating in concert with peer ASOIs.

5.4.7 An ASO-type describes the communication capabilities of ASOs of a particular type. An ASO-type includes:

- a) a definition of the OSI-service provided by ASOIs of that type as a result of their operation in concert with peer ASOIs;
- b) one or more references to component ASE-types and/or ASO-types that are partly or fully included;
- c) a specification of the CF which determines how the component ASEIs and ASOIs of an ASOI of that type operate in combination and make use of the Presentation service and/or the OSI services provided by other ASOs or ASEs so as to provide the OSI-service that is particular to that ASO-type.

An ASO-type may be the subject of international standardization.

NOTE – The creation of appropriate ASO-types is dependent upon a variety of systems requirements and constraints. Some ASO-types will be the subject of international standardization; other ASO-types will be the subject of definition in more limited communities of interest.

5.4.8 The state information modelled by an ASOI (including all its components) reflects the net effect of its communications with other ASOIs. The existence of this state information provides a basis for modelling the co-ordinated consecutive, and/or concurrent use of multiple ASO-associations.

NOTE – For example, this provides one possible method for modelling the continuation of an activity following the loss of an application-association.

5.4.9 The lifetime of an ASOI is determined by the AEI of which it is a part. An AEI may have a longer lifetime than any or all of its component ASOIs. The lifetime of an ASOI is not determined by the duration of the ASO-associations in which it is a participant. Since an AEI is an ASOI, at least one ASOI exists for the lifetime of the AEI.

5.5 Application-service-elements

5.5.1 An ASE is an indivisible component of an ASO. It is a combination of application communication functions within an ASO that is distinguished for purposes of OSI service and protocol specification.

5.5.2 An ASE-type describes the communication capabilities of ASEs of a particular type. An ASE-type specifies the set of application-protocol-data-units (APDU) handled by the ASE and the procedures governing their use. This constitutes the application-protocol among ASEs.

5.5.3 An ASEI represents a specific use of the capabilities of an ASE. The behaviour of an ASEI is characterized by:

- a) the OSI-service which it provides to its OSI-service- user(s), in conjunction with its peer(s);
- b) the APCI it exchanges with its peer(s); and
- c) its requirements for the use of the Presentation service, ASO services, and ASE services.

5.5.4 ASEs may occur as components of ASOs at any level of recursion in the Application Layer structure.

5.5.5 An ASE-type may be the subject of international standardization.

NOTE – The creation of appropriate ASE-types is dependent upon a variety of systems requirements and constraints. Some ASE-types will be the subject of international standardization; other ASE-types will be the subject of definition in more limited communities of interest.

5.6 Control functions

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5.6.1 The specification of a CF is an integral part of an ASO-type. The CF of an ASOI provides the OSI-service of the ASOI through coordination and use of:

- a) OSI-services of component ASOIs and ASEIs, and
- b) supporting OSI-services available to the ASOI which are external to the ASOI; these may be provided by other ASOIs and/or by the OSI Presentation Layer.

5.6.2 A CF provides functions of the following kinds:

- a) mapping and coordination between the OSI-service provided by the ASOI and the OSI-services provided by the component ASOI(s) and ASEI(s);
- b) mapping and coordination between the supporting OSI-services provided to the ASOI and the OSI-services required by the component ASOI(s) and ASEI(s);
- c) any other control and coordination functions that may be necessary to achieve the cooperative operation of the component invocations within the ASOI.

The characteristics of the mappings are determined by the properties of the OSI-services involved: there need not be a one-to-one mapping between OSI-service primitives.

NOTE – For instance, a CF of an ASOI may generate a sequence of OSI-service primitives as a consequence of the invocation of a single OSI-service primitive of the ASOI.

5.6.3 The mapping between OSI-service primitives of the ASOI and the OSI-service primitives of the components, requires the CF of an ASOI to accommodate:

- a) provision for the OSI-service of the ASOI;
- b) coordination of the communications behaviour of the components of the ASOI so that they are consistent with the range of communications behaviours permitted for a particular ASO-association;
- c) coordination of communications behaviours on multiple (and possibly concurrent) ASO-associations.