PD ISO/IEC TR 14369:2018

BSI Standards Publication

# Information technology — Programming languages, their environments and system software interfaces — Guidelines for the preparation of language-independent service specifications (LISS)

bsi.

# National foreword

This Published Document is the UK implementation of ISO/IEC TR 14369:2018. It supersedes PD ISO/IEC TR 14369:2014, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/5, Programming languages, their environments and system software interfaces.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018
Published by BSI Standards Limited 2018

ISBN 978 0 580 95234 0

ICS 35.060; 35.200

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 28 February 2018.

**Amendments/corrigenda issued since publication**

| Date | Text affected |
|---|---|

PD ISO/IEC TR 14369:2018

TECHNICAL REPORT

# ISO/IEC TR 14369

Second edition
2018-02-01

# Information technology — Programming languages, their environments and system software interfaces — Guidelines for the preparation of language-independent service specifications (LISS)

*Technologies de l'information — Langages de programmation, leurs environnements et interfaces du logiciel d'exploitation — Lignes directrices pour l'élaboration de spécifications de service indépendantes du langage (LISS)*

Reference number
ISO/IEC TR 14369:2018(E)

© ISO/IEC 2018

## COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2018, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

# Contents

Page

**Foreword** ..... **vii**
**Introduction** ..... **viii**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms and definitions** ..... **1**
**4 Abbreviated terms** ..... **4**
**5 Overview** ..... **4**
5.1 Services, interfaces, service providers and service users ..... 4
5.2 Information technology services ..... 4
5.3 Services and language independence ..... 5
5.4 Language-independent specifications ..... 6
5.5 Problems of language dependence and inbuilt assumptions ..... 7
5.5.1 General ..... 7
5.5.2 Representational assumptions ..... 7
5.5.3 Implementation assumptions ..... 7
**6 Guidelines on strategy** ..... **8**
6.1 General ..... 8
6.2 General guidelines ..... 8
6.2.1 Guideline: Dependence of the interface on the service ..... 8
6.2.2 Guideline: What to do when there are interoperability, concurrency, or time constraint issues ..... 8
6.2.3 Guideline: Use of marshalling/unmarshalling ..... 8
6.2.4 Guideline: Recruiting expertise from a variety of backgrounds ..... 9
6.3 What to do if starting from scratch ..... 9
6.3.1 General ..... 9
6.3.2 Guideline: Avoidance of implementation assumptions ..... 9
6.3.3 Specifying the service in language-independent form ..... 9
6.3.4 Specifying the interface to the service in language-independent form ..... 10
6.4 What to do if starting from an existing language-dependent specification ..... 10
6.4.1 General ..... 10
6.4.2 General guidelines ..... 10
6.4.3 Converting an existing language-dependent specification of the service into language-independent form ..... 12
6.4.4 Converting an existing implicit interface into an explicit language-independent interface ..... 13
6.4.5 Specifying a language-independent interface to a service whose specification is language-dependent ..... 14
**7 Guidelines on document organization** ..... **15**
7.1 General ..... 15
7.2 Guideline: The general framework ..... 15
7.2.1 General ..... 15
7.2.2 Checklist of parts for inclusion ..... 15
7.3 Guideline: Production and publication ..... 16
7.4 Guideline: Document organization when starting from a language-specific specification ..... 16
**8 Guidelines on terminology** ..... **17**
8.1 General ..... 17
8.2 Guideline: The need for rigour ..... 17
8.3 Guideline: The need for consistency ..... 17
8.4 Guideline: Use of undefined terms ..... 17
8.5 Guideline: Use of ISO 2382 ..... 17

© ISO/IEC 2018 – All rights reserved

8.6 Guideline: Use of definition by reference ..... 18
8.7 Guideline: Terminology used in bindings ..... 18

**9 Guidelines on use of formal specification languages ..... 18**
9.1 Guideline: Use of a formal specification language ..... 18
9.2 Checklist of formal specification languages ..... 18
9.2.1 General ..... 18
9.2.2 Estelle ..... 18
9.2.3 Lotos ..... 19
9.2.4 VDM-SL ..... 19
9.2.5 Z 19
9.2.6 Extended BNF ..... 20
9.3 Guideline: Using formal specifications from the outset ..... 20
9.4 Guideline: Use of operational semantics ..... 20

