

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.902

(10/2009)

SERIES X: DATA NETWORKS, OPEN SYSTEM
COMMUNICATIONS AND SECURITY

Open distributed processing

Information technology – Open Distributed Processing – Reference model: Foundations

Recommendation ITU-T X.902



Documents

Document Sharing Hub

ITU-T X-SERIES RECOMMENDATIONS
DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

PUBLIC DATA NETWORKS	
Services and facilities	X.1–X.19
Interfaces	X.20–X.49
Transmission, signalling and switching	X.50–X.89
Network aspects	X.90–X.149
Maintenance	X.150–X.179
Administrative arrangements	X.180–X.199
OPEN SYSTEMS INTERCONNECTION	
Model and notation	X.200–X.209
Service definitions	X.210–X.219
Connection-mode protocol specifications	X.220–X.229
Connectionless-mode protocol specifications	X.230–X.239
PICS proformas	X.240–X.259
Protocol Identification	X.260–X.269
Security Protocols	X.270–X.279
Layer Managed Objects	X.280–X.289
Conformance testing	X.290–X.299
INTERWORKING BETWEEN NETWORKS	
General	X.300–X.349
Satellite data transmission systems	X.350–X.369
IP-based networks	X.370–X.379
MESSAGE HANDLING SYSTEMS	X.400–X.499
DIRECTORY	X.500–X.599
OSI NETWORKING AND SYSTEM ASPECTS	
Networking	X.600–X.629
Efficiency	X.630–X.639
Quality of service	X.640–X.649
Naming, Addressing and Registration	X.650–X.679
Abstract Syntax Notation One (ASN.1)	X.680–X.699
OSI MANAGEMENT	
Systems Management framework and architecture	X.700–X.709
Management Communication Service and Protocol	X.710–X.719
Structure of Management Information	X.720–X.729
Management functions and ODMA functions	X.730–X.799
SECURITY	X.800–X.849
OSI APPLICATIONS	
Commitment, Concurrency and Recovery	X.850–X.859
Transaction processing	X.860–X.879
Remote operations	X.880–X.889
Generic applications of ASN.1	X.890–X.899
OPEN DISTRIBUTED PROCESSING	X.900–X.999
INFORMATION AND NETWORK SECURITY	X.1000–X.1099
SECURE APPLICATIONS AND SERVICES	X.1100–X.1199
CYBERSPACE SECURITY	X.1200–X.1299
SECURE APPLICATIONS AND SERVICES	X.1300–X.1399

For further details, please refer to the list of ITU-T Recommendations.

**INTERNATIONAL STANDARD ISO/IEC 10746-2
RECOMMENDATION ITU-T X.902****Information technology – Open Distributed Processing –
Reference model: Foundations****Summary**

Recommendation ITU-T X.902 | ISO/IEC 10746-2 contains the definition of the concepts and analytical framework for normalized description of (arbitrary) distributed processing systems. It introduces the principles of conformance to ODP standards and the way in which they are applied. This is only to a level of detail sufficient to support Recommendation ITU-T X.903 | ISO/IEC 10746-3 and to establish requirements for new specification techniques.

Source

Recommendation ITU-T X.902 was approved on 29 October 2009 by ITU-T Study Group 17 (2009-2012) under Recommendation ITU-T A.8 procedures. An identical text is also published as ISO/IEC 10746-2.

...

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2010

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

CONTENTS

Page

1	Scope	1
2	Normative references	1
2.1	Identical Recommendations International Standards	1
3	Definitions	1
3.1	Definitions from other Recommendations International Standards	1
3.2	Background definitions	1
4	Abbreviations	2
5	Categorization of concepts	2
6	Basic interpretation concepts	3
7	Basic linguistic concepts	3
8	Basic modelling concepts	4
9	Specification concepts	6
9.1	Composition	6
9.3	Decomposition	6
10	Organizational concepts	10
11	Properties of systems and objects	11
11.1	Transparencies	11
11.2	Policy concepts	11
11.3	Temporal properties	12
12	Naming concepts	13
13	Concepts for behaviour	13
13.1	Activity structure	13
13.2	Contractual behaviour	13
13.3	Service concepts	15
13.4	Causality	15
13.5	Establishing behaviours	15
13.6	Dependability	16
14	Management concepts	16
15	ODP approach to conformance	17
15.1	Conformance to ODP standards	17
15.2	Testing and reference points	17
15.3	Classes of reference points	17
15.4	Change of configuration	18
15.5	The conformance testing process	18
15.6	The result of testing	19
15.7	Relation between reference points	19

Introduction

The rapid growth of distributed processing has led to a need for a coordinating framework for the standardization of open distributed processing (ODP). This reference model of ODP provides such a framework. It creates an architecture within which support of distribution, interworking, and portability can be integrated.

