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Software and system engineering — High-level Petri nets —

Part 1: Concepts, definitions and graphical notation

*Ingénierie du logiciel et du système — Toiles de Petri de haut niveau —
Partie 1: Concepts, définitions et notation graphique*

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Contents

Foreword	vi
Introduction	vii
1 Scope	1
1.1 Purpose	1
1.2 Field of Application	1
1.3 Audience	2
2 Terms, Definitions, Abbreviations and Symbols	2
2.1 Glossary	2
2.2 Abbreviations	5
3 Conventions and Notation	5
4 Semantic Model for High-level Petri Nets	6
4.1 Definition	6
4.2 Marking of HLPN	6
4.3 Enabling of Transition Modes	7
4.3.1 Enabling of a Single Transition Mode	7
4.3.2 Concurrent Enabling of Transition Modes	7
4.4 Transition Rule	7
5 Concepts Required for High-level Petri Net Graphs	8
5.1 Introduction	8
5.2 High-level Petri Net Graph Components	8
5.3 Net Execution	8
5.3.1 Enabling	9
5.3.2 Transition Rule for a Single Transition Mode	9
5.3.3 Step of Concurrently Enabled Transition Modes	10
5.4 Graphical Concepts and Notation	10
5.5 Conditionals in Arc Expressions, and Parameters	11
6 Definition of High-level Petri Net Graphs	13
6.1 Introduction	13

This is a preview of "ISO/IEC 15909-1:2004". [Click here to purchase the full version from the ANSI store.](#)

6.2	Definition	13
6.3	Marking	14
6.4	Enabling	14
6.4.1	Enabling of a Single Transition Mode	14
6.4.2	Concurrent Enabling of Transition Modes	15
6.5	Transition Rule	15
7	Notation for High-level Petri Net Graphs	16
7.1	General	16
7.2	Places	16
7.3	Transitions	16
7.4	Arcs	17
7.5	Markings and Tokens	17
8	Semantics of High-level Petri Net Graphs	17
9	Conformance	18
9.1	PN Conformance	18
9.1.1	Level 1	18
9.1.2	Level 2	19
9.2	HLPN Conformance	19
9.2.1	Level 1	19
9.2.2	Level 2	19
Annex A:	Mathematical Conventions (normative)	20
A.1	Sets	20
A.2	Multisets	20
A.2.1	Sum Representation	20
A.2.2	Membership	20
A.2.3	Empty Multiset	21
A.2.4	Cardinality and Finite Multiset	21
A.2.5	Multiset Equality and Comparison	21
A.2.6	Multiset Operations	21
A.3	Concepts from Algebraic Specification	21
A.3.1	Signatures	21

This is a preview of "ISO/IEC 15909-1:2004". [Click here to purchase the full version from the ANSI store.](#)

A.3.2	Boolean Signature	22
A.3.3	Variables	22
A.3.4	Terms built from a Signature and Variables	22
A.3.5	Many-sorted Algebras	23
A.3.6	Assignment and Evaluation	24
Annex B:	Net Classes (normative)	25
B.1	Place/Transition Nets	25
Annex C:	High-level Petri Net Schema (informative)	27
C.1	Introduction	27
C.2	Definition	27
Annex D:	Tutorial (informative)	28
D.1	Introduction	28
D.2	Net Graphs	28
D.2.1	Places and Tokens	28
D.2.2	Transitions	29
D.2.3	Arcs	30
D.2.4	The Net Graph	30
D.3	Transition Conditions	31
D.4	Net Dynamics	31
D.5	Flow Control Example	34
Annex E:	Analysis Techniques (informative)	36
	Bibliography	37

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. 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.

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.

ISO/IEC 15909-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

ISO/IEC 15909 consists of the following parts, under the general title *Software and system engineering — High-level Petri nets*:

— *Part 1: Concepts, definitions and graphical notation*

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Introduction

This International standard is Part 1 of a multi-part standard concerned with defining a modelling language and its transfer format, known as High-level Petri Nets. Part 1 defines a semi-graphical technique for the specification, design and analysis of discrete event systems.

The technique is mathematically defined and may thus be used to provide unambiguous specifications and descriptions of applications. It is also an executable technique, allowing specification prototypes to be developed to test ideas at the earliest and cheapest opportunity. Specifications written in the technique may be subjected to analysis methods to prove properties about the specifications, before implementation commences, thus saving on testing and maintenance time and providing a high level of quality assurance.

Petri nets have been used to describe a wide range of systems since their invention in 1962. A problem with Petri nets is the explosion of the number of elements of their graphical form when they are used to describe complex systems. High-level Petri Nets were developed to overcome this problem by introducing higher-level concepts, such as the use of complex structured data as tokens, and using algebraic expressions to annotate net elements. The use of 'high-level' to describe these Petri nets is analogous to the use of 'high-level' in high-level programming languages (as opposed to assembly languages), and is the usual term used in the Petri net community. Two of the early forms of high-level nets that this standard builds on are Predicate-Transition Nets and Coloured Petri Nets, first introduced in 1979 and developed during the 1980s. It also uses some of the notions developed for Algebraic Petri nets, first introduced in the mid 1980s. It is believed that this standard captures the spirit of these earlier developments (see bibliography).

The technique promises to have multiple uses. For example, it may be used directly to specify systems or to define the semantics of other less formal languages. It may also serve to integrate techniques currently used independently such as state transition diagrams and data flow diagrams. The technique is particularly suited to parallel and distributed systems development as it supports concurrency. The technique is able to specify systems at a level that is independent of the choice of implementation (i.e. by software, hardware (electronic and/or mechanical) or humans or a combination). This International Standard may be cited in contracts for the development of systems (particularly distributed systems), or used by application developers or Petri net tool vendors or users.

Part 1 of this International Standard provides an abstract mathematical syntax and a formal semantics for the technique. Conformance to the standard is possible at several levels. The level of conformance depends on the class of high-level net chosen and the degree to which the syntax is supported. The basic level of conformance is to the semantic model.

Clause 1 describes the scope, areas of application and the intended audience of Part 1 of this International Standard. Clause 2 provides a glossary of terms and defines abbreviations. The main mathematical apparatus required for defining the semantic model and its graphical form is developed in normative Annex A and referred to in clause 3. The basic semantic model for High-level Petri Nets is given in clause 4, while the main concepts behind the graphical form are formally introduced in clause 5. Clause 6 defines the High-level Petri Net Graph, the form of the standard intended for industrial use. Components of the graph are annotated. The annotations are defined at a

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meta-level allowing many different concrete syntaxes to be used. Clause 7 describes several syntactical conventions. Clause 8 maps the graphical form to the basic semantic model. The conformance statement is given in clause 9. Normative Annex B defines Place/Transition nets (without capacities) as a restriction of the definition of Clause 6. Place/Transition nets is often what is meant when the term Petri nets is used. Three informative annexes are included: Annex C defines a High-level Petri Net Schema, which allows classes of systems to be described at a syntactic level; Annex D is a tutorial on the High-level Petri Net Graph; and Annex E provides pointers to analysis techniques for High-level Petri Nets. A bibliography concludes this International Standard.