**10 Guidelines on interoperability ..... 21**
10.1 General ..... 21
10.1.1 Interoperability with what? ..... 21
10.1.2 The nature of the interoperation ..... 22
10.1.3 How interoperation is invoked ..... 22
10.2 Guidelines on interoperability with other instantiations of the same service ..... 22
10.2.1 Guideline: Identifying features affecting interoperability ..... 22
10.2.2 Guideline: Precise definition and rigorous conformity requirements ..... 22
10.2.3 Guideline: Importance of exchange values ..... 23
10.3 Guidelines on interoperability with other services ..... 23
10.3.1 General ..... 23
10.3.2 Guideline: Interoperability with other services being defined at the same time ..... 23
10.3.3 Guideline: Interoperability with a pre-defined service ..... 23

**11 Guidelines on concurrency issues ..... 24**
11.1 General ..... 24
11.2 Guidelines on concurrency within the service specification ..... 24
11.2.1 Guideline: Avoidance of unnecessary concurrency requirements ..... 24
11.3 Guidelines on concurrency of interaction with service users ..... 24
11.3.1 General ..... 24
11.3.2 Guideline: Handling of concurrent service requests ..... 25
11.3.3 Guideline: Number of concurrent service requests handled ..... 25
11.3.4 Guideline: Order of processing of service requests ..... 25
11.3.5 Guideline: Criteria for prioritizing service requests ..... 25
11.4 Guidelines on concurrency requirements on bindings ..... 25
11.4.1 General ..... 25
11.4.2 Guideline: Avoidance of concurrency requirements ..... 25
11.4.3 Guideline: Specification of unavoidable concurrency requirements ..... 26

**12 Guidelines on the selection and specification of datatypes ..... 26**
12.1 General ..... 26
12.2 Guideline: Use of ISO/IEC 11404 General-Purpose Datatypes (GPD) ..... 26
12.3 Guideline: Specification of datatype parameter values ..... 26
12.4 Guideline: Treatment of values outside the set defined for the datatype ..... 27
12.5 Guideline: Specification of operations on data values ..... 27
12.6 Guideline: Recommended basic set of datatypes ..... 27
12.7 Guideline: Specification of arithmetic datatypes ..... 27
12.8 Guideline: Approach to language bindings of datatypes ..... 28
12.9 Guideline: Avoidance of representational definitions ..... 28

**13 Guidelines on specification of procedure calls ..... 28**
13.1 General ..... 28
13.2 Guideline: Avoidance of unnecessary operational assumptions or detail ..... 29
13.3 Guideline: Use of ISO/IEC 13886 procedure calling model ..... 29
13.4 Guidelines on the use of ISO/IEC 13886 ..... 29

 © ISO/IEC 2018 – All rights reserved

13.4.1 General 29
13.4.2 Guideline: Selection of datatypes of parameters 30
13.4.3 Guideline: Selection of parameter passing modes 30
13.4.4 Guideline: Use of bindings to LIPC 31
13.5 Interfacing via remote procedure calling (RPC) 31
13.5.1 General 31
13.5.2 Guideline: Avoid limiting the service specification because of constraints on the interface specification 31
13.5.3 Guideline: Specification of RPC interface 32
13.5.4 Guideline: Use of subsets 32
13.5.5 Guideline: Use of ISO/IEC 11578 32
13.6 Guideline: Guidance concerning procedure calling to those defining language bindings to the language-independent service specification 32

**14 Guidelines on specification of fault handling 33**
14.1 General 33
14.2 Guideline: Fault detection requirements 34
14.3 Checklist of potential faults 34
14.3.1 Invocation faults 34
14.3.2 Execution faults 34
14.4 Guideline: Recovery from non-fatal faults 35

**15 Guidelines on options and implementation dependence 35**
15.1 General 35
15.2 Guidelines on service options 36
15.2.1 Guideline: Optional service features 36
15.2.2 Guideline: Avoidance of assumptions about the use of the service 36
15.2.3 Guideline: Use of query mechanism 36
15.2.4 Guideline: Management of optional service features 36
15.2.5 Guideline: Definition of optional features 37
15.3 Guidelines on interface options 37
15.3.1 Guideline: Completeness of interface 37
15.3.2 Guideline: Interface to service with options 37
15.4 Guidelines on binding options 37
15.4.1 Guideline: Completeness of binding 37
15.4.2 Guideline: Binding to a service with options 37
15.4.3 Guideline: Binding to a language with optional features 38
15.5 Guidelines on implementation dependence 38
15.5.1 Guideline: Completeness of definition 38
15.5.2 Guideline: Provision of implementation options 38
15.5.3 Guideline: Implementation-defined limits 39