The reference model of open distributed processing (RM-ODP), Recommendations ITU-T X.901 | ISO/IEC 10746-1 to X.904 | ISO/IEC 10746-4, is based on precise concepts derived from current distributed processing developments and, as far as possible, on the use of formal description techniques for specification of the architecture.

The RM-ODP consists of:

- Recommendation ITU-T X.901 | ISO/IEC 10746-1: Overview: Contains a motivational overview of ODP, giving scoping, justification and explanation of key concepts, and an outline of the ODP architecture. It contains explanatory material on how the RM-ODP is to be interpreted and applied by its users, who may include standards writers and architects of ODP systems. It also contains a categorization of required areas of standardization expressed in terms of the reference points for conformance identified in Rec. ITU-T X.903 | ISO/IEC 10746-3. This part is not normative.
- Recommendation ITU-T X.902 | ISO/IEC 10746-2: Foundations: Contains the definition of the concepts and analytical framework for normalized description of (arbitrary) distributed processing systems. It introduces the principles of conformance to ODP standards and the way in which they are applied. This is only to a level of detail sufficient to support Rec. ITU-T X.903 | ISO/IEC 10746-3 and to establish requirements for new specification techniques. This part is normative.
- Recommendation ITU-T X.903 | ISO/IEC 10746-3: Architecture: Contains the specification of the required characteristics that qualify distributed processing as open. These are the constraints to which ODP standards must conform. It uses the descriptive techniques from Rec. ITU-T X.902 | ISO/IEC 10746-2. This part is normative.
- Recommendation ITU-T X.904 | ISO/IEC 10746-4: Architectural semantics: Contains a formalization of the ODP modelling concepts defined in this Recommendation | International Standard (clauses 8 and 9). The formalization is achieved by interpreting each concept in terms of the constructs of the different standardized formal description techniques. This part is normative.

This Recommendation | International Standard does not contain any annexes.

Copyright International Telecommunication Union/ITU-Telcommunication Sector

**INTERNATIONAL STANDARD
ITU-T RECOMMENDATION**

**Information technology – Open Distributed Processing –
Reference model: Foundations**

1 Scope

This Recommendation | International Standard covers the concepts which are needed to perform the modelling of ODP systems (see clauses 6 to 14), and the principles of conformance to ODP systems (see 15).

The concepts defined in clauses 6 to 14 are used in the reference model of open distributed processing to support the definitions of:

- a) the structure of the family of standards which are subject to the reference model;
- b) the structure of distributed systems which claim compliance with the reference model (the configuration of the systems);
- c) the concepts needed to express the combined use of the various standards supported;
- d) the basic concepts to be used in the specifications of the various components which make up the open distributed system.

Clause 15 defines how the various standards supported constrain an implementation and how such an implementation can be tested.

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 edition 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

- Recommendation ITU-T X.903 (1995) | ISO/IEC 10746-3:1996, *Information technology – Open Distributed Processing – Reference Model: Architecture*.

3 Definitions

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

3.1 Definitions from other Recommendations | International Standards

There are no definitions from other Recommendations | International Standards in this Recommendation | International Standard.

3.2 Background definitions

- 3.2.1 data:** The representations of information dealt with by information systems and users thereof.
- 3.2.2 distributed processing:** Information processing in which discrete components may be located in different places, and where communication between components may suffer delay or may fail.
- 3.2.3 ODP standards:** This Reference Model and those standards that comply with it, directly or indirectly.
- 3.2.4 open distributed processing:** Distributed processing designed to conform to ODP standards.
- 3.2.5 ODP system:** A system (see 6.5) which conforms to the requirements of ODP standards.

3.2.6 information: Any kind of knowledge that is exchangeable amongst users, about things, facts, concepts and so on, in a universe of discourse.

Although information will necessarily have some forms of representation to make it communicable, it is the interpretation of this representation (the meaning) that is relevant in the first place.

3.2.7 viewpoint (on a system): A form of abstraction achieved using a selected set of architectural concepts and structuring rules, in order to focus on particular concerns within a system.

3.2.8 viewpoint correspondence: A statement that some terms or other linguistic constructs in a specification from one viewpoint are associated with (e.g., describe the same entities as) terms or constructs in a specification from a second viewpoint. The forms of association that can be expressed will depend on the specification technique used.

