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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

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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*

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 in 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

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.