**16 Guidelines on conformity requirements 40**
16.1 General 40
16.2 Guidelines for specifying conformity of implementations of the service 41
16.2.1 Guideline: Avoidance of assumptions about the implementation language 41
16.2.2 Guideline: Avoidance of representational assumptions 41
16.2.3 Guideline: Avoidance of implementation model 41
16.2.4 Guideline: Requiring end results rather than methods 41
16.3 Guidelines for specifying conformity of implementations of the interface 41
16.3.1 Guideline: Requirements on implementation-defined aspects 41
16.4 Guidelines for specifying conformity of bindings 42
16.4.1 Guideline: Propagating requirements to conforming bindings 42
16.4.2 Guideline: Adherence to defined semantics 42

**17 Guidelines on specifying a language binding to a language-independent interface specification 42**
17.1 General 42
17.2 Guideline: Use of bindings to LID and LIPC 42
17.3 Guideline: Adherence to defined semantics 42

© ISO/IEC 2018 – All rights reserved

17.4 Guideline: Binding document organization ... 43
17.5 Guideline: "Reference card" binding documents ... 43

**18 Guidelines on revisions ... 44**
18.1 General ... 44
18.2 Kinds of change that a revision can introduce ... 44
18.2.1 General ... 44
18.2.2 Addition of a new feature ... 44
18.2.3 Change to the specification of a well-defined feature ... 44
18.2.4 Deletion of a well-defined feature ... 44
18.2.5 Deletion of ill-defined feature ... 44
18.2.6 Clarification of ill-defined feature ... 45
18.2.7 Change or deletion of obsolescent feature ... 45
18.2.8 Change of level definition ... 45
18.2.9 Change of specified limit to implementation-defined value ... 45
18.2.10 Change of other implementation requirement ... 45
18.2.11 Change of conformity clause ... 45
18.3 General guidelines applicable to revisions ... 45
18.3.1 Guideline: Revision compatibility ... 45
18.4 Guidelines on revision of the service specification ... 45
18.4.1 Guideline: Determining impact on interface and language bindings ... 45
18.4.2 Guideline: Minimising impact on interface and language bindings ... 46
18.4.3 Guideline: Use of incremental approach to revision ... 46
18.5 Guidelines on revision of the service interface ... 46
18.5.1 Guideline: Buffering unrevised bindings from changes ... 46
18.5.2 Guideline: Use of incremental amendments ... 46
18.6 Guidelines on revision of language bindings following revision of the service interface ... 46
18.6.1 Guideline: Buffering application programs from changes ... 46
18.6.2 Guideline: Use of incremental amendments ... 46
18.7 Guidelines on revision of a language binding following revision of the language ... 47
18.7.1 Guideline: Use of new language features ... 47
18.7.2 Guideline: Buffering "legacy" application programs from changes ... 47
18.7.3 Guideline: Buffering application programs by use of options ... 47

**Annex A** (informative) **Brief guide to language-independent standards ... 48**

**Annex B** (informative) **Glossary of language-independent terms ... 51**

**Bibliography ... 64**


© ISO/IEC 2018 – All rights reserved

# 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

This second edition cancels and replaces ISO/IEC TR 14369:1999 andISO/IEC TR 14369:2014, of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

— the reference section has been corrected/updated;

— editorial changes have been made to fully align with ISO/IEC Directives.

© ISO/IEC 2018 – All rights reserved

# Introduction

This document is dedicated to Brian L. Meek in grateful recognition of his leadership and vision in the development of the concepts on programming language independent specifications, and his efforts in producing a set of documents in this area. Without his commitment this document never would have been published.

## 0.1 Background

This document provides guidance to those writing specifications of services, and of interfaces to services, in a language-independent way, in particular as standards. It can be regarded as complementary to ISO/IEC TR 10182, which provides guidance to those performing language bindings for such services and their interfaces.

NOTE 1 Here and throughout, "language", on its own or in compounds like "language-independent", means "programming language", not "specification language" nor "natural (human) language", unless explicitly stated.

NOTE 2 A "language-independent" service or interface specification can be expressed using either or both of a natural language like English or a formal specification language like VDM-SL or Z. In a sense, a specification can be regarded as "dependent" on VDM-SL, for example. The term "language-independent" does not imply otherwise, since it refers only to the situation where programming language(s) can otherwise be used in defining the service or interface.