NOTE – The terms associated by a correspondence need not necessarily be expressed using a single specification technique. The correspondence may associate a term in one specification technique with a term in some different specification technique. Rather than linking every individual pair of terms, general correspondences can also be expressed between specification techniques themselves. For example, composition operators defined in different specification techniques can be associated, implying correspondences wherever these operators are used to link terms in the respective viewpoints.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

ODP	Open Distributed Processing
OSI	Open Systems Interconnection
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation Extra Information for Testing
RM-ODP	Reference Model of Open Distributed Processing
TP	Transaction Processing

5 Categorization of concepts

The modelling concepts defined in this Recommendation | International Standard are categorized as follows:

- Basic interpretation concepts:* Concepts for the interpretation of the modelling constructs of any ODP modelling language. These concepts are described in clause 6.
- Basic linguistic concepts:* Concepts related to languages; the grammar of any language for the specification of the ODP architecture must be described in terms of these concepts. These concepts are described in clause 7.
- Basic modelling concepts:* Concepts for building the ODP architecture; the modelling constructs of any language must be based on these concepts. These concepts are described in clause 8.
- Specification concepts:* Concepts related to the requirements of the chosen specification languages used in ODP. These concepts are not intrinsic to distribution and distributed systems, but they are requirements to be considered in these specification languages. These concepts are described in clause 9.
- Structuring concepts:* Concepts that emerge from considering different issues in distribution and distributed systems. They may or may not be directly supported by specification languages adequate for dealing with the problem area. Specification of objects and functions that directly support these concepts must be made possible by the use of the chosen specification languages. These concepts are described in clauses 10 to 14.
- Conformance concepts:* Concepts necessary to explain the notions of conformance to ODP standards and of conformance testing. These concepts are defined in clause 15.

Recommendation ITU-T X.903 | ISO/IEC 10746-3 uses the concepts in this Recommendation | International Standard to specify the characteristics for distributed processing to be open. It is organized as a set of viewpoint languages. Each viewpoint language refines concepts from the set defined in this Recommendation | International Standard. It is not necessary for all viewpoint languages to adopt the same notations. Different notations may be chosen as appropriate to reflect the requirements of the viewpoint. These notations may be natural, formal, textual or graphical. However, it will be necessary to establish correspondences between the various languages to ensure overall consistency.

6 Basic interpretation concepts

Although much of the ODP architecture is concerned with defining formal constructs, the semantics of the architectural model and any modelling languages used have to be described. These concepts are primarily meta-concepts, i.e., concepts which apply generally to any form of modelling activity. It is not intended that these concepts will be formally defined, or that they be used as the basis of formal definition of other concepts.

Any modelling activity identifies:

- a) elements of the universe of discourse;
- b) one or more pertinent levels of abstraction.

The elements of the universe of discourse are entities and propositions.

6.1 entity: Any concrete or abstract thing of interest. While in general the word entity can be used to refer to anything, in the context of modelling it is reserved to refer to things in the universe of discourse being modelled.

6.2 proposition: An observable fact or state of affairs involving one or more entities, of which it is possible to assert or deny that it holds for those entities.

6.3 abstraction: The process of suppressing irrelevant detail to establish a simplified model, or the result of that process.

6.4 atomicity: An entity is atomic at a given level of abstraction if it cannot be subdivided at that level of abstraction.

Fixing a given level of abstraction may involve identifying which elements are atomic.

6.5 system: Something of interest as a whole or as comprised of parts. Therefore a system may be referred to as an entity. A component of a system may itself be a system, in which case it may be called a subsystem.

NOTE – For modelling purposes, the concept of system is understood in its general, system-theoretic sense. The term "system" can refer to an information processing system but can also be applied more generally.

6.6 architecture (of a system): A set of rules to define the structure of a system and the interrelationships between its parts.

7 Basic linguistic concepts

Whatever the concepts or semantics of a modelling language for the ODP Architecture, the language will be expressed in some syntax, which may include linear text or graphical conventions. It is assumed that any suitable language will have a grammar defining the valid set of symbols and well-formed linguistic constructs of the language. The following concepts provide a common framework for relating the syntax of any language used for the ODP architecture to the interpretation concepts.

7.1 term: A linguistic construct which may be used to refer to an entity.

The reference may be to any kind of entity including a model of an entity or another linguistic construct.

7.2 sentence: A linguistic construct containing one or more terms and predicates; a sentence may be used to express a proposition about the entities to which the terms refer.

A predicate in a sentence may be considered to refer to a relationship between the entities referred to by the terms it links.

7.3 model: A system of postulates, value declarations and inference rules presented as a description of a state of affairs (universe of discourse).

NOTE – Construction of a model allows precise description and reasoning about the state of affairs.

7.4 specification: A concrete representation of a model in some notation. Being in the real world, a specification can be inspected, manipulated or communicated.

NOTE 1 – The specification may itself be an entity in the universe of discourse of the model it represents, but in simple cases it will generally only be modelled in a separate universe of discourse addressing the system development process.

NOTE 2 – The specification can be instantiated by one or more implementations, particularly, for example, in the specification of commodity software products. Each instantiation of the specification will, in general, represent a separate universe of discourse and so lead to a separate set of entities with the relationships defined in the specification. Thus declaration of, for example, a singleton object (such as the ODP system) in a specification will lead to a separate ODP system instance each time the specification is implemented. This specification-instantiation distinction should be distinguished from the familiar type-instance distinctions between terms within the specification.