The development of this document was prompted by the existence of an earlier draft IEEE Technical Report (IEEE TCOS-SCC Technical Report on Programming Language Independent Specification Methods, draft 4, May 1991). The TCOS draft was concerned with specifications of services in a POSIX systems environment, and as such contained much detailed POSIX-specific guidance; nevertheless it was clear that many of the principles, if not the detail, were applicable much more generally. This document was conceived as a means of providing such more general guidance. Because of the very different formats, and the POSIX-related detail in the TCOS draft, there is almost no direct correspondence between the two documents, except in the discussion of the benefits of a language-independent principles below. However, the spirit and principles of the TCOS draft were of great value in developing this document, and reappear herein, albeit in much altered and more general form.

NOTE 3 The TCOS draft has not in fact been published, as the result of an IEEE decision to concentrate activities in other POSIX areas.

## 0.2 Principles

Service or interface specifications that are independent of any particular language, particularly when embodied in recognized standards, are increasingly seen as an important factor in promoting interoperation and substitution of system components, and reducing dependence on and consequent limitations due to particular language platforms.

NOTE It is possible for a specification to be "independent" of a particular language in a formal sense, but still be dependent on it through inbuilt assumptions derived from that language which do not necessarily hold for other languages. The term "language-independent" here is meant in a much stronger sense than that, though complete independence from all inbuilt assumptions can be difficult if not impossible to achieve.

Potential benefits from language-independent service or interface specifications include:

— A language-independent interface specification specifies those requirements that are common to all language bindings to that interface, and hence provides a specification to which language bindings can conform.

— A language-independent interface specification is a re-usable component for constructing language bindings.

— A language-independent interface specification aids the construction of language bindings by providing a common reference to which all bindings can relate. Through this common reference it is possible to make use of pre-existing language bindings to language-independent standards


© ISO/IEC 2018 – All rights reserved

for common features such as datatypes and procedure calls, and to other language-independent specifications with related concepts.

— A language-independent service or interface specification provides an abstract specification of a service in isolation from language-dependent extensions or restrictions, and hence facilitates more rigorous modelling of services and interfaces.

— Language-independent service specifications facilitate the specification of relationships between one service and another, by making it easier to relate common concepts than is generally possible when the specifications are dependent on different languages.

— A language-independent interface specification facilitates the definition of relationships between different language bindings to a common service (such as requirements for interoperability between applications based on different languages that are sharing a common service implementation), by providing a common reference specification to which all the languages can relate.

— A language-independent interface specification facilitates the definition of relations between bindings to multiple services, including the requirements on management of multiple name spaces.

— A language-independent service or interface specification brings economic benefits by reducing the effort and resources needed to ensure compatibility and consistency of behaviour between implementations of the same service in different languages or between applications based on different languages using the same interface.

© ISO/IEC 2018 – All rights reserved

*This page deliberately left blank*

# Information technology — Programming languages, their environments and system software interfaces — Guidelines for the preparation of language-independent service specifications (LISS)

## 1 Scope

This document provides guidelines to those concerned with developing specifications of information technology services and their interfaces intended for use by clients of the services, in particular by external applications that do not necessarily all share the environment and assumptions of one particular programming language. The guidelines do not directly or fully cover all aspects of service or interface specifications, but they do cover those aspects required to achieve language independence, i.e. required to make a specification neutral with respect to the language environment from which the service is invoked. The guidelines are primarily concerned with the interface between the service and the external applications making use of the service, including the special case where the service itself is already specified in a language-dependent way but needs to be invoked from environments of other languages. Language bindings, already addressed by ISO/IEC TR 10182, are dealt with by providing advice on how to use the two documents together.

This document provides technical guidelines, rather than organizational or administrative guidelines for the management of the development process, though in some cases the technical guidelines can have organizational or administrative implications.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**client**
application (typically a program in some language) which makes use of a *service* (3.13)

Note 1 to entry: The term “service user” (3.15) is often used in a similar sense, where “client” more often implies the physical computer system on which the application is running, rather than just the application itself.

**3.2**
**datatype**
set of values, usually accompanied by a set of operations on those values

**3.3**
**formal language**
formal *specification language* (3.16)

© ISO/IEC 2018 – All rights reserved